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Letter of Transmittal

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To:	Larry Alden, P.E. NYSDEC, Albany	Date:	September 28, 2006
Re:	Ward Products Site	Proj. No:	NWR01-15852-400

PLEASE FIND ATTACHED:

Copies	Date	Description
2	September 25, 2006	Feasibility Study Report and Risk Assessment - Ward Products Site, Amsterdam, New York

The attached report incorporates the changes suggested in NYSDEC's letter dated August 22, 2006, which provided comments on the March 28, 2006, revised draft Feasibility Study Report and Risk Assessment.

We have included a second copy that you may provide to the public document repository.

Should you have any questions, please feel free to call me at 607-277-5716.
Sincerely,

The RETEC Group, Inc.

Mark Hofferbert, P.E.

cc: R. Conway, Jr., Esq. – Schenck, Price, Smith & King
B. Littleton – New Water Realty
A. Larson – Normandeau Associates
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J. Purcell, Esq. - Purcell, Ries, Shannon, Mulcahy, & O'Neill
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File: NWR01-15852

Feasibility Study Report and Risk Assessment

Ward Products Corporation Site
Amsterdam, New York
Site Code 4-29-004

Prepared by:

RETEC ENGINEERING, P.C. / The RETEC Group, Inc.
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RETEC Project Number: NWR01-15852-400

Prepared for:

New Water Realty Corporation
(f/k/a Ward Products Corporation)
c/o 2900 Orchard Place
Orchard Lake, Michigan 48324

September 25, 2006

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Reviewed by:

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September 25, 2006

Executive Summary

Introduction

This report presents the Feasibility Study (FS) and Qualitative Human Health Risk Assessment (RA) for the Ward Products Site in Amsterdam, New York. This September 2006 version revises the prior March 2006 version to address NYSDEC comments of August 2006.

The purpose of the FS is to identify and evaluate a range of remedial action alternatives to support the selection of actions for the final remedy for the Site. This FS has been prepared in accordance with the Order on Consent #W4-0762-96-06 [NYSDEC, 1997]. The RA (in Section 3 of the FS) identifies potential human receptors and exposure pathways, determines if any of the complete exposure pathways are likely to present unacceptable risk, and assists in the prioritization of remedial actions, where warranted.

Media of Concern

There are principally four media associated with the former Ward Products Site which have contaminants of concern (COC) in exceedance of New York State standards, criteria, and guidance values (SCGs):

- On-site surface and subsurface soils, impacted with cadmium, chromium, cyanide, nickel, and zinc;
- Soils and sediments in the intermittent drainages and Mohawk River, impacted with cadmium, chromium, and nickel;
- Groundwater impacted with chromium and chlorinated volatile organic compounds (VOCs), primarily trichloroethene (or trichloroethylene, TCE) and dichloroethene (DCE); and
- Indoor air, formerly impacted with TCE.

Remedial Action Objectives

The remedial action objectives (RAOs) for the Site include elimination, to the extent practicable, of potential risks to human health and the environment from impacted soils, sediments, groundwater, and indoor air.

Soils Evaluation

There are currently no significant risks to human health or the environment associated with the on-site soils. A site management plan, with environmental easement, would be sufficiently protective and is the recommended remedy.

Sediments Evaluation

The primary concern regarding the sediments is the possibility that COC could be mobilized by erosion. Secondarily, human exposure at isolated locations may be a concern. Thirdly, NYSDEC has stated that the LEL exceedances in the Mohawk, particularly at the East Branch outfall area, could have an effect on the local biota.

Full excavation of sediments was evaluated then eliminated from further consideration because the IRMs performed at the Site have already removed the most impacted sediments and the remaining impacts are of lower risk and generally located in low access areas. Furthermore, full excavation would result in significant destruction of natural habitat and disproportionate cost. Limited excavation of sediments with COC concentrations in excess of the human health risk screening levels would remove the most impacted material from the drainages.

NYSDEC has suggested [NYSDEC, 2006] that an intermediate level excavation may be an appropriate solution for the site. Intermediate excavation, with upgradient detention basins, is the recommended remedy.

Groundwater Evaluation

There are currently no significant risks to human health or the environment associated with on- and off-site groundwater, and the concentrations of COC can be expected to decline over time. The primary concern regarding groundwater is the potential (prior to reaching steady state) for additional migration of COC (primarily TCE) to adjacent, less impacted, areas.

Long-term groundwater monitoring will be administratively required by the NYSDEC. Treatment and discharge of groundwater to the City of Amsterdam's municipal wastewater treatment plant (POTW) is technically viable and would help control the mobility of the on-site plume, but presents unique risks, liabilities and permit issues. In Situ Chemical Oxidation (ISCO) or In Situ Bioremediation would enhance the potential for additional, long term natural attenuation by reducing the concentration of COC in the most impacted area on site. Of the two in-situ technologies, chemical oxidation could be faster.

NYSDEC has suggested [NYSDEC, 2006] that a combined recovery and oxidation approach may be an appropriate solution for the site. The combined approach is the recommended remedy.

Indoor Air Evaluation

Concentrations of TCE measured in the indoor air and sub-slab soil gas of the Ward Products building have been found, in the past, to be in slight exceedance of the New York State Department of Health (NYSDOH) draft guidance value for air. Indoor air mitigation was subsequently completed with an Indoor Air and Soil Vapor Mitigation IRM, including the construction of a sub-slab depressurization system [RETEC, 2005b]. Continued operation of these mitigation measures (during periods in which the Ward Products building is occupied) is the recommended remedy.

Recommended Remedy - Summary

Based on these analyses, and accounting for NYSDEC suggestions, RETEC recommends that the proposed remedial action plan for the Ward Products Site consist of the following components:

- Continued operation of the on-site sub-slab depressurization system;
- An environmental easement as required by, and consistent with, New York law and NYSDEC regulations and site management plan for on-site soils and groundwater;
- Intermediate excavation of certain off-site sediments;
- Groundwater extraction for on-site plume control, and pre-treatment of effluent for discharge to the POTW, in combination with limited ISCO for source reduction; and
- Long-term on and off-site groundwater monitoring, including monitored natural attenuation.

The recommended remedy will provide effective short-term and long-term overall protection of human health and the environment. The recommended remedy will use a combination of proven technologies that are technically feasible and result in a far lower short-term exposure risk, and far less destruction of natural habitat, than full excavation. The recommended remedy, except groundwater monitoring, could be implemented within two construction seasons after remedy selection, Record of Decision (ROD), commitment of a party to do the remedial action under the ROD, and depending upon weather.

The estimated cost (net present value) of the recommended remedy is approximately $1,865,000. This estimated cost does not include contingencies for unforeseen issues, NYSDEC fees, or transactional and legal fees.

Certification

The undersigned hereby certifies that this Feasibility Study was prepared in accordance with the Order on Consent between New York State and Ward Products, Inc. (n/k/a New Water Realty Corporation, f/k/a Ward Products Corporation), Index #W4-0762-96-06.

Work for this project was performed, and this report prepared, in accordance with generally accepted professional practices for the nature and condition of work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of New Water Realty Corporation, with NYSDEC approval, for specific application to the Ward Products Site in Amsterdam, New York. No other warranty, expressed or implied, is made.

This report presents opinions of probable cost to aid in the evaluation of various remediation alternatives. They have been based, in part, on approximate quantity evaluations that are not accurate enough to permit contractors to prepare bids. Such bids will be based in substantial part on the cost of labor and materials and the competitive bidding climate at the time the bids are formulated, the specific details of the design, and other factors over which RETEC has no control and of which RETEC in some instances has no knowledge. Accordingly, RETEC does not guarantee the accuracy of its opinions of probable cost as compared to contractors' bids or actual price to perform the work.

STATE OF NEW YORK
MARK R. HOFFERBERT
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LICENSED PROFESSIONAL ENGINEER

9/25/06

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1 Introduction

This report presents the Feasibility Study (FS) and Qualitative Human Health Risk Assessment (RA) undertaken for the environmental remediation of the Ward Products Site in Amsterdam, New York.

1.1 Purpose

The purpose of the FS is to identify and evaluate a range of remedial action alternatives to support the selection of actions that will constitute the final remedy for the Site. The FS has been conducted in a manner consistent with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), the National Contingency Plan (NCP), and guidance by the New York State Department of Environmental Conservation (NYSDEC). NYSDEC guidance documents include the Technical and Administrative Guidance Memorandum (TAGM) #HWR-90-4030 "Selection of Remedial Actions at Inactive Hazardous Waste Sites" [NYSDEC, 1994B], Draft DER-10 "Technical Guidance for Site Investigation and Remediation" [NYSDEC, 2002], and other applicable NYSDEC guidance. Additional input has been provided by the New York State Department of Health (NYSDOH).

This FS has been prepared in accordance with the Order on Consent #W4-0762-96-06 [NYSDEC, 1997]. This FS was based on the Revised Remedial Investigations Report (RRIR) [NAI, 2005a], which presents the findings of investigations of environmental conditions at the Site, and the results of several Interim Remedial Measures. NYSDEC issued its approval of the RRIR on June 6, 2005.

This report also presents the results of a RA. The RA identifies potential human receptors and exposure pathways, determines if any of the complete exposure pathways are likely to present unacceptable risk, and assists in the prioritization of remedial actions, where warranted.

The March 2006 FS addressed NYSDEC's January 2006 comments [NYSDEC, 2006] regarding a draft FS submitted to them in October 2005. This September 2006 version of the FS/RA revises the prior March 2006 version to address NYSDEC comments of August 2006.

1.2 Site Description and History

The Ward Products Site is located in the Amsterdam Industrial Park at 61 Edson Street, Amsterdam, New York. The site is near the eastern boundary of the City of Amsterdam within the Town of Amsterdam, approximately 3,300 feet northeast of the Mohawk River (see Figure 1). The Site encompasses approximately 8.6 acres and includes a 69,556 square foot single story building used for manufacturing and warehousing, a large paved parking lot, lawn areas, and approximately 3.5 acres of undeveloped land. The Site is bordered by a small business to the west (Saratoga Horseworks), additional undeveloped land to the north, a fiberglass manufacturing company (Fiberglass Industries or FGI) to the east, and Edson Street to the south. The current and expected future use of the Site is for the manufacturing, assembly, and/or distribution of automobile radio antennas and/or wiring.

The Site was added to the NYSDEC Registry of Inactive Hazardous Waste Disposal Sites due to past waste handling, storage, and disposal practices for the following hazardous wastes: spent cyanide plating bath solutions (F007), plating bath residues with cyanide (F008), chromium (D007), and trichloroethylene (or trichloroethene, TCE) (U228). These materials have been used historically at the Site as part of a metal finishing operation (cyanide and chromium) and as part of vapor degreasing operations TCE associated with the manufacturing of radio antennas. The general manufacturing process conducted at the Site involved the machining of brass tubing and other small metal parts, electroplating of the machined parts, and assembly of the components. An integral part of the manufacturing process was the metal finishing operations, which included an automated nickel/chromium electroplating line, manually operated zinc/cyanide and cadmium/cyanide electroplating lines, and vapor degreasing. Soils, groundwater, and sediments at and about the Site have been impacted by the historical release of electroplating solutions and/or vapor degreasing solvents to the environment. The predominant contaminants identified at and about the Ward Products Site are TCE, cadmium, and hexavalent chromium.

Prior to the connection of a waste discharge line to the municipal sewer system in 1983, untreated (and later treated) spent electroplating solutions were discharged, via a drainage pipe, to a small drainage ditch that runs north of the manufacturing building and along the eastern property line. This drainage ditch is a former ephemeral stream that was diverted around the Site in the late 1960s to early 1970s. The drainage ditch then flows under Edson Street and through the adjoining industrial park. Prior to the development of the industrial park in the 1980s, the drainage diverged into two unnamed intermittent streams referred to in this report as the West Branch and East Branch. Both of these drainages flow south to the lowlands adjacent to the Mohawk River. During the development of the industrial park, flow from the West Branch was diverted and sent to the East Branch. It now passes around buildings of the industrial park, under Sam Stratton Road, down the forested hillside, under an abandoned railroad spur, through a residential area, under a highway (Rt. 5) and active railroad tracks (CSX), until it finally reaches the Mohawk River.

In 1988 and 1989, the manufacturing facility was expanded with the construction of a new grinding shop in the area of the former sludge drying pad and a new warehouse along the north side of the existing manufacturing building. During construction, soil from the area of the former sludge-drying pad was removed and stockpiled on site. In 1997 high concentrations of cadmium were detected in two samples collected from the pile and the soil was classified as hazardous waste. A Soil Pile Interim Remedial Measure (IRM) was conducted in 1997 that removed the soil from the Site and disposed of it in a secure landfill.

In 1997 and 1998, investigations of soils surrounding the facility transformer pad were conducted. Elevated concentrations of metals, volatile organic compounds (VOCs), and polychlorinated biphenyls (PCBs) were identified in the soil. A PCB IRM was conducted in 1999 that removed the PCB-contaminated soils. The excavated soil was classified as hazardous waste and disposed of off site in a secure landfill.

During the remedial investigation, high concentrations of metals and VOCs were detected in the sediment in a floor and roof drainage system that discharged via a concrete drain pipe to a ditch located near the eastern property line. A Drain Pipe IRM was conducted in December 2000, and the bulk of the contaminated sediments were successfully removed from the drain pipe for disposal. Due to the high concentrations of cadmium, chromium, and lead, the sediment was classified as hazardous waste and disposed of off site in a secure landfill.

To further address surface deposits of impacted soil and sediment, a fourth IRM for Soils and Sediments was conducted in early 2004. The most impacted on-site and off-site soils and sediments, and all soils or sediments that contained concentrations of contaminants in excess of TCLP limits, were removed from the Site and properly disposed of off site in secure landfills.

In 2002, based on the concentrations of VOCs in on-site groundwater, indoor air within the Ward Products building was sampled and analyzed to evaluate the existence and impact, if any, of chemical vapor intrusion into the manufacturing building. In 2005, in response to comments received from the NYSDOH, sub-slab soil vapor and additional indoor air samples were again collected and analyzed. Only TCE was detected in indoor air at concentrations above the NYSDOH draft guidance level for air. In the sub-slab soil vapor samples, the concentration of TCE was significantly higher. The suspected source of TCE in the sub-slab soil vapor is volatilization from the groundwater underlying the building. An Indoor Air and Soil Vapor Mitigation IRM was constructed and became operational in October 2005 per the NYSDEC and NYSDOH approved work plan dated August 31, 2005 [RETEC, 2005b].

2 Summary of Remedial Investigations and Relevant SCGs

This section provides a summary of the available data regarding the location and type of Site-related contaminants. The summary is based on the following documents:

- The Revised Remedial Investigations Report (RRIR) [NAI, 2005a], which includes:
  - Descriptions of the site stratigraphy and hydrogeology,
  - Results of the environmental investigations conducted at the site to date,
  - Results of 2002 Indoor Air Sampling [RETEC, 2002],
  - Results of the Soils and Sediments IRM [RETEC, 2004], and
  - Results of 2005 Indoor Air / Soil Gas Sampling [RETEC, 2005a].
- The Fish and Wildlife Impact Analysis and Addendum [NAI, 2002 and 2006];
- The PCB IRM Final Report [RETEC, 1999A]; and
- The Drain Pipe IRM Interim and Final Reports [RETEC, 1999B and 2001].

The potentially applicable environmental standards, criteria, and guidance documents (SCGs) are referenced in Table 2-4. The SCG documents include:

- NYSDEC's Technical and Operational Guidance Series 1.1.1 (with subsequent errata sheet and addenda 1999, 2000, and 2004) [NYSDEC, 1993A],
- NYSDEC's Technical Guidance for the Screening of Contaminated Sediments [NYSDEC, 1993B], and
- NYSDEC's TAGM: Determination of Soil Cleanup Objectives and Cleanup Levels, a/k/a TAGM 4046 [NYSDEC, 1994A].

Consideration was also given to NYSDOH's draft guidance matrix for TCE in air and soil vapor [NYSDOH, 2005].

There are principally four media associated with the former Ward Products Site which have contaminants of concern (COC) in exceedance of New York State standards, criteria, and guidance values (SCGs):

- On-site surface and subsurface soils, impacted with cadmium, chromium, cyanide, nickel, and zinc;
- Soils and sediments in the intermittent drainages and Mohawk River, impacted with cadmium, chromium, and nickel;
- Groundwater impacted with chromium and chlorinated volatile organic compounds (VOCs), primarily trichloroethene (or trichloroethylene, TCE) and dichloroethene (DCE); and
- Indoor air, formerly impacted with TCE.

The sample locations with contaminant concentrations in excess of the SCGs are summarized in Tables 2-1, 2-2, and 2-3, and shown in Figures 2, 3, and 4.

2.1 Distribution of Contaminants in Soils

Several environmental impacts that were identified during the remedial investigations were subsequently, and successfully, removed from the Site during implementation of the IRMs.

Table 2-1 provides a summary of analytical data for residual (post-IRM) soils that are still in exceedance of the NYSDEC TAGM 4046 values. The locations of these soil samples are shown in Figure 2.

2.1.1 Soils Under the Building

The RRIR identified metals, cyanide, and VOCs at concentrations in excess of TAGM 4046 SCGs in the vicinity of a former sludge drying pad and a former vapor degreaser, now located under the expanded building's concrete slab-on-grade floor. The expansion of the manufacturing building over this area has eliminated the bulk of the contaminant mass and the potential for migration of, or exposure to, the residuals remaining. The soils from the former sludge drying pad were significantly excavated during the building expansion, stockpiled, and then removed from the Site during subsequent IRMs.

The RRIR identified metals and VOCs at concentrations in excess of TAGM 4046 SCGs in the sediments in a floor drain and storm water discharge pipe. These materials were substantially removed during the 1999-2000 Drain Pipe IRM.

2.1.2 Surface Soils Exterior to the Building

The RRIR identified several metals at concentrations in excess of TAGM 4046 SCGs in the surface soils (0 to 12 inches below grade) around the remainder of the Site. The metals are sporadically located, primarily around the east and north sides of the building. The most impacted of these materials were removed during the IRMs, particularly during the 2004 Soils and Sediments IRM. Lesser, residual impacts remain in surface soils.

The RRIR identified metals and PCBs in surface soils at concentrations in excess of TAGM 4046 SCGs outside an active transformer pad near the eastern edge of the building. The impacted soils were removed from the Site during the 1999 PCB IRM.

2.1.3 Subsurface Soils Exterior to the Building

The RRIR identified several metals at concentrations in excess of TAGM 4046 SCGs in the subsurface soils (>12 inches below grade) around the Site. Much of the impacted material has been removed during the IRMs. Lesser, residual impacts remain in subsurface soils.

Following the PCB IRM, post excavation sampling showed cadmium (130 to 150 mg/Kg) in two subsurface samples; one within the fenced (restricted access) transformer area and one between the fence and the building [RETEC, 1999A]. The location near the building was re-sampled for TCLP analysis and shown to be non-hazardous (< 0.05 mg/L cadmium).

The highest concentration of subsurface chromium (total chromium 301 mg/Kg) remaining at the Site was detected in a sample collected approximately 4 feet below grade from below the drain pipe during implementation of the Drain Pipe IRM.

2.2 Distribution of Contaminants in Sediments

Several environmental impacts that were identified during the remedial investigations were subsequently, and successfully, removed from the Site during implementation of the IRMs.

Table 2-1 provides a summary of analytical data for residual (post-IRM) sediments that are still in exceedance of the lower effect levels (LELs) as provided in the Technical Guidance for the Screening of Contaminated Sediments [NYSDEC, 1993B]. The sediment sample locations with exceedances of LELs are also shown in Figure 3.

2.2.1 North of Sam Stratton Road

The highest concentrations of metals in the intermittent drainages north of Sam Stratton Road were removed from the Site during the 2004 Soils and Sediments IRM. Residual impacts include cadmium, chromium, lead and nickel in excess of LELs, though most of these locations are now capped in armor stone.

2.2.2 East and West Branch Drainages

The results of the samples collected from the lower drainages indicate that cadmium, chromium, and nickel are present in the intermittent drainages over 2,000 feet downstream of the Site. In the West Branch drainage, concentrations of cadmium, total chromium, and nickel above the respective

LELs are located between Sam Stratton Road and the culvert north of NYS Highway 5. In the East Branch drainage, concentrations of cadmium, total chromium, and nickel above the respective LELs are located between Sam Stratton Road and the Mohawk River.

In early 2002, a detention basin was constructed in the East Branch just downstream of Sam Stratton Road at former sample location EB-1, a depositional location. Soil and sediment analyses detected the highest concentration of chromium (560 mg/Kg) in the disturbed berm soils.

2.2.3 Mohawk River

The results of sediment samples collected from the banks and shallow waters of the Mohawk River show metals impacts in the vicinity of the East and West Branch outlets. More than half of the samples collected had exceedances of NYSDEC LEL criteria (for aquatic sediments) for cadmium. Other exceedances were detected for chromium, nickel, and to a lesser degree, lead and zinc [NAI, 2006]. The data indicate, however, that the extent of impacts is narrow and limited.

2.3 Distribution of Contaminants in Surface Water

The intermittent drainages contain significant flow primarily during spring snow melt and storm events. Prior to the Drain Pipe IRM, exceedances of surface water standards for metals were occasionally detected in the drainage surface water. Following the IRM, however, no contaminants have been detected in surface water in excess of standards, except one highly turbid sample (containing cadmium) taken downgradient of railroad culvert (at location EB-9) being excavated at the time (March 2002).

2.4 Distribution of Contaminants in Groundwater

Twenty-two groundwater monitoring wells have been installed on and around the Site. Two wells, previously used for groundwater production, are located on FGI property to the east of the Site. Four of the on-site wells (MW-1, -2, -3, and -4) collect groundwater samples from the shallow glacial till aquifer. The other 18 wells collect groundwater from the fractured bedrock.

The RRIR reports the analytical results of groundwater samples collected to date. Groundwater sampling and analysis results from the last two years are also summarized in Table 2-2. The analytical results are compared to the groundwater SCGs provided in TOGS 1.1.1 [NYSDEC, 1993A].

2.4.1 Metals in Groundwater

Cadmium and lead have not been detected in any of the groundwater samples collected from the monitoring wells at the Site. Nickel and zinc are present in Site groundwater, but not at concentrations above the NYSDEC Groundwater Quality Standards.

Chromium has been consistently detected in three of the four glacial till monitoring wells and in eight of the fractured bedrock monitoring wells, all on site. Chromium has not been detected above the groundwater standard in the off-site wells. The highest concentrations of chromium have been detected in monitoring wells MW-1 and MW-1R, with the predominant form being hexavalent (Cr^{+6}). Chromium concentrations in groundwater appear to be generally decreasing over time.

The concentrations of cyanide in the groundwater samples collected have been less than the NYSDEC Groundwater Quality Standard of 0.20 mg/L.

2.4.2 VOCs in Groundwater

Tetrachloroethylene (or perchloroethylene (PCE)) has been consistently detected in only two of the groundwater monitoring wells, MW-4R and MW-6. PCE has also been detected in monitoring wells MW-7 and MW-10, which are located downgradient of MW-4R and MW-6. All four are located downgradient of the former drainpipe, which is the suspected source of PCE. The limited extent of the PCE in groundwater may reflect the small volume of PCE released and/or its biodegradation to TCE.

Trichloroethene (or trichloroethylene (TCE)) has been consistently detected above its NYSDEC Groundwater Quality Standard in samples collected from 14 of the 22 monitoring wells installed at and around the Site. TCE is also detected above the NYSDEC standard in the two FGI wells. The highest concentrations of TCE have been detected in the on-site monitoring wells MW-4R and MW-6, located immediately downgradient of the drain pipe, which is the suspected historical source of the TCE.

Other chlorinated VOCs (e.g., dichloroethene, DCE) have also been detected in the groundwater at concentrations slightly above SCGs.

2.5 Distribution of Contaminants in Indoor Air

Indoor air from within the Ward Products building and soil vapor samples from beneath the slab of the Ward Products building, were collected and analyzed in November 2002 and in January 2005. The concentrations of TCE in indoor air ranged from non-detectable to 13 ug/M^3. The concentrations of TCE in the sub-slab soil vapor ranged from 1,500 to 1,800 ug/M^3. These TCE concentrations are all several orders of magnitude lower than the permissible occupational exposure levels provided by the Occupational Safety and Health Administration (OSHA) (537,000 ug/M^3), the National Institute for

Occupational Safety and Health (NIOSH) (134,000 ug/M^3), and the American Conference of Governmental Industrial Hygienists (ACGIH) (269,000 ug/M^3). The NYSDOH, however, has presented a draft guidance value for TCE of 5 ug/M^3 in air, which they have stated is applicable to this site.

Other VOCs were not detected in the indoor air or the soil gas at concentrations in excess of published limits.

The sub-slab TCE vapors are assumed to originate from TCE-impacted groundwater, which is prevalent at the site. TCE has also been detected at low (less than the NYSDEC cleanup level) concentrations in soil samples collected from below the building floor slab.

An Indoor Air and Soil Vapor IRM was conducted to address the concerns of the NYSDOH and to mitigate, to the extent practicable, the indoor air TCE concentrations. The IRM includes the construction and operation of a sub-slab depressurization system. Indoor air samples collected since completion of this IRM confirm that air concentrations are now below the NYSDOH draft guidance values.

2.6 Summary of Environmental Impacts

In summary, there are principally three media associated with the former Ward Products Site which have impacts in exceedance of NYSDEC SCGs: on-site surface and subsurface soils, soils and sediments in the intermittent streams and Mohawk River, and on- and off-site groundwater. In addition, on-site indoor air may be considered an impacted media based on draft NYSDOH guidance values. The contaminant impacts are summarized as follows:

- <u>On-site surface and subsurface soils</u>:
  - Cadmium;
  - Chromium (total);
  - Cyanide;
  - Nickel; and
  - Zinc.

- <u>Soils/Sediments in the Intermittent Drainages and Mohawk River</u>:
  - Cadmium;
  - Chromium (total); and
  - Nickel.

- <u>Groundwater</u>:
  - TCE;
  - DCE;
  - Other trace VOCs; and

  - Chromium (hexavalent).

- On-site Indoor Air:
  - TCE.

3 Qualitative Human Health Risk Assessment

This section presents a qualitative human health risk assessment for the Ward Products Site. The objectives of this assessment are to identify potential human receptors and exposure pathways, to determine if any complete exposure pathways are likely to present unacceptable risk, and to determine whether remedial action is warranted.

3.1 Potential Sources and Contaminant Migration Routes

There are four environmental media impacted by contaminants at the Ward Products Site. These environmental media are:

- On-site surface and subsurface soils (see Section 2.1);
- Sediments in the intermittent drainages and the Mohawk River (see Section 2.2);
- On- and off-site groundwater (see Section 2.4); and
- On-site indoor air (see Section 2.5).

The concentration of contaminants in soils above NYSDEC Recommended Soil Cleanup Objectives or Site-specific background concentrations in soil are summarized in Table 2-1. The concentration of contaminants above NYSDEC LELs in sediment samples collected from the East and West Branch Drainages and the Mohawk River are also summarized in Table 2-1. The recent contaminant concentrations detected in monitoring wells above the New York State Groundwater Effluent Limitations are presented in Table 2-2 (past four sampling events only). Indoor air and soil vapor results to date are summarized in Table 2-3 and compared to the applicable occupational exposure limits and to draft NYSDOH recommended guidance values.

Surface water is not considered a potential source of significant exposure. With the elimination of the direct discharge of aqueous electroplating wastes into the drainage ditch, and the removal of the contaminated sediment from within the drain pipe and upper reaches of the drainage ditch, the only remaining potential source that may contribute contaminants to surface water would be the re-suspension of the residual sediments containing metals from within the drainage ditches.

3.1.1 Surface and Subsurface Soils

The metals cadmium, chromium, lead, nickel, and zinc have been detected in on-site soils at concentrations above TAGM 4046 Recommended Cleanup Objectives or background concentrations. There are no known off-site exceedances of SCG values in soil (see Sections 3.1.2, 3.1.3, and 3.1.4, regarding exceedances in sediments and groundwater).

Although hexavalent chromium was used in the metal plating process, this form of chromium is generally below detection in soil samples, or has been detected in only low concentrations. Elevated concentrations of total chromium have, however, been detected in on-site soils. The total chromium is presumed to consist primarily of the less toxic trivalent form. Trivalent chromium may have been used and discharged in the manufacturing process, or hexavalent chromium may have been released to the ground surface and in the presence of naturally occurring ferrous iron in the soil, it was reduced to the trivalent form. The potential for chromium reduction from hexavalent to trivalent by iron rich soil minerals has been documented at other sites. The trivalent form of chromium is insoluble when bound to soil minerals containing iron hydroxide and tends to be very immobile in moderately alkaline soils, like those present at the Site.

The potential for the leaching of cadmium and lead from the soil into the underlying groundwater is considered low due to the limestone parent materials and soil chemistry present at the Site. The glacial till soils at the Site are derived from the local carbonate bedrock (dolomite and limestone), and the pH of these soils is generally greater than seven. The immobility of the cadmium in the soil is due to its sorption onto the soil particles or its precipitation with carbonate minerals in the soil. Cadmium is readily adsorbed onto the natural iron and manganese hydroxides that commonly coat soil particles. Cadmium would also precipitate with the carbonate ion (as cadmium carbonate) or replace calcium in the calcium carbonate minerals present in the Site soils.

