ARCADIS
Infrastructure, environment, buildings

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ENVIRONMENT

Mr. Walter Wintsch
New York State Department of Environmental Conservation
Region 4
1150 North Wescott Rd
Schenectady, NY 12306

Subject:
Remedial Action Work Plan Addendum, Mohawk Finishing Products Site, Amsterdam, New York.

Date:
4 October 2005

Contact:
Marc W. Sanford

Phone:
518.452.7826 Ext. 15

Email:
msanford@arcadis-us.com

Our ref:
AY000273.0004

Dear Mr. Wintsch:

ARCADIS has received additional verbal comments from Mr. Dan Geraghty of the New York State Department of Health (NYSDOH) regarding the Remedial Action Work Plan (RAWP). Following discussions with Mr. Alan Geisendorfer regarding these comments in regard to the approval of the RAWP, ARCADIS has developed this addendum to address the NYSDOH requests in regard to indoor air monitoring during implementation of the remedial program.

The RAWP includes indoor air sampling to be developed as part of the Operation & Maintenance Plan. The elements of the O&M Plan related to indoor air, groundwater monitoring, and system influent/effluent vapor and water sampling will be determined once the VER pilot test has been completed and the system layout and ancillary components have been incorporated into the 90% remedial design. The O&M Plan will specify the analytical parameters, sampling frequency and analytical test methods for each media. In addition, as requested by the NYSDOH, the O&M Plan will include a baseline indoor air sampling event prior to the startup of the remedial system, and the collection of indoor sampling on an annual basis during the system operational period.

With respect to the requested Environmental Easement, our client is the volunteer and is working with the property owner to implement the groundwater use restrictions at the site.

We trust that this addendum addresses this final issue regarding the monitoring plan and will allow the Department to approve the RAWP. If you have any questions, please contact me at (518) 452-7826.

Sincerely,

ARCADIS G&M, Inc.

Marc W. Sanford
Project Manager

Copies:

Dennis Finn - RPM
Mia Lombardi – McMahon Degulis
Alan Geisendorfer - NYSDEC
File

ARCADIS

Infrastructure, environment, buildings

Remedial Action Work Plan for Voluntary Cleanup

Mohawk Finishing Products
4715 State Highway 30
Amsterdam, New York

PREPARED FOR

Mohawk Finishing Products
Amsterdam, New York

ARCADIS

Remedial Action Work Plan for Voluntary Cleanup

Mohawk Finishing Products
4715 State Highway 30
Amsterdam, New York

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Date:
July 28, 2005

Tables

Figures

Appendices

DISCLOSURE STATEMENT

THE LAWS OF NEW YORK STATE REQUIRE CORPORATIONS THAT RENDER ENGINEERING SERVICES IN NEW YORK BE OWNED BY INDIVIDUALS LICENSED TO PRACTICE ENGINEERING IN THE STATE. ARCADIS G&M, INC. CANNOT MEET THAT REQUIREMENT. THEREFORE, ALL ENGINEERING SERVICES RENDERED TO MOHAWK FINISHING PRODUCTS (RPM) IN NEW YORK ARE BEING PERFORMED BY ARCADIS ENGINEERS & ARCHITECTS OF NEW YORK, P.C., A NEW YORK PROFESSIONAL CORPORATION QUALIFED TO RENDER PROFESSIONAL ENGINEERING SERVICES IN NEW YORK. THERE IS NO SURCHARGE OR EXTRA EXPENSE ASSOCIATED WITH THE RENDERING OF PROFESSIONAL SERVICES BY ARCADIS ENGINEERS & ARCHITECTS OF NEW YORK, P.C.

ARCADIS G&M, INC. IS PERFORMING ALL THOSE SERVICES THAT DO NOT CONSTITUTE PROFESSIONAL ENGINEERING AND IS PROVIDING ADMINISTRATIVE AND PERSONNEL SUPPORT TO ARCADIS ENGINEERS & ARCHITECTS OF NEW YORK, P.C. ALL MATTERS RELATING TO THE ADMINISTRATION OF THE CONTRACT WITH MOHAWK FINISHING PRODUCTS (RPM) ARE BEING PERFORMED BY ARCADIS G&M, INC. PURSUANT TO ITS AMENDED AND RESTATED SERVICES AGREEMENT WITH ARCADIS ENGINEERS & ARCHITECTS OF NEW YORK, P.C. ALL COMMUNICATIONS SHOULD BE REFERRED TO THE DESIGNATED PROJECT MANAGER AT ARCADIS G&M.

1. Introduction

ARCADIS Inc. ARCADIS Engineers & Architects of New York, P.C. (ARCADIS), on behalf of Mohawk Finishing Products (RPM), have prepared this Remedial Action Work Plan (RAWP) for the Mohawk Finishing Products site in Amsterdam, New York, pursuant to the Voluntary Cleanup Agreement (Index No. #A4-0425-0006) entered into between Mohawk Finishing Products and the New State Department of Environmental Conservation (NYSDEC) in May 2001. This RAWP has been prepared in accordance with the Voluntary Cleanup Program (VCP) and compliance with the substantive requirements of the remedy selection process stipulated in 6 NYCRR Part 375-1.10. The RAWP provides a brief site background, summarizes the previous investigations, site conditions, areas of concern, and the extent of contamination at the site. The primary areas of concern at the site as identified in the supplemental investigation report (ARCADIS, November 2003) consist of the area north of the tank farm, drainage ditch spur, area beneath Building 6, and an area south of Building 6. The characterization of the subsurface conditions and the nature and occurrence of chemical constituents in soil and groundwater at this site, based on the results from the previous investigations, establishes the basis for the remedial alternatives evaluation and remedy selection for the areas of concern at the site.

2. Site Background

The following sections summarize the site location and description, site operational history, site classification.

2.1 Site Location and Description

Mohawk Finishing Products is located at 4715 State Highway 30 in the Town of Amsterdam, New York. The Site location is shown on Figure 1. The facility formally manufactured various wood finishing products. The facility is comprised of a group of connected buildings that cover an area of approximately 5 acres. The facility previously housed a tank farm consisting of 22 underground storage tanks (USTs) located southwest of the facility building near Highway 30, which was used for storage of various chemicals. An aboveground pipeline was formerly situated between the tank farm and Building 6 (Figure 2). The former tank farm and associated aboveground piping were decommissioned and closed out (i.e., demolition, removal, with off-site disposal) in November and December 2000, followed by the submittal of the closure report to the NYSDEC (ARCADIS G&M, April 2001). This tank farm replaced the former tank farm located within the footprint and beneath Building 8, which was reportedly abandoned in-place.

All manufacturing, warehousing, and shipping operations have ceased at the facility. The 135,000 square feet building remains at the Site; however, all manufacturing process related equipment and products have been decommissioned and removed.

The facility is situated on approximately 28 acres in an area of sparse commercial development. Geographically, the Site is located within the Hudson-Mohawk Lowlands physiographic province of New York State, with the local area characterized by undulating upland areas. The site is located at an approximate elevation of 745 feet above mean sea level. The topography of the site slopes slightly to the south and has one main drainage ditch that flows to the south and east. This ditch eventually drains to the south flowing Bunn Creek, which is a tributary of North Chuctanunda Creek, which ultimately discharges into the Mohawk River.

2.2 Site Operational History

Prior to 1964, the Site was used as a dairy farm. Mohawk Finishing Products began to build and manufacture wood products at the Site in 1964. By 1968, Buildings 1, 2, and 3 were constructed, and Buildings 4 through 9 were completed during the 1970s and 1980s. Mohawk Finishing Products manufactured a range of chemical-based wood products including; wood finishes, coatings, stains, and repair products. These chemicals were piped from the former tank farm to Building 6 via the former aboveground pipeline. These raw materials were combined by the use of mixing vats to form various wood finishing products. The facility continued to operate until it was closed in 2002. The facility formerly employed approximately 225 people.

