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Preliminary Draft Remedial Design/Remedial Action Work Plan

D.C. Rollforms/Ingersoll-Rand Site,
Jamestown, New York
Site Code 907019

ARCADIS
Infrastructure, buildings, environment, communications

ARCADIS

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1. Introduction

ARCADIS and ARCADIS Engineers & Architects of New York, P.C. (collectively herein referred to as "ARCADIS"), on behalf of the Ingersoll-Rand Company, have prepared this Remedial Design / Remedial Action (RD/RA) Work Plan in accordance with the Administrative Order on Consent (AOC) No. B9-0446-94-01 dated March 13, 1997, and the Record of Decision (ROD, March 2003) for the D.C. Rollforms Inactive Hazardous Waste Site in Jamestown, Chautauqua County, New York. The purpose of this RD/RA work plan is to provide the basis of design for the selected remedy for the site as specified in the Record of Decision (ROD) and described herein.

2. Site Background

2.1 Site Location and Description

The site is approximately 3.2 acres in size, consisting of two parcels - a southern parcel (currently vacant) and a northern parcel containing a building and parking lot (see Figure 1). The site is located at 583 Allen Street in Jamestown, Chautauqua County, New York. The site is bounded by Allen Street on the east, the Chadakoin River on the north and northwest, and the Webber Knapp and Jamestown Urban Renewal Agency properties on the south. The site is located in a mixed residential and commercial area, which is served by a public water supply. The municipal well-fields supplying water to the area are located 2.5 miles to the northeast of the site.

2.2 Site Operational History

Manufacturing operations conducted by the J.P. Daniel Company began at the site in approximately 1910. In 1948, Pendleton Tool Industries acquired this property; in 1950, Pendleton Tool Industries also acquired the northern parcel. In 1964, Ingersoll-Rand purchased Pendleton Tool Industries, renaming the facility Proto Tool. In 1985, Ingersoll-Rand donated this property to Jamestown Urban Renewal Agency (JURA). JURA sold this property to the current owner - Dowcraft Corporation - in 1987. At present, the American Locker Group leases the northern parcel of the site. The Proto Tool Company manufactured hand tools. The tool making operations involved processes such as forging, machining, heat-treat oil quench, sandblasting, polishing, punch-press operations, plastisol dipping of handles, painting, paint stripping, vapor degreasing, electroplating, and wastewater treatment in the southern portion of the site (as indicated on Figure 2). The facility was permitted as a RCRA treatment and storage facility (TSF) since hazardous wastes generated from the manufacturing processes were stored. These hazardous wastes were classified as F006 - sludges from the treatment of electroplating wastes; F001- waste trichloroethylene from vapor degreasing; F005- waste toluene; F003 and F005 - waste paint containing solvents. The on-site treatment plant effluent and process water from the facility buildings was discharged directly to the Chadakoin River through seven outfalls.

In 1984, Ingersoll-Rand Company initiated closure activities for the Proto Tool Facility under the RCRA program. These activities included the identification of wastes for subsequent off-site disposal, closure of hazardous waste management units including the wastewater treatment facility; electroplating baths; vapor degreaser tanks; pumping the liquid from machine pits, tanks, and sumps for disposal; decontamination of tanks; and removal of an underground storage tank. The underground storage tanks were abandoned in place by filling with sand. Most of the buildings were demolished in 1986. The TSF permit was terminated in December 1988.

In 1990 and 1991 a series of environmental investigations commissioned by Dowcraft determined that groundwater was contaminated with solvents and oil.

2.3 Site Classification

This site was listed in the registry of Inactive Hazardous Waste Disposal Sites in New York State in 1994. The site is classified as Class 2 because hazardous wastes as defined in 6NYCRR Part 371, were discovered at the site. A Class 2 means that the site poses a significant threat to the public health and environment and action is required.

3. Site Conditions

3.1 Summary of the Site Investigations

3.1.1 Environmental Site Assessments 1990-1991

Previous investigations at the site include Phase I and Phase II Environmental Site Assessments (ESAs) and a supplemental environmental investigation. Empire Soils Investigations performed these investigations for Dowcraft Corporation in 1990 and 1991 (Empire Soils Investigations, 1990a, 1990b, 1991b). An environmental investigation report was prepared in 1991 (Empire Soils Investigations 1991a) which summarized the results of the Phase I and Phase II ESAs and the supplemental environmental investigation, and further included information obtained from employee interviews and public records regarding site use and manufacturing operations at the former Proto Tool Company.

During the performance of the Phase I ESA at the site, an orange-brown staining and oil sheen were observed in a seep alongside the bank of the Chadakoin River. These observations prompted a Phase II ESA at the site.

The Phase II ESA consisted of a sub-surface soil and groundwater investigation. Eight test pits were excavated and subsurface soil samples were collected from several of these test pits for analysis. Seven monitoring wells were installed and groundwater samples were analyzed from these wells.

3.1.2 Remedial Investigation 1998 - 1999

In order to determine the nature and extent of contamination, a Remedial Investigation (RI) was conducted. The RI was completed in two phases; the first phase was completed in April 1998 and the second in February 1999. The RI results are summarized in the following sections.

3.2 Summary of Site Geology and Hydrogeology

The subsurface geologic conditions at the site consist mainly of two overburden units - a surficial layer of fill material and an underlying dense till. Along the western side of the site and adjacent to the Chadakoin River, an approximate 2 to 4-foot thick layer of native deposits consisting of sand, silt, and gravel, occurs between the fill and till layers. The fill layer consists of sand, gravel, cinders, bricks, concrete, and slag and varies in thickness from 7 to 15 feet. The thickness of till varies from less than one foot to over 15 feet in depth. The till is underlain by shale bedrock. On-site surface water and groundwater flow in a westerly direction towards the Chadakoin River. A representative cross-section of the site geology is presented on Figure 3.

The horizontal hydraulic conductivity of the surficial fill material, based on slug tests in monitoring wells, is in the range of 10^{-3} to 10^{-4} centimeters per second (cm/s). The underlying till is generally dense silt and clay-rich soil with a horizontal hydraulic conductivity, based on slug tests, on the order of 10^{-6} cm/s.