The ability of nickel and zinc to leach from soils is also controlled in part by chemical reactions with soil minerals. The sorption of nickel and zinc to soil minerals is a dominant removal process for soils with pH values greater than seven and naturally occurring iron oxides and hydroxide minerals. Also, in soils having high concentrations of carbonate minerals, nickel will precipitate as insoluble nickel carbonates.

The PCB IRM eliminated the PCB concentrations above NYSDEC levels at the Site.

The only remaining migration pathway for contaminants present in surface soils is erosion produced by runoff during rainfall events. Runoff from the northern and eastern portions of the Site ultimately discharges to the drainage ditch located along the eastern property line. Because this portion of the Site is fully vegetated and has a gentle slope, erosion of on-site soils due to runoff is not considered a potential source for significant migration of contaminants into and from the drainage ditch.

3.1.2 Sediments in Intermittent Drainage Ditches

The metals cadmium, chromium, lead, and nickel have been detected in sediments of the intermittent drainages (East and West Branch, on site and off site) at concentrations above NYSDEC Recommended Soil Cleanup Objectives and Aquatic Sediment Lowest Effect Levels.

The Drain Pipe IRM [RETEC, 1999B and 2001] and the Soils and Sediments IRM [RETEC, 2004] removed contaminated sediment from the upper ditches and the on-site drain pipe. The result of these IRMs is that the upper reaches of the drainages no longer contribute significant contaminant mass to the lower drainages. Sediments within the lower drainages that already have elevated levels of contaminants will either be covered by more recent clean sediment or will be transported downstream to depositional areas. The rate at which these sediments are transported through the drainages, or covered by more recent sediment, will be dependent upon the frequency, magnitude, and duration of snow melt or storm water runoff flow events.

3.1.3 Mohawk River Sediments

Sediment samples collected in the Mohawk River near the East and West Branch drainage outfalls were found to have concentrations of cadmium, chromium, lead, and nickel above NYSDEC Recommended Soil Cleanup Objectives and Aquatic Sediment LELs. Metals present in the Mohawk River sediments are subject to the same geochemical precipitation and immobilizing processes as described for soils. In addition, precipitation of metals by sulfides may also reduce their mobility and toxicity.

3.1.4 Groundwater

Metals in Groundwater

The absence of cadmium in the groundwater demonstrates the immobility of cadmium in Site soils and eliminates migration from soil to groundwater as a potential migration pathway for this constituent.

Chromium is present in on-site groundwater and its transport with groundwater flow represents a potential migration pathway. The fate of hexavalent chromium in groundwater is controlled by the geochemistry of the groundwater and mineralogy of the bedrock. The low observed velocity of chromium transport, and the declining concentrations in the majority of the monitoring wells, reflects retardation by its adsorption and precipitation on soil minerals. Chromium does not appear in off-site groundwater in excess of NYSDEC standards.

The absence of lead in the groundwater at the Site results from its strong attenuation in soils by naturally occurring minerals. Lead readily combines with carbonates, sulfates, and hydroxides normally present in water to form compounds of low solubility. The movement of lead in the glacial till and fractured bedrock has been limited by its sorption onto iron hydroxides or by its precipitation as lead carbonate. Thus, groundwater does not represent a migration pathway for lead at the Site.

The limited distribution of cyanide in the groundwater at the Site may reflect a relatively small source volume and/or the effects of the natural attenuation of cyanide in the aquifer. Thus, groundwater flow is not considered a migration pathway for the transport of cyanide off site.

VOCs in Groundwater

TCE has been detected in on- and off-site monitoring wells at concentrations higher than the NYSDEC Groundwater Quality Standard. The results of the RRIR suggest that TCE has migrated and may continue to be migrating off site via groundwater flow in the fractured bedrock.

Detections of DCE in the groundwater downgradient of the Site and in the FGI wells suggest that the transport of TCE in the dissolved state is being retarded due to biodegradation. DCE is a by-product ("daughter product") of the biodegradation of PCE and TCE. DCE may also be present in more impacted on-site areas, though at concentrations below the higher on-site detection limits.

The limited distribution of PCE in the groundwater downgradient of its suspected source suggests that its transport in the dissolved state is being retarded due to sorption or biodegradation.

No PCBs were detected in any of the groundwater samples analyzed, providing evidence that PCBs have not migrated through soils into groundwater.

Groundwater represents a migration pathway for the transport of VOCs (PCE, TCE, and DCE) from the Site. In general, the fate of VOCs in groundwater is controlled by volatilization, diffusion, sorption, and biodegradation. The presence of TCE in the upgradient FGI wells could indicate localized transport due to induced flow from periodic pumping during their former use of the wells.

3.1.5 Indoor Air

TCE and other VOCs have been detected in the indoor air of the Ward Products manufacturing building and in the building's sub-slab soil vapor. Prior to the October 2005 Indoor air and Soil Vapor Mitigation IRM, the concentration TCE in indoor air was slightly in excess of the NYSDOH draft air guidance value.

The sub-slab TCE vapors are assumed to originate from TCE-impacted groundwater, which is prevalent at the site, though other sources (such as residuals from former spills) within the building may also be present. The groundwater wells immediately adjacent to the building have TCE concentrations of up to 3,500 ug/L with groundwater elevations ranging from 1.8 to 14.7 feet below ground surface [NAI, 2005a]. Organic contaminants can volatilize from groundwater to vadose zone soils, followed by migration into indoor air through the building foundation.

3.2 Potential Exposure Pathways and Receptors

The Site is located within the Amsterdam Industrial Park and is expected to be used as a manufacturing and/or non-residential facility for the foreseeable future. Future receptors are, therefore, the same as current receptors. Under current Site uses the potential receptors that could be exposed to contaminants include indoor workers, outdoor workers, and recreational users of the intermittent stream and Mohawk River. On-site trespassers and construction workers (other than excavation workers) were not considered in this evaluation, because their exposure would be less than the exposure for a full time outdoor worker.

The Site and surrounding area are supplied with municipal water. The nearest use of groundwater is approximately 2,600 feet to the southwest along Chapman Drive and East Main Street. The adjacent property at FGI has two groundwater production wells and the UCMI property has (formerly) one, all of which are not in use, though they have been used for industrial process water in the past. The UCMI well was recently decommissioned and sealed.

3.2.1 Indoor Worker

Indoor workers present at the Site may be potentially exposed to contaminants in soils through direct contact during short periodic breaks from work during time spent outside the building. The ingestion, inhalation, and dermal routes of exposure through direct contact with soil are, therefore, potentially complete exposure pathways, although exposure is expected to be minimal.

The potential for significant exposure to VOCs from volatilization from soils and groundwater below the building to indoor air is low. This pathway has, however, been shown through sampling and analyses to possibly be complete and the indoor air concentration of TCE may, at times, exceed the NYSDOH draft guidance value. The NYSDOH value is orders of magnitude lower than the allowable exposure limits for occupational (8 to 10 hour per day) workers.

An Indoor Air and Soil Vapor IRM successfully addressed the concerns of the NYSDOH and to mitigate, to the extent practicable, the indoor air TCE concentrations. The IRM included the construction and operation of a sub-slab depressurization system.

The dissolution of contaminants in surface and subsurface soils to groundwater is not a potential exposure pathway because there are no groundwater users (for drinking or industrial purposes) within the affected area.

3.2.2 Outdoor Worker

Outdoor workers are individuals who may maintain the exterior of the building grounds and grassy areas of the Site, or who deposit or retrieve items from exterior locations to the indoor working area. These individuals may be potentially exposed to Site contaminants in surface soils via incidental ingestion, dermal contact, and inhalation of volatilized constituents and fugitive dust. Grass cutting and lawn maintenance are limited to the warmer months and the existence of the grass covers provides a significant barrier to direct contact with the soil.

The ingestion, inhalation, and dermal exposure pathways for contaminated soils are potentially complete for outdoor workers. As noted above, groundwater is currently not used as a source of drinking water at the Site and related pathways are incomplete.

On a very infrequent basis, subsurface utility lines may require repair or new building construction may occur. In this case, construction workers may handle impacted soil and be exposed to constituents from both the surface and subsurface. These exposures would be through incidental ingestion, dermal contact, and inhalation of volatilized constituents and fugitive dust. These exposures are likely to be quite short in duration.

3.2.3 Off-site Recreational User

The off-site receptor selected for evaluation in this assessment is a youth visiting the intermittent drainages or Mohawk River. This would be the most sensitive receptor to contaminated sediments or surface water. Both incidental ingestion and dermal contact with sediments are potentially complete for a youth playing in the East or West Branch drainages or Mohawk River. The potential exposure of recreational users to sediments is conservatively defined, for this risk assessment, to be similar to the exposure of outside workers to industrial soils. The area and depth of existing impacts to Mohawk River sediments is small. The locations of the impacts are not readily accessible by the public and the risk of direct contact is negligible.

Although incidental ingestion of and dermal contact with surface water is possible, the intermittent stream contains water primarily during spring snow melt and storm events. Such exposures are likely to be quite short in duration, and very infrequent. Sampling and analysis have shown (in the RRIR) that surface water concentrations of contaminants are generally low or non-detectable.

Potential for exposure to contaminants present in Mohawk River surface water is expected to be minimal due to low frequency of contact and the low concentration of contaminants anticipated in surface waters. Thus incidental ingestion and dermal contact with surface water from either the intermittent drainages or the Mohawk River is not considered to be significant.

3.2.4 Groundwater Users

Potential receptors of contaminated groundwater would include any groundwater users located downgradient of the Site, or users of the adjacent FGI wells.

The FGI wells are located over 100 feet to the east and upgradient of the Site. Based on information provided by the property occupant, one or both of these wells was previously used to provide cooling and lubricating water to several areas of their fiberglass manufacturing process. Use of groundwater by FGI has been halted, though the wells remain intact. FGI is currently supplied by the municipal water system.

The closest potential downgradient groundwater user is located approximately 150 feet southwest of the Site in an industrial park. Based on information provided by the tenant in this building, the well is not currently in use and water is being provided to their facility by the municipal water supply system.

According to the City of Amsterdam Water Department, the only water users not on the municipal water supply system are located in the Town of Amsterdam southeast of the Site. The RRIR observed that seven residences with domestic water supply wells are located east of the City/Town boundary and are located over 2,500 feet south-southeast of the Site. Based on the topography of the land between the Site and the Mohawk River, contaminated groundwater at the Site is not expected to flow towards these wells. No existing groundwater users are located between the Site and the expected groundwater discharge zone, the Mohawk River, some 3,000 feet southwest of the Site.

Groundwater on and near the Site is currently not used as drinking water. Since the City of Amsterdam, including local residences, is serviced by a municipal water supply, the groundwater under the Site is not expected to be used as a source of drinking water at any time in the foreseeable future. The exposure pathway of a local resident consuming contaminated drinking water is thus incomplete.

3.3 Screening Site Data for Potential Human Health Impacts

An assessment of potential risk, based on the exposure pathways identified for current and future receptors, has been conducted by comparing Site data to generic cleanup criteria and screening level values. If the Site data exceed the cleanup criteria or screening levels, further evaluation of that pathway may be warranted or remedial goals developed to address potential risk to human health.

3.3.1 Screening Level Values

Table 3-1 presents human health screening values used for soils and sediments, as well as the NYSDEC Recommended Soil Cleanup Objectives and the Site-specific background values. The values selected for protection of human health were obtained from the USEPA Region IX Preliminary Remediation Goals (PRGs), dated October 2004. The USEPA Region IX PRGs are tools for evaluating and cleaning up contaminated sites. They are risk-based soil concentrations derived from standardized equations, combining exposure information assumptions and USEPA toxicity data. The Region IX soil screening values for industrial land were selected because they combine conservative estimates of risk using the most recent toxicity criteria and combine all three exposure routes (ingestion, dermal contact, and inhalation). The screening level values include risks associated with both cancer and non-cancer endpoints using a 10^{-6} cancer risk factor for carcinogens, or Hazard Index of 1.0 for systemic toxicants (whichever is more restrictive). Though the Site is located in EPA Region II, neither the NYSDEC nor Region II has published screening values for human health. Details on the derivation of the Region IX PRGs for soils can be viewed at the web site:

http://www.epa.gov/Region9/waste/sfund/prg/index.htm

Sediment screening values for the protection of human health were not readily available for a receptor defined as a youth visiting the intermittent drainages and being exposed to contaminated sediments. For this evaluation, USEPA Region IX PRGs for industrial soil have been used to screen for potential impacts resulting from exposure to these contaminated sediments. This approach is conservative as concentrations of chemicals below the industrial PRGs are considered acceptable for an exposure that occurs 8 hours per day, 5 days per week (250 days per year), for 25 years. Therefore, exposure to sediments in the drainage ditch that meet the Region IX PRG screening values by a recreational user or construction worker would not pose a significant risk.

Table 3-1 also presents soil screening values used for soils for the protection of groundwater. The values selected for protection of groundwater were obtained from the NYSDEC TAGM 4046. Where TAGM 4046 was missing values for protection of groundwater (metals and cyanide), screening values were obtained from the USEPA Region III Risk Based Concentration (RBC) Table published in April 2005. These soil screening values for protection of groundwater combine conservative estimates of soil parameters and develop the screening values using a 10^{-6} cancer risk factor for carcinogens or Hazard Index of 1.0 for systemic toxicants (whichever is more restrictive). The screening value listed for total chromium is based on the EPA Region III value for trivalent chromium, which is the dominant form in the Site soils.

Details on the derivation of the USEPA Region III RBC Table can be viewed at the web site:

http://www.epa.gov/reg3hwmd/risk/

3.3.2 Results of Screening Analysis

A comparison of Site data to the screening criteria has been conducted for each area of interest identified in Section 2. These areas include on-site surface and subsurface soils, sediments in the intermittent drainages and the Mohawk River, on- and off-site groundwater, and the indoor air of the manufacturing building.

Surface and subsurface soil data are compared to the human health soil screening values (protective of the direct contact pathways) as well as the groundwater protection screening values. Sediment data are compared to the recreational soil screening values. Groundwater data are compared to the NYS Water Quality Standards. Indoor air data are compared to occupational exposure limits and to NYSDOH draft guidance values. Tables 2-1, 2-2, and 2-3 highlight the samples exceeding the screening criteria.

On-site Surface and Subsurface Soil Samples

No on-site surface or subsurface soil samples exceed the human health screening values for direct contact by industrial workers as described in Table 3-1. A large number of samples exceeded the screening value for nickel designed for the protection of groundwater and several samples exceeded the screening value for cadmium and lead for the protection of groundwater. However, these metals have never been detected in groundwater above NYSDEC standards. The geochemistry of the Site includes carbonate bearing limestone and dolomite bedrock formations which explains the lack of impacts to groundwater from these metals present in surface soils.

Sediment Samples in the Intermittent Drainages and Mohawk River

Four sediment samples collected from the East and West Branch Intermittent Drainages and Mohawk River exceed the conservative human health sediment screening values established for recreational users. These samples are identified as DB-8, EB-9, and EB-14 (which were observed to have elevated concentrations of chromium) and WB16 (which had elevated concentrations of lead). The maximum concentration of chromium detected in sediments was 560 mg/kg (at DB-8) compared to the sediment screening value for total chromium of 450 mg/kg. Sample location EB-9 was subsequently excavated by railroad personnel during maintenance of a culvert under their tracks. The excavated sediments were stockpiled on dry ground within the railroad right-of-way, adjacent to the culvert, and no longer pose a significant risk of downstream transport by erosion. Additional sampling conducted adjacent to sample WB-16 (samples WB-16A, WB-16B, and WB-16C) did not identify elevated concentrations of lead, indicating that the lead at the WB-16 sampling location is isolated and may not be due to former Site activities. The limited extent of sediment having chromium and lead concentrations exceeding the conservative human health screening values indicates that there is little risk to recreational users from direct contact with sediments in the East and West Drainages and Mohawk River.

Residential and Industrial Groundwater Use

Metals and VOCs have been detected in groundwater at concentrations exceeding NYS Water Quality Standards. However, downgradient groundwater is not currently used as a drinking water source. The industrial park and surrounding area are supplied with water from the City of Amsterdam municipal water supply. Ingestion of groundwater as drinking water is an incomplete pathway and no further risk evaluation is required.

The closest groundwater well downgradient of the Ward Products Site was located in the industrial park roughly 150 feet southwest of the Site. According to the representatives of the company leasing the property (UCMI), this well was not recently used as a water supply source. Considering the proximity of this well to the Site, and to reduce potential for exposure to the contaminated groundwater by future users, the well was permanently decommissioned and sealed by NWR and RETEC, with UCMI's cooperation, in August 2006.

Two groundwater wells located on FGI property were formerly used to supply industrial process water. Those wells are no longer in use. Potable water was supplied by the municipal system.

Indoor Air

Concentrations of TCE in the Ward Products' building's indoor air and sub-slab soil gas samples were all several orders of magnitude lower than the permissible occupational exposure levels. The NYSDOH, however, has presented a draft guidance value for TCE of 5 ug/M^3 in air, which they have stated is applicable to this site. Construction of the Indoor Air and Soil Vapor IRM subsequently reduced the concentration of TCE in indoor air to below the NYSDOH draft value. The continued operation of this system (while the Ward Products building is occupied and until remediation of vapor source materials is completed) eliminates soil vapor migration as a potential exposure pathway.

3.4 Risk Assessment Conclusions

RETEC's site-wide Qualitative Human Health Risk Assessment has identified only chromium (total) in the off-site sediments as exceeding both NYSDEC guidance values and human health risk-based standards, and as also presenting a potentially complete exposure pathway through dermal contact and ingestion.

Chromium (hexavalent), TCE, and other VOCs are present in groundwater in excess of both NYSDEC guidance values and human health risk-based standards, but the pathway (ingestion) is currently incomplete.

Although cadmium and zinc have been measured in surface and subsurface on-site soils in concentrations in excess of the screening values for the protection of groundwater, the absence of cadmium and the trace concentrations of zinc in the groundwater demonstrate the immobility of these metals in Site soils. Thus, leaching from soil to groundwater as a potential migration pathway is not considered significant for these constituents.

Hexavalent chromium has not been detected in on-site soils in concentrations exceeding the risk-based screening values for protection of human health (64 mg/kg) or protection of groundwater (42 mg/kg). Thus, hexavalent chromium is unlikely to present a continued risk of leaching from soil to groundwater. Hexavalent chromium has been detected in on-site groundwater in excess of NYSDEC standards; however, chromium concentrations in groundwater are generally in decline.

On- and off-site surface water quality has improved since completion of the Drain Pipe IRM and is not considered a significant exposure pathway.

Soils and sediments having total chromium in concentrations in excess of the risk-based screening values for protection of human health (450 mg/kg) were substantially removed during the IRMs performed at the Site. The screening analysis has indicated that only three isolated sampling locations (DB-8, EB-9, and EB-14) had concentrations of chromium exceeding the human health screening values.

The maximum detected concentration of TCE in the indoor air was 13 ug/M^3. NYSDOH has presented a draft guidance value for TCE in air of 5 ug/M^3. Regardless of actual risk to building occupants, an Indoor Air and Soil Vapor IRM was successfully conducted to address the concerns of the NYSDOH and to mitigate the concentrations of TCE in the indoor air.

4 Nature and Extent of Contaminants of Concern

The RRIR [NAI, 2005a] identified the contaminants that exceed NYSDEC SCGs at the former Ward Products Site. The Qualitative Human Health Risk Assessment (RA) (Section 3 of this report) has identified the specific constituents and sample locations that exceed the generic risk-based values for protection of human health. This section condenses the findings and conclusions to date, and summarizes the media, contaminants of concern (COC), and locations requiring consideration of remedial action.

4.1 Soil

Following completion of the IRMs, the most impacted soils have been removed from the Site. Other than the sediments discussed in the following Section 4.2, there are no SCG exceedances in off-site soils.

Many residual on-site soils still include cadmium, chromium, lead, nickel, and/or zinc in exceedance of NYSDEC TAGM 4046 SCGs, but not in exceedance of industrial and commercial human health risk standards. All of these soils are currently covered in lawn or lightly forested, are non-erosional, and are not considered significant contaminants of concern. The volume, however, of the TAGM exceedances would be approximately 4,100 cubic yards, assuming an average depth of 1 foot over an area of approximately 110,000 square feet. TAGM 4046 SCGs are applicable to the top 12 inches of surface soil at an industrial / commercial site (top 24 inches for residential properties).

An additional volume of soil in exceedance of TAGM values is assumed to be present below the building's slab-on-grade foundation, primarily below the grinding room and warehouse sections (former vapor degreaser and sludge pad areas). Some of these soils contain TCLP exceedances for cadmium but do not pose a risk to groundwater or human health. Assuming an average depth of 2 feet, the volume of impacted sub-slab soil could be in the magnitude of 700 cubic yards.

These calculations do not include subsurface soils that may be in excess of NYSDEC SCGs for the protection of groundwater. As detailed in Section 2, ongoing groundwater impacts from soils do not appear to be occurring at this site.

4.2 Sediments

Chromium, cadmium, lead, and nickel are present in the off-site drainages in concentrations in excess of NYSDEC LELs. The majority of LEL exceedance areas also contain one or more COC in concentrations above the NYSDEC Severe Effect Levels (SELs).

The East Branch, West Branch, and on-site drainage ditches are intermittent streams. They are typically overgrown with dense foliage or mature forest, much of which is inaccessible to conventional equipment. Portions of the ditches run through culverts under highways and railroads. For the purpose of this FS, the soil within the drainages will be referred to as "sediments".

Most of the samples collected for the RRIR in the East and West drainages between Edson Street and Quist Road were collected in steep drainages from small quantities of sediment among large, mossy cobbles. Only the lower drainages south of Route 5 were typically depositional with finer grained material.

The West Branch drainage has approximately 1,750 linear feet of material in exceedance of NYSDEC's LELs. Assuming an average width of 10 feet, and depth of 18-inches, the total volume of West Branch drainage sediments in exceedance of LELs is potentially in the magnitude of 1,000 cubic yards. The East Branch drainage has approximately 3,000 linear feet of material in exceedance of NYSDEC's LELs. Assuming an average width of 10 feet, and depth of 18-inches, the total volume of East Branch drainage sediments in exceedance of LELs is potentially in the magnitude of 1,700 cubic yards, including approximately 400 cubic yards located south of the CSX Railroad corridor.

The drainage sediments are, however, spread thinly between and below large cobbles. Assuming the contamination is primarily associated with finer sediment particles and that 50% of the material in the drainage bottoms is coarse, it can be estimated that the actual mass of contaminants within the drainages may be far less than implied above.

During the Soils and Sediments IRM in early 2004 [RETEC, 2004], all known sediments with leachable constituents in exceedance of TCLP limits were excavated and removed from the Site. These sediments were all located in the drainages north of Sam Stratton Road. The residuals remaining in the IRM areas are capped with armor stone. The IRM successfully removed the most impacted sediments and, consequently, a large portion of the COC mass is no longer exposed to surface contact by receptors and erosion. Of the sediments remaining, only chromium is identified (at DB-8, EB-9, and EB-14) in concentrations in excess of the USEPA human health screening values.

EB-14 is located in the Mohawk River and is not considered a human health risk due to lack of exposure pathway. DB-8 (identified as a soil rather than a sediment in the RRIR) is located in the berm of the recently constructed detention basin at Sam Stratton Road. The volume of soil exceeding human health values at DB-8 is likely to be approximately 2 cubic yards.

EB-9 is located in a natural sediment depositional area between Route 5 and the CSX Railroad corridor. The volume of soil exceeding LELs at EB-9 is assumed to be approximately 150 cubic yards.

Another sediment depositional area is at WB-5 near a culvert under an abandoned railroad spur. The volume of impacted sediments exceeding LELs at WB-5 is assumed to be approximately 50 cubic yards.

Based on surface water sampling and analysis, surface water in the East and West Branch drainages is not in itself a medium of concern. Typical, seasonal runoff conditions over the impacted sediments have been shown not to generate exceedances of COC in surface water.

Chromium, cadmium, and nickel are also present in Mohawk River sediments in concentrations in excess of NYSDEC LELs at the outfalls of both the East and West Branch Drainages. The volume of Mohawk River sediments in exceedance of NYSDEC LELs at the East Branch outfall, assuming an 18-inch depth and 12,000 square foot of area, could be approximately 700 cubic yards. The volume of River sediments in exceedance of NYSDEC LELs at the West Branch outfall, assuming an 18-inch depth and 16,000 square foot of area, could be approximately 900 cubic yards.

Lead was detected at location WB-16 at a concentration in excess of the USEPA human health screening value, but the impact is not related to the Site.

The total mass of the contaminants in the Mohawk River is small and limited to fine-grained sediment located within and below the cobble river bed. The Mohawk sediments are not readily accessible by the public and the risk of direct contact, and the risk to human health, is negligible. In their January 2006 letter, however, NYSDEC stated that these sediments could have a significant effect on the biota in contact with them.

4.3 Groundwater

TCE (and to a lesser extent DCE, PCE, and carbon tetrachloride) is present in exceedance of the groundwater SCGs in 11 of the 14 on-site monitoring wells and five of the 10 off-site monitoring wells. The presence of these compounds, along with an increase in chloride concentrations and a decrease in dissolved oxygen concentrations, as reported in the RRIR, suggests that the TCE is undergoing (limited) natural attenuation and biodegradation.

The TCE in groundwater is primarily a bedrock contaminant. The concentration on site is several orders of magnitude higher than off site. The greatest mass of TCE appears to be located around the on-site monitoring wells MW-4R (near the drain pipe outfall) and, to a lesser extent, MW-6 and MW-10.

TCE impacts also extend to the recently discovered (and upgradient) FGI wells. These impacts are probably due to past pumping of the wells by FGI, which induced groundwater flow through discrete bedrock fractures and pulled the plume onto the FGI Site. The natural groundwater flow in the vicinity of the FGI wells is assumed to be back towards the Ward Site. The FGI wells are not presently in use and the TCE concentrations there are in decline.

Recent reviews of groundwater treatment technologies in use at similar sites indicate that restoration of the on- and off-site groundwater to achieve Class GA (drinking water) SCGs would be technically impracticable within a reasonable timeframe [USEPA, 2001, USEPA, 2003, and USEPA, 2004] Based on the characteristics of the fractured bedrock at the Site and the evaluation of technologies available, residual TCE and hexavalent chromium will remain in the bedrock fractures and constitute a long-term impact to on-site groundwater, despite the remedial alternative ultimately selected. There are currently no wells supplying drinking water in the impacted area and potential for ingestion of groundwater is minimal. The groundwater RAOs will focus, therefore, on preventing future exposure to on-site and off-site groundwater exceeding SCGs and control of plume migration through the long-term reduction in groundwater COC toxicity, mass, volume, and/or mobility.

Based on data from the RRIR, the lateral extent of TCE impacts in excess of the NYSDEC SCG (5 ug/L) is approximately 430,000 square feet. Approximately half of that area (and by far the bulk of the TCE mass) is on site.

As seen in Figure 4, the source of the TCE impacts appears to be located in the vicinity of MW-4R and the drain pipe outfall, within a distance of approximately 30 to 60 feet from these features. This location is defined as the “source area” for the purposes of this FS.

The volume of groundwater impacted by total or hexavalent chromium is generally shallower overburden and upgradient of the bulk of the TCE-impacted groundwater. The highest concentrations appear around MW-1 and MW-1R. The chromium, much or nearly all of which may be attributed to the hexavalent form (Cr^{+6}) chromium, is below or near the standard, or in steadily declining concentrations, in most on-site wells. In September 2005, [NAI, 2005b] only MW-1R, MW-2, and possibly MW-1, had chromium concentrations of concern. On-site chromium concentrations are generally in decline due to natural attenuation. Chromium is not detected above the SCG in off-site wells.

4.4 Indoor Air

The groundwater wells immediately adjacent to the on-site building have TCE concentrations of up to 3,500 ug/L with groundwater elevations ranging from only 1.8 to 14.7 feet below ground surface [NAI, 2005a]. Concentrations of TCE measured in the indoor air and sub-slab soil gas of the building were found in exceedance of the NYSDOH draft guidance value for air [RETEC, 2005a].

4.5 Summary

The causes of the historical releases of COCs to the environment have been eliminated by alteration of business practices and implementation of IRMs.

Concerns regarding the future migration of residual contaminants are limited to:

- Groundwater migration;
- The possibility of sediment re-suspension and transport; and
- Soil vapor intrusion into the Ward Products Site building.

The post-IRM soil and sediment sample locations identified in this FS as *potentially* being of concern are listed in Table 2-1 and shown on Figure 3.

The groundwater sample locations identified in this FS as *potentially* being of concern (based on September 2005 data) are listed in Table 2-2 and shown in Figure 4.

The sample locations and COC summarized in the Tables and Figures define the limits of remedial concern at the Site. This FS will focus specifically on those areas.

5 Remedial Action Objectives

The Remedial Action Objectives (RAOs) are site-specific goals that address the media of concern, specific contaminants, and the active exposure pathways at the Site.

Based on an understanding of the RRIR, the RA, and the site model, NWR's RAOs for the Ward Products Site are to eliminate to the extent practicable:

- Potential risks to human health and the environment from impacted soils;

- Potential risks to human health and the environment from impacted sediments;

- Potential risks to human health and the environment from impacted groundwater; and

- Potential risks to human health and the environment from impacted indoor air.