2.3 Site Classification

This site is being investigated and remediated under the Voluntary Cleanup Agreement (Index No. #A4-0425-0006) entered into between Mohawk Finishing Products and the NYSDEC in May 2001. Under the VCP, the cleanup program for a specified site is required to be protective of public health and the environment under the conditions of the Contemplated Use of the site. The specified contemplated use of this site will fall under the category of restricted commercial/industrial land use. Under this category residential uses are not allowed, allowing only commercial/industrial type uses but requiring engineering controls and/ or institutional controls.

3. Site Conditions

3.1 Previous Investigations and Remedial Actions

In May 2001, ARCADIS G&M Inc. submitted an Investigation Summary Report (ARCADIS G&M 2001) summarizing the site investigation and remedial activities conducted between April 1999 and March 2001. The investigation / remediation focused on two areas of the site (see Figures 2 and 3):

- The former tank farm area, and
- The n-butyl acetate spill in the Building 6 area.

The tank farm spill area included the soils adjacent to the north wall of the former tank farm's french drain system, and a portion of the drainage ditch to the east end of the former tank farm. Volatile organic compounds (VOCs), naphtha, and alcohols detected in soil and sediment were largely remediated as part of the removal and closure of the tank farm in November 2000 (ARCADIS G&M 2001). The soils adjacent to the north wall of the tank farm were found to have elevated levels of VOCs, naphtha, and alcohols in post-excavation samples collected during the removal of the tank farm and in soil samples collected during a subsequent Geoprobe ™ investigation conducted in February 2001. Soil and groundwater impacts were also delineated laterally in the former tank farm north wall area during the 2001 Geoprobe ™ investigation and were found to be limited to the area of soil boring GP-16 located off the northeast corner of the former tank farm (see Figures 2, 3, and 15).

The second area of investigation at the site consisted of the Building 6 area. In April 1999, an n-butyl acetate spill occurred adjacent to the west wall of Building 6 where the aboveground pipeline formerly entered the facility. Initial investigations identified dissolved and separate-phase n-butyl acetate in groundwater adjacent to and beneath Building 6. Subsequent investigations (ARCADIS G&M 2001) indicated that the n-butyl acetate in soil and groundwater beyond Building 6 had significantly attenuated to non-detect concentrations; however, dissolved n-butyl acetate impacts beneath Building 6 were detected along with chlorinated VOCs. Groundwater sampling of monitoring wells GM-3, GM-4, GP-7, and GP-10 was discontinued as n-butyl acetate concentrations declined to non-detect.

In March 2002, (ARCADIS 2002) ARCADIS G&M Inc. conducted an additional investigation of the former tank farm north wall and Building 6 area as outlined in the *Investigation Work Plan, Former Tank Farm North Wall and Building 6 Areas* (ARCADIS G&M 2001). Results of this investigation indicate that n-butyl acetate was not detected in groundwater along the north wall of the former tank farm. However, low levels of naphtha and 2-butanone were detected in the groundwater sample from GM-12. Groundwater samples collected from shallow monitoring wells inside Building 6 and directly south of Building 6 contained elevated concentrations of naphtha, n-butyl-acetate, and VOCs.

Groundwater samples were also collected from deep monitoring wells inside Building 6 (GM-16 and GM-17), water supply Well No. 7, and deep monitoring well GM-13, located adjacent to Well No. 7, to determine if groundwater within the deep till had been impacted. Volatile organic compounds, alcohols, naphtha, and n-butyl-acetate were not detected in groundwater samples from Well No. 7 and GM-13. The absence of VOCs in groundwater samples from GM-16 and GM-17 indicates that there isn't a downward migration pathway within the deep till. The majority of VOC impacts, including the chlorinated compounds, occurred predominantly in the areas of the northern portion of Building 6, the southern portion of Building 8, north of the former tank farm, with only slightly elevated levels in Building 6c and low levels detected in Building 7, as shown in Tables 4 and 5 and Figures 9 through 15. Further discussion on the extent of contamination for the AOCs is provided in Section 3.

3.2 Site Geology and Hydrology

The subsurface conditions encountered at the site consist of three primary units: fill material, brown till, and gray till (ARCADIS 2003). The vertical and lateral extent of the geologic units are depicted in the generalized geologic cross sections A-A' and B-B'. The orientation of the transects for the geologic cross sections are shown on Figure 4. Cross section A-A' is oriented in a generally northwest-southeast transect (Figure 5). Cross section B-B' is oriented generally west-east across Buildings 6 and 7 (Figure 6).

The surficial geological unit at the Site is a moderately dense and moist brown till with light brown fine to medium sand seams located throughout the unit. The brown till unit was encountered at depths ranging from 0.8 feet to 8.0 feet below grade. Saturated conditions within the brown till were typically encountered at approximately 2.0 to 5.0 feet below grade (Tables 1 and 2). Horizontal hydraulic conductivities determined from slug tests conducted in the field ranged from 8.10×10^{-4} centimeters per second (cm/sec) to 1.61×10^{-6} cm/sec (Table 3).

The brown till is underlain by a very dense gray till of low permeability and less moisture content than the brown till. Vertical permeability of the gray till unit ranges from 2.10×10^{-6} cm/sec to 1.14×10^{-8} cm/sec determined from laboratory tests on Shelby tube samples.

Beneath Building 6, a layer of construction fill is present just below the concrete floor slab. The fill material consists of loose brown fine to medium sands with varying amounts of silt and clay and rounded and angular medium gravel. The depth of fill material ranges from approximately 4 to 8.0 feet below grade. The fill material has a relatively moderately low horizontal hydraulic conductivity (10^{-4} cm/sec) attributable to the presence of silts and clays.

Shallow groundwater has been encountered at depths ranging from 1.0 to 5.0 feet below grade throughout the site, with typical depths within the limits of Building 6 ranging from 2.0 to 5.0 feet below grade. Based on the configuration of the water table at the site, the horizontal direction of groundwater flow is to the south (see Figures 7 and 8). The horizontal gradients across the site ranged from 0.017 to 0.028 (ARCADIS 2003).

3.3 Nature and Extent of Contamination

The results of previous investigations and the extent of subsurface soil and groundwater contamination are discussed in this section (ARCADIS, Nov 2003). Specifically, the constituents of concern (COCs) identified at the site consist of VOCs, alcohols, naphtha, and n-butyl acetate. The extent of the COCs detected in the areas of concern (AOCs) at the site, the tank farm and Building 6 areas, is defined in this section. A summary of the soil and groundwater analytical results are also provided in Tables 4 and 5 and are shown on Figures 9 through 15. In addition, field parameters measured during these investigations that provide insight into the subsurface biogeochemical environment at the site are also discussed in this section and are summarized in Table 6.

As indicated previously, the primary AOCs consist of the area off the north wall of the former tank farm, the northern portion of Building 6 and southern portion of Building 8, the area south of the Building 6 around GM-18, and the drainage spur ditch located off the southwest corner of Building 6. The general cleanup criteria for the soil and groundwater (as provided in Tables 4 and 5 per COCs) include the NYSDEC TAGM #4046 cleanup objectives and levels (applied to the north wall of the former tank farm and drainage ditch spur AOCs) and the NYSDEC Class GA groundwater standards (applied to the AOCs of Building 6 and southern portion of Building 8, and south of Building 6 near GM-18). Additional details are provided in this section (Section 3.3) and in Section 4 regarding the identification of specific COCs pertaining to each AOC, the site-specific remedial action objectives and a summary and evaluation of the applicable remedial alternatives to address the specific COCs associated with each AOC, respectively. As discussed further in Section 4, Table 7 provides a list of the technologies being considered for each AOC, along with their applicability (effectiveness and implementability).