3.3 Nature and Extent of Contamination

The sampling of soil, groundwater, sediment and surface water was conducted during the RI. The locations of these samples, as well as those during previous investigations are presented on Figure 4. A brief summary of chemical constituents detected in each medium is provided below.

3.3.1 Surface Soil

Surface soil samples were collected during the RI at fifteen locations throughout the site. VOCs were not detected in any of the surface soil samples. Analysis of SVOCs indicated total SVOC concentrations ranging from 2,768 ug/kg in SS-2 to 88,961 ppb in SS-13.

PCBs were detected in each sample (mainly Arochlor-1260 and Arochlor-1254) ranging in concentration from 13 ug/kg (estimated) to 10,700 ug/kg (highest found in SS-1A).

Concentrations of metals in the surface soil samples varied considerably. The concentrations ranged for copper from 19.4 ppm in SS-9 to 3,090 ppm in SS-1; lead from 26.6 ppm in SS-9 to 210 ppm in SS-7; nickel from 14.2 ppm in SS-9 to 347 ppm in SS-1A; and, zinc from 58 ppm in SS-9 to 1840 ppm in SS-7. Cyanide and cadmium were not detected in any of the surface soil samples.

3.3.2 Subsurface Soil

During the 1991 investigation, 8 test pits were excavated and subsurface soil samples were collected from 6 locations where visual contamination was present. Analytical results indicated contamination of metals above the TAGM-4046 levels for arsenic, cadmium, chromium, copper, mercury, nickel, and zinc over a widely dispersed area. No volatile organic compounds were detected in unsaturated sub-surface soil samples. Oil and grease varied from 0.21% to 7.1% while cyanide ranged from non-detect (ND) to 15.4 ppm.

During the first phase of the remedial investigation, a sub-surface soil sample collected from location GP-13 in the northern parcel indicated metal contamination, primarily due to lead (86,900 ppm). In February 2000, 19 additional test pits were excavated to determine the extent of lead contamination in the northern parcel. Samples collected from the test pits indicate total lead levels ranged from 20 to 33,100 ppm. The results of TCLP lead analysis determined that soils were not a hazardous waste as the TCLP levels for lead were below the regulatory limit of 5 mg/l.

In order to determine the source of the oily seep into the Chadakoin River, 18 test pits were excavated in 2000. Total VOCs ranged from 0.024 to 66 ppm as compared to the TAGM value of 10 ppm. Total VOCs in excess of 10 ppm were identified in TP-11, TP-12, and TP-15. SVOCs concentrations ranged from ND to 79 ppm.

3.3.3 Groundwater

Fifteen groundwater monitoring wells and 27 geoprobes were installed and sampled during the investigation. VOCs including trichloroethene (TCE), dichloroethene (DCE), and vinyl chloride (VC) were reported in several groundwater samples. The highest level of chlorinated solvents was reported in wells GP-5 and MW-8 S/D located in the former TCE, paint and thinner storage area. At GP-5, concentrations of TCE and DCE were 830,000 ppb and 34,000 ppb, respectively. At MW-8S/D, levels of TCE, DCE, and VC varied from 96 to 920,000ppb, 7,100to 18,000 ppb, and ND to 1,600 ppb respectively. Tetrachloroethene was also found in MW-8D at a concentration of 1,100 ppb. Locations of geoprobes and monitoring wells, and the distribution of VOCs throughout the site are depicted in Figure 5.

Total SVOCs, consisting primarily of PAHs, were present in most of the groundwater samples. Due to high detection limits, the comparison of individual SVOC contaminant levels to groundwater standards is not, however, feasible. The highest concentrations of PAHs were in GP-5 (60,646 ppb) and in GP-6 (248,600 ppb). The concentrations of SVOCs in the remaining wells varied from ND to 3,649 ppb.

Groundwater standards were exceeded for dissolved metals, including arsenic, cadmium, chromium, copper, mercury, iron, lead, nickel, and zinc. The highest levels of each of these metals were in GP-2. Total metals also exceeded groundwater standards in several monitoring wells.

Non-Aqueous Phase Liquid (NAPL) consisting primarily of total petroleum hydrocarbons (TPHs) was observed in ESI-3, ESI-4, and MW-8. The highest concentrations of TPHs were recorded in GP-6 (2,405,930 ppb or 0.24%), ESI-3 (420,671 ppb), and GP-5 (332,600 ppb). The extent of NAPL in the subsurface has been delineated and depicted in Figure 6.

3.3.4 Surface Water

Surface water samples collected from the Chadakoin River upstream and downstream of the site did not detect any VOCs, SVOCs, or PCBs. Further, surface water samples collected adjacent to the site indicated non-detectable concentrations to low concentrations of metals typical of the ambient surface-water quality of the Chadakoin River based on the generally higher concentrations of metals in upstream samples.

3.3.5 Sediment

Sediment samples were collected on two separate occasions during the RI and supplemental RI. A total of ten samples were collected at locations upstream, adjacent and downstream of the site. Analytical results of samples indicated that metals were the primary COPC in sediments upstream, downstream and adjacent to the site. The resulting primary areas of concern are those associated with samples SED 1/5 and 6 (see Figure 4).

3.3.6 Air

Air monitoring was performed during all intrusive field activities conducted during the RI. A photoionization detector (PID) and a MINIRAM particulate monitor were used to monitor air in the immediate vicinity of the boreholes and breathing zones during the drilling activities. No exceedences in action levels specified in the HASP were recorded during any of the field activities.

3.4 Summary of Environmental Assessment and Exposure Pathways

The types of environmental exposures which may be presented by the Site have been identified in the RI, which contains a more detailed discussion of the potential impacts from the site to fish and wildlife resources. The following pathways for environmental exposure have been identified:

- Waterfowl feeding in the river may be hunted for human consumption.
- Benthic invertebrates in the river are in direct contact with sediments in the river.
- Common varieties of mammals (e.g. squirrels, muskrats) may contact the contaminated surface soils and sediments.

- Plants growing at the site may uptake contamination and incorporate it into the plant material. Higher fauna may then be exposed to contamination through the ingestion of plant matter.

3.5 Summary of Human Health Risk Assessment and Exposure Pathways

A Human Health Risk Assessment identifying potential exposure pathways has been conducted in the RI. This section contains a summary of the types of human exposures that may present added health risks to persons at or around the site.