An additional criterion to be strongly considered in selection of a remedial alternative is the minimization of disruption to the daily operations of Ward Products LLC, adjacent businesses, and homes, in the form of noise, vibration, construction traffic, odors, and increased risk of short-term exposure to impacted soil and air emissions. Site management of other risks (traffic or construction accidents, worker exposures during material handling, etc.) would be a significant component to be considered in evaluation of a potential remedial action.

6 Identification and Analysis of Remedial Alternatives

This section identifies, describes, and evaluates remedial alternatives for the Site.

6.1 Description of Analysis Criteria

The remedial alternatives developed in this section are evaluated using the following seven criteria:

1. Overall protection of human health and the environment
2. Compliance with SCGs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume
5. Short-term impacts and effectiveness
6. Implementability
7. Cost

6.1.1 Overall Protection of Human Health and the Environment

This criterion provides an overall assessment of protection based on a composite of factors. Evaluations of the overall protectiveness address:

- How well a specific site remedial action achieves protection over time;
- How well site risks are reduced; and
- How well each source of contamination is eliminated, reduced, or controlled for each remedial alternative.

6.1.2 Compliance with the SCGs

This criterion is used to determine how each remedial alternative complies with SCGs. Each alternative is evaluated in detail for:

- Compliance with chemical-specific SCGs (e.g. groundwater standards);
- Compliance with action-specific SCGs (e.g. RCRA minimum technology standards); and
- Compliance with location-specific SCGs.

6.1.3 Long-term Effectiveness and Permanence

This criterion addresses the results of the remedial actions in terms of the potential risk remaining at the Site after the RAOs have been met. The components of this criterion include the magnitude of the remaining risks, the adequacy and suitability of controls used to manage treatment residuals or untreated wastes, and the long-term reliability of management controls for providing continued protection from residuals (i.e. the assessment of potential failure of the technical components).

6.1.4 Reduction of Toxicity, Mobility, or Volume

This criterion addresses the statutory preference that treatment is used to achieve a reduction in the total mass of toxic contaminants, the irreversible reduction in contaminant mobility, or the reduction of the total volume of the impacted media. Factors to be evaluated in this criterion include the treatment process employed; the amount of hazardous material destroyed or treated; the degree of reduction in toxicity, mobility or volume expected; and the type and quantity of treatment residuals. Prior IRMs should also be considered.

6.1.5 Short-term Impacts and Effectiveness

This criterion addresses the impacts of the action during the construction and implementation phase until the RAOs have been met. Factors to be evaluated include protection of the community and Site workers during the remedial actions, environmental impacts resulting from the implementation of the remedial actions, and the time required to achieve protection.

6.1.6 Implementability

This criterion addresses the technical and administrative feasibility of implementing a remedial action and the availability of various services and materials required during the implementation. Technical feasibility factors include construction and operation difficulties, reliability of technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. Administrative feasibility includes the ability and time required for permit approval and for coordination with other agencies. Factors employed in evaluating the availability of services and materials include availability of treatment, storage, and disposal services with required capacities; availability of equipment and specialists; and availability of prospective technologies for competitive bid.

6.1.7 Cost

The types of costs that are addressed include: capital costs, operation and maintenance (O&M) costs, costs of five-year reviews where required, present value of capital and O&M costs, and potential future remedial action costs. Capital costs consist of direct and indirect costs. Direct costs include expenditures for the equipment, labor, and materials necessary to install remedial actions. Indirect costs include expenditures for engineering, administrative, and other services required to complete the implementation of remedial alternatives. Annual O&M costs include auxiliary materials and energy, disposal of residues, purchased services, administrative costs, insurance, taxes, license costs, maintenance reserve and contingency funds, rehabilitation costs, and costs for long-term monitoring.

This assessment evaluates the costs of the remedial actions on the basis of present worth. Present worth analysis allows remedial actions to be compared on the basis of a single cost representing an amount that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life. A required operating performance period and a discount rate are assumed to calculate the present worth cost. A discount rate of 2.0 percent was used in this FS for the present worth calculations. The discount rate represents the anticipated difference between the rate of investment return and inflation. Unless otherwise noted, the estimated costs provided for the remedial actions have an accuracy of –30 to +50 percent, in accordance with FS guidance documents.

6.2 General Response Actions

The RAOs are expressed in terms of eliminating access to, and the risk of, exposure pathways for impacted soil, sediment, and groundwater. To meet the RAOs developed for the Site the following general response actions are identified:

No Action. The Site would be left in its existing state without additional remedial actions.

Administrative Actions and Institutional Controls. These actions involve restrictions of access to soil or groundwater.

Monitoring. Long-term monitoring of contaminant concentrations records changing conditions over time, such as COC migration or natural reduction.

Containment. Containment actions involve little or no treatment, but effectively immobilize COC or otherwise remove or control pathways of exposure.

Treatment/Disposal. These actions include on-site or off-site reduction in the volume, toxicity, and/or mobility of the contaminants. Disposal actions include removal and disposal of contaminated media in properly permitted secure landfills.

6.3 Analysis of Soil Remedial Alternatives

6.3.1 Initial Screening of Soil Technologies

Remedial technologies that could potentially address impacted soils are identified and screened in Table 6-1. Brief process descriptions and technical feasibility screening comments are provided. Process effectiveness, permanence, implementability, and cost were considered at this stage of the evaluation. Reduction in COC toxicity, mass, and mobility were also considered.

Upon initial screening, the following three alternatives were retained for further evaluation:

- No Action;
- Site Management Plan with Environmental Easement; and
- Surface Excavation and Capping.

As detailed in Section 2, ongoing groundwater impacts from soils do not appear to be occurring at this site and, therefore, full excavation is not considered for subsurface soils that may be in excess of NYSDEC SCGs for the protection of groundwater. Furthermore, full excavation would not be technically practicable, economically feasible, nor to the benefit of human health and the environment. The IRMs performed at the Site have already removed the most impacted soils and there is no residual "source area" for ongoing contamination from on-site soils.

On-site soils do not exceed human health screening criteria and are not a significant remedial concern.

6.3.2 No Action

Description

No Action is an option that includes no remedial measures, or no remedial measures other than periodic site inspections.

Overall Protection of Human Health and the Environment

Under the No Action alternative, the current Site related risks to human health and the environment would remain unchanged.

Compliance with SCGs

This alternative does not, in the short term, meet NYSDEC recommended cleanup criteria.

Long-term Effectiveness and Permanence

Long-term natural attenuation of VOCs and adsorption of metals would continue. Periodic inspections, with reporting to NYSDEC, may be required.

Reduction of Mobility, Toxicity, or Volume

This alternative would not reduce mobility, toxicity, or volume, except through long-term natural attenuation.

Short-term Impacts and Effectiveness

Under the No Action alternative, the short-term impacts to human health and the environment would remain unchanged. This alternative would not result in additional environmental impacts.

Implementability

This alternative is technically and administratively feasible. No specialized services or materials would be required.

Cost

The cost for implementing a No Action alternative without periodic site inspections would be negligible. If coupled with periodic inspections and reporting (once every one to five years), the estimated 30-year net present value could be less than $30,000.

6.3.3 Site Management Plan with Environmental Easement

Description

Environmental easements are written legal instruments that are recorded in the chain of title for the property. At a minimum they provide information regarding environmental conditions of the Site. They also may limit the use of the Site in some way for the protection of human health and the environment. New York law and NYSDEC regulations permit and/or require the use of an environmental easement in instances where engineering and/or institutional controls are to be used as or for a remedy, such as is proposed for the Site. The use of such an easement would be consistent with future land use considerations, current zoning and groundwater use ordinances, and the tenant's use, rights, and obligations under its lease. The Site is already located within an industrial zone and NWR, the owner, has no plans to change that designation. The easement would be "an interest in real property, created under and subject to the provisions of ECL Article 71 Title 36 which contains a use restriction and/or a prohibition on the use of land in a manner inconsistent with engineering controls", would follow standard NYSDEC format, and would be recorded against and limited to title records for NWR's property. The easement would conceptually include:

- Summary descriptions of the nature and extent of contamination
- Descriptions of engineering controls and "as-built" remedies, any use restrictions, institutional controls, and/or any Site Management Plan requirements
- Reference to, and/or attachment of, the Site Management Plan.

Notice of the easement would be given to the City of Amsterdam after recording

A separate Site Management Plan (SMP) would provide more detailed information regarding the existing soil contaminants and would address all future soil excavation work. Future subsurface excavation in some areas would likely be limited by the SMP to workers who have proper OSHA training and personal protective equipment. Maintenance procedures for controls, such as the existing Site fencing, signage, or covers, would also be detailed in the SMP. The SMP would follow standard NYSDEC format, and would be limited to NWR's property. The SMP would conceptually include:

- Reference to the easement and controls thereunder
- Contemplated use(s) of the Site
- Descriptions of the nature and extent of contamination
- Summary of any "as-built" remedies
- Future soil management during Site upgrades, including:
    - Excavation and grading
    - Excavated soil characterization
    - Soil disposal or reuse
    - Erosion and dust control
    - Construction water management
    - Construction personnel protection
    - Community air monitoring
- Access and institutional controls (e.g. restrictions against some uses)
- Operation, monitoring & maintenance work plan for site controls
- Notification and reporting requirements

Small quantities of TCLP-hazardous (cadmium) soil may still exist below the building's slab-on-grade foundation. In the event of future building demolition, excavation and management of those soils would be conducted under the approved SMP.

Overall Protection of Human Health and the Environment

This remedial alternative is protective of human health and the environment because it controls exposure to impacted soil.

Compliance with SCGs

This alternative is protective of human health and the environment but does not, in the short term, meet NYSDEC recommended cleanup criteria. It would meet site-specific criteria, in that compliance with the restriction would control potential exposures.

Long-term Effectiveness and Permanence

Environmental easements and SMPs are long-term and permanent. Periodic (annual or less) inspections, with reporting to NYSDEC, would be required.

Reduction of Mobility, Toxicity, or Volume

Conceptually, environmental easements, SMPs, and other institutional controls will not in themselves reduce the mobility, toxicity, or volume of COC in the soil. They do, however, restrict and control exposure to COC in the area of concern.

Short-term Impacts and Effectiveness

Protection of Community. This alternative is protective of the community.

Protection of Workers. This alternative is protective of workers.

Environmental Impacts. This alternative would not result in additional environmental impacts.

Time Until Response Objectives are Achieved. This alternative may be implemented, and be in effect, in the very short-term.

Implementability

Technical Feasibility. This alternative is technically feasible. The Site is owned by NWR, and NWR has the power to execute and record any restrictions.

Administrative Feasibility. The environmental easement would be filed with the County Clerk. The SMP would require approval by NYSDEC. Periodic inspection of the property, with reporting to NYSDEC, may also be required.

Availability of Services and Materials. The services required for this alternative are readily available and routine.

Cost

The cost for implementation of an appropriate environmental easement, a SMP, and annual inspections for on-site soils (see Table 6-2) is estimated (net present value) to be approximately $80,000.

6.3.4 Surface Excavation and Capping

Description

This technology involves the partial excavation and off-site disposal of impacted surface soils, resulting in the removal of a small amount of additional COC mass from the Site beyond that already removed in the IRMs.

Initially, the wooded area behind (north of) the building would be cleared of all above ground vegetation. An average of approximately 6 inches of existing soil would then be stripped from the lawn area east of the building and disposed of off site. Locations where previous IRMs had placed a minimum of 12 inches of clean imported fill would be avoided. The total disturbed area would be approximately 110,000 square feet.

Excavated soil would be transported to an off-site, licensed disposal facility as a non-hazardous waste.

Following excavation and off-site disposal, a 12-inch cap of clean imported topsoil would be placed and seeded. The top soil would meet TAGM 4046 guidance values and would provide a barrier to human contact with residual subsurface soils.

Overall Protection of Human Health and the Environment

The most impacted soils have already been removed from the Site. There is currently little or no risk associated with the remaining soils. Because of the invasive nature of excavation, there would be risk of short-term exposure to noise, vibration, and airborne COC to the public during implementation, though the risk of exposures would be minimized through the use of air monitoring and other engineering controls. The excavated materials would be transported to the landfill on public roadways. Overall protection of human health could be diminished by implementation of excavation because of truck traffic and worker safety issues.

Compliance with the SCGs

This alternative would, in the short term, meet NYSDEC recommended cleanup criteria for surface soil. Subsurface exceedances of SCGs would remain unaffected.

Long-term Effectiveness and Permanence

Capping is a long-term technology. Periodic (annual or less) inspection and maintenance of the cap would be required. Long-term institutional controls, such as fencing or an environmental easement, are also commonly used in conjunction with a constructed cap.

Reduction of Toxicity, Mobility, or Volume

Excavation would provide a limited reduction in the volume of impacted soil. Capping will not reduce the toxicity or volume of COC in subsurface soils but would restrict and control potential exposure to COC in the area of concern.

Short-term Impacts and Effectiveness

Protection of Community. This alternative would not be protective of the community in the short-term. The potential for fugitive emissions and exposure to truck traffic, heavy equipment, and noise would be greater than the Site Management alternative, and greater than the current environmental risks.

Protection of Workers. Direct contact with impacted material during excavation will be minimized by use of heavy equipment to perform the excavation and loading activities. Workers involved in excavation activities will wear appropriate PPE as required in a site-specific health and safety plan. This alternative would involve substantial on-site construction activities that would also require worker safety protection and traffic control. Excavation would create greater risk to individual workers than currently exists to human health or the environment.

Environmental Impacts. Destruction of natural habitat would be required to access portions of the excavation area.

Time Until Response Objectives are Achieved. The work could be completed in as little as one construction season following remedy selection, ROD, commitment of a party to do the remedial action under the ROD, and depending upon weather.

Implementability

Technical Feasibility. Excavation, transportation, and disposal of impacted soils are conventional remedial techniques that are implementable. Capping is technically feasible using conventional construction methods. To avoid adversely affecting the use of the building (because of the height of the cap) some excavation of surface soils would be required. Design-phase testing would be required to further delineate the extent of soil to be removed and to pre-characterize the material for disposal.

Administrative Feasibility. Administratively, this alternative is feasible.

Availability of Services and Materials. Excavation, transportation, and disposal services to implement this alternative are all readily available.

Cost

The cost of excavating and capping on-site surface soils (see Table 6-3) is estimated to be approximately $500,000, including annual inspections and reporting. This cost does not include a budget for an environmental easement or accidental damage repairs.

6.4 Analysis of Sediment Remedial Alternatives

6.4.1 Initial Screening of Sediment Technologies

Remedial technologies that could potentially address impacted sediments are identified and screened in Table 6-4. Brief process descriptions and technical feasibility screening comments are provided. Process effectiveness, permanence, implementability, and cost were considered at this stage of the evaluation. Reduction in COC toxicity, mass, and mobility were also considered.

Following initial screening, and in accordance with NYSDEC's comments of January 2006, five sediment remedial technologies were retained for further evaluation:

- No Action;
- Monitoring;
- Limited Excavation;
- Intermediate Excavation; and
- Full Excavation.

6.4.2 No Action

Description

No Action is an option that includes no remedial measures, or no remedial measures other than periodic site inspections.

Overall Protection of Human Health and the Environment

Under the No Action alternative, the current Site related risks to human health and the environment would remain unchanged.

Compliance with SCGs

This alternative does not, in the short term, meet NYSDEC recommended cleanup criteria.

Long-term Effectiveness and Permanence

Long-term natural attenuation and adsorption of metals would continue. Periodic inspections, with reporting to NYSDEC, may be required.

Reduction of Mobility, Toxicity, or Volume

This alternative would not reduce mobility, toxicity, or volume, except through long-term natural attenuation.

Short-term Impacts and Effectiveness

Under the No Action alternative, the short-term impacts to human health and the environment would remain unchanged. This alternative would not result in additional environmental impacts.

Implementability

This alternative is technically and administratively feasibility. No specialized services or materials would be required.

Cost

The cost for implementing a No Action alternative without periodic site inspections would be negligible. If coupled with periodic inspections and reporting (once every one to five years), the estimated 30-year net present value could be less than $30,000.

6.4.3 Monitoring

Description

A sediments monitoring program would include periodic collection and analysis of surface sediment samples from pre-designated locations. Sediment samples would be periodically collected from the top 4 inches of deposited material in those locations. Depth of sediment (or elevation of top of sediment) would be estimated to confirm that additional material is being deposited rather than eroded. Sediment monitoring could be conducted concurrently with groundwater monitoring, every one to three years.

Tentatively, the monitoring locations (to be used in the absence of other remedial actions) would include the downstream depositional areas near former sample locations WB-5, DB-2, and EB-9.

Location WB-5 is at the inlet side of a culvert leading under an abandoned railroad spur. The culvert is currently buried under tree limbs, miscellaneous debris, and a large quantity of railroad ballast stone. Fresh, soft sediments are also present at the surface. None of these conditions have their origin in historic operations at the Site, but rather appear related to off-site activities and storm events. The ballast stone may have been placed on purpose by the railroad as a runoff control. The location is effectively a drainage basin and flow from the West Branch currently percolates through the debris and stone. The effect of this is to create a depositional sediment trap. Future transport of significant COC mass beyond this point is unlikely.

Location DB-2 is in the inlet side of the constructed drainage basin near Sam Stratton Road. Like WB-5, sediment transported by erosion from upstream of this location will generally collect here. Natural transport of significant COC mass beyond this point is unlikely.

Location EB-9 is at the inlet of a culvert leading under the CSX Railroad. The entire area between Route 5 and the railroad is flat and depositional. At some time after sample EB-9 was collected for the RRIR, CSX personnel excavated the sediment at EB-9 and stockpiled it nearby. The culvert has again, however, become plugged with fresh debris and sediment. Additional sampling and analysis has not been conducted, so it is not possible to say if the fresh sediment is as impacted as the material in the original EB-9 sample.

Sediment monitoring, as described herein, would determine the characteristics of re-deposited sediments so that future remedial action (such as limited excavation, if necessary) could be taken. If the depth of contaminated sediment does not increase materially at the monitoring locations, or if sediment monitoring indicates that the COC in the surface sediments is decreasing over time, then, in consultation with NYSDEC, monitoring will be halted.

Overall Protection of Human Health and the Environment

There is currently no significant risk to human health and the environment from the on- or off-site sediments. This remedial alternative is, however, further protective of the environment because it monitors against migration of COC. Because of the existing configuration of the depositional areas, and because of the previous IRMs and cessation of new discharges, future transport of significant COC mass beyond EB-9 or WB-5 to the Mohawk River is unlikely.

Compliance with SCGs

This alternative is protective of human health and the environment but does not, in the short term, meet NYSDEC guidance values.

Long-term Effectiveness and Permanence

Assuming no new releases from Site operations, or other properties for which NWR would have no responsibility, a long-term monitoring program would verify that impacts are not increasing or migrating to previously uncontaminated areas.

Reduction of Mobility, Toxicity, or Volume

Sediment monitoring will record the mobility and volume of COC and sediments. If the COC are shown, through monitoring, to be significantly mobile, then the volume may be reduced through limited excavation. Sediment monitoring would reduce the potential for migration of additional COC to the Mohawk River.

Short-term Impacts and Effectiveness

Protection of Community. This alternative is protective of the community.

Protection of Workers. This alternative is protective of workers.

Environmental Impacts. This alternative would not result in additional environmental impacts.

Time Until Response Objectives are Achieved. This alternative will not have a significant impact on the concentrations of COC over the short-term but will, in the mid-term (2 years), determine the mobility of the COC, if any. This remedy could be implemented immediately upon remedy selection, issuance of a ROD, and commitment of a party to do the remedial action under the ROD.

Implementability

Technical Feasibility. This alternative is technically feasible.

Administrative Feasibility. This alternative would require periodic monitoring and data review by NYSDEC, as a component of the long-term groundwater monitoring program. Access agreements may also be required.

Availability of Services and Materials. The services and materials required for this alternative are readily available.

Cost

The cost of sediment monitoring (see Table 6-5) is estimated to be only $1,200 per year, as an additional cost to a groundwater monitoring program. Assuming a 30-year groundwater program with annual sediment sampling for costing purposes, the NPV for this additional sediment program is approximately $27,000. Sampling at less frequency, or termination of the program after favorable results, will reduce this cost.

Assuming, as a contingency (which may not occur) that favorable results are not obtained but instead conditions deteriorate materially such that some excavation of sediments may ultimately be required, then the additional cost of excavation and disposal could be similar to the Limited Excavation alternative (see below), i.e. an additional $186,500, resulting in a total cost of approximately $213,000 for this alternative. Lesser excavation and disposal may be warranted as determined by the data.

6.4.4 Limited Excavation

Description

This technology involves the removal of some of the remaining (post-IRM) impacted sediments by conventional earth-moving equipment. Excavated sediment would be transported to an off-site, licensed disposal facility as a non-hazardous waste (the Soils and Sediments IRM addressed all known sediments classifiable by RCRA TCLP testing as hazardous wastes). Excavation and off-site disposal would remove some additional mass of COC, within limitations, beyond that already removed in the IRM.

Limited excavation would be conducted near locations EB-8 and EB-9. DB-8 would also be excavated. Only sample locations DB-8 and EB-9 have COC in excess of the recreational/industrial exposure limit (see Section 3). These areas are also moderately accessible.

Limited excavation would result in the construction of a shallow drainage basin immediately upstream of EB-9, which would subsequently facilitate the controlled deposition and monitoring of additional transported sediment, if any. This action would also be protective of the Mohawk River.

At EB-9 (near the CSX Railroad), NWR's personnel or equipment will *not* enter within 25 feet of the nearest rail without specific railroad safety training and certification. This means that the currently stockpiled EB-9 material would likely be transferred, if practicable, by CSX-operated equipment to NWR's work area for off-site disposal. Clearing, maintenance, and improvements to the CSX culvert likewise would *not* be performed by NWR. Remedial efforts would need to be coordinated with CSX.

Overall Protection of Human Health and the Environment

The most impacted sediments have already been removed from the East and West Branch drainages. There is currently little or no human health risk associated with the remaining soils/sediments. Because of the invasive nature of excavation, there would be risk of short-term exposure to noise, vibration, and airborne COC to the public during implementation, though the risk of exposures would be minimized through the use of air monitoring and other engineering controls. The excavated materials would have to be transported to the landfill on public roadways. Overall protection of human health could be diminished by implementation of excavation because of truck traffic and worker safety issues.

Compliance with SCGs

The limited excavation of contaminated sediments would result in reduction of COC mass, but some soils/sediments in excess of SCGs would remain.

Long-term Effectiveness and Permanence

This alternative would permanently remove a limited mass of COC from the drainage, but re-deposition could occur.

Reduction of Mobility, Toxicity, or Volume

This alternative would provide reduction in the toxicity and volume of impacted sediment. Removal of impacted sediment from the vicinity of EB-9 would reduce the potential for migration of COC from that area to the Mohawk River.

Short-term Impacts and Effectiveness

Protection of Community. This alternative would not be protective of the community in the short-term. The potential for fugitive emissions and exposure to truck traffic, heavy equipment, and noise would be greater than the sediment monitoring alternative, and greater than the current environmental risks. Unlike the previous IRMs, this work would be conducted near residences, highways, and railroads.

Protection of Workers. Direct contact with impacted material during excavation will be minimized by use of heavy equipment to perform the excavation and loading activities. Workers involved in excavation activities will wear appropriate PPE as required in a site-specific health and safety plan. This alternative would involve substantial on-site construction activities that would also require worker safety protection and traffic control. Excavation would create greater risk to individual workers than currently exists to human health or the environment.

Environmental Impacts. Destruction of natural habitat would be required to access portions of the excavation area.

Time Until Response Objectives are Achieved. The work could be completed in one construction season following remedy selection, issuance of a ROD, commitment of a party to do the remedial action under the ROD, permit acquisitions and access negotiations, and depending upon weather.

Implementability

Technical Feasibility. Excavation, transportation, and disposal of impacted sediments are conventional remedial techniques that are implementable. However, access to the area between Route 5 and the CSX Railroad is via a short but steep embankment and the area may be too soft for most excavation equipment. During the design phase, the affected sediments would be pre-characterized for disposal, and a survey of the topography for construction layout would be performed to design access routes and processes for the work, and prepare contractor bidding specifications.

Administrative Feasibility. Administratively, this alternative would be difficult. Coordination with local authorities, CSX, and the New York State Department of Transportation (NYSDOT) would be required to establish an acceptable plan (and agreement) for equipment access, egress, and trucking route. This evaluation assumes that no construction work will be performed within 25 feet of the nearest CSX rail.

Availability of Services and Materials. Excavation, transportation, and disposal services to implement this alternative are all readily available.

Cost

The estimated cost of this alternative (see Table 6-6) is approximately $187,000.

6.4.5 Intermediate Excavation

Description

This technology involves the excavation and off-site disposal of site-related LEL exceedances in the East Branch Drainage south of the CSX railroad corridor, and within a portion of the Mohawk River at the East Branch outfall. Intermediate sediment excavation is evaluated in response to a NYSDEC request stated in their January 2006 letter [NYSDEC, 2000]. The remedial action is conceptually shown in Figure 5

The East Branch outfall channel, south of the CSX corridor, is assumed to be approximately 600 feet long, 18-inches deep, and average 12 feet wide (400 cubic yards). The Mohawk River area at the East Branch outfall is assumed to cover approximately 12,000 square feet and a depth of 18-inches (700 cubic yards).

To prevent the potential for future migration of impacts to the Mohawk River, two (2) sedimentation basins will be constructed at locations EB-9 and WB-5 by limited clearing and excavation as described in Section 6.4.4. Sediments in exceedance of SELs at these locations will also be removed and disposed off site during the work. These basins would subsequently facilitate the controlled deposition of additional transported sediment from upstream, if any, and would be protective of the Mohawk River. Each of the sedimentation basins will be designed and constructed to provide sufficient surface area and detention time for the purpose. For estimating, it is assumed that a total of approximately 200 cubic yards of material, including all SEL and most LEL exceedances, would be removed from EB-9 and WB-5.

A small amount of soil (assumed 2 cubic yards) at location DB-5 with chromium in excess of the human health screening values will also be removed under this alternative.

Excavation in the Mohawk River will involve the temporary installation of a sheet pile cofferdam, or a fabric cofferdam (such as a Portadam), around the excavation area. Surface water from the East Branch will be diverted around the work area with pumps and the work area within the cofferdam will be dewatered. Downstream turbidity will be controlled, but no water treatment will be performed. Excavators and loaders will access the work area from Quist Road. Haul trucks will be staged on Quist Road for loading. The work within the Mohawk would be performed during winter due to the lower river elevation.

Access to EB-9 will be via a short but steep embankment from Route 5 and will likely require a permit from the NYSDOT and possibly CSX. Access to WB-5 will be from Chapman Drive via the abandoned railroad spur and may also require permission from CSX, the presumed owner of the spur. Access to and work within the Mohawk River will require a permit from the US Army Corps of Engineers.

At EB-9 (near the CSX Railroad), NWR's personnel or equipment will *not* enter within 25 feet of the nearest rail without specific railroad safety training and certification. This means that the currently stockpiled EB-9 material would likely be transferred, if practicable, by CSX-operated equipment to NWR's work area for off-site disposal. Clearing, maintenance, and improvements to the CSX culvert likewise would *not* be performed by NWR. Remedial efforts would need to be coordinated with CSX.

Excavated sediment would be transported to an off-site, licensed disposal facility as a non-hazardous waste (the Soils and Sediments IRM addressed all known sediments classifiable by RCRA TCLP testing as hazardous wastes). Post-excavation sampling will confirm that exceedances were removed and quantify the concentrations in remaining sediments. Excavation and off-site disposal would remove some additional mass of COC, within limitations, beyond that already removed in the IRM.

Due to the nature of the work in the river (cofferdams, water pumping and handling during winter operations, high costs of downtime), and based on generally accepted professional practices for sediment remediation projects under NYSDEC oversight at other similar NY State sites, residual sediments within the excavation area that remain in excess of LELs following a minimum excavation depth of 18- to 24-inches, will be left in place. All sediments in excess of the SELs (based on pre- and post-excavation sampling) will be removed regardless of depth.

Following receipt of acceptable post-excavation sampling results (3 to 5 day turnaround), the entire excavation within the main channel of the Mohawk River will receive geofabric, 12-inches of armor stone, and 6- to 8-inches of topsoil for benthic restoration (the topsoil will settle partially into the armor stone). The East Branch outfall channel is a depositional environment and will not require armor stone or soil, unless LEL exceedances remain below an 18-inch excavation. The constructed sediment basins at WB-5 and EB-9 will not be armored or backfilled. All vegetation will be restored by natural re-growth, except for applications of grass hydro seed in select areas such as the Route 5 right-of-way.

Following construction, a sediments monitoring program would be initiated (as described in Section 6.4.3) for the constructed sedimentation basins at EB-9, WB-5, and the pre-existing DB-2. Sediment samples would be annually or biannually (once every two years) collected from the top four inches of deposited material within the basins to determine the characteristics of re-deposited sediments so that future remedial action, if necessary, could be taken.