3.3.1 Subsurface Soil

Soil samples collected during the previous investigation were analyzed for the COCs. The highest levels of VOCs were detected in the northern area of Building 6 and the southern end of Building 8 (near GP-28), and the north wall of the Tank Farm in the vicinity of GP-16. VOCs in these AOCs are at concentrations above the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) # 4046 Soil Cleanup Objectives (Table 4). The soil sample collected at a depth of 5-6 feet at boring GP-28 contained toluene (13,000 µg/kg), ethylbenzene (13,000 µg/kg), and total xylenes (78,000 µg/kg). However, the soil samples were collected below the water table and therefore; the analytical result likely reflects COCs associated with the dissolved phase, as indicated by the groundwater analytical results. The soil sample collected at a depth of 5 and 15 feet at boring GP-16 contained acetone ranging from 770 to 6800 µg/kg, xylenes ranging from 1700 to 34,000 µg/kg, and 1,2,4-trimethylbenzene ranging from 8800 to 160,000 µg/kg. . Naphtha was also detected in these AOCs at concentrations ranging from 4.43 J mg/kg (GP-37 12') to 18.7 mg/kg (GP-28 5-6'), as shown in Figures 9, 10 and 15.

3.3.2 Groundwater

The following section describes the groundwater analytical results within Building 6 and associated areas of the site (ARCADIS 2003).

Building 6

The highest concentrations of VOCs were generally detected in groundwater samples collected from monitoring wells GM-14, GM-15, and GM-21, screened within the shallow brown till and located along the northern wall of Building 6. VOC concentrations generally decrease towards the middle and southern portion of Building 6; however, several VOCs were detected at concentrations above the NYSDEC Class GA Groundwater Standards in groundwater samples collected from monitoring wells GM-5, GM-6, and GM-7, located near the western wall of Building 6 (see Table 5 and Figures 11 through 14).

Groundwater samples collected from monitoring well GM-7 contained detectable concentrations of alcohols. As shown in Table 5, detected concentrations of n-butyl acetate ranged from 0.010 mg/L (GM-9, GM-16, GM-17, and GM-21) to 299 mg/L (GM-7). Naphtha was detected at concentrations ranging from 0.10 mg/L (at the reporting limit for this compound)(GM-16 and GM-17) to 2,150 mg/L (GM-7). VOCs were generally not detected or were detected at levels near the detection limit in groundwater samples collected from monitoring wells screened within the deeper zone consisting of dense gray till (GM-16 and GM-17).

Adjacent to West Wall of Building 6

VOCs in groundwater samples collected adjacent to the west wall of Building 6 were non-detect or were detected at concentrations below NYSDEC Class GA Standards. Alcohols were not detected in groundwater samples collected west of Building 6. Detected concentrations of naphtha ranged from 0.13 mg/L (GP-1) to 8.74 mg/L (GM-A). Monitoring well GM-A is located within two feet of the Building 6 foundation wall within the construction fill. Naphtha in groundwater samples collected from monitoring well GM-A suggests that impacted groundwater beneath Building 6 (see results for monitoring well GM-6) is the source of naphtha.

Building 6C and Building 7

Analytical results for groundwater samples collected from temporary monitoring wells GP-38 through GP-42 indicate that only slightly elevated concentrations of 1,1-dichloroethane were present beneath Building 6C and directly east of the Building 6C wall. Low levels of 1,1-dichloroethane and toluene, at concentrations below NYSDEC Class GA Standards, were detected within Building 7, with levels of alcohols, naphtha or n-butyl acetate below detectable limits (Figure 11).

Building 8

Similar to the groundwater samples collected from monitoring wells located in Building 6, elevated concentrations (above the NYSDEC Class GA Standards) of acetone, ethylbenzene, MIBK, 1,2,4-trimethylbenzene, xylenes, and chlorinated VOCs were also detected in groundwater samples collected from temporary monitoring wells GP-28 and GP-29. Alcohols were not detected in groundwater samples collected in Building 8. N-butyl acetate was detected at a concentration of 0.188 mg/L in the groundwater sample collected from monitoring well GM-20. Naphtha was detected at concentrations of 1.77 mg/L and 0.88 mg/L in groundwater samples collected from temporary monitoring wells GP-28 and GP-29.

South of Building 6 and Building 7

Previous investigations conducted in the area south of Building 6 indicated the presence of chlorinated VOCs in monitoring well GM-18. Groundwater data collected from well GM-13 just south of Building 7 (screened within the gray till) indicated that VOCs, alcohols, naphtha, and n-butyl acetate were not detected in groundwater samples. VOCs, alcohols, naphtha, and n-butyl acetate were also non-detect in groundwater samples collected from supply Well-7, located adjacent to the southeast corner of Building 7. Consistent with previous investigations, chlorinated VOCs, toluene, ethylbenzene, and xylenes were detected in the groundwater samples collected in 2003 from shallow monitoring well GM-18. However, the concentrations of chlorinated VOCs were significantly lower than prior sampling events. VOCs were not detected in groundwater samples collected from monitoring well GM-22 and temporary monitoring well GP-31, located downgradient of GM-18.

Alcohols were not detected in groundwater samples collected south of Building 6 and Building 7. The groundwater sample colleted from GM-18 and GM-22 contained n-butyl acetate at a low concentration of 0.011 mg/L; however, the reported concentration is at the reporting limit. Naphtha was only detected in samples collected from GP-33, GM-18, and GM-22 at concentrations of 0.11 mg/L, 0.25 mg/L, and 0.15 mg/L, respectively.

3.3.3 Biogeochemical Environment

In accordance with USEPA low flow sampling protocol, field measurements of pH, ORP, and DO were recorded during investigation sampling activities. Field measurements are summarized in Table 6. Measured pH values at the site ranged from 5.31 to 7.21 standard units (s.u.). In general, microbes that are capable of degrading organic contaminants prefer pH values ranging from 6 to 8 s.u, indicating that the pH is in the correct range for microbiological degradation.

The oxidation-reduction potential of groundwater is indicative of the relative tendency of the groundwater to accept or transfer electrons. Measured redox potentials at the site ranged from (+) 110 to (-) 104.6 millivolts (mV). Since aerobic degradation normally occurs at potentials above (+) 500 mV, these data indicate that biodegradational processes occurring at the site are primarily anaerobic.

Dissolved oxygen concentrations ranged from 5.90 mg/L to 0.23 mg/L. Given that typical DO values in groundwater range from 8 to 9 mg/L; these data also indicate that the biodegradational processes occurring at the site are primarily anaerobic.

4. Summary of Technologies and Remedy Selection

This section summarizes the remedial technologies evaluation, remedial alternatives development, and remedy selection process for the site. Remedial technologies are evaluated based on applicability of addressing the impacted media in the AOCs, and ability to achieve remedial action objectives (RAOs) for the site. Technologies retained from this initial screening process will be formulated into remedial alternatives to be further evaluated in detail against key criteria as part of the remedy selection process.