An exposure pathway is defined as "how an individual may come into contact with a contaminant". The five elements of an exposure pathway are 1) the source of contamination; 2) the environmental medial and transport mechanisms; 3) the point of exposure; 4) the route of exposure; and 5) the receptor population. These elements of an exposure pathway may be based on past, present, or future events.

Pathways that are known to or may exist at the site include:

- Direct contact with seeps discharging into the river.
- Incidental ingestion of contaminated soil or sediments by local residents or workers who may visit the site or the river.
- Inhalation of volatile compounds and contaminated particulates by visitors or workers at the site.

Currently, exposure to site-related contaminants in drinking water is unlikely since the residents and businesses in the area are connected to public water. Institutional controls, which will preclude future residential development of the site and use of groundwater for potable purposes, will further reduce the potential for exposure to site-related contaminants in the groundwater.

4. Summary of Interim Remedial Measures / Pilot Testing

4.1 Enhanced Reductive Dechlorination (ERD)

The area impacted by VOCs (predominantly TCE and "daughter" products) around wells MW-8S and MW-8D was selected for the implementation of a pilot enhanced reductive dechlorination (ERD) technology system as the IRM for groundwater. ERD is founded on the concept of enhancing the natural reducing conditions in the subsurface system in order to expedite reductive dechlorination of VOCs present at the site. The presence of levels of DCE and VC, which are "daughter" products produced via biological degradation, as well as the reducing biogeochemical conditions observed during sampling, indicated that natural reductive dechlorination of TCE was ongoing in the MW-8S/8D vicinity. These natural conditions were enhanced by injecting an easily degradable carbon source (molasses) into the source area. The addition of this carbon source provided a substrate for additional bacteria growth, which led to the generation of even more strongly reducing conditions in the subsurface. These two factors greatly enhanced the existing reductive dechlorination, resulting in greater mass reduction of the VOCs in the source area.

As part of the IRM, two reagent injection wells and one additional monitoring well were installed in the vicinity of wells MW-8S and MW-8D. The ERD IRM was initiated in December 1998 via weekly reagent injections. The initial IRM monitoring results were favorable, indicating both the establishment of an in-situ reactive zone and the reduction of VOC concentrations. The system was subsequently expanded in 2000 to include three additional injection wells (see Figure 2). The effectiveness of the ERD technology has been demonstrated through the monthly groundwater monitoring of VOC concentrations, natural attenuation parameters and field parameters including oxidation-reduction potential, sulfide, ferrous iron and dissolved oxygen.

4.2 Recovery of Non-Aqueous Phase Liquid (NAPL)

Manual free product recovery activities were initiated in September 1998 to collect LNAPL and/or DNAPL in wells ESI-3, and ESI-4. In addition, manual bailing of periodic DNAPL (less than 0.10 feet) in well MW-8D was initiated in February 1999. NAPL thickness measurements have indicated that the NAPL thicknesses have declined since initiation of the IRM; however, recovery rates have been low due to the limited thickness of floating product in the areas.

4.3 Lead Impacted Soil Removal

A soil sample collected from the geoprobe GP-13 location during the RI indicated an anomalously high concentration of lead. The approach for the remedial action at the lead "hot-spot" in the area of GP-13 included a pre-remedial delineation in the area to define the size of the excavation and to limit post-excavation sampling. This work was completed on October 21, 1999 and consisted of the installation of nine Geoprobe borings around the GP-13 area on a 3-foot by 3-foot grid for the collection of 9 soil samples from a depth of 4- to 6-feet below ground surface (bgs) for lead analysis.

A concentration of 1000 parts per million (ppm) lead was the cleanup objective established by NYSDEC for the soil excavation. In December 1999, an area encompassing the GP-13 and the GP-13-8 areas was excavated. Approximately 12 cubic yards of soil were excavated and stockpiled on polyethylene sheeting for off-site disposal. Post-excavation samples were collected from the base and sidewall of the excavation as well as an additional sample from a black soil/ash layer located approximately 2 feet below grade (approximately one foot thick). The NYSDEC collected a split sample of the black ash layer for the analysis of total lead. Lead concentrations for the base and sidewall samples were 317 ppm and 1,250 ppm, respectively. The lead concentration for the sample collected from the black ash layer was 7,250 ppm; the lead concentration of the NYSDEC split sample was 68,200 ppm.

In January 2000, ARCADIS G&M conducted a test pit investigation to further delineate the extent of soils exceeding 1,000-ppm lead. The results of this investigation were summarized in a letter report (ARCADIS G&M, 2000) provided to the NYSDEC. Based on concurrence with the NYSDEC, a work plan was prepared and approved for the removal of soils exceeding 1,000-ppm lead from the northern parcel on the property. The removal of soils, approximately 929 tons, was performed (May 2000) using conventional excavation and soil handling equipment. The soil was directly transported by Riccelli Enterprises to the Chautauqua County Landfill for disposal.

After the excavation was completed, visually inspected and approved by NYSDEC, three additional grab samples were collected by the NYSDEC from the bottom of the excavation. The results for each of the bottom samples were reported by the NYSDEC to be below the cleanup objective. Therefore, it is expected that the NYSDEC will delist this site based on the petition to delist this parcel of the property from the New York State Inactive Hazardous Waste site registry that was submitted to the NYSDEC as part of a completion report (ARCADIS, February 2001).

4.4 PCB Impacted Soil Removal

In August 2000, surface soil sample collection and analysis from two areas on-site indicated PCB concentrations above the NYSDEC Technical Administrative Guidance Memorandum (TAGM) HWR-94-4046 recommended soil cleanup levels. The soil analytical results defined an area of surface soil above TAGM levels; approximately 49 tons of soil were excavated and stockpiled for later disposal at the Chautauqua County Landfill.