Overall Protection of Human Health and the Environment

The most impacted sediments were already removed from the Site during the Soils and Sediments IRM. There is currently little or no human health risk associated with the remaining soils/sediments. Overall protection of human health could be diminished by implementation of sediment excavation because of truck traffic and worker safety issues. The benthic organisms sought to be protected would be damaged by the work, but ultimately would restore themselves.

Compliance with SCGs

Excavation of contaminated soils would result in reduction of known COC mass, but soils/sediments in excess of SCGs could remain.

Long-term Effectiveness and Permanence

This alternative would permanently remove COC mass from the drainage.

Reduction of Mobility, Toxicity, or Volume

This alternative would provide reduction in the volume of impacted sediment.

Short-term Impacts and Effectiveness

Protection of Community. This alternative would not be protective of the community in the short-term. Unlike the previous IRMs, this work would be conducted near residences, highways, and railroads. The potential for exposure to truck traffic and heavy equipment may be greater than the current environmental risks. The risk of short-term exposure to noise, vibration, and airborne COC would be minimized through the use of air monitoring and other engineering controls. The excavated materials would have to be transported to the landfill on public roadways.

Protection of Workers. Direct contact with impacted material during excavation will be minimized by use of heavy equipment to perform the excavation and loading activities. Workers involved in excavation activities will wear appropriate PPE as required in a site-specific health and safety plan. This alternative would involve substantial on-site construction activities that would also require worker safety protection and traffic control. Excavation would create greater risk to individual workers than currently exists to human health or the environment.

Environmental Impacts. The remedial action will have no long-term environmental effect, beneficial or detrimental, except for destruction of river bank trees and disruption of the benthic ecosystem within the work area. It will, however, remove some COC which may potentially be in contact with some benthic organisms. The benthic organisms themselves will be removed by the excavation but should be readily replaced by others. Potential releases to the river will be controlled during the work.

Time Until Response Objectives are Achieved. The work could possibly be completed in as little as 18 months following remedy selection, issuance of the ROD, commitment of a party to do the remedial action under the ROD, permit acquisitions and access negotiations, and depending upon weather. The pre-design investigation and design engineering would require approximately 6 months. Permits would be required from the US Army Corps of Engineers, the NYSDOT, CSX, and possibly from adjacent property owners. Permit acquisition is anticipated to require at least 6 months.

Implementability

Technical Feasibility. Sheet piling (or Portadam), excavation, transportation, and disposal of impacted sediments are conventional remedial techniques that are implementable. However, access to the work areas will require permits, access rights, destruction of habitat, construction of haul roads, and interruption of public traffic. During the design phase, the affected sediments would be pre-characterized for disposal, and a survey of the topography for construction layout would be performed to design access routes and processes for the work, and prepare contractor bidding specifications.

Administrative Feasibility. Administratively, this alternative would be difficult. Coordination with local authorities, CSX, NYSDOT, the POTW, NYSDEC Fish and Wildlife Division, the US Army Corps of Engineers, City of Amsterdam and site owners would be required to establish an acceptable plan and permits.

Availability of Services and Materials. Sheet piling (or Portadam), excavation, transportation, and disposal services to implement this alternative are all readily available. Sheet piling or Portadam work would, however, require a specialty contractor.

Cost

The estimated cost of this alternative (see Table 6-7) is approximately $1,017,000, including a long-term sediment monitoring program and a contingency for future excavations within the detention basins (similar to that allowed in Section 6.4.3).

6.4.6 Full Excavation

Description

This alternative is included in the FS to evaluate a complete (to the extent feasible) sediment removal scenario.

This technology involves the removal of all known LEL exceedances from both Drainages and the Mohawk River by conventional earth-moving equipment. LEL exceedances are shown in Figure 3. Excavated sediment would be transported to an off-site, licensed disposal facility as a non-hazardous waste (the Soils and Sediments IRM addressed all known sediments classifiable by RCRA TCLP testing as hazardous wastes). No detention basins would be constructed at EB-9 and WB-5 because all upstream sediments in excess of LELs would be addressed, as confirmed by post-excavation confirmation sampling. Excavation and off-site disposal would remove additional mass of COC, within limitations, beyond that already removed in the IRM.

Excavation of LEL exceedances would be conducted in the West Branch drainage from Sam Stratton Road (at WB-1) to the abandoned railroad spur (at WB-5), at the isolated exceedances WB-6 and WB-10, and in the Mohawk River. For estimating, the drainage area excavation is assumed to be approximately 1,750 feet long, 18-inches deep, and average 10 feet wide (1,000 cubic yards). The Mohawk River area at the Western Drainage outfall is likewise assumed to cover approximately 16,000 square feet and a depth of 18-inches (900 cubic yards).

Excavation of LEL exceedances would also be conducted over the entire length of the East Branch drainage from the toe of the Soil/Sediment IRM (at Edson Street) into the Mohawk River. For estimating, the drainage area excavation is assumed to be approximately 3,000 feet long, 18-inches deep, and average 10 feet wide (1,700 cubic yards). The eastern Mohawk River area is likewise assumed to cover approximately 12,000 square feet and a depth of 18-inches (700 cubic yards).

At EB-9 (near the CSX Railroad), NWR's personnel or equipment will *not* enter within 25 feet of the nearest rail without specific railroad safety training and certification. This means that the currently stockpiled EB-9 material would likely be transferred, if practicable, by CSX-operated equipment to NWR's work area for off-site disposal. Clearing, maintenance, and improvements to the CSX culvert likewise would *not* be performed by NWR. Remedial efforts would need to be coordinated with CSX.

Access to the East and West Branch drainages will be up from the unused railroad spur. The large mature trees within the work area will be cut and felled manually. An excavator and a loader will clear the smaller trees and cut a haul road as necessary, working primarily directly up the creek bed.

Material will be excavated by the excavator and transported directly down the drainages by the loader. Excavated material will be screened on site and coarse particles (>1-inch) will be returned to the excavation as armor stone cover. Screening and other support equipment will be staged on the rail spur nearest the work area. Fine screenings will be transferred directly to a haul truck by a second excavator. Coarse screening will be returned to the loader for transport back to the finished excavation.

Haul trucks will back into the spur one at a time to be loaded. Additional haul trucks will park along Chapman Drive while waiting.

Surface water will be routed around the active excavation by pumps. Downstream turbidity will be controlled, but no water treatment will be performed.

Access to the East Branch north of Sam Stratton Road will be from the public roads, as performed during the Soil/Sediment IRM. Access to the East Branch between Chapman Drive and Quist Road will be as described in Section 6.4.4.

Restoration of the remediated areas will be limited. Erosional areas will be armored with excavated or imported stone. Depositional areas will not be armored. Vegetation will be restored by natural re-growth, except for select applications of grass hydro seed in disturbed grassy areas such as the Route 5 right-of-way. Trees will not be replaced.

Excavation of the Mohawk River will involve the temporary installation of a sheet pile cofferdam, or a fabric dam (such as a Portadam) around the excavation area. Surface water from the East Branch will be diverted around the work area with pumps and the work area within the cofferdam will be dewatered. Again, downstream turbidity will be controlled, but no water treatment will be performed. Cobbles and sediments will be excavated and removed within the coffer dam. Excavators and loaders will access the work area from Quist Road. Haul trucks will be staged on Quist Road for loading. The Mohawk River excavation will receive 12-inches of armor stone and 6-inches of topsoil (for benthic restoration).

Permits would be required from the USACE, the NYSDOT, CSX, and possibly from adjacent property owners. Permit acquisition is anticipated to require 6 months.

Following construction, a sediments monitoring program would not be initiated.

Overall Protection of Human Health and the Environment

The most impacted sediments have already been removed from the Site. There is currently little or no risk associated with the remaining soils/sediments. Because of the invasive nature of excavation, there would be risk of short-term exposure to noise, vibration, and airborne COC to the public during implementation, though the risk of exposures would be minimized through the use of air monitoring and other engineering controls. The excavated materials would have to be transported to the landfill on public roadways. Overall protection of human health could be diminished by implementation of excavation because of truck traffic and worker safety issues. The benthic organisms sought to be protected would be damaged by the work, but ultimately would restore themselves.

Compliance with SCGs

Excavation of contaminated soils would result in reduction of known COC mass, but soils/sediments in excess of SCGs could still remain in technically inaccessible locations.

Long-term Effectiveness and Permanence

The intent of this alternative would be to permanently remove all site-related COC mass from the drainages and the river, to the extent technically feasible.

Reduction of Mobility, Toxicity, or Volume

This alternative would provide reduction in the volume of impacted sediment.

Short-term Impacts and Effectiveness

Protection of Community. This alternative would not be protective of the community in the short-term. The potential for fugitive emissions and exposure to truck traffic, heavy equipment, and noise would be greater than the other sediment alternatives, and far greater than the current environmental risks. The risk of short-term exposure to noise, vibration, and airborne COC would be minimized through the use of air monitoring and other engineering controls. The excavated materials would have to be transported to the landfill on public roadways. Unlike the previous IRMs, this work would be conducted near residences, highways, and railroads.

Protection of Workers. Direct contact with impacted material during excavation will be minimized by use of heavy equipment to perform the excavation and loading activities. Workers involved in excavation activities will wear appropriate PPE as required in a site-specific health and safety plan. This alternative would involve substantial on-site construction activities that would also require worker safety protection and traffic control. Excavation, particularly along steeper slopes, would create greater risk to individual workers than currently exists to human health or the environment.

Environmental Impacts. Significant destruction of natural habitat would be required. The existing drainages (currently steep, mossy creek beds in mature hardwood forest) would be cleared of trees for many feet on either side and the creek bed would be replaced with armor stone. In the Mohawk River and East Branch outlet, the remedial action will involve the removal of some river bank trees and disruption of the benthic ecosystem within the work area. It will, however, remove some COC which may potentially be in contact with some benthic organisms. The benthic organisms themselves will be removed by the excavation but should be readily replaced by others.

Time Until Response Objectives are Achieved. The work could possibly be completed in as little as one year following remedy selection, issuance of a ROD, commitment of a party to do the remedial action under the ROD, completion of design work, acquisition of all permits and access agreements, and depending upon weather.

Implementability

Technical Feasibility. Sheet piling (or Portadam), excavation, transportation, and disposal of impacted sediments are conventional remedial techniques that are implementable. However, access to the work areas will require destruction of habitat, construction of haul roads, and interruption of public traffic. During the design phase, the affected sediments would be pre-characterized for disposal, and a survey of the topography for construction layout would be performed to design access routes and processes for the work, and prepare contractor bidding specifications. While this alternative may be technically feasible, it is *not* considered technically practicable, economically feasible, nor to the benefit of human health and the environment.

Administrative Feasibility. Administratively, this alternative would be most difficult. Coordination with local authorities, CSX, NYSDOT, the POTW, NYSDEC Fish and Wildlife Division, the US Army Corps of Engineers, City of Amsterdam and site owners would be required to establish an acceptable plan and permits.

Availability of Services and Materials. Excavation, transportation, and disposal services to implement this alternative are all readily available. Sheet piling or Portadam work would be performed by a specialty contractor, also available.

Cost

The estimated cost of this alternative (see Table 6-8) is approximately $2,170,000. This alternative is *not* considered economically feasible.

6.5 Analysis of Groundwater Remedial Alternatives

6.5.1 Initial Screening of Groundwater Technologies

Remedial technologies that could potentially address impacted groundwater are identified and screened in Table 6-9. Brief process descriptions and technical feasibility screening comments are provided. Process effectiveness, permanence, implementability, and cost were considered at this stage of the evaluation. Reduction in COC toxicity, mass, and mobility were also considered.

It is recognized that the NYSDEC groundwater / drinking water standard for TCE, as a long-term "goal", is 5 ug/L. It is further recognized that this level is not practically attainable in all groundwater now or in the foreseeable future by any available technology. The FS screening process will, therefore, focus on those technologies that will effectively reduce the mass and/or mobility of the source of ongoing groundwater impacts.

Following initial screening, six remedial technologies were retained for further evaluation:

- No Action;
- Groundwater Use Restrictions and Monitoring;
- Groundwater Extraction and Treatment;
- In-situ Bioremediation;
- In-situ Chemical Oxidation (ISCO); and
- Combination of Extraction and In-situ Oxidation.

Use restrictions and groundwater monitoring are elements that will be common to all of the active groundwater alternatives. The treatment alternatives will be evaluated for implementation on site, focusing on source area (as defined in Section 4.3), rather than at the downgradient plume edge (at which remediation would be less effective).

6.5.2 No Action

Description

No Action is an option that includes no remedial measures, or no remedial measures other than periodic site inspections.

Overall Protection of Human Health and the Environment

Under the No Action alternative, the current Site related risks to human health and the environment would remain unchanged. In the absence of groundwater consumption, No Action could provide acceptable protection.

Compliance with SCGs

This alternative does not, in the short term, meet NYSDEC recommended cleanup criteria.

Long-term Effectiveness and Permanence

Long-term natural attenuation of VOCs and adsorption of metals would continue. Periodic inspections, with reporting to NYSDEC, may be required.

Reduction of Mobility, Toxicity, or Volume

This alternative would not reduce mobility, toxicity, or volume, except through long-term natural attenuation.

Short-term Impacts and Effectiveness

Under the No Action alternative, the short-term impacts to human health and the environment would remain unchanged. This alternative would not result in additional environmental impacts.

Time Until Response Objectives are Achieved.

The work could be initiated immediately upon remedy selection. It is not expected, however, that this remedy would attain drinking water standards in any foreseeable period.

Implementability

This alternative is technically and administratively feasible. No specialized services or materials would be required.

Cost

The cost for implementing a No Action alternative without periodic site inspections would be negligible.

If coupled with periodic inspections and reporting (once every one to five years), the estimated 30-year net present value could be less than $30,000.

6.5.3 Groundwater Use Restrictions and Monitoring

Description

Institutional controls, including environmental easements or other restrictions or land use controls, are written legal instruments, often recorded in the chain of title for the property, that restrict or control future uses, or accomplish other goals. At a minimum, they provide information regarding the environmental conditions of the Site. They also may limit the use of the Site in some way for the protection of human health and the environment. To address groundwater on the Ward Products Site, an institutional control such as an environmental easement would preclude the installation of production wells and/or the use of untreated groundwater from the Site. New York law and NYSDEC regulations permit and/or require the use of an environmental easement in instances where engineering and/or institutional controls are to be used as or for a remedy, such as is proposed for the Site. See Section 6.3.3 for further aspects of an easement.

Off-site wells (i.e. those on FGI property) should be abandoned or converted to monitoring-only wells, as a means of eliminating groundwater use. FGI has been so advised and NWR has offered to seal and/or disconnect their wells. At this time, withdrawal of FGI groundwater has ceased indefinitely. As reported by RETEC to NYSDEC (letter report dated September 8, 2006), the off-site well on UCMI property was decommissioned and sealed in August, 2006.

Regardless of the remedial action(s) ultimately selected, on- and off-site groundwater will not meet NYSDEC SCGs in the foreseeable future. For that reason, it is prudent to assume that a long-term (30 years) groundwater monitoring program will be implemented.

Groundwater monitoring assures that migration of the plume and/or concentration changes are tracked and reported. The current groundwater monitoring program includes sampling and analysis from 20 monitoring wells and two surface water locations. Currently, samples are collected twice per year. Analyses include priority pollutant VOCs, total chromium, hexavalent chromium, and turbidity. A reasonable long-term monitoring program for the Site would be less extensive and may include approximately four monitoring wells being sampled once per year. Some new wells may be installed. Other wells would be decommissioned. The specifics of the reduced program would be negotiated with the NYSDEC based on data compiled at the time.

Monitoring with use restrictions (by agreement or regulation) can be effective and permanent, and may be preferable to monitoring-only scenarios in some circumstances.

Overall Protection of Human Health and the Environment

Under this alternative, the current Site related risks to human health and the environment would arguably remain unchanged because of the absence of groundwater consumption. This remedial alternative is, however, additionally protective of human health and the environment because an environmental easement would further control or eliminate future exposure pathways. Periodic groundwater sampling monitors migration of COC, if any.

Compliance with SCGs

This alternative is protective of human health and the environment but does not, in the short term, meet NYSDEC recommended cleanup criteria. It may meet site-specific criteria in that actual exposures are monitored or controlled.

Long-term Effectiveness and Permanence

In the absence of new releases on-site or off-site (for which NWR would have no responsibility), TCE, chromium, and other COC concentrations in groundwater will be reduced over time due to natural attenuation, chemical precipitation, and adsorption.

Reduction of Mobility, Toxicity, or Volume

Conceptually, groundwater use restrictions and/or groundwater monitoring will not in themselves reduce the mobility, toxicity, or volume of COC in the groundwater. However, as long as use is restricted and groundwater is monitored, exposures to COC are reduced in the area of concern.

Short-term Impacts and Effectiveness

Protection of Community. This alternative is protective of the community.

Protection of Workers. This alternative is protective of workers.

Environmental Impacts. This alternative would not result in additional environmental impacts.

Time Until Response Objectives are Achieved. This alternative will not have a significant impact on the concentrations of COC over the short-term, but can be initiated immediately upon remedy selection, issuance of a ROD, and commitment of a party to do the remedial action under the ROD.

Implementability

Technical Feasibility. This alternative is technically feasible. NWR owns the Ward Products Site. Implementation of environmental easements on off-site properties, if necessary, would require the consent of the property owners absent changes in federal, state or local laws or regulations.

Administrative Feasibility. This alternative would require periodic monitoring and data review, as required by NYSDEC.

Availability of Services and Materials. The services and materials required for this alternative are readily available and would be routine over time.

Cost

The cost for implementation of a long-term (30-year) groundwater monitoring program, including monitored natural attenuation, would be approximately $24,000 per year for the first four years (continuation of the existing monitoring program, plus MNA), followed by approximately $9,000 per year for the next 26 years (approximately 4 wells sampled annually, plus MNA) (see Table 6-10). The NPV cost of the entire program would be approximately $279,000. This total cost includes approximately $20,000 for implementation of a groundwater easement for the Site.

6.5.4 Groundwater Extraction and Treatment

Description

Under this remedial technology, a central groundwater recovery well, with an electric submersible pump and an on-site treatment system, would be installed. The pump would discharge to the treatment system. Treated effluent would be discharged to the City of Amsterdam's municipal wastewater treatment plant (POTW), via the sanitary sewer, under an appropriate discharge permit. Periodic monitoring would be required. The discharge limit to the POTW for chromium is 5.0 mg/L, though local POTW officials have stated verbally that because they are operating under an Order on Consent with the NYSDEC, they may require a lower chromium limit. RETEC has proposed to the POTW a discharge limit of 0.5 mg/L.

The NYSDEC (Division of Water, Schenectady, NY) has recommended to the POTW a TCE limit of 0.71 mg/L because of the volatility of TCE. This limit was derived from USEPA guidance documents pertaining to establishing limits on POTW plant influents, not necessarily individual discharges to the sewer, and may be negotiable.

To meet the assumed TCE discharge limit, the treatment system would include an air stripper, a flow totalizer, a heated shed, and a separate electric service. This treatment train assumes that the existing groundwater concentrations of chromium (<0.5 mg/L) will already be within the negotiated chromium limit, and that chromium treatment will not be required.

The recovery well would be constructed of 4-inch diameter PVC, 60-feet deep, and screened within the bedrock from 30 to 60-feet (existing Site wells are screened to depths up to 50 feet). The pump would be a standard 4-inch submersible pump with surge protection. The central well would be installed at a location near MW-4R, as shown in Figure 6. This location should hydraulically control groundwater flow in the most impacted area, resulting in a capture zone significantly encompassing the source area of ongoing groundwater impacts, and greatly reducing the off-site migration of COC.

At 5 to 10 gpm per well, one pore volume of the most impacted groundwater could be discharged in two to three months. The system would be expected to operate at a total average flow rate of 10 to 15 gpm and remove several pore volumes per year. It may be prudent to shut the system down during the coldest winter months.

The groundwater treatment system would be phased out, with NYSDEC concurrence, when on-site groundwater quality reached a stable value and off-site concentrations begin to exhibit a long-term decline, indicating that the source area of the TCE had been substantially and permanently remediated within the limits of technical feasibility. Groundwater would thereafter be monitored for natural attenuation, and to detect possible rebounds of concentrations. In the event that this source area target cannot be achieved, NWR will consult with NYSDEC about a change in approach.

During system startup, a pilot study would be required to assure that POTW discharge criteria could be met.

This alternative would be combined with on-site groundwater use restrictions and long term groundwater monitoring.

For estimating purposes, a 10-year groundwater extraction/treatment period will be assumed with a 30-year groundwater monitoring program.

Overall Protection of Human Health and the Environment

Under this alternative, the current Site related risks to human health and the environment would remain unchanged because of the absence of groundwater consumption. This remedial alternative is, however, further protective of future human health and the environment because it captures impacted on-site groundwater before it migrates off site. Over time, the natural flushing of COC in soil and bedrock would reduce the concentrations of contaminants in the subsurface at the Site. Groundwater outside the zone of influence would naturally attenuate. Periodic groundwater sampling would monitor the migration of COC, if any.

Compliance with SCGs

This alternative will accelerate mass removal and is protective of human health and the environment, but would not, in the foreseeable future, meet NYSDEC recommended cleanup criteria. This alternative would likely require groundwater use restrictions, as full compliance with drinking water standards will not be met.

Long-term Effectiveness and Permanence

The system would permanently remove contaminant mass from the Site, but long-term monitoring would still be required. Groundwater will remain unusable (without appropriate pre-treatment) for the foreseeable future. The time necessary to attain SCGs cannot be predicted.

Reduction of Mobility, Toxicity, or Volume

Groundwater removal and treatment would reduce the volume of COC in the on-site groundwater over time. Off-site levels would, in time, be reduced due to the reduction in the on-site source material mass and would continue to decline thereafter, partly through natural attenuation. Consumption of water would still be prohibited for an indefinite period.

Short-term Impacts and Effectiveness

Protection of Community. The subsurface capture of impacted groundwater reduces contact with future Site users and reduces migration of off-site impacts. As with air strippers at other remedial locations, the vent stack will be elevated to avoid vapor exceedances at the ground surface. Restrictions on water use would need to continue indefinitely.

Protection of Workers. This alternative is protective of workers. Installation and operation of the collection and treatment system creates no significant hazards. An operations and maintenance health and safety plan would be necessary for system operations and groundwater monitoring activities.

Environmental Impacts. This alternative would not produce short-term environmental impacts.

Time Until Response Objectives are Achieved. The work could be initiated in as little as six months, including the design-phase work , following remedy selection, issuance of the ROD, commitment of a party to do the remedial action under the ROD, acquisition of an acceptable POTW permit, and depending upon weather. It is not expected, however, that this remedy would attain the goal of drinking water standards in any foreseeable period. Restrictions on water use would need to continue indefinitely.

Implementability

Technical Feasibility. The design, scheduling, and construction of a groundwater extraction and treatment system is not difficult. A pilot test as described above may be necessary for permitting and to optimize the effectiveness of the system. The results of the pilot test may alter the feasibility of this alternative.

Administrative Feasibility. This alternative would require periodic sampling and data review to ensure that the system is performing within the specifications required for discharge. A long-term permit and agreement would be required with the POTW. The feasibility of this option may be adversely affected by requirements of the POTW. An air permit may be required from NYSDEC for the air stripper.

Availability of Services and Materials. The services and materials required for this alternative are readily available. The operations and maintenance of groundwater systems can be labor intensive at the outset, but O&M activities are expected to become routine over time.

Cost

The capital cost of system construction and startup would be approximately $138,000 (see Table 6-11). The annual O&M cost would be approximately $20,000. Assuming an operating period of ten years to achieve acceptable reductions in the source area, the total program cost (NPV) would be approximately $337,000. These costs could be further increased by additional requirements of the POTW.

6.5.5 In-Situ Bioremediation

Description

The reductive dechlorination (bioremediation) of TCE by anaerobic microorganisms results in the production of intermediate compounds (daughter products) cis-1,2-dichloroethene and vinyl chloride [ITRC, 1998]. Low concentrations of dichloroethene have been detected in the samples collected from monitoring wells MW-1R, -5, -12, -13, -16, and -17. These wells are located around and downgradient of the central mass (source area) of the contaminant plume. The presence of daughter products, along with an increase in chloride concentrations and a decrease in dissolved oxygen concentrations, as reported in the RRIR, suggests that the TCE may already be undergoing limited natural bioremediation. The daughter products, particularly vinyl chloride, may also be COCs until they themselves degrade. In-situ bioremediation of TCE and the daughter products can be enhanced by injection of a hydrogen releasing compound such as HRC (from Regenesis Corporation) or an edible oil substrate.

Groundwater data from outside the source area indicates that limited biodegradation is already occurring, as described above. Biodegradation could also be occurring within the source area, though the analytical detection limits have been too high to quantify daughter products. In-situ biodegradation also effectively reduces chromium to stable, non-soluble forms.

Initially, a treatability study, performed with the Regenesis Corporation (supplier of HRC), would be required. Based on the results of the treatability study, a field pilot test may also be required prior to full implementation. Matching the injectant and in-situ delivery system to the COC and the Site conditions is key to successful implementation. The feasibility of this option may be adversely affected by results of the treatability study and pilot test.

A full-scale application would likely involve installation of several semi-permanent injection points (wells) into the impacted bedrock. The radius of influence of each HRC injection point is assumed to be 50 feet or less. Conceptually, approximately eight injection wells distributed linearly from

MW-10, around the southeast corner of the building to MW-6, and extending along the concrete drain pipe through MW-4R (see Figure 4). An additional four wells would likely be installed along the north edge of Edson Street west of MW-09. HRC would be injected into the wells at most once or twice per year for a maximum of three injections. It is assumed that the concentrations will initially decrease, followed by a significant though incomplete rebound, which would be typical of the remedial technology.

HRC applications would be phased out either (i) after three applications or (ii) earlier, with NYSDEC concurrence, if and when on-site groundwater quality reached a stable value and off-site concentrations began to exhibit a long-term decline, indicating that the source of the TCE had been substantially and permanently eliminated within the limits of technical feasibility. Groundwater would thereafter be monitored for natural attenuation, and to detect possible rebounds of concentrations. In the event that this source area target cannot be achieved NWR will consult with NYSDEC about a change in this approach.

This alternative would be combined with on-site groundwater use restrictions and a long-term groundwater monitoring program.

For estimating purposes, a 3-injection 4-year HRC injection program will be assumed, with a 30-year groundwater monitoring program.

Overall Protection of Human Health and the Environment

Under this alternative, the current Site related risks to human health and the environment would remain unchanged because of the absence of groundwater consumption. This remedial alternative is, however, further protective of human health and the environment because it results in the destruction of COC. The intermediate compounds (daughter products) may also, however, be COCs until they themselves degrade. Periodic groundwater sampling will monitor the migration of existing and new COC, if any.

Compliance with SCGs

This alternative would likely require permanent groundwater use restrictions, as full compliance with drinking water standards will not be met.

Long-term Effectiveness and Permanence

In-situ bioremediation will, over time, permanently reduce the concentrations of COC. The rate of bioremediation is dependent upon the rate at which HRC can be transported to, and contacted with, the COC. Effectiveness is partly dependent on the bedrock heterogeneities, which could result in the development of preferential flow paths, resulting in untreated subsurface areas. Rebound of dissolved phase concentrations is anticipated to occur after initial treatment has ceased, resulting in the need for repeated treatment events. Long-term groundwater monitoring and permanent restrictions of groundwater use would be required. Groundwater will remain unusable (without appropriate pre-treatment) for the foreseeable future. The time necessary to attain SCGs cannot be predicted.

Reduction of Mobility, Toxicity, or Volume

This remedial alternative will result in a reduction in the mobility, toxicity, and volume of COC over time. The volume of impact is reduced over long time periods of treatment. There are changes to the mobility of COC over time, as biotreatment is most effective on more soluble VOCs. Over time, residual COC will be of an increasingly insoluble (and therefore less mobile) form. Consumption of water would still be prohibited indefinitely.

Short-term Impacts and Effectiveness

Protection of Community. This relatively unobtrusive alternative would be protective of the community. Chemicals would be transported to the Site as needed following all applicable federal and state laws. Restrictions on water use would need to continue indefinitely.

Protection of Workers. An operations and maintenance plan and health and safety plan would be developed to address the handling of HRC and standard operating procedures during groundwater monitoring events. Workers would be properly trained in the handling and injecting of HRC, a highly viscous, though benign, non-toxic compound.

Environmental Impacts. This alternative will not have a significant impact on the concentrations of COC over the short-term. Clean-up criteria would only be met, if ever, after the treatment system is active for a long period of time.

Time Until Response Objectives are Achieved. The work could possibly be initiated, including engineering design and a treatability study, in as little as six months following remedy selection, issuance of a ROD, commitment of a party to do the remedial action under the ROD, and depending upon weather. Actual construction and pilot testing would require an additional six months. It is not expected, however, that this remedy would attain drinking water standards in any foreseeable period. Restrictions on water use would need to continue indefinitely.

Implementability

Technical Feasibility. The technical feasibility of in-situ biological treatment of the high contaminant concentrations present in the source area is uncertain. A pilot study for characterization of the microbial populations and hydraulic modeling may be required. The results of the pilot test may alter the feasibility of this alternative. Treatment time would not be rapid, and would vary depending on the contaminant type and concentration, nutrient transfer rates, and Site homogeneity. Designing and installing the injection wells and/or the associated trenching would not be difficult to perform. Multiple injections of HRC will be required because of COC rebound, as outlined above, though the cost/benefit of additional injections will decrease rapidly.