4.1 Remedial Action Objectives

The remedial action objectives (RAOs) for this site have been established in accordance with the VCA and VCP, and compliance with the substantive requirements of the remedy selection process outlined within 6 NYCRR Part 375-1.10. The overall remedial objective is to meet the site-specific cleanup goals and be protective of human health and the environment consistent with the contemplated future use. Under the VCP, the general soil cleanup criteria for the on-site impacted subsurface soils have been established pursuant to the NYSDEC TAGM #4046 soil cleanup objectives and criteria, and in accordance with site-specific, risk-based cleanup objectives developed for this site. As indicated within the Remedial Investigation Report submitted during 2001 by ARCADIS, specific soil cleanup standards have not been developed for n-butyl acetate; however, the NYSDEC has outlined (in a letter dated September 28, 2000) a soil cleanup goal for this compound of 50 parts per million (mg.kg) based on it's definition as a principal organic contaminant (POC). ARCADIS has alsio developed a site-specific, risk-based cleanup objective for this compound of 830 mg/kg for soil using methods similar to those approved under the current NYSDEC Brownfield Cleanup Program. The site-specific RAO for soil will be to remove, treat or contain impacted soils that would potentially degrade off-site groundwater quality. Engineering controls will be applied, where necessary, to prevent contact with soils exceeding NYSDEC TAGM 4046 recommended soil cleanup objectives and/or below an acceptable risk range under an industrial use scenario. The general cleanup objectives for on-site groundwater have been established pursuant to the NYSDEC Class GA groundwater standards and in accordance with site-specific, risk-based cleanup objectives developed for this site. Specific groundwater standards have not been developed for n-butyl acetate; however, the NYSDEC (in a letter dated September 28, 2000) outlined a cleanup goal for n-butyl acetate (as a principal organic contaminant (POC)) in groundwater of 50 parts per billion (ug/L). ARCADIS has also developed a site-specific, risk-based ceanup objective for this compound of 26 mg/L for groundwater using methods similar to those approved under the current NYSDEC Brownfield Cleanup Program. The RAOs have already been met for the former n-butyl acetate spill area west of Building 6. Specific groundwater standards have not been developed for n-butyl acetate. The RAOs have already been met for the former n-butyl acetate spill area west of Building 6.

As previously indicated, the use of the Mohawk Finishing Products site is classified under the category of restricted commercial/industrial land use. Under this category residential uses are prohibited, allowing only commercial/industrial type uses but requiring engineering controls and/ or institutional controls. Under this scenario and land use, a RAO will also be to limit direct exposure to soil exceeding NYSDEC TAGM 4046 recommended soil cleanup objectives and/or below an acceptable risk range for the restricted site use.

4.2 Summary of Technologies Evaluation

The remedial technologies evaluated for soil and groundwater in the former Tank Farm Area and Building 6 Areas include the following:

- Monitored Natural Attenuation (MNA)
- Soil Excavation
- Vacuum Enhanced Recovery (VER) and Treatment
- Conventional Pump and Treat
- Air Sparging (AS)
- Soil Vapor Extraction (SVE)
- Oxygen Release Compound (ORC)

The following sections describe the remedial technologies considered for each area along with a brief discussion of their applicability (see also Table 7).

4.2.1 Former Tank Farm Area

4.2.1.1 Monitored Natural Attenuation (MNA)

Natural attenuation processes are ongoing in groundwater that result in mass reductions in existing impacts as well as plume control. These processes include dispersion, volatilization, mineralization, and biodegradation. In many cases, sufficient natural attenuation is ongoing such that monitoring of the natural attenuation can be employed as a stand-alone remedy.

Monitored Natural Attenuation (MNA) would include a groundwater-sampling program to monitor COCs. As part of this option, both groundwater and biogeochemical data would be collected on a continuing basis as a means to document the natural degradation of n-butyl acetate, naphtha, alcohols, and VOCs.

Monitored natural attenuation through groundwater analysis could not be implemented as a stand-alone remedial technology in the former Tank Farm area (off the north wall) due to the limited dissolved-phase impacts. Therefore, MNA would be retained and implemented as an element of the overall remedial strategy for this AOC. MNA will be retained and utilized in conjunction with other technologies to evaluate the effectiveness of the remedial approach in achieving the RAOs for the site.

4.2.1.2 Soil Excavation

Soil excavation is often the most expeditious method of achieving source removal and reductions in contaminant mass in the subsurface. However, off-site disposal of contaminated soils can drive remediation costs higher than in-situ remediation techniques. Although, in the case of the former Tank Farms North Wall area excavation, soil removal would be an effective approach considering the relatively small volume of soil and time frame to complete the removal. Soil excavation is a proven remedial technology that can be implemented through conventional means at this AOC. Therefore this remedial technology will be retained for further consideration.

4.2.2 Building 6 Area

4.2.2.1 Monitored Natural Attenuation (MNA)

MNA will be retained and utilized in conjunction with other technologies to evaluate the effectiveness of the remedial approach in achieving the RAOs for the site. Refer to discussion in Section 4.2.1.

4.2.2.2 Soil Excavation

Soil excavation beneath the Building 6 areas would be difficult to implement and cost prohibitive. The majority of the area to be excavated would be within the footprint of the buildings; therefore, would be cost prohibitive due to the inability to perform the work with large conventional equipment (lack of accessibility) and thus requiring the use of smaller equipment resulting in lower productivity rates, double handling, and the potential need to temporarily stockpile material for load-out at a later date. This effort would be in direct contrast to the relatively easy access approach to soil removal at the Tank Farm via large conventional equipment with the potential for direct load-out (cost effective minimal handling approach). In addition, soil excavation operations within the limits of the building could compromise the structure integrity of the building. Therefore, use of this technology would be much less technically and economically feasible than the use of other in-situ and ex-situ remedial technologies for areas associated with Building 6, and will not be retained for further consideration. The area such as the impacted drainage spur ditch located southwest of Building

6 would be effectively addressed through the use of the soil removal technology and will be retained for this area. However, the subsurface impacts at the area in the vicinity of GM-18 would be best suited for less costly in-situ passive technologies.

4.2.2.3 Vacuum Enhanced Recovery (VER) and Treatment

VER, also called dual phase extraction (liquid and gas), is a groundwater remedial technology best suited for hydrogeologic conditions with low permeability, similar to the conditions at this site. The basic operating principal of VER is that the application of a high vacuum enhances the withdrawal of groundwater and causes a steep hydraulic gradient in the vicinity of the well. VER will increase the drawdown and expands the capture zone (hydraulic radial influence) of an extraction well as compared to conventional pumping. The movement of air in the de-watered zone resulting from the high-vacuum enhances volatilization of contaminants from the subsurface. The VER technology will increase the rate of mass removal from impacted areas over conventional pumping technology.

VER systems involve dual phase extraction (liquid and vapor), which requires a treatment system that addresses both the vapor and liquid phases (i.e., phase separation and treatment equipment including knock tanks and oil/water separator, if LNAPL is present in the influent stream, and activated carbon). Operation and maintenance costs for VER systems are moderate to high. This technology is applicable to low permeability subsurface conditions like those found at the site; therefore this remedial technology will be retained for further consideration.

4.2.2.4 Air Sparging

Air sparging is an in-situ remedial technology in which air is injected under pressure below the water table. Air sparging is primarily used for the treatment of VOCs dissolved in groundwater as well as adsorbed to soils in the saturation-zone. Air sparging can often provide enhanced biodegradation of both dissolved and adsorbed-phase contaminants by introducing oxygen into the saturated zone which subsequently enhances aerobic bacterial activity. Typically air sparging is used in combination with soil vapor extraction for the treatment of VOCs. The combined approach is often limited to use in high-permeability soils with a large saturated thickness and also having high permeability soils above the groundwater table (vadose zone) to allow for capture and control of the vapors via SVE. The saturated zone in the Building 6 area is not conducive for this technology, which consists primarily of a moderately low permeability fill material underlain by a moderately dense low-permeability till. Therefore, traditional air sparging is not applicable and will not be retained for further consideration.