4.5 VEP Pumping Test

A pilot test was performed on January 10, 2000 to evaluate the feasibility of using vacuum-enhanced pumping (VEP) as a remedial technique for impacts to the shallow water-bearing zone (i.e., the surficial "fill" zone). The goals for successful application of VEP included the removal of VOC-impacted groundwater from the fill zone, the removal of separate phase (free) product present in the fill zone, the control and containment of both the impacted groundwater and free product, and removal and/or enhanced degradation of adsorbed phase petroleum hydrocarbons from the vadose zone and dewatered soils. The pilot test was conducted to provide the design data necessary to implement a full-scale system. The pilot test layout is shown on Figure 7. The test duration consisted of approximately 8 hours, of which both conventional pumping and VEP were performed. Details on the VEP pumping test can be found in the Feasibility Study (ARCADIS G&M, May 2002). Data generated from the VEP pumping test is included in Appendix **A**.

The VEP pumping test indicated that a hydraulic influence of approximately 35 to 40 feet was achieved during the pumping of PW-1. A pumping rate of 4 gpm was produced during the test, but this rate could be increased during higher streamflow conditions. The volume of product recovery was relatively limited based on the short duration of the pumping test. Sheens were observed on the water surface in the recovery tank. Dewatering of the saturated soils during the VEP test resulted in an approximate 1.5-feet of drawdown as observed in VEP well OW-2, located 9 feet from PW-1.

5. Summary of Remedial Action Goals

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375-1.10.

The overall remedial objective is to meet the site-specific clean-up goals and be protective of human health and the environment. At a minimum, the remedy selected should eliminate or mitigate all significant threats to public health and/or the environment presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles.

The specific remedial goals selected for this site are the following:

- Eliminate, to the extent practicable, the potential for ingestion of groundwater that does not attain the NYSDOH Drinking Water Standards.
- Eliminate, to the extent practicable, the off-site migration of groundwater that does not attain NHSDEC Class GA Ambient Water Quality Criteria.
- Eliminate, to the extent practicable, the migration of NAPL (LNAPL and DNAPL).
- Eliminate, to the extent practicable, exposures to contaminated soils at levels that present a health concern.
- Eliminate, to the extent practicable, the migration of site contaminants in soils into the surface water, groundwater, and sediments.
- Eliminate, to the extent practicable, exceedances of applicable environmental quality standards related to releases of contaminants to the waters of the state.
- Eliminate, to the extent practicable, the exposure of fish and wildlife to levels of river sediment contaminants above standards/guidance values.

6. Summary of Feasibility Study and Selected Remedy

A Feasibility Study (FS) was conducted to identify, screen, and evaluate potential remedial alternatives for the site (ARCADIS , May 2002). Based upon the results of the RI/FS, collectively an alternative was selected as the remedy for the Site. The elements of the selected remedy are as follows:

- Installation of a physical barrier wall (e.g., sheet-pile or Gundwall) along the riverbank;
- Enhanced Reductive Dechlorination to address elevated chlorinated VOCs along the southern side of the site in the area of MW-8S/D;
- Vacuum-Enhanced Pumping and Vacuum-Enhanced Recovery (VEP/VER) to address NAPL and elevated groundwater concentrations along the west side of the site;

- Excavation of the contaminated soil between the barrier wall and the river to native soil or bedrock and backfilling with clean material;
- Dewatering and treatment of impacted groundwater during soil excavation;
- River-bank stabilization and restoration;
- Covering surface soils in any disturbed area along the riverbank with certified clean soil;
- The removal of approximately 10 cubic yards of contaminated sediment from the Chadakoin River;
- Fish habitat construction in the river;
- Operation, maintenance, and monitoring plan development; and
- Imposition of a deed restriction, if warranted, for residual soil or groundwater contamination remaining on-site after remedy implementation.

7. Remedial System Design

7.1 General Process Description & Design Parameters

The selected remedy includes the installation of a vertical barrier wall [e.g., interlocking steel sheet-pile (Z-pile) or high density polyethylene (HDPE) Gundwall] within the riverbank toward the top portion of the slope to prevent the migration of free product into the Chadakoin River. The barrier wall will be approximately 300-feet in length, installed within the top portion of the slope, and will be keyed into the till layer an adequate toe-in length to structurally secure the wall. A conceptual layout in plan view of the remediation areas and proposed systems is Figure 8.

After the installation of the vertical barrier wall, a temporary dam type structure (e.g., "Port-A-Dam" or water-filled bladder dam) will be installed along the 300-foot section of the riverbank. The area between the temporary dam and the riverbank will be dewatered through the use of a sump and "trash" pump. The inlet to the trash pump will be placed in a gravel sump installed in the riverbed. Water will first be pumped into a fractionalization (frac) tank for primary treatment (i.e., primary settling of solids). After allowing for settling in the frac tank, the water will be decanted from the tank and pumped through an on-site temporary mobile treatment system consisting of an oil/water separator, filtration (e.g., bag filters) and liquid-phase granular activated carbon (GAC) vessels. The treated water will likely be discharged to the river under a temporary State Pollutant Discharge Elimination System (SPDES) permit. An additional option would be to discharge to the local publicly owned treatment works (POTW).

With the temporary dam in place along the river edge, petroleum impacted soils and the eight outfalls located between the barrier wall and the temporary dam would be excavated. In addition, metal impacted sediment from the riverbed would also be excavated. Both the excavated soils and sediments would be temporarily stockpiled on site, placed on and covered by polyethylene sheeting, characterized through laboratory analysis, and transported off-site for disposal at a permitted facility based upon analytical results.

The riverbank and riverbed will subsequently be backfilled with clean fill and graded to reflect pre-existing conditions. The reconstructed riverbank will include stabilization and erosion controls using geofabric and plantings on the upper slope as well as riprap on the lower slope (see Figure 9). Surficial soils along the disturbed area of riverbank will be covered with certified clean fill and a wing deflector will be constructed along the riverbank to improve fish habitat. The temporary dam will be removed at the completion of construction.

A VER/VEP system will be installed in order to capture and treat contaminated groundwater as well as to prevent excessive hydraulic head build-up behind the barrier wall. Extraction wells will be installed along the upgradient side of the barrier wall to create an inward hydraulic gradient and extract free product. Extraction wells will be spaced using a conservative radius of influence of 20 feet along the entire length of the barrier wall to ensure full coverage of the impacted area. The radius of influence was based on the results of the VEP pumping test conducted on January 10, 2000. The wells will be screened through the bottom five feet of the fill material. A submersible pump will be placed in each extraction well and used to dewater the overburden, while a blower applies a vacuum to each extraction well. An alternative approach to this extraction system is to use a liquid-ring pump (LRP) that achieves total-phase (i.e., liquid, product, and vapor phases) removal through a high-vacuum enhanced pumping system. Recovered groundwater will be treated through an oil/water separator, filtration (bag filters), and liquid-phase GAC vessels or a low-profile (shallow-tray) air stripper. The vapor stream will be treated through the use of a knockout tank and vapor-phase GAC. The treated groundwater will be discharged to the local POTW or to the Chadakoin River under a SPDES permit. The process flow diagram for the VER/VEP system is provided in Figure 10.