Administrative Feasibility. This alternative would require thorough periodic groundwater monitoring and data review to ensure that the alternative is performing as expected. No special permits would be required.

Availability of Services and Materials. The services and materials required for this alternative are readily available.

Cost

The cost of in-situ bioremediation (see Table 6-12) is estimated to be approximately $272,000 (for a four year program), including approximately $39,000 for a pilot study.

6.5.6 In-Situ Chemical Oxidation (ISCO)

Description

ISCO rapidly converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, and permanganates. These oxidants can cause the rapid and complete chemical destruction of many toxic organic chemicals, and is particularly suited for remedial actions focused on source areas. [ITRC, 2005]. For other organic compounds, the oxidation reaction can result in partial degradation as an aid to subsequent bioremediation (see Section 6.5.5). In general, the oxidants have been capable of achieving high treatment efficiencies (>90%). Field applications have clearly affirmed that matching the oxidant and in-situ delivery system to the COC and the Site conditions is the key to successful implementation and achieving performance goals.

Initially, a pilot study would involve a single injection of potassium permanganate ($KMnO_4$) into existing monitoring wells MW-4R and/or MW-6 (proximate to the source area). $KMnO_4$ is a relatively low-cost and safe oxidant that has been shown to be highly effective on TCE. Residual concentrations of TCE would be measured immediately before, 1 week after, and 3 months after. It is assumed that the concentrations will initially decrease, followed by a significant though incomplete rebound, which would be typical of this remedial technology. Groundwater temperature will be monitored during injection to avoid damage to the PVC well casing due to the exothermic reaction between TCE and $KMnO_4$. The information gathered during the pilot study would be used to determine the efficacy of the technology, and the potential for a full-scale application. The feasibility of this option may be adversely affected by results of the treatability study and pilot test.

Hexavalent chromium concentrations in groundwater at the site have decreased over time, which suggests natural attenuation of chromium as it changes oxidation state to the less soluble trivalent chromium. It is possible that the introduction of an oxidant to the subsurface would re-mobilize some of that chromium back to the hexavalent form. If the ISCO pilot study indicates substantial mobilization of chromium, then additional injections will be halted.

A full-scale application would likely involve installation of several semi-permanent injection points (wells) with steel risers and stainless steel screens into the impacted bedrock. The radius of influence of each ISCO injection point is assumed to be 50 feet or less. Conceptually, approximately eight injection wells would be distributed linearly from MW-10, around the southeast corner of the building to MW-6, and extending along the concrete drain pipe through MW-4R (see Figure 4). $KMnO_4$ would be injected into the wells at most once or twice per year for a maximum of three injections.

Oxidant injections would be phased out either (i) after three applications or (ii) earlier, with NYSDEC concurrence, if and when on-site groundwater quality reached a stable value and off-site concentrations began to exhibit a long-term decline, indicating that the source of the TCE had been substantially and permanently eliminated within the limits of technical feasibility. Groundwater would thereafter be monitored for natural attenuation, and to detect possible rebounds of concentrations. In the event that this source area target cannot be achieved NWR will consult with NYSDEC about a change in this approach.

This alternative would be combined with on-site groundwater use restrictions and a long-term groundwater monitoring program.

For estimating purposes, a 3-year ISCO injection program will be assumed: first year pilot study, followed by three full scale applications over 18-36 months. Groundwater monitoring will continue for 30 years (estimated).

Overall Protection of Human Health and the Environment

Under this alternative, the current Site related risks to human health and the environment would remain unchanged because of the absence of groundwater consumption. This remedial alternative is, however, further protective of human health and the environment because, if successful, it results in the rapid destruction of some of the COC mass that could contribute to the groundwater plume. Introduction of an oxidant to the subsurface may, however, re-mobilize some chromium back to the hexavalent form. Periodic groundwater sampling will monitor the migration of existing and new COC, if any.

Compliance with SCGs

It is anticipated that NYSDEC SCGs would not be fully met by in-situ oxidation, but that following initial treatment, concentrations would be reduced and natural attenuation would then continue to improve groundwater quality over time. Groundwater will remain unusable (without appropriate pre-treatment) for the foreseeable future.

Long-term Effectiveness and Permanence

Chemical oxidation would, over time, permanently reduce the concentrations of COC. The rate of oxidation is dependent upon the rate at which oxidizing agents can be transported to, and contacted with, the COC. Effectiveness is partly dependent on the bedrock heterogeneities, which could result in the development of preferential flow paths, resulting in untreated subsurface areas. It is important that the oxidation is complete, in order to avoid excess production of intermediate daughter compounds. Rebound of dissolved phase concentrations is anticipated to occur after initial treatment has ceased, resulting in the need for two or three treatment events. Long-term groundwater monitoring and permanent restrictions of groundwater use would be required. Groundwater will remain unusable (without appropriate pre-treatment) for the foreseeable future. The time necessary to attain SCGs cannot be predicted.

Reduction of Mobility, Toxicity, or Volume

This remedial alternative would result in initial destruction (mass reduction) of COC residuals and eventual reduction in the toxicity of COC over time. In-situ treatment of contaminated groundwater with ISCO would destroy a portion of the COC mass, assuming the oxidant could be delivered effectively.

ISCO oxidants have been capable of achieving high treatment efficiencies with fast reaction rates. Anticipated reduction of COC mass is, however, difficult to estimate prior to a pilot study or IRM.

Introduction of an oxidant to the subsurface may re-mobilize some chromium back to the more soluble hexavalent form.

Consumption of water would still be prohibited indefinitely.

Short-term Impacts and Effectiveness

Protection of Community. This alternative is generally protective of the community. The work area would be inaccessible to the general public during remediation activities. Chemicals would be transported to the Site as needed following all applicable federal and state laws. ISCO reactions are typically exothermic and some oxidants can cause the formation of gases and high temperatures that could volatilize organic compounds. An air monitoring plan would be needed to assess and control fugitive emissions from the Site. Restrictions on water use would need to continue indefinitely.

Protection of Workers. This remedial alternative requires the handling of large quantities of potentially dangerous oxidizing chemicals due to the oxidant demand of the target organic chemicals. A site-specific health and safety plan, which includes a section on appropriate PPE, would be required. Special PPE would be required for those handling the oxidants, such as chemical-resistant coveralls, gloves, and face shields. Workers would need to be trained on appropriate handling, storage, and application of the chemicals. Application of the oxidants would be carefully monitored.

Environmental Impacts. This alternative could result in rapid destruction of COC mass in the subsurface (with an initial time frame of days, followed by a series of longer-term subsequent treatments). This alternative's effectiveness is site specific. Some chromium will likely be re-mobilized following introduction of an oxidant to the subsurface.

Time Until Response Objectives are Achieved. The work could possibly be initiated, including engineering design and a treatability study, in as little as six months following remedy selection, issuance of a ROD, commitment of a party to do the remedial action under the ROD, and depending upon weather. Actual construction and the pilot study would require an additional six months. It is not expected, however, that this remedy would attain drinking water standards in any foreseeable period. Restrictions on water use would need to continue indefinitely.

Implementability

Technical Feasibility. A pilot study is typical in the design of an in-situ chemical oxidation project because the effectiveness is dependent on the COC, the Site geochemistry, the oxidant, and the method of application. Designing and installing the injection wells and/or the associated injection system would not be difficult to perform. ISCO is a readily available technology, which has been implemented with varied levels of success at numerous sites. The disruption to the community using ISCO would be minimal. The potential for mobilization of chromium would be evaluated during a pilot study.

Administrative Feasibility. This alternative would require thorough periodic groundwater monitoring and data review to ensure that the alternative is performing as expected. No special permits would be required.

Availability of Services and Materials. The services and materials required for this alternative are available, although deliveries of oxidizing agents would require scheduling, planning, and the appropriate health and safety precautions.

Cost

The cost of in-situ chemical oxidation (see Table 6-13) is estimated to be approximately $237,000 for a 3 year program, including approximately $35,000 for a pilot study.

6.5.7 Groundwater Extraction and In-situ Oxidation

Description

Under this remedial alternative, a groundwater extraction and treatment system, as discussed in Section 6.5.4, would be installed and operated. In addition, limited ISCO, similar to that described in Section 6.5.6, would be performed at the TCE source area in the vicinity of MW-4R and the outfall pipe. This alternative is presented conceptually in Figure 6. This alternative is provided in response to NYSDEC suggestions [NYSDEC, 2006].

A central groundwater recovery well, with an electric submersible pump and an on-site treatment system, would be installed. The pump would operate continuously and discharge to the treatment system. Treated effluent would be discharged to the City of Amsterdam's municipal wastewater treatment plant (POTW), via the sanitary sewer, under an appropriate discharge permit. Periodic monitoring would be required.

To meet the assumed POTW discharge limits (see Section 6.5.4), the treatment system would include an air stripper, a flow totalizer, a heated shed, and a separate electric service. This FS assumes that chromium treatment will not be required.

The recovery well would be constructed of 4-inch diameter PVC, 60-feet deep, and screened within the bedrock from 30 to 60-feet (existing Site wells are screened to depths up to 50 feet). The pump would be a standard 4-inch submersible pump with surge protection. The well would be installed at a location near MW-4R, as shown in Figure 6. This location should hydraulically control groundwater flow in the most impacted area, resulting in a capture zone significantly encompassing the source area of ongoing groundwater impacts, and greatly reducing the off-site migration of COC.

The treatment system would be expected to operate at an average flow rate of 10 to 15 gpm and remove several pore volumes of groundwater per year. It may, however, be prudent to shut the system down during the coldest winter months.

The groundwater extraction and treatment system would be phased out, with NYSDEC concurrence, if and when on-site groundwater quality reached a stable value and off-site concentrations began to exhibit a long-term decline, indicating that the source area of the TCE had been substantially and permanently remediated within the limits of technical feasibility. Groundwater would thereafter be monitored for natural attenuation, and to detect possible rebounds of concentrations. In the event that this source area target cannot be achieved NWR will consult with NYSDEC about a change in this approach.

For the ISCO component of this alternative, four ISCO injection wells with steel risers and stainless steel screens would be installed in a grid encompassing the source area near the drain pipe outfall and MW-4R. The radius of influence of each ISCO injection point is assumed to be 50 feet or less. Each well would receive three injections of potassium permanganate ($KMnO_4$), one injection every six months. Residual concentrations of TCE would be measured immediately before injection, 1 week after, and 3 months after. It is assumed that the concentrations will initially decrease, followed by an incomplete rebound.

Hexavalent chromium concentrations in groundwater at the site have decreased over time, which suggests natural attenuation of chromium as it changes oxidation state to the less soluble trivalent chromium. It is possible that the introduction of an oxidant to the subsurface would re-mobilize some of that chromium back to the hexavalent form. Mobilized chromium would be captured by the groundwater extraction system, but if concentrations exceed the treatment system discharge limit, then system modifications, in consultation with NYSDEC, may be required.

Oxidant injections would be halted following three injections, with the assumption that (in combination with the extraction/treatment system) on-site concentrations will have reduced substantially, indicating that the bulk of the source of the TCE had been substantially and permanently eliminated. Groundwater extraction and treatment would continue as described above.

For this alternative, a groundwater extraction and treatment pilot study would be required to assure that POTW discharge criteria could be met. The feasibility of this option may be adversely affected by results of the pilot study.

The intent of the application of ISCO in this remedial alternative would be to reduce the duration of extraction and treatment system operations. For estimating purposes, however, a 10-year groundwater extraction/treatment period will be assumed with a 30-year groundwater monitoring program.

This alternative would be combined with groundwater use restrictions and a long-term groundwater monitoring program.

Overall Protection of Human Health and the Environment

Under this alternative, the current Site related risks to human health and the environment would remain unchanged because of the absence of groundwater consumption. This remedial alternative is, however, further protective of future human health and the environment because it captures impacted groundwater before it migrates off site. Over time, the natural flushing of COC in soil and bedrock would reduce the concentrations of contaminants in the subsurface at the Site. Groundwater outside the zone of influence would naturally attenuate. ISCO results in the rapid destruction of a portion of the

COC that could contribute to the groundwater plume. Introduction of an oxidant to the subsurface may re-mobilize some chromium back to the hexavalent form, though the extraction system would hydraulically contain the mobilized chromium. Periodic groundwater sampling will monitor migration of COC, if any.

Compliance with SCGs

This alternative will likely accelerate mass removal and is protective of human health and the environment, but would not, in the foreseeable future, meet NYSDEC recommended cleanup criteria. This alternative would likely require groundwater use restrictions, as full compliance with drinking water standards will not be met. Groundwater will remain unusable (without appropriate pre-treatment) for the foreseeable future. Following a period of operation, however, concentrations would be reduced and natural attenuation would then continue to improve groundwater quality over time.

Long-term Effectiveness and Permanence

The system would permanently remove contaminant mass from the Site, but long-term monitoring would still be required. Chemical oxidation would reduce the time required to reach steady state. Long-term groundwater monitoring and permanent restrictions of groundwater use would, however, be required. Groundwater will remain unusable (without appropriate pre-treatment) for the foreseeable future. The time necessary to attain SCGs cannot be predicted.

Reduction of Mobility, Toxicity, or Volume

Groundwater extraction and treatment would reduce the volume of COC in the on-site groundwater over time and, through limited hydraulic containment, greatly reduce the risk of future off-site migration. COC concentrations in downgradient groundwater would slowly decrease, partly through natural attenuation. Consumption of water would still be prohibited indefinitely.

Short-term Impacts and Effectiveness

Protection of Community. The subsurface capture of impacted groundwater reduces the risk of contact with future Site users and reduces migration of off-site impacts. As with air strippers at other remedial locations, the vent stack will be elevated to avoid vapor exceedances at the ground surface. The work area would be inaccessible to the general public during remediation activities. ISCO chemicals would be transported to the Site as needed following all applicable federal and state laws. ISCO reactions are typically exothermic and some oxidants can cause the formation of gases and high temperatures that could volatilize organic compounds. An air monitoring plan would be needed to assess and control fugitive emissions. Restrictions on water use would need to continue indefinitely.

Protection of Workers. This alternative is protective of workers. Air monitoring would be required during the installation and operation of the collection and treatment system. This remedial alternative does require the handling of potentially dangerous oxidizing chemicals. A site-specific health and safety plan, which includes sections on appropriate system operations and PPE, would be required. Special PPE would be required for those handling oxidants, such as chemical-resistant coveralls, gloves, and face shields. Workers would need to be trained on appropriate handling, storage, and application of the chemicals. Application of the oxidants would be carefully monitored.

Environmental Impacts. Some chromium will likely be re-mobilized following introduction of an oxidant to the subsurface, though the mobilized chromium would be captured by the extraction system. Clean-up criteria would only be met, if ever, after the treatment system is active for a long period of time.

Time Until Response Objectives are Achieved. The work could possibly be initiated, including design-phase work, in as little as six months following remedy selection, issuance of a ROD, commitment of a party to do the remedial action under the ROD, and depending upon weather. Actual construction and the pilot study would require an additional six months. It is not expected, however, that this remedy would attain drinking water standards in any foreseeable period. Restrictions on water use would need to continue indefinitely.

Implementability

Technical Feasibility. The design, scheduling, and construction of a groundwater extraction system is not difficult. A pilot test as described in Section 6.5.4 may be necessary for permitting and to optimize the effectiveness of the system. Results of design work and pilot tests may alter the feasibility of this alternative.

Administrative Feasibility. This alternative would require periodic sampling and data review to ensure that the system is performing within the specifications required for discharge. A long-term permit and agreement would be required with the POTW. The feasibility of this option may be adversely affected by requirements of the POTW. No special permits would be required for the ISCO component. An air permit may be required from NYSDEC for the air stripper.

Availability of Services and Materials. The services and materials required for this alternative are readily available. Installing the groundwater recovery and ISCO injection wells would be done with standard drilling equipment. Air stripping and ISCO are readily available technologies, which have been implemented with varied levels of success at numerous sites. While some oxidants, such as hydrogen peroxide, require specialized contractors, permanganate (as proposed herein) requires less specialization. Deliveries of oxidizing agents would, however, require scheduling, planning, and the appropriate health and safety precautions. The operations and maintenance of groundwater systems can be labor intensive at the outset, but O&M activities are expected to become routine over time.

Cost

The capital cost of the groundwater system construction and startup would be approximately $138,000 and $18,000 respectively (see Table 6-14). A 10 year O&M program would cost approximately $181,000 (NPV). The cost of limited ISCO application is estimated to be approximately $150,000. Assuming an operating period of 10 years, the total program cost (NPV) would be approximately $487,000.

6.6 Analysis of Indoor Air Remedial Alternatives

The most common indoor mitigation method is the installation of a sub-slab depressurization system in conjunction with identifying and eliminating preferential soil vapor intrusion pathways.

An active sub-slab depressurization system was installed within the Ward Products building during the 2005 Indoor Air and Soil Vapor Mitigation IRM [RETEC, 2005b]. The system consists of fourteen slab penetrations with riser vent pipes manifolded to six vent fans. The system was constructed in substantial compliance with the U.S. EPA's Radon Mitigation Standards.

The system successfully reduced the concentration of TCE in the building's indoor air to a concentration below 5 $\mu g/M^3$, and will continue to be operated as long as the building is occupied.

7 Comparison of Alternatives and Remedial Action Plan

This section compares the alternatives for each media based on the feasibility analyses presented in the previous sections. An overall conceptual remedial action plan for the Site is then recommended.

7.1 Comparison of Alternatives

A comparative analysis of the alternatives was conducted in which the alternatives were compared to one another with regard to each of the seven analysis criteria. Special consideration was given for combined implementation of soil, sediment, and groundwater alternatives to provide a site-wide remedial solution.

7.1.1 Comparative Analysis of Soil Alternatives

All of the soil alternatives, including No Action, would meet the RAOs. There are currently no significant risks to human health or the environment associated with the Site soils remaining after the IRMs. The No Action alternative may not sufficiently address future exposure scenarios. Excavation and capping would require extensive site clearing, grubbing, re-grading, generation of waste, disruption to Site operations, destruction of habitat, and cost, for little or no environmental benefit. A Site Management Plan, with Site environmental easement, would be sufficiently protective.

7.1.2 Comparative Analysis of Sediment Alternatives

All of the sediment alternatives except No Action would meet the RAOs. The primary concern regarding the drainage sediments is the possibility that COC could be mobilized by erosion. Secondarily, human exposure to sediments at locations EB-9 and DB-8 may be a concern. Limited excavation of sediments with COC concentrations in excess of the human health risk screening levels would remove the most impacted material from the drainages and alleviate both concerns. A sediment monitoring plan in itself would be administratively protective, but would likely require some limited excavation anyway, either to enhance the deposition of transported sediments at an accessible monitoring location, or to clear sediments following deposition.

Full excavation of sediments was eliminated for further consideration because the IRMs performed at the Site have already removed the most impacted sediments. The remaining impacts are of lower concentrations, lower risk, and generally located in low access areas. The samples collected for the RRIR in the East and West drainages between Sam Stratton Road and Chapman Drive were collected in steep, wooded drainages from small quantities of sediment among large, mossy cobbles. The remaining sediments are generally located within the industrial rights-of-way of CSX Railroad and

Route 5. Significant destruction of natural habitat, and disproportionate cost, would be required to implement full excavation.

The NYSDEC has stated (in their January 2006 letter and in a subsequent discussion) that they are of the opinion that the impacted sediments in the Mohawk River, particularly at the East Branch outfall, could have a "significant effect" on biota. An intermediate excavation of sediments would address these concerns, would be protective of the Mohawk, and could be technically feasible.

7.1.3 Comparative Analysis of Groundwater Alternatives

All of the groundwater alternatives would meet the RAOs. There are currently no significant risks to human health or the environment associated with on- and off-site groundwater, and the concentrations of COC can be expected to decline over time. The data presented in the RRIR indicated that limited natural biodegradation of the COC was occurring, but the data is insufficient at this time to indicate if the plume is at steady state and no longer migrating. The primary concern regarding groundwater is, therefore, the potential (prior to reaching steady state) for additional migration of COC (TCE) to adjacent, less impacted, areas.

Long-term groundwater monitoring will be administratively required by the NYSDEC regardless of the alternative selected. A Site Management Plan and Site environmental easement would further address groundwater usage.

Extraction and treatment of groundwater, with discharge to the POTW, has a risk of generating added liabilities and permit issues, but would effectively reduce mass and provide a degree of control over mobility.

In-situ chemical oxidation and bioremediation would both enhance the potential for additional, long-term natural attenuation by reducing the concentration of COC in the most impacted area on site. Of the two in-situ technologies, chemical oxidation (if shown successful in a pilot study) would be faster and more cost-effective because the more potent chemical oxidation process would act with more vigor and certainty in the source area than the biological process. In situ chemical oxidation could also be cost effectively utilized in conjunction with a groundwater extraction and treatment system to reduce the duration of required treatment system operations. In their January 2006 correspondence, the NYSDEC requested that this (combined) alternative be evaluated.

7.1.4 Comparative Analysis of Indoor Air Alternatives

Indoor air mitigation has been performed under a separate IRM [RETEC, 2005b] and will not be further addressed in this FS except to acknowledge that the on-site sub-slab depressurization system will continue to operate as long as the Ward Products building is occupied.

7.2 Recommended Remedial Alternative

Based on the RRIR, the results of the previous IRMs, the evaluations presented in this Feasibility Study, and accounting for NYSDEC preferences, RETEC recommends that the proposed remedial action plan consist of the following components:

- Continued operation of the on-site sub-slab depressurization system during periods of occupancy so long as significant contamination persists under the slab;
- A Site environmental easement and Site Management Plan for on-site soils and groundwater;
- Intermediate excavation of off-site sediments;
- Groundwater extraction for on-site plume control, and pre-treatment of effluent for disposal to the POTW, in combination with limited in-situ chemical oxidation for source reduction; and
- Long-term on- and off-site groundwater monitoring, including monitored natural attenuation.

The recommended remedy provides effective short-term and long-term overall protection of human health and the environment.

The recommended remedy uses a combination of proven technologies that are technically feasible, though may result in moderate short-term exposure risk and temporary destruction of natural habitat.

The recommended remedy, except groundwater treatment and monitoring, can be substantially completed within two construction seasons.

The estimated cost of the recommended remedy (see Table 7-1) is approximately $1,865,000.

8 References

ITRC, 1998. Technical and Regulatory Requirements for Enhanced In Situ Bioremediation of Chlorinated Solvents in Groundwater, Interstate Technology and Regulatory Cooperation Workgroup, December 1998.

ITRC, 2005. Technical and Regulatory Guidance for In Situ Chemical Oxidation of Contaminated Soil and Groundwater, Interstate Technology and Regulatory Council, January 2005.

NAI, 2002. Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites, Step I-II(B), Normandeau Associates, Inc., October 2002.

NAI, 2005a. Revised Remedial Investigations Report - Ward Products Corporation, Normandeau Associates, Inc., May 2005.

NAI, 2005b. Results of September 2005 Water Quality Samples, Normandeau Associates, Inc., December 13, 2005.

NAI, 2006. Addendum to the Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites, Step I-II(B), Normandeau Associates, Inc., March 2006 (draft).

NYSDEC, 1993A. Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, Technical and Operational Guidance Series 1.1.1, October 1993, revised 1998, with subsequent errata sheet and addenda 1999, 2000, and 2004.

NYSDEC, 1993B. Technical Guidance for Screening Contaminated Sediments, November 1993, revised 1998 and 1999.

NYSDEC, 1994A. Revised TAGM 4046 - Determination of Soil Cleanup Objectives and Cleanup Levels, memo from Michael J. O'Toole, NYSDEC #HWR-94-4046, January 1994.

NYSDEC, 1994B. TAGM 4030 - Selection of Remedial Actions at Inactive Hazardous Waste Sites, NYSDEC #HWR-90-4030, 1994.

NYSDEC, 1997. Order on Consent, Ward Products, Inc. Index #W4-0762-96-06, Site Code #4-29-004.

NYSDEC, 2002. Draft DER-10 Technical Guidance for Site Investigation and Remediation, December 2002.

NYSDEC, 2006. Comment Letter to RETEC regarding the October 4, 2005 Draft Feasibility Study Report and Risk Assessment, January 18, 2006.

NYSDOH, 2005. Guidance for Evaluating Soil Vapor Intrusion in the State of New York, Public Comment Draft, February, 2005.

RETEC, 1999A. Ward Products PCB IRM - Final Report, The RETEC Group, December 1999.

RETEC, 1999B. Ward Products Drain Pipe IRM - Interim Report, The RETEC Group, December 1999.

RETEC, 2001. Ward Products Drain Pipe IRM - Final Report, The RETEC Group, February 2001.

RETEC, 2002. Results of Indoor Air Sampling, New Water Realty Corporation Site, The RETEC Group, December 2002.

RETEC, 2004. Construction Complete Final Engineering Report - Soils and Sediments IRM, The RETEC Group, August 2004.

RETEC, 2005a. Results of January 2005 Indoor Air / Soil Gas Sampling, Ward Products LLC Building, The RETEC Group, February 2005.

RETEC, 2005b. IRM Work Plan - Indoor Air and Soil Vapor Mitigation, Ward Products Site, The RETEC Group, August 31, 2005.

USEPA, 2001. Groundwater Pump and Treat Systems: Summary of Selected Cost and Performance Information at Superfund-financed Sites. http://www.epa.gov/superfund/action/postconstruction/p1report.pdf

USEPA, 2003. EPA 540/R-00/504, Enhanced In-Situ Bioremediation Process, Innovative Technology, Earth Tech Inc., September 2003, Section 2.7 Limitations of the Technology. http://www.epa.gov/ORD/NRMRL/pubs/540r00504/540r00504sect2.pdf

USEPA, 2004. Treatment Technologies for Site Cleanup: Annual Status Report (Eleventh Edition), EPA 542-R-03-009, 2004.