4.2.2.5 Soil Vapor Extraction

Soil vapor extraction (SVE) is an in-situ technology for the remediation of soils contaminated with VOCs and semi-volatile organic compounds (SVOCs). The process involves inducing airflow in the subsurface (vadose zone) with an applied vacuum thus enhancing the volatilization of contaminants. SVE is not applicable to the Building 6 areas base on the fact that the groundwater table is shallow at the site (i.e., limited vadose zone) and the majority of the impacts are located in the saturated zone of low-permeability till. Therefore, SVE will not be retained for further consideration.

4.2.2.6 Oxygen Release Compound (ORC)

In-situ bioremediation is the enhancement of naturally occurring biological activity in groundwater to degrade chemical constituents present in the subsurface. Through the introduction of additives into the subsurface, the activity of the indigenous bacteria can be stimulated resulting in an increase in the microbial population and degradation rates. One available means of enhancing biodegradation of various organic compounds including those present in the Building 6 areas is the addition of oxygen to the subsurface. Oxygen is often the limiting factor for aerobic microbes capable of biologically degrading contaminants. Without adequate oxygen, contaminant degradation will either cease or may proceed by much slower anaerobic processes. One way to introduce oxygen to the subsurface is with Oxygen Release Compound (ORC), which is designed to release oxygen into the subsurface for up to one year depending on site conditions. In the presence of this oxygen source, aerobic microbes will accelerate the natural attenuation of VOCs

The effectiveness of in-situ bioremediation as a treatment technology depends on the nature and biodegradability of constituents, the availability of nutrients, geology and hydrogeology, and evidence of biogeochemical parameters and conditions at the site. Therefore, since the existence of anaerobic activity has been established based on the results of field parameters collected during site investigations in the Building 6 areas (Section 3.3.3), in-situ bioremediation technologies are applicable. ORC can be utilized in the GM-18 area to stimulate the activity of the aerobic microbes and turnover the conditions in this area from the slower anaerobic process to the expedient aerobic degradation process.

4.2.2.7 Conventional Pump and Treat

Conventional pump and treat technologies provide a means of removing impacted groundwater from the subsurface. Removing the groundwater can reduce the mass of contaminated groundwater and limit the migration of the affected groundwater at the site. Recovery wells and pumps or collection trench and sump are the most common means of extracting impacted groundwater at remediation sites. The number and placement of wells and location of trench is generally determined based on achievable pumping rates (based on hydraulic conditions), capture zones, and estimated remediation objectives (i.e., plume control, constituent removal, or both) and time frames. Following extraction, groundwater is normally treated to remove dissolved-phase constituents (e.g., separation if LNAPL is present, and air stripping or activated carbon). Based on the low permeability of the till found in the saturated zone at the site, groundwater collection through conventional pumping was not considered effective relative to the VER technology due to the limited hydraulic influence and low yield of conventional recovery systems. The conventional recovery technologies would require a significantly greater number of wells to accomplish a comparable level of hydraulic influence achieved with the VER system (high vacuum in combination with pumping); therefore, conventional recovery technologies will not be retained for further evaluation.

4.3 Summary of Remedial Alternatives Development and Evaluation

A summary and preliminary screening of the remedial technologies to address the impacted media at the site was contained in the previous section (Section 4.2). Remedial technologies were eliminated during this preliminary screening process based on their applicability, and the technologies that were retained were utilized in the formulation of remedial alternatives for the AOCs at the site. These remedial alternatives include the following:

Former Tank Farm Area

Alternative 1: Soil Excavation with MNA

Building 6 Areas

Alternative 2: Vacuum Enhanced Recovery (VER) with MNA

Alternative 3: Oxygen Release Compound (ORC) with MNA

The above remedial alternatives developed from the applicable technologies retained from Section 4.2 will be evaluated in detail in accordance with the VCP and the substantive requirements stipulated in the 6 NYCRR 375-1.10, and their ability to achieve the established RAOs for the site. The remedial alternatives are evaluated against five key criteria that include the following:

- Short-term effectiveness;

- Long-term effectiveness and performance;
- Reduction of toxicity, mobility, or volume;
- Implementability - Technical Feasibility;
- Overall protection of human health and the environment.

4.3.1 Short-Term Effectiveness

The evaluation of the short-term effectiveness of each remedial alternative includes:

- Consideration of the protection of the community during the remedial action;
- Protection of workers during the construction phase of the remedial actions;
- Environmental impacts resulting from the remedial actions.

Remedial Alternatives 2 and 3 will have no short-term risks to public health since these remedial activities will be conducted on-site away from unauthorized access. Remedial Alternative 1 will have associated short-term risk based on the potential for fugitive dust or odor generation during soil excavation and load-out activities. However, odor and dust suppression measures will be implemented as needed during remedial operations. Similarly, risk to site workers associated with each remedial alternative would be limited by the proper use of personal protective equipment (PPE) and strict compliance with the site-specific health & safety plan to prevent possible exposure to impacted media.

4.3.2 Long-Term Effectiveness and Permanence

The evaluation of the long-term effectiveness and permanence of each alternative includes the following factors:

- Residual risks,
- Adequacy of controls; and
- Reliability of controls.

In the long-term it is expected that Remedial Alternatives 1, 2, and 3 will limit the level of residual risk remaining at the site, control any potential for migration of the impacts, and maintain the reliability of these controls. Each alternative will reduce the level of residual risk through either source removal (Alternative 1), mass removal (Alternative 2), or through the degradation of impacts (Alternative 3). Given the more aggressive remedial action for Alternative 1, it would likely provide a more expedited reduction in residual risk than Alternatives 2 and 3. In order to maintain control of the reliability of all the remedial alternatives, post-remedial monitoring would be implemented (e.g., monitoring for the remaining presence of residual COCs levels). In addition, system operation and maintenance activities would be implemented for Alternative 2 to ensure reliability (e.g., perform maintenance on the system in order to ensure optimal performance and maximum effectiveness of the technology based on performance monitoring that includes tracking reductions in COCs over time).

4.3.3 Reduction of Toxicity, Mobility or Volume

The evaluation of the reduction of toxicity, mobility or volume for each of the combined remedial alternatives includes consideration of the following:

- Reduction in toxicity, mobility and volume of the impacts or impacted media;
- Irreversibility of the treatment; and
- Type and quantity of treatment residual.

Each of the Remedial Alternatives will ultimately reduce the toxicity level of the impacts, which will result in substantial reduction in the mobility and volume of the impacted media. Alternative 1 will provide the most significant reduction in the mobility/toxicity/volume of the impacts in the short-term. Based on the less intrusive nature of the remedial approaches of Alternatives 2 and 3, the reductions in mobility/toxicity/volume will be achieved by Alternatives 2 and 3 over a slightly longer period.

In addition, Alternatives 1, 2, and 3 will ultimately result in permanent, irreversible treatment based on immediate source removal or reductions over time. Alternative 1 will produce a quantity of impacted soil to be removed from the site, whereby Alternative 2 treatment residuals may be in the form of spent carbon from the treatment system requiring off-site disposal (carbon regeneration), respectively. Alternative 3 will not generate any significant quantities of treatment residuals.

4.3.4 Implementability - Technical Feasibility

As outlined in the preliminary technologies evaluation in Section 4.2, all of the retained technologies will be implementable on a technical basis; therefore, Remedial Alternatives 1, 2, and 3 are also technically implementable. Each alternative would require some construction activities that will be technically feasible and easy to undertake at the site. In addition, the technologies included in each alternative have been proven reliable based on applications at other sites. A pilot test would be implemented to refine the remedial design parameters for constructing the full-scale system of Alternative 2. Each of the remedial alternatives would require baseline monitoring prior to commencing operations, which follow-up performance monitoring of each alternative will be compared.