Based upon the success of the ERD pilot test, the existing ERD system will continue to operate on site in the area around wells MW-8S and MW-8D. Currently, a dilute solution of molasses is injected into five injection wells screened in the fill zone on a bi-weekly basis. Based upon the performance monitoring of the ERD system, it will be modified and/or expanded as required.

7.2 Vertical Barrier Wall Installation

A vertical barrier (e.g., interlocking steel Z-pile or HDPE Gundwall) will be installed along the riverbank of the property from the southern property line to approximately 300-feet upstream. The steel Z-pile wall will be constructed with liquid tight interlocking joints (e.g., grouted joints or gasket sealed joints). If HDPE sheets are use, they will also employ liquid tight interlocking joints (elastomer sealed joints). The barrier wall will be aligned approximately with the top of slope and keyed into the till layer at a depth of approximately 10 feet bgs. The barrier wall will penetrate to the depth necessary to resist rotation and toe kick-out, as well as global slope instability on the progress of the dewatering operation (i.e., progressively lowered as the water level recedes) . . Water will be pumped to an equalization storage tank (e.g., frac or Baker tank) to allow for the settling of solids re-suspended in the water column during the excavation operations. A transfer pump will be used to pump water from the storage tank into an on-site temporary mobile treatment system. The treatment system will consist of an oil/water separator, filtration (e.g., bag filters) for additional solids and metals removal, and liquid-phase GAC vessels. The treated water will be discharged to the river under a temporary SPDES permit or to the local POTW. The treatment system performance will be monitored through system sampling as required by a temporary SPDES or POTW permit.

Stream flow within the Chadakoin River is controlled by a dam located upstream of the site at Washington Street. Flow during the period from May 1997 to February 1998 ranged from 43 cfs to 1,100 cfs, with a fluctuation in river stage of approximately 4 feet. The dewatering and excavation of the sediments operations will be scheduled during low flow conditions and coordinated with the Washington Street dam operator to minimize uncontrolled stream flow releases. However, the temporary dam will be designed to accommodate the maximum stream flow. Similarly, the dewatering pump and treatment system will be sized to allow for continuous operation under maximum stream flow conditions.

7.4 Riverbank and Sediment Removal

This portion of the remedy will include the excavation of all petroleum-impacted soils along the riverbank between the barrier wall and the temporary dam, the excavation of all metal-impacted sediment, and the removal of the eight former outfalls located at the site.

All petroleum-impacted soils between the barrier wall and the temporary dam will be removed via mechanical excavation following the effective dewatering of the area. Subsequent to the completion of the excavation activities, the riverbank and riverbed will be backfilled with imported, certified-clean fill, compacted, and graded as part of the riverbank stabilization. All excavated soils will be stockpiled on-site at a designated soil handling/staging area. The staging area will be designated based on its accessibility to the river; potential areas under consideration include the concrete pad on the west side of the building or the west side of the property. . The excavated soils will be stockpiled in piles of approximately 100 cubic yards for characterization purposes. The staged soil will be placed on and covered with polyethylene sheeting throughout the stockpiling process. The stockpile area(s) will be constructed with a perimeter berm (e.g., straw bales or earthen) , covered with a layer of sheeting, and a base that will be sloped to a temporary sump (gravel packed perforated pipe) to contain water resulting from gravity drainage through the soil and to provide an extraction point to remove any accumulated water. Each stockpile will be physically separated from other stockpiles by approximately 5-feet, or by temporary "jersey" barriers, straw bales, or other appropriate physical separation barriers. Each stockpile will be placed on and covered with 6-mil (minimum) polyethylene sheeting. Samples will be collected from the stockpiled soils in accordance with the analytical requirements of the designated off-site permitted disposal facility.

In addition to the petroleum-impacted soils, two areas of the riverbed along the riverbank that contain metals concentrations above the baseline will be excavated. The two subject areas of concern are the sample SED-1/5 area and the sample SED-6 area (Figure 8). The sediment removal action is focused on two reaches extending to either side of these areas in parallel with the riverbank. Each reach extends 40-feet and encompasses the sediment approximately extending four feet from the riverbank. Assuming a sediment depth of 6-inches, a total of approximately 10 cubic yards of sediment will be excavated. The excavated sediments will be stockpiled in a designated staging area constructed as outlined previously. Excavated sediments may require stabilization with cement kiln dust (CKD) or lime to lower the moisture content, if the initial gravity dewatering efforts at the staging area are not sufficiently effective in achieving the desired moisture content stipulated by the off-site disposal facility. The dewatered and stabilized sediment will be characterized through sampling and disposed at an off-site permitted disposal facility.

The remedial contractor will determine the specific location and configuration of the soil and sediment staging area. The contractor will also be responsible for the installation and maintenance of the soil staging area for the duration of site remedial operations.

7.5 Outfall Removal

There are currently eight former outfalls present at the site; these will be removed as part of the site remedy. Removal of each outfall will include excavation of the overlying soils, removal of the outfall piping and associated pipe bedding material to a landward location that would be considered upgradient of the barrier wall.

All excavated soil and pipe bedding material will be stockpiled on-site as outlined in Section 7.4. Pipe material will be segregated, crushed, and stockpiled separately as construction debris for subsequent load-out, transport, and disposal at an off-site permitted facility. Following the completion of the excavation operation, the exposed pipe and remaining bedding material will be plugged or blocked with a minimum 1-foot thick concrete or grout plug to seal the ends of the former outfalls and mitigate any possible groundwater flow through the remaining pipe and bedding material towards the river.