Tables

TABLE 2-1

Relevant Soil and Sediment Data - Ward Products Site, Amsterdam, NY

(This table includes all known exceedances of levels as shown) 09/25/06 RETEC

Sample ID	Average Sample Depth, feet		Cadmium, mg/Kg	TCLP Cadmium, mg/L	Total Chromium, mg/Kg	Hex Chromium, mg/Kg	Lead, mg/Kg	Nickel, mg/Kg	Zinc, mg/Kg
Surface Soils									
TAGM 4046 Recommended Cleanup Levels			**1**	**1.0 (TCLP)**	**10**	**10**	**61**	**13**	**20**
C5	0.50		11.0						
C7	0.50		37.0						
C8	0.50		22.0						
C9	0.50		130.0						
S-16	0.50				27.6			31.3	105.0
S-20	0.50		6.4		130.0			357.0	595.0
S-21	0.50				45.6			49.8	100.0
S-22	0.10		13.0		170.0			749.0	663.0
S-22	0.60		8.3		118.0			593.0	678.0
S-23	0.10		7.7		90.0			206.0	367.0
S-23	0.60		17.0		67.0			231.0	304.0
S-24	0.10		2.9		54.0			143.0	165.0
S-24	0.60				18.0			24.0	59.0
S-25	0.10		5.3		45.0			106.0	231.0
S-25	0.60		3.5		63.0			103.0	220.0
S-26	0.10		2.4		32.0			34.0	78.0
S-26	0.60		1.3		30.0			33.0	78.0
S-27	0.10				14.0				52.0
S-27	0.60				20.0			22.0	58.0
S-28	0.10		4.1		69.0			59.0	129.0
S-28	0.60		16.0		191.0			172.0	292.0
S-29	0.10				15.0			17.0	54.0
S-29	0.60				17.0			19.0	53.0
S-30	0.10		6.6		60.0			49.0	88.0
S-30	0.60				21.0			30.0	65.0
S-31	0.10				16.0			19.0	49.0
S-31	0.60				16.0			20.0	59.0
S-32	0.10		4.5		25.0			26.0	63.0
S-32	0.60		3.3		42.0			41.0	91.0
S-33	0.10				15.0			17.0	52.0
S-33	0.60				14.0			20.0	51.0
S-34	0.10				28.0			32.0	73.0
S-34	0.60		14.0		294.0		76.0	188.0	395.0
S-35	0.10				14.0			17.0	47.0
S-35	0.60				15.0			15.0	41.0
S-36	0.60				24.0			16.0	41.0
S-37	0.10				25.0			15.0	45.0
S-37	0.60				62.0			35.0	77.0
S-38	0.10		2.3		71.0			58.0	156.0
S-38	0.60				29.0			28.0	67.0
S-39	0.10		4.9		82.0			63.0	245.0
S-39	0.60				17.0			20.0	50.0
S-41	0.10		12.0		230.0			136.0	372.0
S-41	0.60				21.0			24.0	78.0
S-43	0.10				24.0			34.0	88.0
S-43	0.60				17.0			18.0	55.0
S-44	0.10		6.4		62.0			54.5	144.0
S-44	0.60		14.6		236.0		104.0	198.0	375.0
S-45	0.10		3.2		37.4			40.3	114.0
S-45	0.60		2.0		37.9			31.9	94.9
S-48	0.10				11.8				28.8
S-48	0.60				16.8				34.6
S-49	0.10				28.0			23.8	58.8
S-49	0.60				24.9			24.6	64.8
S-50	0.10				28.3			17.8	45.2
S-50	0.60				17.8				36.5
S-51	0.10				13.5				32.6
S-51	0.60				22.6			19.4	53.3
S-52	0.10				15.9			15.5	44.0
S-52	0.60				11.3				34.3
S-53	0.46		28.7						
S-53	0.60		7.2		102.0		145.0	113.0	245.0
S-54	0.95				94.2				

Sample ID	Average Sample Depth, feet		Cadmium, mg/Kg	TCLP Cadmium, mg/L	Total Chromium, mg/Kg	Hex Chromium, mg/Kg	Lead, mg/Kg	Nickel, mg/Kg	Zinc, mg/Kg
S-55	0.10		2.7		53.0			92.5	155.0
S-55	0.60		3.1		21.4			24.7	73.9
S-56	0.10		5.9		51.4			169.0	264.0
S-56	0.60		20.3		266.0			945.0	778.0
S-57	0.10		2.9		34.3			107.0	172.0
S-57	0.60		1.2		23.7			60.3	89.5
S-58	0.10		1.2		27.2			33.9	77.1
S-58	0.60				28.9			18.5	50.1
S-59	0.10		5.9		54.8			95.7	175.0
S-59	0.60				20.7			54.9	88.2
S-60	0.10		2.5		23.6			28.0	58.9
S-60	0.60				20.5			23.3	48.9
S-61	0.10		7.9		84.1			236.0	385.0
S-61	0.60				22.9			76.1	117.0
S-62	0.10		6.1		41.1			506.0	504.0
S-62	0.60		12.6		91.1			313.0	564.0
S-63	0.10		4.1		35.4			120.0	206.0
S-63	0.60				31.0			53.6	84.7
S-64	0.10		1.2		41.0			46.3	117.0
S-64	0.60				20.0				41.6
S-65	0.10		10.4		120.0			112.0	266.0
S-65	0.60		3.0		63.8			55.4	79.9
S-66	0.10		1.3		25.4				59.5
S-66	0.60				45.8			15.7	72.5
S-67	0.10		1.4		27.4			115.0	155.0
S-67	0.60				10.2				49.6
S-68	0.10				33.3			63.0	135.0
S-68	0.60				12.5				51.5
S-69	0.10				25.3			20.1	68.0
S-69	0.60				16.5				45.2
S-70	0.10				26.8				63.0
S-70	0.60				51.0				33.8
S-71	0.10				14.8				132.0
S-71	0.60				12.3				46.6
S-72	0.10		4.9		78.7			132.0	292.0
S-72	0.60				11.8				39.0
S-73	0.10				19.7			39.4	95.0
S-73	0.60				15.2				50.4
S-74	0.10								30.3
S-74	0.60				11.2				37.3
S-75	0.10		2.9		56.5			22.8	140.0
S-75	0.60		7.0		96.0			94.0	263.0
S-76	0.10				14.1				66.0
S-76	0.60				17.1				47.0
S-77	0.10		2.7		54.2			54.0	236.0
S-77	0.60				19.2				73.0
S-78	0.10		2.3		35.8				132.0
S-78	0.60				16.0				55.6
S-79	0.10		3.0		42.5			28.2	94.5
S-79	0.60		1.4		32.0			19.0	160.0
S-80	0.10		2.7		59.0			30.1	157.0
S-80	0.60				27.0				106.0
S-81	0.10				13.1				44.0
S-81	0.60				10.2				34.6
S-83	0.10				13.0				41.4
S-83	0.60				15.0				43.8
S-84	0.10				10.2				35.3
S-84	0.60				10.7				32.4
S-85	0.10								22.3
S-85	0.60								24.7
S-86	0.10				12.1				45.7
S-86	0.60				11.9				41.6
S-87	0.10				10.3				36.6
S-87	0.60				14.1				44.4
S-88	0.10								31.2
S-88	0.60				16.5				41.6

Sample ID	Average Sample Depth, feet		Cadmium, mg/Kg	TCLP Cadmium, mg/L	Total Chromium, mg/Kg	Hex Chromium, mg/Kg	Lead, mg/Kg	Nickel, mg/Kg	Zinc, mg/Kg
Subsurface Soils									
TAGM 4046 Recommended Cleanup Levels			**1**	**1.0 (TCLP)**	**10**	**10**	**61**	**13**	**20**
C1	1.00		33.0						
C2	1.00		150.0						
C3	1.00		32.0						
C4	1.00		12.0						
Drain Excav Bottom	8.00		10.0		301.0				
Drain Excav NorthEast	4.00		14.3		238.0		84.9		
Drain Excav NorthWest	4.00		2.4		141.0				
Drain Excav South	4.00		3.8		78.7				
S-8	1.50				13.2			21.5	63.0
S-8	2.25				14.3			23.5	100.0
S-13A	1.30		3.3		29.6			30.5	133.0
S-13A	2.25		6.3		134.0			48.3	146.0
S-14	1.08				164.0				
S-14A	1.06		11.4						
S-14A	1.50				19.1			23.6	64.5
S-14A	2.50		1.5		18.0			25.0	61.0
S-16	1.50				25.9			27.3	79.0
S-17	0.50				33.6			40.2	99.0
S-17	1.50				48.0			27.6	96.0
S-40	1.28		15.3						
S-46	1.37		53.5						
S-47	1.78		4.7						
S-82	1.51		30.2						
Soils Under Building									
TAGM 4046 Recommended Cleanup Levels			**1**	**1.0 (TCLP)**	**10**	**10**	**61**	**13**	**20**
Location A	0.50				47.0			52.8	99.0
Location A	1.50		5.0		139.0	11.2		110.0	217.0
Location B	0.50		7.9		162.0	14.7		270.0	128.0
Location B	1.50		16.4		273.0	11.8		309.0	588.0
Location B	2.50		1.2		37.0			17.2	52.0
Location C	0.50		31.9		153.0			18.1	28.0
Location C	1.50		56.9		24.3			18.4	63.0
Location D	0.50		26.6	1.8	70.7			73.4	86.0
Location D	1.50		72.4		59.2			20.7	74.0
Location E	0.50		263.0	1.8	54.1			45.5	193.0
Location E	1.50		314.0	1.4	51.4			44.8	241.0
Location F	0.50		62.8	1.8	27.4			19.5	75.0
Location F	1.50		1.2		17.3			22.7	57.0
Location F	2.50		65.9	1.7	35.8			20.7	72.0
Drainage North of Sam Stratton Road									
Aquatic Sediment Lowest Effect Level			**0.6**		**26**		**31**	**16**	**120**
Aquatic Sediment Severe Effect Level			**9**		**110**		**110**	**50**	**270**
D1	0.67		20.7						
D3	0.70		2.2						
Midpoint (upper)	1.50		13.4		130.0		259.0	148.0	
D4	1.60		2.0		58.5			41.8	
D5	1.80		6.9						
D7	2.15		4.9		42.6			68.4	
D8	1.90		7.1						
D10	1.10		12.2		148.0			193.0	
D11	1.60		14.8						
D12	1.40		0.9						
Downstream 100'	0.25		41.2		263.0			204.0	
Downstream 100'	0.75		3.0		66.4			58.4	
Downstream 200'	0.25		45.4		399.0			212.0	
Downstream 200'	0.75		39.2		403.0			328.0	
Downstream 400'	0.10		12.4		252.0			97.0	
Downstream 400'	0.35		5.7		150.0			69.5	
EC-1/EC-2	3.50		10.2		84.8			48.9	
WC	0.50		4.2		191.0				
WC	0.75		26.5		214.0			102.0	

Sample ID	Average Sample Depth, feet		Cadmium, mg/Kg	TCLP Cadmium, mg/L	Total Chromium, mg/Kg	Hex Chromium, mg/Kg	Lead, mg/Kg	Nickel, mg/Kg	Zinc, mg/Kg
East Branch Drainage									
Aquatic Sediment Lowest Effect Level			**0.6**		**26**		**31**	**16**	**120**
Aquatic Sediment Severe Effect Level			**9**		**110**		**110**	**50**	**270**
DB-2	0.25		12.2		175.0			78.4	
DB-8	0.25		31.2		560.0			146.0	
EB-2	0.25		6.1		80.0			65.0	
EB-3	0.25		9.7		119.0			64.0	
EB-3	0.75		8.8		82.0			61.0	
EB-4	0.25		8.9		69.0			66.0	
EB-4	0.75		19.0		198.0			259.0	
EB-5	0.25		14.0		140.0			102.0	
EB-5	0.75		19.0		156.0			126.0	
EB-6	0.25		15.0		124.0			160.0	
EB-6	0.75		18.0		111.0			201.0	
EB-7	0.25		42.0		443.0			459.0	
EB-7	0.75		31.0		238.0			58.0	
EB-8	0.25		15.0		120.0			129.0	
EB-8	0.75		36.0		385.0			348.0	
EB-9	0.25		27.0		473.0			261.0	
EB-9	0.75		37.0		405.0			305.0	
EB-10	0.25		6.4		34.0			50.0	
EB-10	0.75		3.6		48.0			45.0	
West Branch Drainage									
Aquatic Sediment Lowest Effect Level			**0.6**		**26**		**31**	**16**	**120**
Aquatic Sediment Severe Effect Level			**9**		**110**		**110**	**50**	**270**
WB-1	0.25		29.0		398.0			102.0	
WB-1	0.75		15.0		316.0			52.0	
WB-2	0.25		12.0		151.0			50.0	
WB-2	0.75		6.0		95.0			40.0	
WB-3	0.25		13.0		119.0			69.0	
WB-3	0.75		16.0		184.0			106.0	
WB-4	0.25		13.0		142.0			124.0	
WB-4	0.75		15.0		134.0			165.0	
WB-5	0.25		13.0		116.0			115.0	
WB-5	0.75		9.0		70.0			91.0	
WB-6	0.25		4.3		54.0			30.0	
WB-6	0.75		4.2		46.0			37.0	
WB-10	0.75		0.8						
Mohawk River @ East Branch Outlet									
Aquatic Sediment Lowest Effect Level			**0.6**		**26**		**31**	**16**	**120**
Aquatic Sediment Severe Effect Level			**9**		**110**		**110**	**50**	**270**
EB-11	0.25		12.0		196.0		48.2	167.0	
EB-11	0.75		16.4		206.0		33.0	164.0	131.0
EB-12	0.25		9.1		112.0			73.5	
EB-12	0.75		8.5		93.0			68.5	
EB-13	0.25		5.6		96.0			68.5	
EB-13	0.75		5.9		70.0			103.0	
EB-14	0.25		8.6		227.0			156.0	
EB-14	0.75		27.1		519.0		82.0	247.0	158.0
EB-15	0.25		0.7					23.0	
EB-16	0.25		1.6					22.9	
EB-16	0.75							17.1	
EB-17	0.25		64.6		64.5			37.0	
EB-17	0.75		3.5		210.0			74.5	
EB-18	0.25		2.1		69.6		33.0		
EB-19	0.25		6.6		211.0			80.2	
EB-22	0.25		2.6		45.4				
EB-22	0.75		1.9		46.8				

Sample ID	Average Sample Depth, feet		Cadmium, mg/Kg	TCLP Cadmium, mg/L	Total Chromium, mg/Kg	Hex Chromium, mg/Kg	Lead, mg/Kg	Nickel, mg/Kg	Zinc, mg/Kg
Mohawk River @ West Branch Outlet									
Aquatic Sediment Lowest Effect Level			**0.6**		**26**		**31**	**16**	**120**
Aquatic Sediment Severe Effect Level			**9**		**110**		**110**	**50**	**270**
WB-13	0.25		1.2						
WB-13	0.75		1.0						
WB-15	0.25		1.1		47.0			16.6	
WB-16	0.75				162.0		955.0		
WB-16A	0.25				63.8				
WB-16A	0.75				83.6				
WB-16B	0.25				32.8				
WB-16C	0.25				52.6				

Summary of Applicable Criteria:	Total Cadmium, mg/Kg	TCLP Cadmium, mg/L	Total Chromium, mg/Kg	Total Hex Chromium, mg/Kg	Total Lead, mg/Kg	Total Nickel, mg/Kg	Total Zinc, mg/Kg
USEPA Human Health Risk Screening Values	450		450	64	750	20,000	100,000
TCLP		1					
TAGM 4046 Recom'd Cleanup Levels	1		10		61	13	20
Aquatic Sediment Severe Effect Level	9		110		110	50	270
Aquatic Sediment Lowest Effect Level	0.6		26		31	16	120

Table 2-2
SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS
Ward Products Site, Amsterdam, NY

PARAMETER	NYSDEC STANDARD	MW-1						MW-1R					
		Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05	Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05		**0.27**	**0.24**	**0.233**	**0.14**		**0.16**	**0.25**	**0.14**	**0.2**	**0.12**	0.03
Total Chromium	0.05		**0.232**	**0.256**	**0.241**	**0.129**		**0.16**	**0.22**	**0.139**	**0.214**	**0.124**	**0.319**
VOCs (*u* g/L)													
Acrylonitrile	5		nd	nd	nd	nd		nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	5		**6.3**	nd	nd	2		nd	**17**	nd	nd	4	**10**
Chlorobenzene	5		nd	nd	nd	nd		nd	nd	nd	nd	nd	nd
Chloroform	7		nd	nd	nd	nd		nd	nd	nd	nd	nd	2
Dichlorodifluoromethane	5		nd	nd	nd	nd		nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	5		nd	nd	nd	nd		nd	nd	nd	nd	nd	nd
cis-1,2-Dichloroethene	5		nd	nd	nd	0.7		nd	**14**	nd	nd	2	**14**
trans-1,2-Dichloroethene	5		nd	nd	nd	nd		nd	nd	nd	nd	nd	nd
Tetrachloroethene	5		nd	nd	nd	nd		nd	nd	nd	nd	nd	2
Trichloroethene	5		**96**	**65**	**100**	**50**		**110**	**180**	**96**	**180**	**94**	**200**
Vinyl Chloride	2		nd	nd	nd	nd		nd	nd	nd	nd	nd	nd

Notes: Blank spaces indicate no analysis performed.
Bold numbers indicate exceedance of NYSDEC groundwater objective.

Table 2-2
SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS
Ward Products Site, Amsterdam, NY

PARAMETER	NYSDEC STANDARD	MW-2						MW-3					
		Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05	Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05	nd	nd	nd	nd	nd	nd	nd	nd				
Total Chromium	0.05	0.037	0.01	0.006	0.0037	0.03	**0.317**	nd	nd				
VOCs (*u* g/L)													
Acrylonitrile	5	nd	nd	nd	nd	nd	nd	nd	nd				nd
Carbon Tetrachloride	5	nd	nd	nd	nd	nd	nd	nd	nd				nd
Chlorobenzene	5	nd	nd	nd	nd	nd	nd	nd	nd				nd
Chloroform	7	nd	nd	nd	nd	nd	nd	nd	nd				nd
Dichlorodifluoromethane	5	nd	nd	nd	nd	nd	nd	nd	nd				nd
1,1-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd				nd
cis-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd				nd
trans-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd				nd
Tetrachloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd				nd
Trichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd				nd
Vinyl Chloride	2	nd	nd	nd	nd	nd	nd	nd	nd				nd

Table 2-2
SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS
Ward Products Site, Amsterdam, NY

PARAMETER	NYSDEC STANDARD	MW-4						MW-4R					
		Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05	Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05	0.04	0.05	**0.06**	0.04	**0.05**	0.03	nd	nd	nd	nd	nd	nd
Total Chromium	0.05	0.039	nd	0.045	**0.057**	0.044	0.0288	0.005	0.006	nd	0.0071	0.0076	0.0047
VOCs (*u* g/L)													
Acrylonitrile	5	**50**	nd	nd	nd	nd	nd	**50**	nd	nd	nd	nd	nd
Carbon Tetrachloride	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
cis-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
trans-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethene	5	**6,000**	**430**	**330**	**390**	**340**	**20,000**	**7,500**	**19,000**	**49,000**	**28,000**	**180,000**	**70,000**
Vinyl Chloride	2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 2-2
SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS
Ward Products Site, Amsterdam, NY

PARAMETER	NYSDEC STANDARD	MW-5						MW-6					
		Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05	Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05	nd	nd			nd	nd	**0.08**	**0.14**	**0.14**	**0.14**	**0.13**	0.04
Total Chromium	0.05	0.006	0.005			0.0059	nd	**0.096**	**0.112**	**0.145**	**0.152**	**0.135**	0.043
VOCs (*u* g/L)													
Acrylonitrile	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	7	nd	nd	nd	nd	nd	5	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
cis-1,2-Dichloroethene	5	nd	nd	**6.3**	nd	**7**	**16**	nd	nd	nd	nd	nd	nd
trans-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	**34**	nd	nd
Trichloroethene	5	**250**	**190**	**120**	**260**	**250**	**480**	**1,700**	**2,800**	**3,500**	**1,700**	**3,400**	**19,000**
Vinyl Chloride	2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 2-2

SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS

Ward Products Site, Amsterdam, NY

PARAMETER	NYSDEC STANDARD	MW-7						MW-8					
		Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05	Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05	0.04	**0.06**	0.04	0.04	nd	nd	nd	nd				nd
Total Chromium	0.05	0.048	**0.057**	0.025	0.0232	0.0397	0.0232	nd	nd				0.0083
VOCs (*u* g/L)													
Acrylonitrile	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
cis-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	2
trans-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd
Trichloroethene	5	**280**	**750**	**210**	**250**	**270**	**790**	**32**	**130**	**74**	**180**	**320**	**100**
Vinyl Chloride	2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 2-2
SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS
Ward Products Site, Amsterdam, NY

PARAMETER	NYSDEC STANDARD	MW-9						MW-10					
		Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05	Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Chromium	0.05	nd	nd	nd	0.011	0.016	0.0288	0.012	nd	0.045	0.0229	0.0269	0.0232
VOCs (*u* g/L)													
Acrylonitrile	5	nd	nd	nd	nd	nd	nd	**5**	nd	nd	nd	nd	nd
Carbon Tetrachloride	5	nd	nd	nd	nd	nd	nd	**5**	nd	nd	nd	nd	nd
Chlorobenzene	5	nd	nd	nd	nd	nd	nd	**5**	nd	nd	nd	nd	nd
Chloroform	7	nd	nd	nd	nd	nd	nd	**5**	nd	nd	nd	nd	nd
Dichlorodifluoromethane	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	5	nd	nd	nd	nd	nd	nd	**5**	nd	nd	nd	nd	nd
cis-1,2-Dichloroethene	5	nd	nd	nd	nd	1	nd	nd	nd	nd	nd	nd	nd
trans-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	5	nd	nd	nd	nd	nd	nd	**5**	nd	nd	nd	nd	nd
Trichloroethene	5	**140**	**170**	**110**	**160**	**120**	**180**	**4,500**	**5,000**	**3,800**	**3,500**	**3,800**	**4,100**
Vinyl Chloride	2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 2-2
SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS
Ward Products Site, Amsterdam, NY

PARAMETER	NYSDEC STANDARD	MW-11						MW-12					
		Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05	Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05	nd	nd				nd	nd	nd				
Total Chromium	0.05	nd	nd				0.005	nd	nd				
VOCs (*u* g/L)													
Acrylonitrile	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	3	3
cis-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	**9.8**	**8.5**	nd	**6**	**8**
trans-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	2	2
Tetrachloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethene	5	nd	nd	nd	nd	nd	3	**110**	**120**	**96**	**110**	**160**	**130**
Vinyl Chloride	2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 2-2
SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS
Ward Products Site, Amsterdam, NY

PARAMETER	NYSDEC STANDARD	MW-13						MW-14					
		Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05	Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05	nd	nd	nd	nd	nd	nd	nd	nd				
Total Chromium	0.05	nd	nd	nd	0.0027	0.0084	nd	nd	nd				
VOCs (*u* g/L)													
Acrylonitrile	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
cis-1,2-Dichloroethene	5	nd	**59**	**46**	**44**	nd	**26**	nd	nd	nd	nd	nd	nd
trans-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethene	5	**700**	**800**	**740**	**740**	**950**	**540**	nd	nd	nd	nd	nd	nd
Vinyl Chloride	2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 2-2
SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS
Ward Products Site, Amsterdam, NY

PARAMETER	NYSDEC STANDARD	MW-15						MW-16					
		Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05	Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05	nd	nd					nd	nd				
Total Chromium	0.05	nd	nd					nd	nd				
VOCs (*u* g/L)													
Acrylonitrile	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
cis-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	**26**	nd	nd	nd	nd
trans-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethene	5	nd	nd	nd	nd	nd	nd	**33**	**400**	**33**	**43**	**7**	**10**
Vinyl Chloride	2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 2-2
SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS
Ward Products Site, Amsterdam, NY

PARAMETER	NYSDEC STANDARD	MW-17						MW-18					
		Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05	Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05	nd	nd					nd	nd				
Total Chromium	0.05	nd	nd					nd	nd				
VOCs (*u* g/L)													
Acrylonitrile	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	5	nd	**9.9**	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
cis-1,2-Dichloroethene	5	nd	**35**	**20**	**13**	nd	**14**	nd	nd	nd	nd	nd	nd
trans-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethene	5	**700**	**1,100**	**550**	**590**	**610**	**610**	nd	**7**	**7**	4	4	3
Vinyl Chloride	2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 2-2
SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS
Ward Products Site, Amsterdam, NY

PARAMETER	NYSDEC STANDARD	MW-19						MW-20					
		Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05	Sept '02	Sept '03	May '04	Aug '04	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05	nd						nd					
Total Chromium	0.05	nd						nd					
VOCs (*u* g/L)													
Acrylonitrile	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
cis-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
trans-1,2-Dichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethene	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Vinyl Chloride	2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table 2-2
SUMMARY OF RECENT GROUNDWATER QUALITY RESULTS
Ward Products Site, Amsterdam, NY

PARAMETER	**NYSDEC STANDARD**	**FGI-1**						**FGI-2**					
				Dec '04	Feb '05	May '05	Sept '05			Dec '04	Feb '05	May '05	Sept '05
METALS (mg/L)													
Hexavalent Chromium	0.05			nd	nd	nd	nd			nd		nd	nd
Total Chromium	0.05			0.011	0.007	0.0246	0.0063			0.006		0.0077	0.0106
VOCs (*u* g/L)													
Acrylonitrile	5			nd	nd	nd	nd			nd		nd	nd
Carbon Tetrachloride	5			nd	nd	nd	nd			nd		nd	nd
Chlorobenzene	5			nd	nd	nd	nd			nd		nd	nd
Chloroform	7			nd	6.5	nd	nd			nd		nd	nd
Dichlorodifluoromethane	5			nd	nd	nd	nd			nd		nd	nd
1,1-Dichloroethene	5			nd	nd	nd	nd			nd		nd	nd
cis-1,2-Dichloroethene	5			nd	**6**	nd	nd			nd		nd	nd
trans-1,2-Dichloroethene	5			nd	nd	nd	nd			nd		nd	nd
Tetrachloroethene	5			nd	nd	nd	nd			nd		nd	nd
Trichloroethene	5			**440**	**190**	**1100**	**65**			nd		**52**	**20**
Vinyl Chloride	2			nd	nd	nd	nd			nd		nd	nd

Table 2-3

Summary of Indoor Air, Ambient Air, and Soil Vapor Sampling Results

Former Ward Products Site
Sample Date - January 21, 2005 and January 20, 2006

Compound	CAS#	Units	Analytical Results ug/M^3												DOH Draft Air Guidance
			Assembly Floor			Grinding Room			Warehouse			Ambient			
			Indoor Air 2005	Soil Vapor 2005	Indoor Air 2006	Indoor Air 2005	Soil Vapor 2005	Indoor Air 2006	Indoor Air 2005	Soil Vapor 2005	Indoor Air 2006	Upwind 2005	Upwind 2006	Downwind 2006	
1-1 Dichloroethene	75-35-4	ug/M^3	< 0.60	< 0.60	< 0.60	< 0.60	3.3	< 0.60	< 0.60	79	< 0.60	< 0.60	< 0.60	< 0.60	NL
Carbon Tetrachloride	56-23-5	ug/M^3	< 0.96	4.8	< 0.96	< 0.96	7.5	< 0.96	< 0.96	< 0.96	< 0.96	< 0.96	0.58	0.58	NL
Chloroform	67-66-3	ug/M^3	0.94	13	< 0.74	0.65	55	< 0.74	< 0.74	15	< 0.74	< 0.74	< 0.74	< 0.74	NL
cis-1,2-Dichloroethene	156-59-2	ug/M^3	< 0.60	17	< 0.60	< 0.60	37	< 0.60	< 0.60	940	< 0.60	< 0.60	< 0.60	< 0.60	NL
Tetrachloroethene	127-18-4	ug/M^3	< 1.0	1.4	< 1.0	< 1.0	1.4	< 1.0	< 1.0	0.83	< 1.0	< 1.0	1.03	< 1.0	100
Trichloroethene	79-01-6	ug/M^3	8.4	1500	1.97	13	1500	1.20	6.4	1800	1.64	< 0.82	< 0.22	< 0.22	5

8.4 Exceedance of NYSDOH Draft Guidance Value

Notes:

NL Not Listed

Table 2-4
Potentially Applicable Standards, Criteria, and Guidance References - Ward Products Site

MEDIA	REQUIREMENTS	CITATION	DESCRIPTION	COMMENT
Soil	NYSDEC Soil Objectives	NYSDEC HWR-94-TAGM 4046	Establishes soil screening-level objectives based on residential land use and protection of groundwater quality.	Specified screening-level goals may be applicable in determining site-specific soil objectives.
	EPA Remediation Goals	EPA Region IX Preliminary Remediation Goals for Industrial or Residential Soil	Establishes soil screening-level objectives for protection of human health based on residential and industrial land use	May be applicable for determining site-specific soil cleanup objectives for protection of human health.
Sediments	NYSDEC Sediment Objectives	NYSDEC, Division of FWMR, Technical Guidance for Screening Contaminated Sediments	Establishes guidance values for sediment quality objectives	May be applicable for determining site-specific sediment cleanup objectives within the Mohawk River (the East and West Branch drainages are intermittent and not aquatic).
Groundwater	NYSDEC Groundwater Objectives	NYSDEC, Division of Water, TOGS (1.1.1) - 6 NYCRR 703.5	Establishes guidance or standard values for groundwater quality objectives	May be applicable in determining site-specific groundwater objectives.
Surface Water	NYSDEC Surface Water Objectives	NYSDEC, Division of Water, TOGS (1.1.1) - 6 NYCRR 703.5	Establishes guidance or standard values for surface waters quality objectives.	May be applicable for determining site-specific surface water objectives, however, the East and West Branch intermittent drainages are not classified.
Indoor Air	Occupational Exposure Values	ACGIH Guide to Occupational Exposure Values, 2005.	Summarizes ACGIH, OSHA, and NIOSH TWAs and STELs.	Is applicable to determining maximum allowable (without respiratory protection) airborne contaminant concentrations in work places.
	NYSDOH Guidance Values	NYSDOH Soil Vapor/ Indoor Air Decision Matrices (draft)	Provides draft guidance for determination of need for TCE or PCE mitigation.	May be applicable to assist in evaluation of need for soil vapor mitigation. Currently issued only as a draft for public comment.

Table 3-1 Risk Assessment Screening Levels for Soils and Sediments

Constituents	Screening Level Values							
	NYSDEC Recommended Soil Cleanup Objective	Site-specific Soil Background [1]	NYSDEC Sediment Criteria For Protection of Benthic Organisms		Protection of Human Health [2]			Groundwater Protection [4]
			Lowest Effect Level	Severe Effect Level	Industrial Soil	Recreational Soil/Sediment [3]	Residential Soil	
Cadmium	1	< 0.25	0.6	9	450	450	37	27 [5]
Chromium, Hexavalent	NA	< 0.4			64	64	30	42 [5]
Chromium, Total	10	25	26	110	450	450	210	$2x10^9$ * [5]
Lead		61 [6]	31	110	800	800	400	NA
Nickel	13	25	16	50	20,000	20,000	1,600	NA
Zinc	20	80	120	270	100,000	100,000	23,000	13,600 [5]
Cyanide	NA	<1			23,000 [7]	23,000	1600 [7]	NA

NOTES:

All units are in **mg/kg**

(1) Site-specific background is the maximum value as reported in the RRIR, adjusted for outliers per NYSDEC DERIO.

(2) Value based on EPA Region IX Preliminary Remediation Goals, dated October 2004, for Industrial or Residential Soil (risk factor = 10^{-6} or Hazard Quotient = 1.0).

(3) Value based on EPA Region IX Preliminary Remediaion Goals assuming recreational exposure is less than the industrial exposure scenario.

(4) Value based on NYSDEC Soil Cleanup Objective to protect groundwater quality.

(5) Value based on EPA Region III RBC Tables, dated April 2005 (Dilution Attenuation Factor [DAF] = 20).

(6) Value based on rural background in TAGM 4046.

(7) Value based on EPA Soil Screening Levels (SSL) for superfund sites using amenable cyanide.

NA - Value is not available.

* Value based on trivalent chromium - this value exceeds maximum possible soil concentration.