4.3.5 Implementability - Administrative Feasibility

Remedial Alternatives 1, 2, and 3 will require performance and post-remedial monitoring in accordance with the applicable NYSDEC Standards, Criteria, and Guidance Values (SCGs) and RAOS for the site.

Remedial Alternative 2 may require permitting/approval related to the discharge of air and water generated from the remedial system (see Section 6).

4.3.6 Overall Protection of Human Health and the Environment

Alternatives 1, 2, and 3 upon completion of implementation, would provide protection of human health and the environment, through the prevention or mitigation of exposure risks to impacts, to acceptable levels commensurate with the Contemplated Future Use of the site (i.e., commercial/industrial uses). All three remedial alternatives would also provide restoration of ground water quality at the site, to the extent practical.

4.4 Selected Remedy

The preliminary remedial technologies screening and the remedial alternatives development and evaluation process were conducted in accordance with the signed VCA, VCP, and the substantive requirements stipulated in the 6 NYCRR 375-1.10. The remedy was selected based on its ability to achieve the established RAOs for the AOCs at the site. The elements of the selected remedy are as follows (see Figure 16):

- Excavation of impacted soil from the area off the north wall of the former tank farm in the vicinity GP-16;

- Excavation of impacted sediments within the spur drainage ditch southwest of Building 6;
- VER for impacted soils and groundwater underneath the Building 6 Area and the southern portion of Building 8;
- ORC for impacted groundwater in the area south of Building 6 in the vicinity of GM-18; and
- Operation, maintenance, performance and post-remedial monitoring (including monitoring for COCs, field parameters, and MNA).

5. Remedial System Design

This section provides a detail description of the various elements of the selected remedy.

5.1 Former Tank Farm North Wall Area

5.1.1 Excavation

This portion of the work would include the excavation of all impacted soils adjacent to the north wall of the former tank farm in the vicinity of GP-16 (see Figure 16). The excavation process would be undertaken with conventional earth moving equipment (e.g., excavator, trucks, dozer, etc). The excavation would be benched as necessary to avoid the need for shoring or sheet-piling. As with the former tank farm decommissioning program, the soils being excavated would be monitored (screened) using a photo-ionization detector (PID) and headspace analysis techniques. Based on the results of the soil screening activities, clean soils (non-impacted) will be segregated temporarily and stockpiled onsite. The estimated quantity of impacted soils to be excavated is approximately 500 cubic yards (cy), based on an area of approximately 30-feet by 30-feet and a depth of 15-feet below grade (as reflected in the results for GP-16). The extent of the excavation will be based on an in-situ confirmatory sampling program for the COCs , which will include the standard approach of collecting representative sidewall and bottom samples from the excavation. Following the achievement of acceptable levels in the sidewalls and bottom of the excavation, based on the confirmatory sampling results, the excavation would be backfilled and undergo site restoration (see Section 5.1.2). All impacted soils would be either directly loaded out following excavation, or staged on and covered with polyethylene plastic liners onsite for later disposal. A waste profile would be generated based on pre-characterization sampling results to determine the proper disposal at an off-site permitted facility.

5.1.2 Grading and Site Restoration

Following the completion of all excavation activities and upon approval from NYSDEC of the confirmatory sampling and analysis program, the backfilling and grading activities at the site would be undertaken with conventional earth moving equipment (e.g., excavator, trucks, dozer, etc). These activities consist of utilizing segregated non-impacted soils for reuse as "clean" backfill material for the former tank farm with imported certified clean fill being utilized to finish backfilling the excavation back to its original grade. Site grading will be performed to minimize soil erosion. Silt fencing will be placed at the base of all graded slopes as an erosion control measure. The graded area will be seeded with native grass as a permanent erosion control measure.

5.2 Building 6 Areas

5.2.1 Excavation of Drainage Spur Ditch

Previous investigations indicated impacts to the spur drainage ditch southwest of Building 6, as noted in Section 3. Sorbent booms were initially placed into the spur ditch to address a sheen on the surface of the standing water in the drainage spur ditch. Subsequent sediment samples collected from the drainage spur ditch were analyzed and confirmed impacts of n-butyl acetate. The spur ditch sediments would be excavated along its entire length, slightly wider than the existing width of the channel and to a depth of 6-inches below grade, up to the point of the confluence with the main drainage ditch (see Figure 16). This remedy would be conducted currently with the Former Tank Farm North Wall excavation. The process will follow the same protocol as discussed in Section 5.1.1 and 5.1.2. The estimated quantity of impacted sediments to be excavated is approximately 12 cy (or 15 to 16 tons), based on an area of approximately 70-feet by 10-feet to a depth of 0.5-feet below grade. The excavation would be conducted in the dry via temporarily isolating this reach of the channel and diverting any clean drainage flows around this segment (bypass) and allow to discharge downgradient. An in-situ confirmatory sampling program for the COCs would consist of collecting representative bottom samples from the excavation. Following the achievement of acceptable levels in the sidewalls and bottom of the excavation, based on the confirmatory sampling results, the ditch would be backfilled with certified imported clean fill to allow proper drainage followed by grading and seeding.

5.2.2 ORC Injection (South of Building 6)

The area south of Building 6 in the vicinity of GM-18 will be injected with an ORC slurry mixture. ORC will be applied to the subsurface via direct push injection (pressure injection). The ORC powder is mixed with water to form an injectable slurry. The slurry is then pumped into the groundwater where it disperses into the aquifer via diffusive and advective forces. The ORC will also take advantage of fluctuating groundwater levels and percolation from the surface to activate the oxygen releasing capabilities of ORC.

The ORC slurry mixture will be pressure injected into temporary Geoprobe borings. The injection layout will be placed in a grid pattern covering a total treated area of approximately 400 square feet (Figure 16). The rows will be spaced 5-feet on center and the spacing between rows will be 5-feet on center, establishing a grid consisting of 4 rows with 4 points per row for a total of 16 ORC injection points. The ORC will be pre-mixed in a portable storage tank (e.g., poly tank) prior to injection. The quantity of ORC slurry mixture required per linear foot of Geoprobe boring was calculated utilizing the Regenesis ORC Design Software to be 3.0 lbs/LF (Regenesis ORC). The assumptions incorporated into the calculation were based on PID readings obtained from the sample logs of monitoring well GM-18 and from the most recent groundwater sampling results. The ORC injection program would be accomplished in a period of one fully productive day. There would be no post-injection operation and maintenance program. The effectiveness of the ORC injection would be assessed through a performance monitoring program consisting of groundwater sampling to track the transition of the existing anaerobic biodegradation conditions (contributed to the reductions in chlorinated compounds) to an aerobic biodegradation environment through the introduction of oxygen. The ORC system is designed to release oxygen into the subsurface for up to one year depending on site conditions. In the presence of this oxygen source, aerobic microbes will accelerate the natural attenuation of VOCs, particularly the BTEX compounds. As the oxygen is utilized and ultimately depleted, following the biodegradation of a majority of the VOCs, the subsurface conditions will return to an anaerobic environment and naturally attenuate (biodegrade) any residual levels of chlorinated compounds remaining in the saturated zone. The ORC injection program is an effective technology at mitigating residual impacts of VOCs in the subsurface in an efficient and reasonably expedient manner.