7.6 Riverbank Stabilization and Restoration

Stabilization and erosion control measures will be constructed along the riverbank to prevent the possible erosion of fill material into the Chadakoin River. These measures will be implemented along an approximately 300-foot reach of riverbank. The portion of the bank to be stabilized extends from the concrete bulkhead at the upstream extent of the property to approximately 50-feet downstream of the furthest downstream outfall, located near Well MW-10.

The bank will be graded at a nominal two horizontal to one vertical (2:1) slope over the area to be addressed by the stabilization and erosion controls. A reinforced silt fence will be installed along the disturbed area immediately following the initial excavation to control potential soil erosion into the river. A geotextile will then be placed over the backfilled and graded area, and anchored into a trench excavated along the bank edges (i.e., key into the bottom and top of slope) as depicted on Figure 9. Following placement of the geotextile, a 1-foot wide course of 6 to 8-inch nominal size riprap will be placed both in front of and behind the silt fence. The upper portion of the bank disturbed during construction activities will be backfilled with certified clean fill, graded, and seeded to provide addition erosion control in the form of a vegetative cover. The vegetative cover will include plantings of a variety of woody species (e.g. shrubs, trees) to assist in stabilizing the upper portion of the bank. A landscape plan for the design of the vegetative cover will be submitted as part of the final design. The lower portion of the slope will be stabilized through armoring with riprap greater than 6-inch nominal size.

7.7 Fish Habitat Enhancement (Wing-wall Structure)

As part of the riverbank stabilization, the NYSDEC Division of Fish and Wildlife has requested additional stream enhancements to be incorporated into the design of the bank cover. These stream enhancements will consist of a fish habitat improvement structure constructed as a single-winged deflector in the riverbed at the base of the upstream bank. The purpose of the single-winged deflector is to enhance fish habitat along the shore of the site and assist in the propagation of warm water fish. A conceptual design of the deflector consists of a physical barrier (e.g., single wing-wall structure constructed of concrete, wood, or steel) extending at an angle from the upstream shoreline armored with riprap.

7.8 VEP/VER and On-Site Treatment System

A VEP/VER treatment system will be installed at the site. The treatment shed will be heated, insulated and equipped with a ventilation fan and will house the treatment equipment and system controls. A preliminary system design has been established based upon the results of the VEP/ VER pumping test conducted on January 10, 2000. The pumping test established an average pumping rate of 4 gpm, and a vapor flow rate of between 22.90 and 26.17 standard cubic feet per minute (scfm) for a single extraction well. The hydraulic radius of influence was observed at 35 to 40 feet during the test. A vacuum was measured at a distance of 24 feet from the extraction well. The VEP/VER treatment system will be designed using a conservative radius of influence of 20- to 25-feet.

The VER system will be comprised of eight to ten extraction wells installed immediately upgradient of, and aligned with the full length of the barrier wall. The well separation will be 40-feet (+/-) on center based on the design radius of influence of 20- to 25-feet. The extraction wells will be constructed of 4-inch diameter PVC and installed to a total depth of approximately 12 feet below land surface (bls). The wells will be completed with a 2-foot sump at the base of the well and screened from approximately 5 to 10 feet bls through the fill and the sand/gravel layer directly above the till layer. Pneumatic or electric submersible pumps will be installed in each extraction well to recover groundwater and NAPL, while a blower provides a vacuum on the well. However, a liquid ring pump (total phase, high-vacuum) will be evaluated during the final design of the system.

Extraction wells will pump at a rate of approximately 4 gpm resulting in a total collectively flow rate for the extraction system ranging between 32 and 40 gpm. Extracted groundwater will be treated via an oil/water separator to remove any recovered NAPL. In addition, groundwater will be treated through particulate filtration (bag filters) followed by either an air stripper (low-profile) or liquid-phase GAC. A more detailed evaluation will be conducted during the final design to determine the effectiveness of an air stripper versus granular activated carbon adsorption for liquid treatment. The treated effluent from the system will discharge to either the local POTW or to the Chadakoin River under a SPDES permit.

A blower will be used to provide a vacuum of 60 inches of water column at each extraction well resulting in a total extracted vapor flow rate of between 208 and 226 scfm. Vapor-phase GAC will be used to treat off-gas from the VER system and/or the air stripper to meet Air Guide 1 effluent standards.

Individual vacuum and liquid lines from each recovery well will be trenched to the treatment area. If pneumatic submersible pumps are used, compressed air lines to each extraction well will be provided. The liquid and vacuum lines will be manifolded together inside the treatment building, valved to control the flow, and equipped with pressure gauges dedicated to monitoring the flow from each extraction well. A compressed air line manifold will be installed if pneumatic pumps are used, along with the appropriate valves to adjust the compressed air delivered to each pump.

The system will be designed to monitor the operational status of critical systems on a continual basis during operation. The system will be interlocked with appropriate sensors, which can temporarily shutdown the system in the event the system malfunctions. A system component failure would result in a system shutdown to assure that the discharge of untreated groundwater or soil vapor is prevented.

7.9 ERD (IRZ) System

ERD technology is currently being implemented at the site as an IRM to address the "hot spot" area of chlorinated VOCs in the vicinity of wells MW-8S/8D. Based upon favorable results, the existing ERD system will continue to operate on site in this area (see Figure 8).

The continued application of ERD will employ the addition of a food-grade carbohydrate reagent to the subsurface in five injection wells, as currently being performed under the IRM, to increase the reducing conditions and provide excess organic carbon for the indigenous anaerobic microbial population to utilize. These factors should result in a more expeditious insitu degradation of the chlorinated VOCs by the bacteria via the reductive dechlorination process. Performance data collected during the IRM indicates that the reducing conditions have already been enhanced by the reagent injection and a decrease in VOC concentrations has occurred within the established reactive zone.

The existing performance monitoring will also be continued as part of the future ERD program to treat the on-site groundwater; therefore, monitoring the biogeochemical parameters and evaluating the effectiveness of this technology in treating the groundwater. Based upon the performance monitoring results, the ERD system will be adjusted and modified as required.

8. 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 remedial system, the following permits may be required.

- Building Permits (local authority)
- Electrical Permit (local authority)

The above listed permits or permit equivalencies will be coordinated and obtained prior to system installation by the remedial contractor.