Table 6-1 Former Ward Products, Amsterdam, NY
Identification and Initial Screening of Technologies and Process Options - SOIL

GENERAL ACTION	TECHNOLOGY	PROCESS OPTION	PROCESS DESCRIPTION	TECHNICAL FEASIBILITY SCREENING COMMENTS
No Action	No Action	None	Site is left in its existing state.	RETAIN
Institutional Controls	Site access and use restrictions	Deed restriction or Environmental Easement	Land use restrictions could be recorded either to disclose conditions and/or to limit activities that might disturb impacted soil.	RETAIN
		Fencing and signage	Site could be fenced and/or warning signs posted to limit access. Long-term maintenance and security would be required.	REJECTED. Site is already substantially fenced and there are no significant surface exposure pathways.
Containment	Capping	Soil/Gravel	Placement and compaction of clean, imported soil and/or gravel over impacted soil.	RETAIN
		Clay	Placement and compaction of clay over impacted soil.	REJECTED. Does not meet projected site use.
		Concrete/Asphalt	Placement of concrete and/asphalt over impacted soil.	REJECTED. Does not meet projected site use.
		Plastic membrane	Placement of synthetic plastic membrane sheeting over impacted soil.	REJECTED. Does not meet projected site use.
	In-situ solidification	Bucket mixing	Excavator bucket mixes grout w/ impacted soil.	REJECTED. More expensive than excavation with same access and technical limitations.
		Soil augering	Grout and impacted soil are mixed using large augers.	REJECTED. More expensive than excavation with same access and technical limitations.
		Pressure grouting	Pressure injection of grout into impacted soil, typically beneath building slabs and other obstructions.	REJECTED. More expensive than excavation with same access and technical limitations.

GENERAL ACTION	TECHNOLOGY	PROCESS OPTION	PROCESS DESCRIPTION	TECHNICAL FEASIBILITY SCREENING COMMENTS
Removal	Excavation	Excavation	Removal of impacted soil by conventional earth-moving equipment.	RETAIN for surface soils only. On-site contaminated soils have already been remediated by IRMs.
In-situ treatment	Soil venting / biodegradation	Air injection	Air is injected into wells in area of contamination to strip volatile compounds and create an aerobic environment for biodegradation of PAHs.	REJECTED. Not applicable to metals contaminated soils.
		Soil gas extraction	Air is drawn from a recovery well that collects gases from the soil above the water table. This draws impacted air from the soil and introduces cleaner air into the impacted area, thereby stripping volatile compounds and creating an aerobic environment for biodegradation.	REJECTED. Not applicable to metals contaminated soils.
	Soil flushing	Surfactant enhanced remediation	Surfactants percolate through impacted material, and loosen bonds of contaminants to the soil. Surfactants are then recycled by a recovery well.	REJECTED. Insufficient hydraulic conductivity. Not technically practicable.
	In-situ thermal treatment	Vitrification	Uses auger and electric current to melt impacted soils and create a solid monolith.	REJECTED. Not technically practicable.

Table 6-2 Remedial Alternative Cost Summary

Environmental Easement and Site Management Plan

Project: NWR0-15852
Location: Amsterdam, NY
Phase: Feasibility Study (-30% to +50%)
Date: September 25, 2006

Description: Easement against residential site use, and site management plan for handling and disposal of excavated soils in the future.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
EASEMENT					
Environmental Easement	1	LS	$20,000	$20,000	Document prep, filing fees
SITE MANAGEMENT PLAN					
Document Preparation	1	LS	$15,000	$15,000	Standard NYSDEC Format
Annual Inspection and Reporting	30	YR	$2,000		
Approx. NPV (30 Years)				$44,793	Assumes 2% Discount
TOTAL (NPV)				**$79,793**	

Table 6-3 Remedial Alternative Cost Summary

Capping of Onsite Soils, followed by visual monitoring and annual report

Project: NWR0-15852
Location: Amsterdam, NY
Phase: Feasibility Study (-30% to +50%)
Date: September 25, 2006

Description: Capping, with topsoil, all soils with concentrations in excess of NYSDEC TAGM 4046 guidance values.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
EXCAVATION					
Clearing, Grubbing, Chipping	5	Days	$1,500	$7,500	
Excavation, Transport, Disposal (non-haz)	1,800	Cubic Yards	$150	$270,000	Excavate around structures to fit 12" clean soil cap
Regrading and Subgrade Compaction	110,000	SqFt	$0.20	$22,000	
CAP CONSTRUCTION					
Topsoil Cover	110,000	SqFt	$0.80	$88,000	
Site Restoration	110,000	SqFt	$0.15	$16,500	Landscape rake and hydroseed
Fence Subcontract	1	LS	$4,000	$4,000	
Project Management	1	LS	$25,000	$25,000	Incl. Final Report
Remedial Design	1	LS	$4,000	$4,000	
Construction Management	20	Days	$1,200	$24,000	Onsite supervision, surveying
Air Monitoring	20	Days	$800	$16,000	Real time monitoring only
CAP MAINTENACE					
Lawn Care (30 years)	30	Years	$0	$0	Not included
Annual Inspections (30 years NPV)	30	Years	$1,000	$22,397	Assumes 2% discount rate
TOTAL:				**$499,397**	

Table 6-4 Former Ward Products, Amsterdam, NY
Identification and Initial Screening of Technologies and Process Options - SEDIMENT

GENERAL ACTION	TECHNOLOGY	PROCESS OPTION	PROCESS DESCRIPTION	TECHNICAL FEASIBILITY SCREENING COMMENTS
No Action	No Action	None	Site is left in its existing state.	RETAIN
Monitor only	Sediment Monitoring	Monitor surface sediment depths and concentrations of COC over time.	Sediment samples would be collected, analyzed, and compared over time.	RETAIN
Institutional Controls	Site access and use restrictions	Environmental Easement	Land use restrictions could be recorded either to disclose conditions and/or to limit activities that might disturb impacted soil.	RETAIN
		Fencing and signage	Site could be fenced and/or warning signs posted to limit access. Long-term maintenance and security would be required.	REJECTED. Impractical at some locations.
Containment	Capping	Armor Stone	Placement of geofabric and clean armor stone over impacted sediment.	REJECTED. Same access and technical limitations as excavation.
	In-situ solidification	Bucket mixing	Excavator bucket mixes grout with impacted sediment.	REJECTED. More expensive than excavation with same access and technical limitations.
Removal	Excavation	Limited or Full Excavation	Removal of most impacted soil by conventional earth-moving equipment.	RETAIN

Table 6-5 Remedial Alternative Cost Summary

Long-Term Sediment Monitoring

Project: NWR0-15852
Location: Amsterdam, NY
Phase: Feasibility Study (-30% to +50%)
Date: September 25, 2006

Description: Long-term monitoring of COC concentrations in deposited sediments at three locations. Three samples per year (EB-9, DB-2, WB-5) collected in conjunction with groundwater sampling events. As contingency, eventual excavation, transport, and disposal of sediments could be same magnitude as Limited Excavation alternative.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
MONITORING PROGRAM					
Surface Sediment Inspection, Sampling, Analysis	30	YR	$800	$24,000	In addition to Groundwater Monitoring program
Project Management	30	YR	$400	$12,000	In addition to Groundwater Monitoring program
Subtotal	30	YR	$1,200	$36,000	
Approx. NPV				**$26,876**	Assumes 2% Discount
SEDIMENT EXCAVATION (CONTINGENCY)					
See Table 6-6 Limited Sediment Excavation	1	LS	$186,500	**$186,500**	Assumed 1 event (see Table 6-6), as contingency.
TOTAL				**$213,376**	

Table 6-6 Remedial Alternative Cost Summary

Limited Excavation of Sediments

Project: NWR0-15852

Location: Amsterdam, NY

Phase: Feasibility Study (-30% to +50%)

Date: September 25, 2006

Description: Excavation and removal of soil and sediments at locations EB-8, EB-9, and DB-8.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
LIMITED SEDIMENT EXCAVATION					
Contractor Mobilization	1	LS	$4,000	$4,000	
Site Preparation, Access	1	LS	$10,000	$10,000	Stone, swamp mats, etc. (to be determined)
Operate Water Management System	10	Day	$1,500	$15,000	2" trash pump
Excavation, Transportation, and Disposal	200	CuYd	$200	$40,000	Direct load to trucks, precharacterized
Site Restoration	1	LS	$3,000	$3,000	Berms/weirs if necessary, hydroseed
Demobilization and Decon	1	LS	$3,000	$3,000	
General Conditions	1	LS	$2,000	$2,000	
Standby	2	Day	$3,000	$6,000	
Sub-Total				**$83,000**	
PROJECT MANAGEMENT AND ENGINEERING					
Permits/Agreements with CSX and DOT	1	LS	$20,000	$20,000	
Project Management	1	LS	$30,000	$30,000	Incl. Final Report
Remedial Design	1	LS	$20,000	$20,000	
Construction Management	15	Days	$2,000	$30,000	Onsite supervision, surveying
Air Monitoring	5	Days	$400	$2,000	Real time monitoring only
Confirmation Sampling	10	samples	$150	$1,500	Total metals only
Sub-Total				**$103,500**	
TOTAL:				**$186,500**	

Table 6-7 Remedial Alternative Cost Summary

Intermediate Excavation of Sediments

Project: NWR0-15852
Location: Amsterdam, NY
Phase: Feasibility Study (-30% to +50%)
Date: September 25, 2006

Description:
Excavation and removal of soil and sediments in exceedance of LELs in the East Branch south of CSX. Construction of detention basins at EB-9 and WB-5.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
LIMITED EXCAVATION FOR DETENTION BASINS AT EB-9 AND WB-5					
Contractor Mobilization	1	LS	$4,000	$4,000	
Site Preparation, Access	1	LS	$10,000	$10,000	Stone, swamp mats, etc. (to be determined)
Operate Water Management System	10	Day	$1,500	$15,000	2" trash pump
Excavation, Transportation, and Disposal	200	CuYd	$200	$40,000	Direct load to trucks, precharacterized
Site Restoration	1	LS	$3,000	$3,000	Berms/weirs if necessary, hydroseed
Demobilization and Decon	1	LS	$3,000	$3,000	
General Conditions	1	LS	$2,000	$2,000	
Standby	2	Day	$3,000	$6,000	
Sub-Total				**$83,000**	
EXCAVATION OF LOWER EAST BRANCH (EB-10, -11, -12)					
Contractor Mobilization	1	LS	$10,000	$10,000	
Site Preparation, Access	1	LS	$8,000	$8,000	Stone, swamp mats, etc. (to be determined)
Operate Water Management System	7	Day	$2,500	$17,500	4" diesel pump
Excavation, Transportation, Disposal	400	CuYd	$200	$80,000	Direct load to trucks, precharacterized
Stabilization for transportation	200	CuYd	$50	$10,000	Portland addition to soft sediments, half of total
Armor Stone and Top Soil	0	CuYd	$60	$0	None anticipated
Terrestrial Site Restoration	1	LS	$10,000	$10,000	
Demobilization and Decon	1	LS	$4,000	$4,000	
General Conditions	1	LS	$6,000	$6,000	
Standby	2	Day	$3,000	$6,000	
Sub-Total				**$151,500**	
EXCAVATION OF EAST MOHAWK					
Contractor Mobilization	1	LS	$20,000	$20,000	
Site Preparation, Access	1	LS	$10,000	$10,000	Stone, swamp mats, etc. (to be determined)
Install / Remove Portadam or Sheet Piles	1	LS	$60,000	$60,000	Assumes Portadam
Operate Water Management System	14	Day	$2,500	$35,000	4" diesel pump
Excavation, Transportation, Disposal	700	CuYd	$200	$140,000	Direct load to trucks, precharacterized
Stabilization for transportation	550	CuYd	$50	$27,500	Portland addition to soft sediments, half of total
Armor Stone and Top Soil	700	CuYd	$60	$42,000	
Terrestrial Site Restoration	0	LS	$10,000	$0	Included above
Demobilization and Decon	1	LS	$8,000	$8,000	
General Conditions	1	LS	$10,000	$10,000	
Standby	5	Day	$3,000	$15,000	
Sub-Total				**$367,500**	
LONG-TERM SEDIMENT MONITORING PROGRAM					
Subtotal NPV	30	YR	$1,200	**$26,876**	Assumes 2% Discount, see Table 6-5
LIMITED (FUTURE) EXCAVATION FROM BASINS - CONTINGENCY					
Excavation/Construction	1	LS	$83,000	$83,000	
Task Engineering/Oversight	1	LS	$50,000	$50,000	
Sub-Total				**$133,000**	Contingency only, re-excavation of basins
PROJECT MANAGEMENT and ENGINEERING					
Pre-Design Investigation	1	LS	$30,000	$30,000	
Permits/Agreements (CSX, DOT, USACE)	1	LS	$35,000	$35,000	
Project Management	1	LS	$60,000	$60,000	Incl. Final Report
Remedial Design	1	LS	$60,000	$60,000	
Construction Management	30	Days	$2,000	$60,000	Onsite supervision, surveying, for 6 weeks
Air Monitoring	15	Days	$400	$6,000	Real time monitoring only
Confirmation Sampling	30	samples	$150	$4,500	Total metals only
Sub-Total				**$255,500**	
TOTAL:				**$1,017,376**	

Table 6-8 Remedial Alternative Cost Summary

Full Excavation of Sediments

Project:	NWR0-15852	Description:	Excavation and removal of soil and sediments in exceedance of LELs.
Location:	Amsterdam, NY		
Phase:	Feasibility Study (-30% to +50%)		
Date:	September 25, 2006		

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
EXCAVATION OF EAST AND WEST BRANCHES					
Contractor Mobilization	1	LS	$12,000	$12,000	
Clearing and Grubbing	1	LS	$8,000	$8,000	Slash/buck and leave onsite
Site Preparation, Access	1	LS	$24,000	$24,000	Stone, swamp mats, etc. (to be determined)
Operate Water Management System	20	Day	$1,500	$30,000	2" trash pump
Excavation, Transportation, and Disposal	2700	CuYd	$200	$540,000	Direct load to trucks, precharacterized
Additional on-site handling	2700	CuYd	$75	$202,500	Transport by loader down drainage
Place Backfill / Armor Stone	1350	CuYd	$100	$135,000	Reuse native material or imported stone, half coverage
Other Site Restoration	1	LS	$10,000	$10,000	
Demobilization and Decon	1	LS	$10,000	$10,000	
General Conditions	1	LS	$4,000	$4,000	
Standby	5	Day	$3,000	$15,000	
Sub-Total				**$990,500**	
EXCAVATION OF MOHAWK RIVER EAST and WEST					
Contractor Mobilization	1	LS	$30,000	$30,000	
Site Preparation, Access	1	LS	$18,000	$18,000	Stone, swamp mats, etc. (to be determined)
Install / Remove Portadam or Sheet Piles	2	LS	$60,000	$120,000	Assumes Portadam, east and west
Operate Water Management System	21	Day	$2,500	$52,500	4" diesel pump
Excavation, Transportation, Disposal	1600	CuYd	$200	$320,000	Direct load to trucks, precharacterized
Stabilization for transportation	800	CuYd	$50	$40,000	Portland addition to soft sediments, half of total
Armor Stone and Top Soil	1600	CuYd	$80	$128,000	
Terrestrial Site Restoration	1	LS	$20,000	$20,000	
Demobilization and Decon	1	LS	$12,000	$12,000	
General Conditions	1	LS	$16,000	$16,000	
Standby	5	Day	$3,000	$15,000	
Sub-Total				**$771,500**	
PROJECT MANAGEMENT					
Pre-Design Investigation	1	LS	$50,000	$50,000	
Permits/Agreements (CSX, DOT, USACE)	1	LS	$30,000	$30,000	
Project Management	1	LS	$60,000	$60,000	Incl. Final Report
Remedial Design	1	LS	$60,000	$60,000	
Construction Management	80	Days	$2,000	$160,000	Onsite supervision, surveying
Air Monitoring	45	Days	$400	$18,000	Real time monitoring only
Confirmation Sampling	200	samples	$150	$30,000	Total metals only
Sub-Total				**$408,000**	
TOTAL:				**$2,170,000**	

Table 6-9 Former Ward Products, Amsterdam, NY
Identification and Initial Screening of Technologies and Process Options – GROUNDWATER

GENERAL ACTION	TECHNOLOGY	PROCESS OPTION	PROCESS DESCRIPTION	TECHNICAL FEASIBILITY SCREENING COMMENTS
No Action	No Action	None	Site is left in its existing state.	RETAIN
Monitor Only	Monitor groundwater concentrations of COC over time.	Groundwater Sampling and Analysis Plan	Groundwater samples would be collected, analyzed, and compared over time.	RETAIN
	Monitor groundwater concentrations of Natural Attenuation indicators over time.	Groundwater Sampling and Analysis Plan	Groundwater samples would be collected, analyzed, and compared over time.	RETAIN

GENERAL ACTION	TECHNOLOGY	PROCESS OPTION	PROCESS DESCRIPTION	TECHNICAL FEASIBILITY SCREENING COMMENTS
Institutional Controls	Use Restrictions	Agreements, regulatory requirements, or environmental easements	Water use restrictions could be agreed to by the affected properties. Water use restrictions could be imposed by law, rule, regulation, or ordinance. Water use restrictions could be recorded either to disclose conditions and/or to limit potable or other use of impacted groundwater.	RETAIN
Ex-situ Actions	Groundwater Removal and Treatment	Fluidized Bed Reactor, with metals pre-treatment	Oxidation-coagulation-sedimentation of metals, followed by aerobic cometabolic degradation of organic COC.	REJECT. High capital and operating cost.
		Air Stripper, no metals pre-treatment	Physical removal of VOCs.	RETAIN
		Air Stripper, with metals pre-treatment	Oxidation-coagulation-sedimentation of metals, followed by physical removal of VOCs.	REJECT. High capital and operating cost.
		Granular Activated Carbon Reactor, with metals pre-treatment	Oxidation-coagulation-sedimentation of metals, followed by physical removal of VOCs.	REJECT. High capital and operating cost.
		Ultraviolet / Chemical Oxidation Reactors	Physical process for destruction of VOCs and COD.	REJECT. High capital and operating cost.

GENERAL ACTION	TECHNOLOGY	PROCESS OPTION	PROCESS DESCRIPTION	TECHNICAL FEASIBILITY SCREENING COMMENTS
In-situ Actions	Chemical Reaction	In-situ Chemical Oxidation	KMnO4 is injected and distributed via wells to enhance chemical reaction with TCE and chromium.	RETAIN
		In-situ Chemical Oxidation	H2O2 is injected and distributed via wells to enhance chemical reaction with TCE and chromium.	RETAIN
	Biodegradation	Bioventing	Air is injected into wells to strip VOCs and enhance biodegradation.	REJECT. Not effective for chromium.
		Aerobic Bioremediation	Oxygen releasing compound is injected and distributed via wells to enhance subsurface biodegradation of VOCs.	REJECT. Not effective for chromium or TCE.
		In-situ Anaerobic Reductive Dechlorination	Hydrogen Releasing Compound is injected and distributed via wells to enhance subsurface biodegradation of VOCs and stabilization of chromium.	RETAIN
		In-situ Aerobic Cometabolic Degradation	Oxygen and methane are cyclically injected via wells to enhance subsurface biodegradation of TCE.	REJECT. Not effective for chromium, expensive.
	Capping	Plastic Membrane	Placement of impermeable layer over impacted soil to reduce infiltration.	REJECT. Existing soil concentrations are not significant threat to future groundwater quality.
	Containment	Slurry Wall or Sheet Pile Wall	Excavate bedrock trench and install soil/bentonite slurry or interlocking steel sheet to reduce groundwater migration.	REJECT. Impractical, would require additional groundwater removal and treatment.

Table 6-10 Remedial Alternative Cost Summary

Long-Term Groundwater Monitoring

Project: NWR0-15852
Location: Amsterdam, NY
Phase: Feasibility Study (-30% to +50%)
Date: September 25, 2006

Description: Long-term groundwater monitoring of COC and Natural Attenuation parameters. Assume existing program for 4 years, followed by reduced program for an additional 26 years.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
ON-SITE GROUNDWATER USE RESTRICTION					
Environmental Easement	1	LS	$20,000	**$20,000**	Document prep, filing fees
INITIAL GROUNDWATER MONITORING PROGRAM					
Groundwater Sampling, Analysis, Reporting	4	YR	$16,000	$64,000	Existing Monitoring Program: 20 wells, twice/year
Natural Attenuation Sampling and Analysis	4	YR	$4,000	$16,000	In addition to routine sampling and analysis
Project Management	4	YR	$4,000	$16,000	
Subtotal (Years 1 to 4)	4	YR	$24,000	$96,000	
Approx. NPV (Years 1 to 4)				**$91,385**	Includes 2% discount
LONG-TERM GROUNDWATER MONITORING PROGRAM					
Groundwater Sampling, Analysis, Reporting	26	YR	$4,000	$104,000	4 wells, once/year
Natural Attenuation Sampling and Analysis	26	YR	$2,000	$52,000	In addition to routine sampling and analysis
Project Management	26	YR	$3,000	$78,000	
Subtotal (Years 4 to 30)	26	YR	$9,000	$234,000	
Approx. NPV (Years 4 to 30)				**$167,299**	Includes 2% discount
TOTAL (NPV)				**$278,684**	

Table 6-11 Remedial Alternative Cost Summary

Treatment of Groundwater

Project: NWR0-15852
Location: Amsterdam, NY
Phase: Feasibility Study (-30% to +50%)
Date: September 25, 2006

Description: Groundwater recovery, pretreatment, and discharge to the Amsterdam municipal wastewater treatment plant, assuming active operation for a period of 10 years.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
SYSTEM CONSTRUCTION					
Contractor Mobilization	1	LS	$4,000	$4,000	
Recovery Well Installation	1	Well	$8,000	$8,000	4-inch PVC recovery wells, 60-feet deep
Waste Soil Disposal	1	LS	$4,000	$4,000	8 drums, with analyticals
Pump (with no-load sensor)	1	LS	$800	$800	Myers Submersible 2NFL52-5, 5 GPM
Flow Totalizer (with remote readout)	1	LS	$200	$200	McMaster 42075K91
Air Stripper	1	LS	$16,000	$16,000	NEEP Model 2321
Other Plumbing	1	LS	$2,000	$2,000	Pressure relief, flow gages, sewer, vent stack
Electric	1	LS	$5,000	$5,000	230 V, breaker box
Trenching	1	LS	$1,500	$1,500	
Shed	1	LS	$1,200	$1,200	4' x 8'
Heater & Insulation	1	LS	$500	$500	36" 120V baseboard, 2" blueboard rigid insulation
System Assembly (labor, other)	1	LS	$10,000	$10,000	
Project Management	1	LS	$30,000	$30,000	Including Final Report
Remedial Design	1	LS	$45,000	$45,000	
Construction Management	1	LS	$10,000	$10,000	
Subtotal				**$138,200**	
STARTUP / SHAKEDOWN					
Discharge Permit Acquisition	1	LS	$4,000	$4,000	
Frac Tank Rental	1	LS	$2,000	$2,000	
Sampling and Analysis	5	LS	$400	$2,000	Initial Pre- / Post-, Final Pre- / Post-, Composite
Field Equipment	3	Days	$200	$600	
System Operations (labor, other)	4	Days	$2,000	$8,000	Including GW drawdown mapping
Air Monitoring	1	LS	$1,200	$1,200	Stack and ambient realtime monitoring
Subtotal				**$17,800**	
OPERATIONS AND MAINTENANCE					
O&M Labor	10	YR	$6,000	$60,000	Avg 1 visit per month by local lab tech
O&M Analyticals	10	YR	$3,600	$36,000	$300 per month average
Spare Parts	10	YR	$1,000	$10,000	
Electricity	10	YR	$894	$8,935	0.85 kW x 24 hrs x 365 days x $.12
Discharge fees	10	YR	$631	$6,307	15 gpm x 365 days x $0.08 per 1000 gallon
Project Management	10	YR	$8,000	$80,000	
Subtotal	10	YR	$20,124	$201,242	
Approx. NPV (10 years)				**$180,768**	Assumes 2% Discount
Approx. NPV (30 years)				**$450,713**	Assumes 2% Discount
TOTAL (NPV)				**$336,768**	10 year program

Table 6-12 Remedial Alternative Cost Summary

In-Situ Bioremediation

Project: NWR0-15852
Location: Amsterdam, NY
Phase: Feasibility Study (-30% to +50%)
Date: September 25, 2006

Description: Injection of Hydrogen Releasing Compound to induce anaerobic biodegradation of TCE and stabilization of Cr. Cost estimates for this alternative are based on a pilot scale IRM (1 year) followed by full scale application (3 years).

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
PILOT STUDY					
Injection Well Installation	0	Wells	$4,500	$0	Use existing wells MW-4R and MW-6
HRC	120	Lbs	$10	$1,200	Avg 60 lbs per well, 2 wells, 1 injection each
Field Equipment	1	LS	$10,000	$10,000	Incl. specialized injection pump (subcontractor)
Field Preparation	1	LS	$2,000	$2,000	
Field Labor	4	Days	$2,000	$8,000	1 trip, 2 days, 2 persons
Groundwater Analyses	1	LS	$12,000	$12,000	VOCs, Metals, MNA factors
Project Management	1	LS	$6,000	$6,000	Including Interim Report
Subtotal				**$39,200**	
FULL SCALE APPLICATION					
Additional Injection Well Installation	12	Wells	$5,000	$60,000	2" PVC x 60' deep
Construction Management	15	Days	$1,500	$22,500	Drilling Supervision
Waste Disposal	1	LS	$3,000	$3,000	Drill cuttings, rolloff rental, analysis
HRC	2160	Lbs	$10	$21,600	60 lbs per well, 12 wells, 3 injections each
Field Equipment	3	LS	$10,000	$30,000	Incl. specialized injection pump (subcontractor)
Field Labor	16	Days	$2,000	$32,000	3 or 4 trips, 2 days each, 2 persons
Project Management	1	LS	$40,000	$40,000	Including Final Report
Remedial Design	1	LS	$24,000	$24,000	
Subtotal				**$233,100**	
TOTAL				**$272,300**	

Table 6-13 Remedial Alternative Cost Summary

In-Situ Chemical Oxidation of Impacted Groundwater in Bedrock

Project: NWR0-15852
Location: Amsterdam, NY
Phase: Feasibility Study (-30% to +50%)
Date: September 25, 2006

Description: Injection of potassium permanganate (KMnO4) to induce chemical oxidation of TCE and Cr. Cost estimates for this alternative are based on a pilot study (year 1) followed by up to 3 full scale applications (in years 2 and 3).