5.2.3 VER System (Inside Impacted Areas of Building 6 and 8)

5.2.3.1 General Process Description

The VER system will be comprised of recovery wells, air inlet wells, a liquid ring pump (LRP), and ancillary process equipment. The LRP will be used to apply a high vacuum to the recovery wells, which will increase well yields and capture zones (compared to conventional pumping) thereby reducing the number of necessary recovery wells and remediation time frame. The LRP will simultaneously extract both groundwater and soil vapor from the zone of influence of the recovery and air inlet wells, creating a negative pressure (vacuum) beneath the floor slabs of Building 6 and 8. The extracted soil vapor and groundwater will be transferred by the LRP from the recovery wells to the treatment system. Groundwater will be treated using liquid-phase granular activated carbon (GAC) prior to the discharge of clean effluent to the surface water of the local spur ditch under a State Pollutant Discharge Elimination System Permit (SPDES) permit or to the sanitary sewer and ultimately to the local publicly owned treatment works (POTW) under permit. Soil vapor will be treated using vapor-phase carbon and potassium permanganate oxidizing beds (if necessary to address VC) prior to discharge to the atmosphere. A more detailed discussion of the remedial process is provided in Section 5.2.3.2.

The design of the full-scale VER system will be based on the performance results of a pilot test proposed for Building 6 on several wells installed in representative areas of concern. The pilot test results to be used in the evaluation and preliminary design of the full-scale system components will include design parameters such as fluid and vapor stream flow rates, constituent concentrations, and sub-slab vacuum and system inlet vacuum readings. A general layout of the pilot skid-mounted unit is provided on Figure 17 [process flow & instrumentation diagram (P&ID)].

Based on a review of the May 2004 Vapor Intrusion Report submitted to the NYSDEC by ARCADIS, the New York State Department of Health (NYSDOH) expressed concerns regarding a possible vapor intrusion exposure pathway within Buildings 6 and 8. The vacuum extraction system proposed for this site will establish a negative pressure gradient beneath these building through the withdrawal of vapor and groundwater at a high rate from the subsurface in these areas. This will establish a preferential pathway for the removal of vapors released from soil and/or groundwater similar to (but at a much higher rate than) the powered sub-slab depressurization systems prescribed by the NYSDOH as a presumptive remedy for radon and vapor intrusion issues. The pilot test will be performed in a manner appropriate for the collection of data necessary to design and construct a vacuum extraction system effective not only at removing groundwater from beneath Buildings 6 and 8, but also effective at creating a negative pressure gradient beneath both buildings.

5.2.3.2 Preliminary Full-scale VER System Layout

A preliminary layout of the full-scale VER system and treatment equipment P & ID pilot unit, and well construction / piping details is shown on Figures 16, 17 and 18, respectively. In general, the LRP will be used to apply a vacuum to the network of recovery wells in the Building 6 area, Building 6c, and the southern portion of Building 8 (see Figure 16). The LRP will be capable of handling approximately 100 to 150 cubic feet per minute (cfm) of soil vapor at 20 to 25 inches of mercury vacuum and is rated at 10 horsepower (Hp), pending the results of the pilot test. The LRP will be equipped with a dual liquid knockout system to control the carryover of liquids and reduce moisture in the vapor stream, enhancing vapor phase carbon adsorption. An oil-sealed, 100 percent recirculating LRP will be selected for the VER system to minimize O&M requirements. Unlike partial recirculating and/or water-sealed LRPs, the oil-sealed pumps do not require the addition of water during operation and will not generate additional process water requiring treatment and disposal. However, oil-sealed LRPs require oil changes (approximately 2 to 3 times per year) and subsequent oil disposal.

The piping for the VER system from each of the approximately 28 recovery wells will be installed above grade where they will be manifolded together inside the treatment building to the LRP. Heat will be maintained in the building to prevent freezing during the winter months. This manifold system will consist of globe valves and vacuum gauges to be able to adjust and optimize the flow and vacuum to each individual recovery well. From the manifold system, liquid and vapor will flow through the liquid knockout tank, which will retain the liquid but allow vapor to pass through. As liquid collects, a high liquid level switch in the liquid knockout tank will activate a 1.5 Hp progressive cavity pump. The low level switch in the knockout tank will turn off the pump. The pump will transfer the liquid through two 1200-pound granular activated carbon (GAC) adsorption units piped in series with discharge under a SPDES permit or POTW permit (see permit discussion in Section 6).

Soil vapor will be allowed to pass through the liquid knockout tank and the LRP to the oil reservoir tank. From the oil reservoir tank, vapor will flow through the vapor phase carbon adsorption units piped in series and subsequently discharged to the atmosphere. Any oil droplets that may have been in the vapor will drop out in the oil reservoir tank to be cooled and recirculated back to the LRP. Level switches in the oil reservoir tank will monitor the oil level and shut down the LRP if a high or low level exists. A fan will be provided to cool the oil as it recirculates back to the LRP through cooling fins.

Vapor phase treatment will consist of two 2,000-pound vapor phase carbon adsorbent units in series. Due to the presence of vinyl chloride in the vapor stream, two additional units will be filled with a bed of activated alumina and potassium permanganate. Vinyl chloride is very poorly absorbed by traditional vapor phase carbon, but will be readily oxidized (destroyed) by the activated alumina and potassium permanganate bed. As the remediation program progresses, and vinyl chloride is no longer present in the influent stream, the alumina and potassium permanganate bed will be taken off-line. The treated vapor phase will be discharged to the atmosphere viaan air discharge stack.

The system will be designed so that the operational status of critical system controls is continually checked while the system is in operation. A system component failure will result in system shutdown to prevent the discharge of untreated groundwater or soil vapor. In the event of a system failure, determined by system sensors and interlocks, a teledialer (e.g., autodialer) will alert the system operator by dialing a pre-programmed phone number (list of numbers), notifying the answering party of the specific system fault and waiting for an acknowledgment prior to disconnecting. By enabling a response to occur soon after system shutdown, the systems effectiveness will be maximized by minimizing system downtime. In addition to automated controls, the system will be equipped with manual master system disconnect switch. The switch will be located within the treatment area. A process and instrumentation diagram will be included as part of the design drawings in the 90 percent submittal.

Hand/Off/Auto switches will be provided for the LRP and transfer pumps at the control panel. While the equipment's switch is in the "auto" position, the equipment will cease to operate under an alarm condition. The equipment and instrumentation will be interlocked to regulate system operation in automatic mode and activate a system shutdown in the event of a malfunction. This mode of "fail-safe" system operation is designed to prevent a discharge of potentially untreated groundwater or soil vapor in the event of a malfunction. "Hand" mode will be used for system maintenance only. When equipment is operated in the "Hand" mode, it will run regardless of system fault status. This mode is used to briefly check the operation of system components following maintenance activities, and can only be actuated by an on-site operator monitoring the system. The effectiveness of the VER system would be assessed through a performance monitoring program consisting of groundwater sampling and system monitoring in order to track key parameters (e.g. concentrations of COCs in influent to track mass removal rates and the reduction of COCs within the subsurface over time; pressures, vacuum, flow rates and total flows to monitor and optimized system performance; and effluent compliance sampling indicating the effectiveness of the pre-treatment process prior to discharge under permit). The pilot test, design and construction of the system, startup and shakedown with the commencement of operations could be achieved within a one-year period. The VER system is an effective technology at mitigating residual impacts of VOCs in the subsurface in an efficient and reasonably expedient manner.

5.2.3.3 Treatment Building

The treatment system will be located inside Building 6. A corner of the Building 6 structure will be isolated by construction of interior walls (partitions) to establish a footprint large enough to house the treatment system. The building is currently served by the following utilities:

- 3 phase, 460 Volt electrical service
- Well water supply
- Sanitary sewer (POTW) connection (for existing lavatories)

- Natural gas (for existing unit heaters).

The building is erected on a concrete foundation and floor slab. The exterior of the Building 6 is made of concrete block. The building is equipped with two lockable exterior personnel doors and three large interior utility doorways connecting to Buildings 6C and 8.