A United States Army Corps of Engineers (USACOE) Nationwide permit will be required for work related to the construction in and along the Chadakoin River. The nationwide permit application will be submitted separately to the NYSDEC and USACOE for review and approval. This permit represents a long-lead /critical schedule activity.

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.

If the treated effluent from the VER/VEP system is discharged to the local POTW, all required permits and approvals will be obtained from the City of Jamestown to discharge the water, as well as to make the connection to the sanitary sewer line. If the treated effluent is discharged to the Chadakoin River, a SPDES permit will be obtained.

9. 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) would likely require one full construction season for full completion pending reasonable weather conditions that do not prohibit implementation. These activities would include the installation of the barrier wall, riverbank and riverbed removal and restoration, fish habitat construction, and installation of the VER/VEP system (i.e., extraction wells, piping, and treatment system). 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/VEP system and the continued operation of the ERD system along with an operation and maintenance program.

10. Construction Drawings and Technical Specifications

Final engineering design, construction drawings and technical specifications will be prepared for the selected remedy for the 90 percent design submittal. Appendix C presents a preliminary list of the construction drawings that will be prepared. Appendix D presents a preliminary list of the technical specifications.

11. System Operation and Monitoring Plan

A detailed operation and maintenance 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. 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.

12. Quality Assurance Project Plan

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

13. Field Sampling Plan

A Field Sampling Plan (FSP) will be prepared and presented in Appendix F as part of the 90 percent design submittal.

14. Health and Safety Plan

A Health and Safety Plan (HASP) will be prepared and presented in Appendix G as part of the 90 percent design submittal.

15. Post Remedial Action Plan

The remedial action goals and objectives for the site are specified in the ROD and provided in Section 5 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. . 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 clean-up goals for both soil and groundwater have been met or a reasonable effort has been made to achieve the 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 anticipated 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.

16. Certification

This is to certify that the Preliminary Draft Remedial Design/Remedial Action Work Plan for the D.C. Rollforms/Ingersoll-Rand Site, Jamestown, New York, Site Code #907019 was prepared in accordance with the Order on Consent, Index # B9-0446-94-01, as entered into by Ingersoll-Rand and the NYSDEC.

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

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Table 1. Summary of Chemical Constituents Above New York State Groundwater Standards, D.C. Rollforms/Ingersoll-Rand Site, Jamestown, New York.

Volatile Organic Compounds
Vinyl chloride
1,2-Dichloroethene (total)
Trichloroethene
Benzene
Xylene (total)

Dissolved Metals
Barium
Iron
Manganese
Sodium

Table 2. Comparison of Average Metals Concentrations in Chadakoin River Sediment Samples to NYSDEC Sediment Screening Criteria, D.C. Rollforms/Ingersoll-Rand Site, Jamestown, New York.

CONSTITUENT: (Units in mg/kg)	ADJACENT/DOWNSTREAM MAXIMUM CONCENTRATION	UPSTREAM ARITHMETIC AVERAGE	ADJACENT/DOWNSTREAM ARITHMETIC AVERAGE	SEVERE EFFECT LEVEL
Aluminum	6,560.00	7,586.67	5,336.43	NL
Antimony*	4.90	0.81	2.20	25
Arsenic*	27.75	12.43	19.26	33
Barium	102.80	99.43	68.17	NL
Beryllium	0.55	0.79	0.48	NL
Cadmium*	2.65	0.72	1.42	9.0
Calcium	24,200.00	27,433.33	10,982.14	NL
Chromium*	211.00	18.37	79.43	110
Cobalt*	13.30	4.67	8.19	NL
Copper**	9,750.00	257.47	1,700.72	110
Iron**	0.10	0.02	0.05	0.04
Lead**	524.00	54.43	192.62	110
Magnesium	7,560.00	5,240.00	4,165.71	NL
Manganese	1,204.00	763.00	653.64	1100
Mercury	0.08	0.08	0.05	1.3
Nickel**	138.00	31.63	62.19	50
Potassium	606.00	525.00	398.29	NL
Selenium*	5.30	1.35	2.61	NL
Silver*	1.50	0.10	0.44	2.2
Sodium	108.00	203.07	84.68	NL
Thallium*	3.90	0.47	1.18	NL
Vanadium*	14.75	9.00	12.25	NL
Zinc**	2,380.00	221.67	531.00	270

Note:
With the exception of iron, all units are mg/kg. Concentration of iron given as a percent.
Concentrations measured in duplicates (SED-05 & DUP-01, SED-01 & SED-01 DUP) were averaged prior to averaging across sampling stations.
Concentrations below the detection limit were assumed to equal one-half the detection limit, for purposes of calculating average concentrations.
*Chemical designated as chemical of potential concern (COPC) because adjacent/downstream concentration is greater than upstream concentration.
**COPC is present at average concentration greater than the SEL.

Table 3. Summary of Soil Analytical Results, Supplemental Test Pit Investigation, D.C. Rollforms/Ingersoll-Rand Site, Jamestown, NY.