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
PILOT STUDY					
Injection Well Installation	0	Wells	$6,000	$0	Use existing wells MW-4R and MW-6
KMnO4	20	Lbs	$8	$160	10 lbs per well, 2 wells, 1 injection each
Field Equipment	1	LS	$6,000	$6,000	Trailer-mounted tankage/pumps, PPE
Field Preparation	1	LS	$2,000	$2,000	
Field Labor	4	Days	$3,000	$12,000	Including followup sampling
Groundwater Analysis	1	LS	$3,000	$3,000	VOCs and metals
Project Management	1	LS	$12,000	$12,000	Including Interim Letter Report
Subtotal				**$35,160**	
FULL SCALE APPLICATION					
Injection Well Installation	8	Wells	$6,000	$48,000	2" Stainless x 60' deep
Construction Management	10	Days	$2,000	$20,000	Drilling supervision
Waste Soil Disposal	1	LS	$2,000	$2,000	Drill cuttings, rolloff rental, analysis
Waste Water Disposal	10,000	gallons	$0.50	$5,000	Purge water, tank rental, analysis
KMnO4	270	Lbs	$8	$2,160	10 lbs per well, 9 wells, 3 injections each
Field Equipment	3	LS	$6,000	$18,000	Trailer-mounted tankage/pumps, PPE
Field Preparation	3	LS	$2,000	$6,000	
Field Labor	12	Days	$3,000	$36,000	Including followup sampling
Groundwater Analysis	3	LS	$5,000	$15,000	VOCs and metals
Project Management	1	LS	$20,000	$20,000	Including Final Report
Remedial Design	1	LS	$30,000	$30,000	
Subtotal				**$202,160**	
TOTAL				**$237,320**	

Table 6-14 Remedial Alternative Cost Summary

Treatment of Groundwater with Extraction and ISCO

Project: NWR0-15852
Location: Amsterdam, NY
Phase: Feasibility Study (-30% to +50%)
Date: September 25, 2006

Description: Groundwater recovery, pretreatment, and discharge to the Amsterdam municipal wastewater treatment plant, assuming active operation for a period of 10 years. Also with limited In Situ Chemical Oxidation of source area.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
GROUNDWATER SYSTEM CONSTRUCTION					
Subtotal				**$138,000**	See Table 6-11
GROUNDWATER SYSTEM STARTUP / SHAKEDOWN					
Subtotal				**$17,800**	See Table 6-11
GROUNDWATER SYSTEM OPERATIONS AND MAINTENANCE					
Subtotal NPV (10 years)				**$180,768**	See Table 6-11
ISCO LIMITED SCALE APPLICATION					
Injection Well Installation	4	Wells	$6,000	$24,000	2" Stainless x 60' deep
Construction Management	8	Days	$1,500	$12,000	Drilling supervision
Waste Soil Disposal	1	LS	$1,500	$1,500	Drill cuttings, rolloff rental, analysis
KMnO4	120	Lbs	$8	$960	10 lbs per well, 4 wells, 3 injections each
Pilot/Startup/Shakedown	1	LS	$10,000	$10,000	At start of first treatment event.
Field Equipment	3	LS	$6,000	$18,000	Trailer-mounted tankage/pumps, PPE
Field Preparation	3	LS	$2,000	$6,000	
Field Labor	12	Days	$3,000	$36,000	Including followup sampling
Groundwater Analysis	3	LS	$5,000	$15,000	VOCs and metals
Project Management	1	LS	$12,000	$12,000	In addition to groundwater system
Remedial Design	1	LS	$15,000	$15,000	In addition to groundwater system
Subtotal				**$150,460**	
TOTAL (NPV)				**$487,028**	10 year program

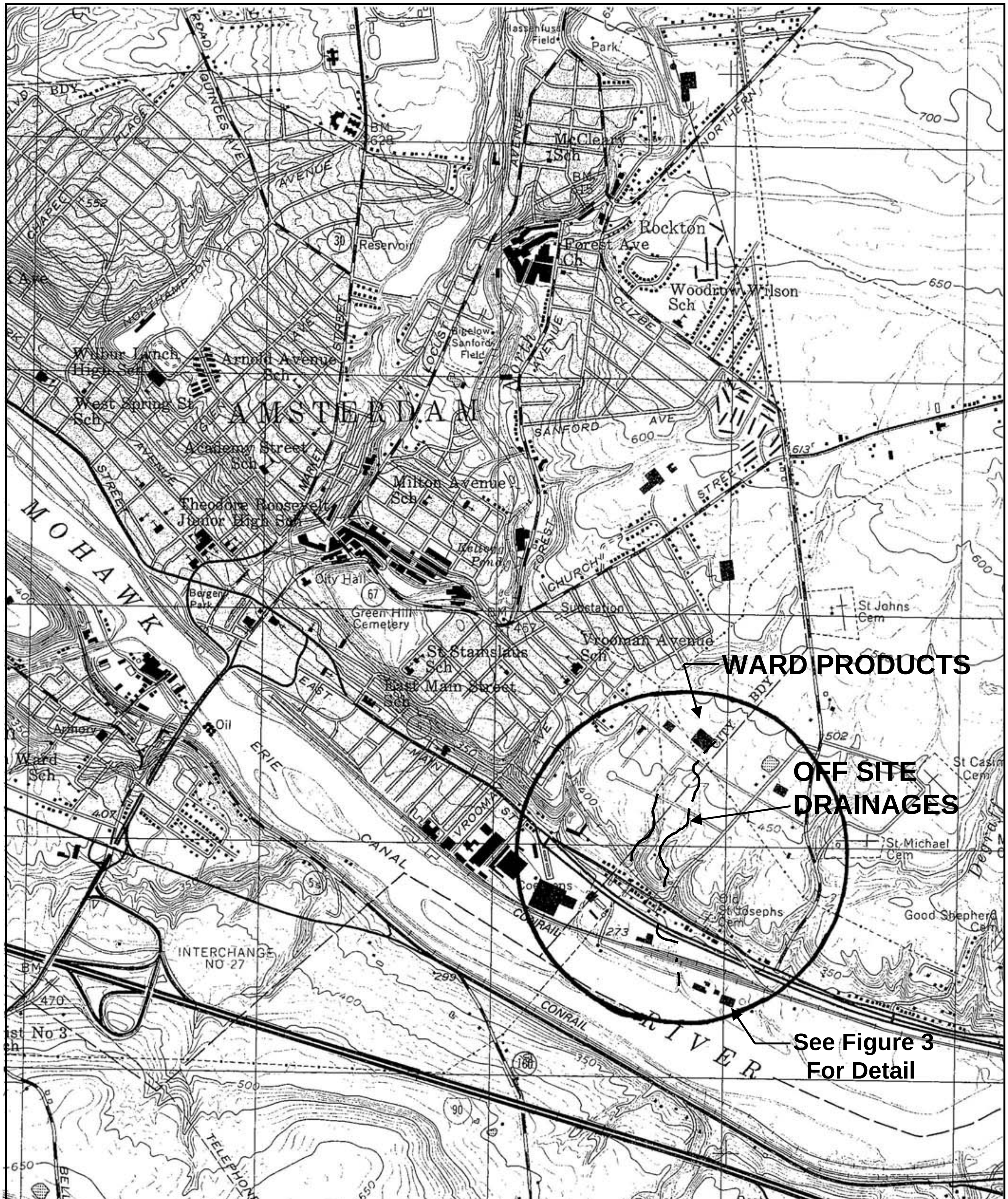
Table 7-1 Remedial Alternative Cost Summary

RECOMMENDED REMEDY

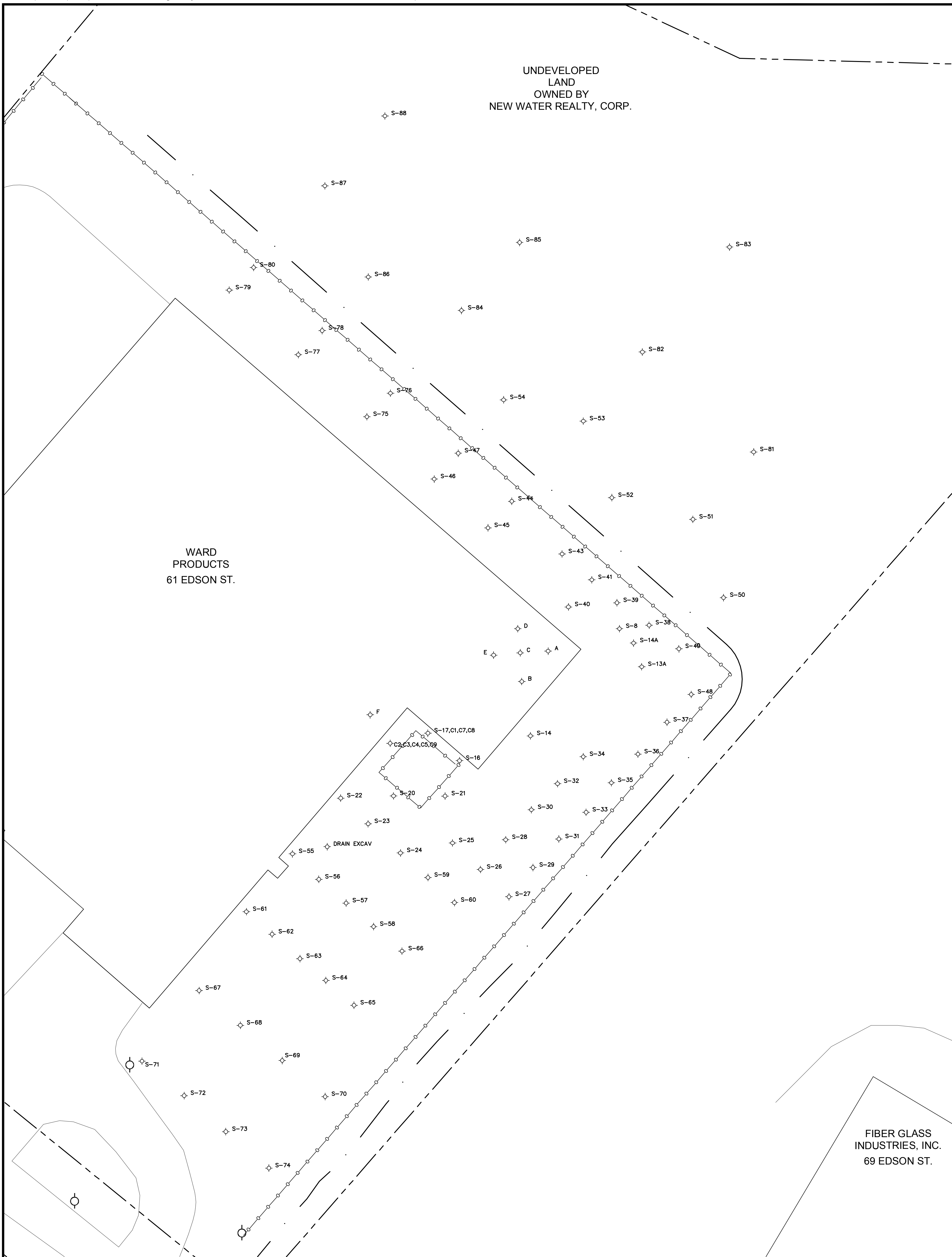
Project:	NWR0-15852
Location:	Amsterdam, NY
Phase:	Feasibility Study (-30% to +50%)
Date:	September 25, 2006

	DESCRIPTION	TOTAL	NOTES	REFERENCE
		(Dollar Values are Rounded Up)		
OPERATION OF SUB-SLAB SOIL VAPOR SYSTEM				
	Sub-Total	**Negligible**	NPV O&M	Text Sec. 7.1.4
EASEMENT AND SITE MANAGEMENT PLAN FOR ONSITE SOILS				
	Environmental Easement	$20,000	Capital cost	Table 6-2
	Soils Management Plan	$15,000	Capital cost	Table 6-2
	Annual Inspections (30 years)	$45,000	NPV O&M	Table 6-2
	Sub-Total	**$80,000**		
INTERMEDIATE SEDIMENT EXCAVATION				
	Construction, Excavation, Transportation, Disposal	$602,000	Capital cost	Table 6-7
	Enginnering, Management, Monitoring, Reporting, Permitting	$256,000	Capital cost	Table 6-7
	Sediment Monitoring (30 years)	$27,000	NPV O&M	Table 6-5
	Additional (Future) Sediment Removal	$133,000	Contingency	Tables 6-6, 6-7
	Sub-Total	**$1,018,000**		
GROUNDWATER EXTRACTION AND IN-SITU CHEMICAL OXIDATION				
	Groundwater System Construction	$138,000	Capital cost	Table 6-11
	Groundwater System Startup	$18,000	Capital cost	Table 6-11
	Groundwater System O&M (10 years)	$181,000	NPV O&M	Table 6-11
	ISCO Construction, Startup, and Application (3 events)	$150,000	Capital cost	Table 6-14
	Sub-Total	**$487,000**		
LONG-TERM GROUNDWATER MONITORING				
	Institutional Controls	$20,000	Capital cost	Table 6-10
	Initial Monitoring Program (4 years)	$92,000	NPV O&M	Table 6-10
	Long-Term Monitoring Program (30 years)	$168,000	NPV O&M	Table 6-10
	Sub-Total	**$280,000**		
TOTAL		**$1,865,000**		

Figures



RETEC	WARD PRODUCTS SITE Amsterdam, NY	**SITE LOCATION**
	DATE: 9/25/06 | DRWN: AK/MH	NWR01-15852-400 | **FIGURE 1**



N

25 0 50

1"=50'

LEGEND

SURFACE DITCH

CHAINLINK FENCE

PROPERTY LINE

S-66 SURFACE OR SUBSURFACE SOIL IN EXCEEDANCE OF TAGM 4046 GUIDANCE VALUE

NOTE:
1. FIGURE BASED ON REVISED REMEDIAL INVESTIGATIONS REPORT AND FINAL IRM REPORTS.

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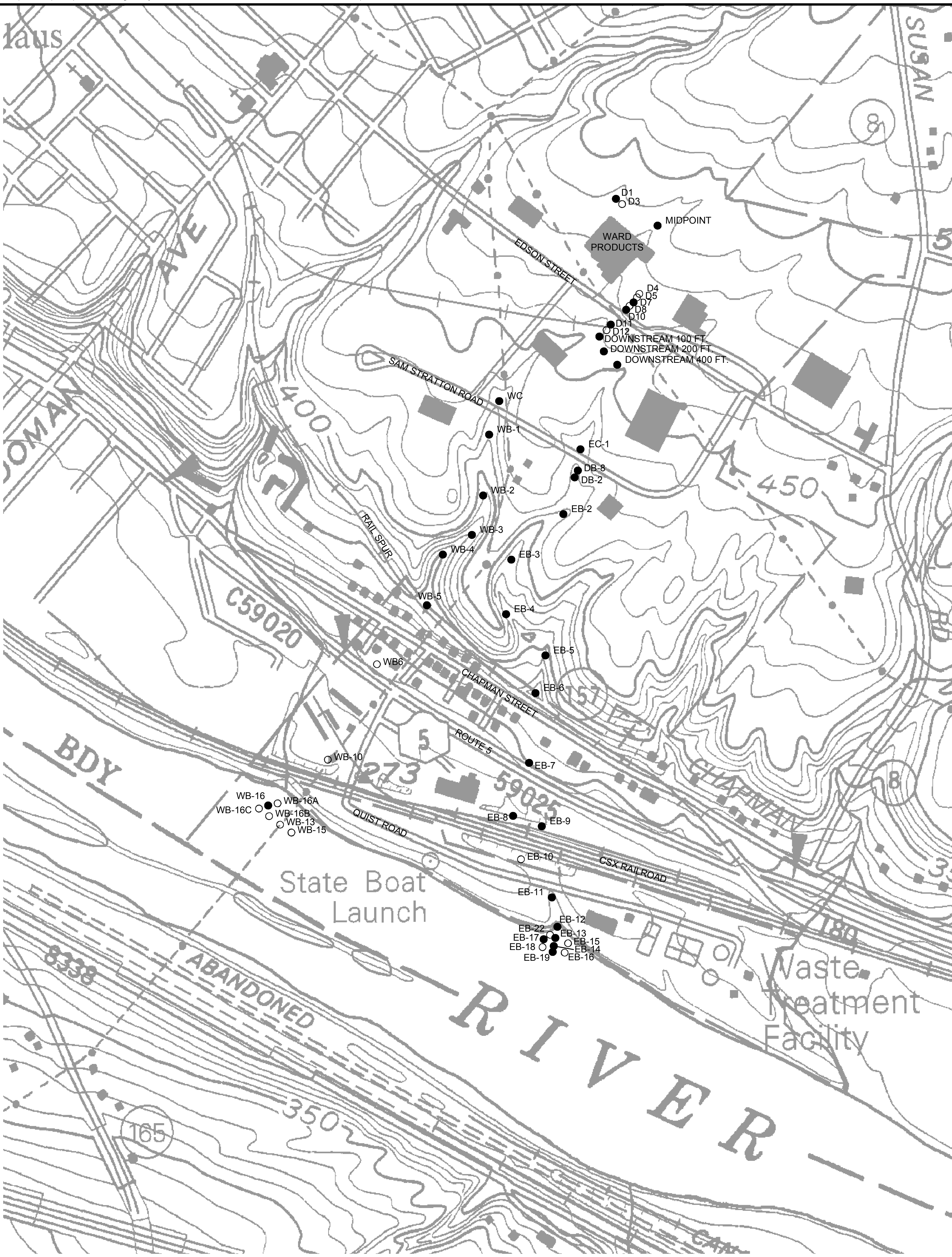
NWR01-15852-400

DATE: 9/25/06 DRWN: MAW/BIL

LOCATIONS OF SCG EXCEEDANCES IN SOILS

FIGURE 2

File: J:\15852\400\FINAL_B.dwg Layout: ANSI_BVI User: mwilliamson Plotted: Sep 21, 2006 - 8:39am Xref's:



LEGEND

● EB-5 SEDIMENT SAMPLE IN EXCEEDANCE OF NYSDEC SELs

○ EB-10 SEDIMENT SAMPLE IN EXCEEDANCE OF NYSDEC LELs

N

250 0 500

1"=500'

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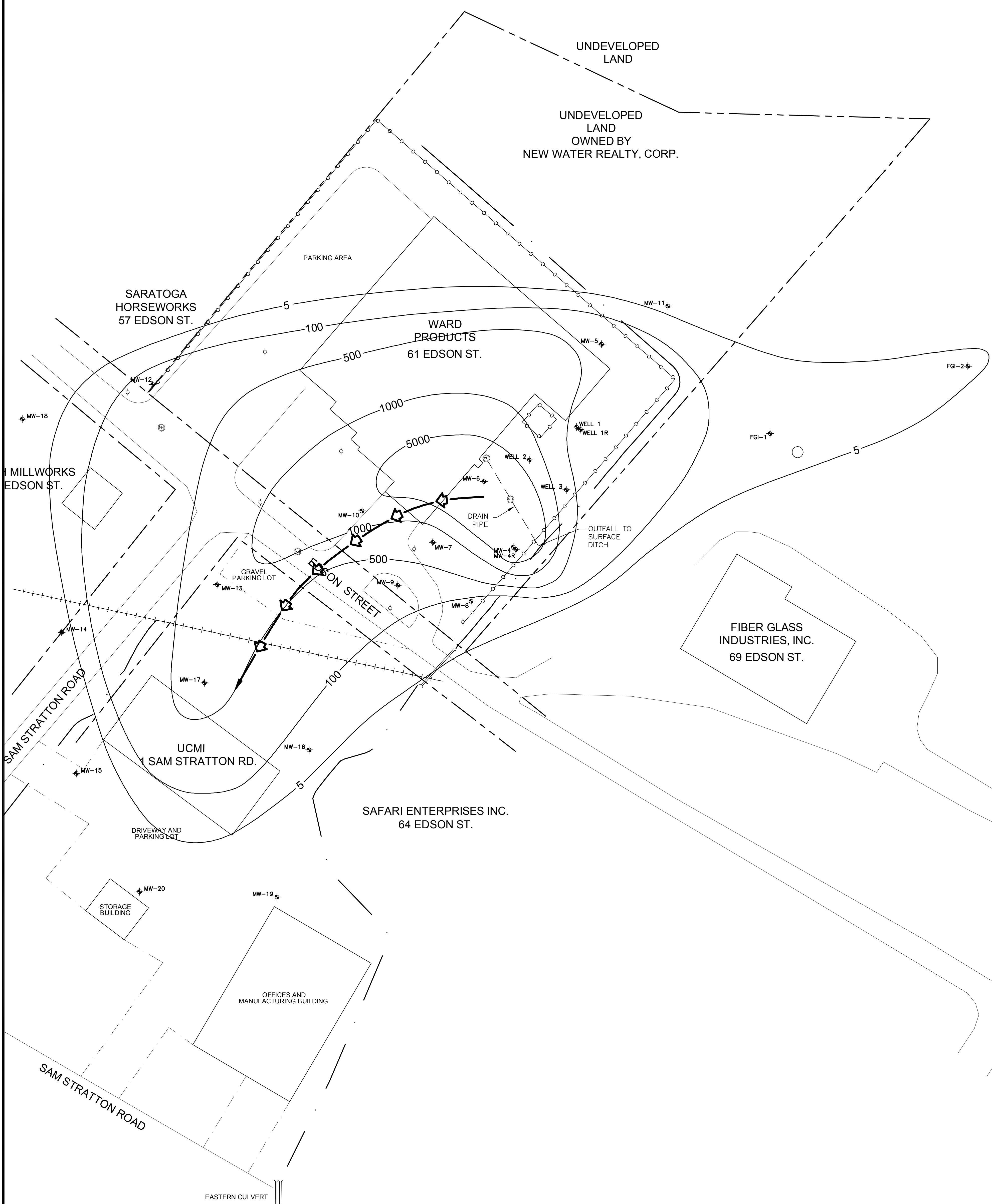
WARD PRODUCTS SITE AMSTERDAM, NEW YORK NWR01-15852-400	LOCATIONS OF SCG EXCEEDANCES IN SEDIMENTS
DATE: 9/25/06 DRWN: MAW/BIL	FIGURE 3

File: J:\15852\400\SCG_GW_EXCEED_REV.dwg Layout: ANSI_BVI-LJ User: mwilliamson Plotted: Sep 21, 2006 - 8:38am Xref's:



NOTES:
1. FIGURE BASED ON LETTER REPORT BY NORMANDEAU ASSOCIATES, DECEMBER 2005.
2. MW-1, MW-2, MW-3 AND MW-4 ARE OVERBURDEN WELLS. ALL OTHERS ARE BEDROCK WELLS.
3. FIGURE SHOWS ONLY TCE CONCENTRATIONS IN BEDROCK GROUNDWATER.
4. OVERBURDEN EXCEEDANCES OF TCE (NOT SHOWN) ARE LIMITED TO MW-1 AND MW-4.
5. EXCEEDANCES OF CHROMIUM (NOT SHOWN) ARE LIMITED TO MW-1, MW-1R AND MW-2.

N

60 0 120

1"=120'

LEGEND

SURFACE DITCH
CHAINLINK FENCE
PROPERTY LINE
5 — TCE CONCENTRATIONS IN GROUNDWATER, µg/L, SEPTEMBER 2005
GROUNDWATER FLOW DIRECTION
MW-18 MONITORING WELL

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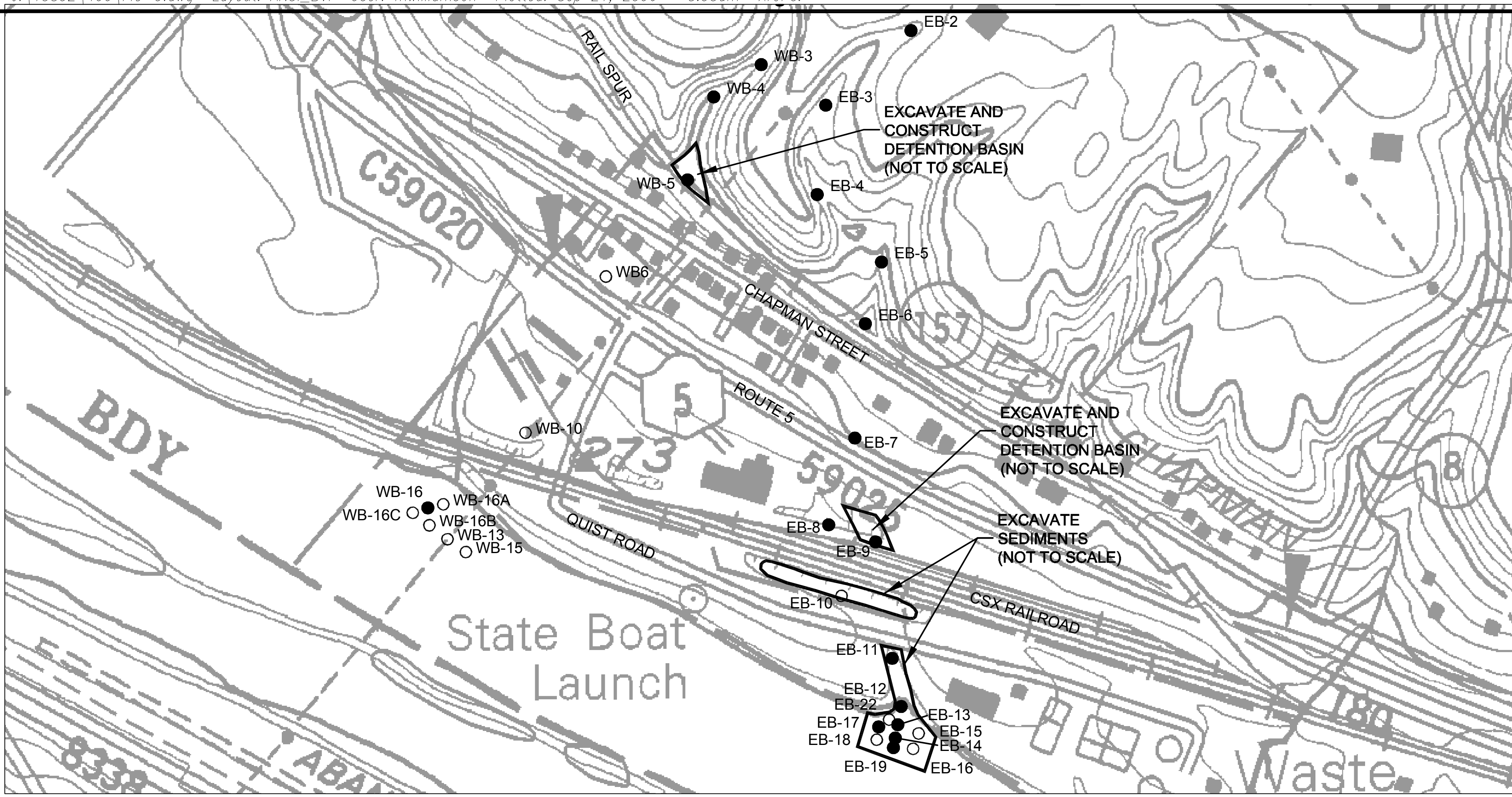
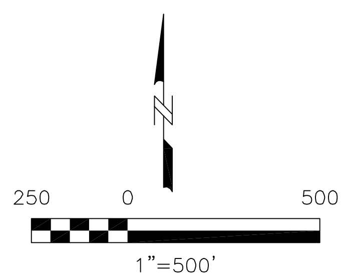
LOCATIONS OF SCG EXCEEDANCES IN GROUNDWATER

DATE: 9/25/06 DRWN: MAW/BIL

FIGURE 4

File: J:\15852\400\FIG-5.dwg Layout: ANSI_BVI User: mwilliamson Plotted: Sep 21, 2006 - 8:38am Xref's:





LEGEND

● EB-5 SEDIMENT SAMPLE IN EXCEEDANCE OF NYSDEC SELs

○ EB-10 SEDIMENT SAMPLE IN EXCEEDANCE OF NYSDEC LELs

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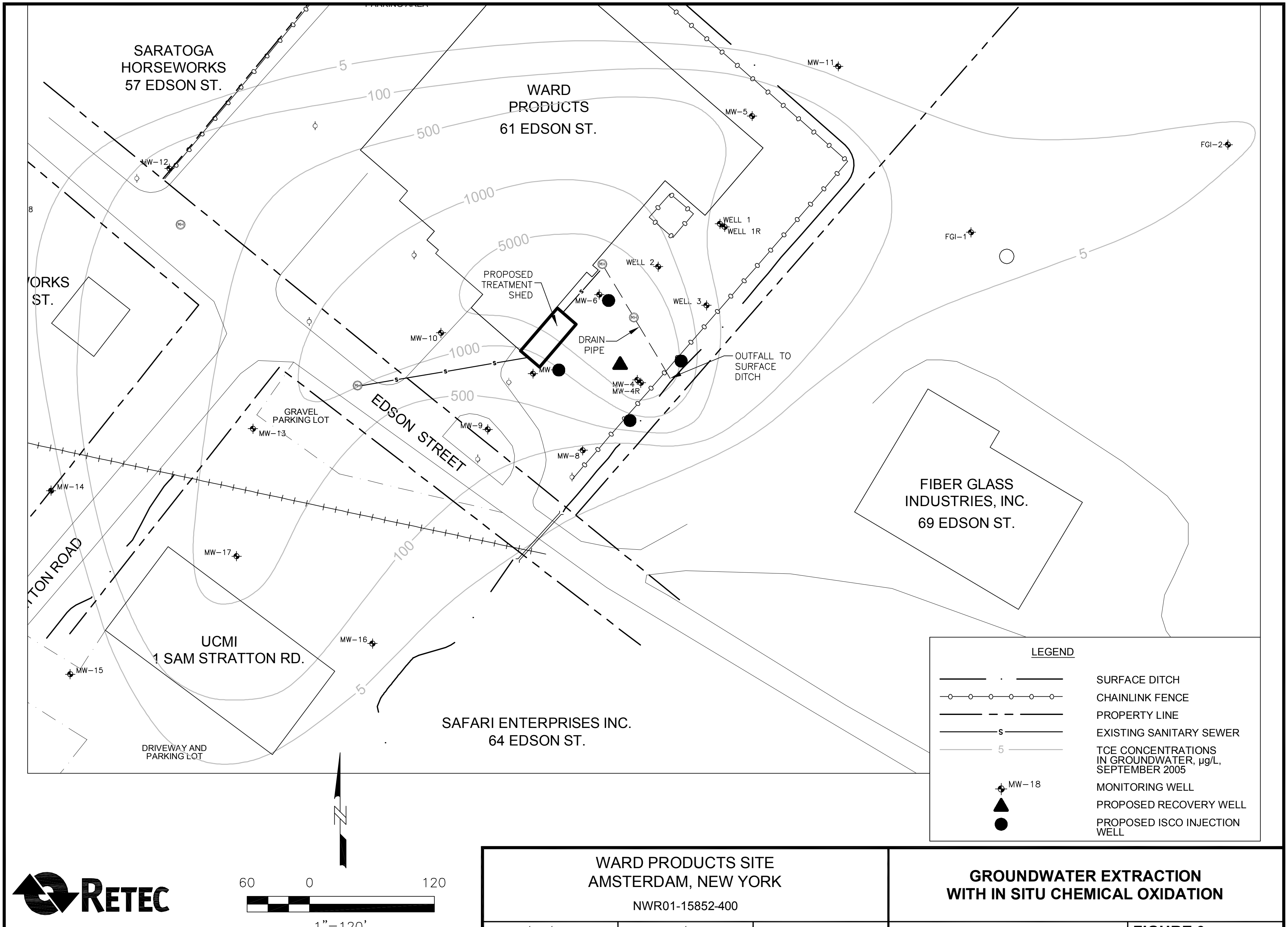
INTERMEDIATE SEDIMENT EXCAVATION

DATE: 9/25/06 | DRWN: MAW/BIL

FIGURE 5

File: J:\15852\400\FIG-6.dwg Layout: ANSI_BVI User: mwilliamson Plotted: Sep 21, 2006 - 8:41am Xref's:



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GROUNDWATER EXTRACTION WITH IN SITU CHEMICAL OXIDATION

DATE: 9/25/06 DRWN: MAW/BIL

FIGURE 6