The existing unit heaters located inside Building 6 are natural gas fired and have proved to provide adequate winter heating. Since the treatment system will not create a need for additional heating, there is no need to provide supplemental heat. In addition, the treatment system will generate heat during its operation. Therefore, an exhaust fan operated by an adjustable thermostat would ensure that adequate ventilation is maintained.

Currently, existing lavatory facilities are located in Building 7 and drain into sanitary sewer piping running west of the Building 6.

In an area of Building 6 proposed for the treatment system, the floor has a zero slope and all existing drains have been sealed with cement grout.

5.2.3.4 Residuals Management

Drill cuttings from the recovery well installation will be placed in drums. The drums of drill cuttings will be sampled in order to characterize the material and to determine proper disposal requirements.

6. Permitting Requirements

Implementation of the selected remedy will require permits or permit equivalencies in accordance with applicable regulations. The need for these permits or permit equivalencies is also dependant on the activity being pursued. A brief discussion of the potential permits is provided herein.

To construct the remediation system, the following permits may be required.

- Building Permit (local authority)

- Electrical Permit (local authority)

The contractor will obtain these permits or permit equivalencies prior to system installation.

Prior to start-up of the remediation system, the following permits or equivalent approvals will be obtained if required:

- NYSDEC SPDES Permit or POTW Discharge Permit
- NYSDEC Air Discharge Permit equivalency

The SPDES permit will be obtained from the NYSDEC, which will authorize the treated groundwater discharge to the drainage spur ditch as surface water, or a permit to discharge to the local POTW would be obtained. The discharge permit would impose limitations on flow rate, pH, chemical constituent concentrations, and inorganic loading. The discharge permit would also stipulate sampling frequency and sample type.

Technical approval to construct and a certificate to operate a process, exhaust, or ventilation system will be obtained from the NYSDEC through an Air Discharge Permit or equivalency. The permit will stipulate air discharge rates and the maximum concentrations of chemical constituents. It will also specify air sampling frequency and sample type.

7. Construction Schedule

A critical path method (CPM) construction schedule will be provided during the 90 percent design stage of the project. However, from a conceptual standpoint the majority of the construction and installation activities (i.e., civil, mechanical, and electrical) of the full-scale remedial program would likely require one full construction season in order for full completion pending reasonable weather conditions that do not prohibit implementation. The pilot test program would be conducted prior to final design and construction of the full-scale remedial program. These activities would include the construction and installation of the VER system (i.e., recovery wells, piping, and treatment system) and excavation of the north wall area and the spur ditch. The startup and shakedown of the treatment system would be implemented as a subsequent phase of the remedial project. The final phase of the remedial project would be the operation of the VER system along with an operation and maintenance program.

8. Design Drawings and Technical Specifications

Final engineering design, construction drawings and technical specifications will be prepared for the 90 percent design submittal of the selected remedy.

9. System Operation and Maintenance Plan

A preliminary operation and maintenance (O&M) plan will be provided at the 90 percent design stage of the project. The schedule of O&M tasks for the remedial system will be outlined in this submittal. Conceptually, during the first three months of remedial system operation, weekly monitoring will be conducted; thereafter, routine O&M will be conducted at least once per month. The O&M plan will also provide a description of indoor air monitoring to be conducted during operation of the VER system and following system shutdown. All field O&M measurements will be recorded on standard forms in a logbook and used to prepare a report summarizing the remedial system performance on a semi-annual basis.

10. Quality Assurance Project Plan

A Quality Assurance Project Plan (QAPP) will be prepared and presented in the 90 percent design submittal.

11. Field Sampling Plan

A Field Sampling Plan (FSP) will be prepared and presented in the 90 percent design submittal.

12. Health and Safety Plan

A Health and Safety Plan (HASP) will be prepared and presented in the 90 percent design submittal.

13. Site Management Plan

ARCADIS will develop a site management plan to address residual impacted soils that may be excavated from the site and restrict the use of groundwater during remediation efforts. The plan will include procedures for soil characterization and, where applicable, disposal/reuse in accordance with NYSDEC regulations. It will also identify any use restrictions; and provide for the operation and maintenance of the components of the VER system. The property is zoned industrial/commercial, thus a sufficient institutional control on the use of the property is in place. The Volunteer will notify the property owner to restrict use of the groundwater within the impacted overburden soils until remedial activities at the site have been completed.

An annual certification will be prepared and submitted by a professional engineer that the VER system is operational and working consistent with the engineering design specified in the RAWP; that nothing has occurred that would impair the ability of the system to protect public health or the environment, or constitute a violation or failure to comply with the site management plan; and that no soil has been disturbed in the impacted areas other than as necessary for the remediation efforts and in accordance with the site management plan.

14. Post Remedial Action Plan

The remedial action goals and objectives for the site are provided in Section 4.1 of this report. Contaminant removal resulting from the operation of the VER system is expected to start at a relatively high rate, then decline rapidly and approach asymptotic concentrations. Operation of the VER system would continue until the remedial action objectives have been achieved, or until the NYSDEC determines that continued operation is technically impracticable or not feasible. Shutdown of the VER system will involve a review and evaluation of the compiled vapor and groundwater quality data. Contaminant concentrations of treatment system influent vapor and water, along with the results from the groundwater monitoring program, will be plotted versus time to evaluate decreasing trends. The treatment system influent vapor and water-quality analytical results from the extraction wells combined with the data from surrounding monitoring wells will allow the evaluation of system effectiveness in specific areas of the site. The VER system would be shutdown when the monitoring data demonstrates that either of the following criteria is met:

a) Concentrations of site-specific groundwater parameters at all locations sampled quarterly during the water-quality monitoring program are less than the cleanup goals for three consecutive sampling events.

b) If following four consecutive groundwater sampling events, the concentrations have reached asymptotic levels and remain above clean up goals, the clean-up goals will be requested to be modified based on the achieved levels representing the minimum concentrations that can reasonably be achieved in a technically practicable manner.

Upon attaining either of the above criteria, shutdown the VER system would be requested. Termination of site remediation and system shutdown will require the approval by NYSDEC. It is understood that the NYSDEC will not consider remediation of the site complete unless the RAOs for both soil and groundwater have been met or a reasonable effort has been made to achieve these clean-up goals. NYSDEC will allow the cleanup goals to be modified only if the following conditions are met.

- Any future residual groundwater and/or soil contamination will not pose an unacceptable risk to human health and environment.

- The residual groundwater and/or soil contamination will be compatible with the Contemplated Future Use of the site.

- A "zero slope" has been reached with regard to groundwater and soil quality improvement (i.e. continued treatment will not result in any noticeable decrease in the concentration of chemicals in the groundwater or soil).

Prior to system shutdown based on NYSDEC approval, a summary status report will be prepared and submitted to the NYSDEC. Confirmatory soil sampling will be performed as part of these closure activities. If operation of the VER system is discontinued prior to the achievement of the remedial action objectives for the site, a post-remediation monitoring program will be instituted to confirm that constituent concentrations within soil, groundwater or indoor air do not pose a risk to human health or the environment. The monitoring program will be designed to provide quantitative measure of constituent concentrations, and the evaluation of these data in report format.

15. Certification

This is to certify that this Remedial Action Work Plan (RAWP) has been prepared for the Mohawk Finishing Products site in Amsterdam, New York, pursuant to the Voluntary Cleanup Agreement (Index No. #A4-0425-0006) entered into between Mohawk Finishing Products and the New State Department of Environmental Conservation (NYSDEC) in May 2001.

ARCADIS Engineers & Architects of New York, P.C.

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Department Manager – NY/NJ Engineering Services

NY PE License Number 074527-1

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