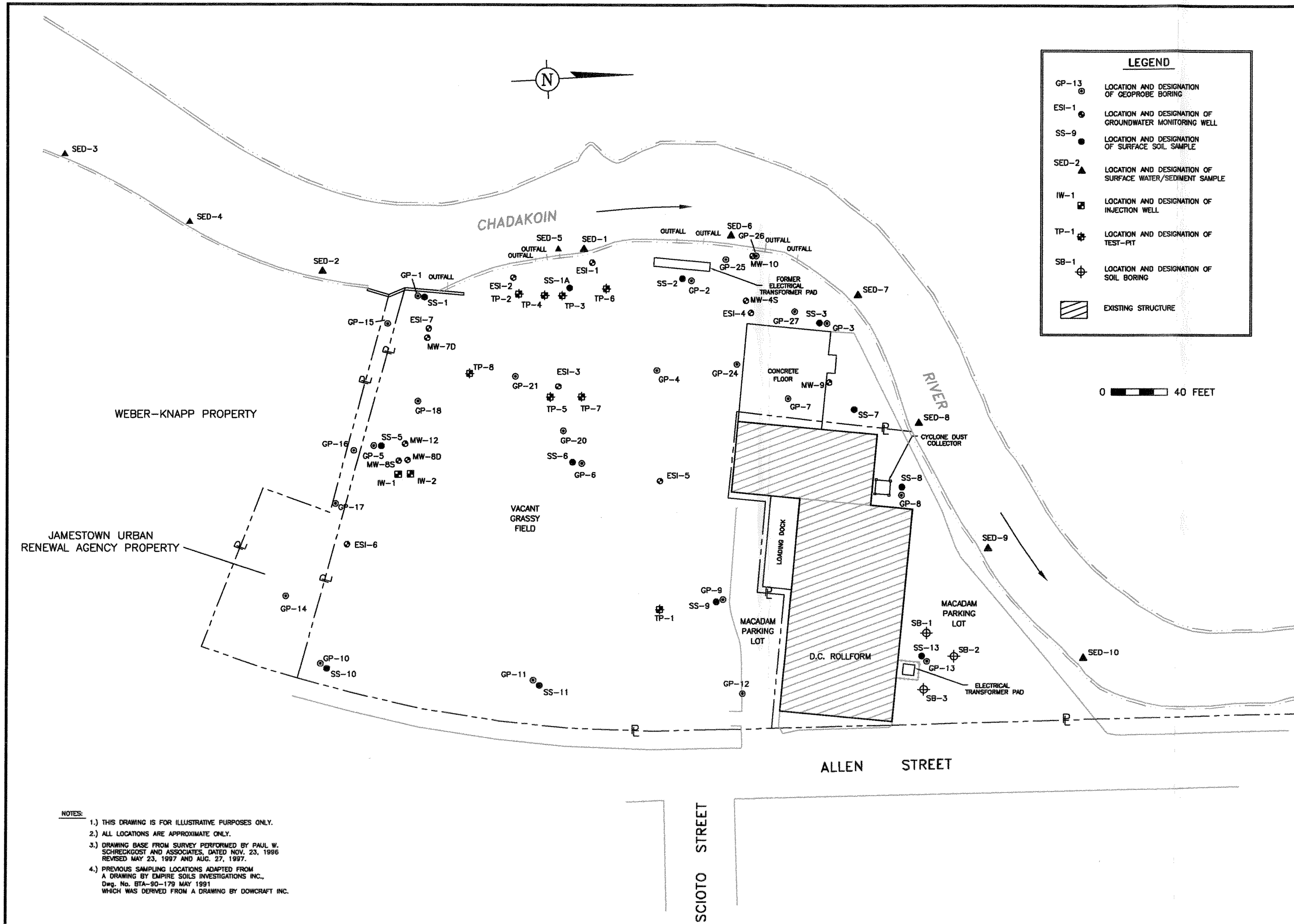
	Cleanup Objective in ug/kg (ppb)	TP-10	TP-11	TP-12	TP-13	TP-14	TP-15	TP-16	TP-17	TP-18
Anthracene	5,500	ND	4,000	1,500	860	ND	3,000	82J	1,800	550J
Benzo(a)anthracene	224	ND	[1,800]	[750]	[3,100]	[500]	ND	[380]	[3,100]	[2,000]
Benzo(b)flouranthene	1,100	ND	[1,600]	[7,600]	[3,500]	800	ND	[3,700]	[3,200]	[2,000]
Benzo(k)flouranthene	1,100	ND	[4,800]	ND	[9,600]	ND	ND	150J	820	750J
Benzo(ghi)perylene	50,000	ND	ND	ND	600	ND	ND	160J	1,200J	910J
Benzo(a)pyrene	61	ND	[1,100]	ND	[2,400]	[450]	[680]	[310J]	[2,200]	[1,500]
Chrysene	600	ND	[1,600]	[770]	[3,000]	[730]	ND	350	[2,600]	[1,800]
Dibenzo(a,h)anthracene	14	ND	ND	ND	ND	ND	ND	[44J]	ND	ND
Flouranthene	50,000	ND	4,000	2,300	8,400	1,100	740	700	7,400	4,100
Flourene	50,000	ND	9,700	4,300	ND	ND	14,000	48J	920	ND
Indeno(1,2,3-cd)pyrene	3,200	ND	ND	ND	670J	ND	ND	150J	1,200J	820J
Phenanthrene	50,000	ND	35,000	14,000	4,000	ND	34,000	340	6,200	2,100
Pyrene	50,000	ND	4,800	2,400	4,200	590J	2,200	630	5,500	3,400
Total			68,400	33,620	40,330	7,170	53,880	7,044	36,140	19,930
Benzene	60	ND	[7,900]	[3,000]	ND	ND	[11,000]	35J	[680J]	ND
Ethylbenzene	5,500	ND	220	170	14	2.8	23	ND	2.3	ND
Toluene	1,500	22	140	ND	30	46	22	27	16	29
0-Xylene	NA	ND	ND	ND	64	8.5	ND	ND	ND	ND
M-Xylene	NA	ND	530 1	300 1	62 1	7.7 1	34 1	1.8 1	3.5 1	ND
P-Xylene	NA	ND	ND 1	ND	ND 1	ND 1	ND 1	ND 1	ND 1	ND
Total Xylenes	1,200	ND	530	300	130	16	ND	ND	ND	ND
Isopropylbenzene	5,000	ND	4,300	1,000	450	ND	290	4.1	36	1.9
n-propylbenzene	14,000	ND	2,200	1,300	160	15	160	ND	18	ND
p-Cymene	NA	2.1	6,100	3,200	1,200	220	320	34	33	21
1,2,4-trimethylbenzene	13,000	ND	ND	ND	ND	38	ND	6.7	15	4.4
1,3,5-trimethylbenzene	3,300	ND	2,100	1,300	650	47	130	5	6.7	2.9
n-butylbenzene	18,000	ND	8,800	5,700	590	100	610	12	43	11
sec-butylbenzene	25,000	ND	11,000	6,900	1,600	220	680	29	42	12
tert-butylbenzene	NA	ND	4,300	2,800	720	38	260	6.4	15	3.2
Methyl tert butyl ether	120	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene (Method 8021)	13,000	ND	[26,000]	[17,000]	140	34	2,700	63	120	23
Naphthalene (Method 8270)	13,000	ND	2,400	ND	ND	ND	ND	ND	440J	ND
Total*		24.1	74,120	42,970	5,810	793	16,229	224	1350.5	108.4

*Higher naphthalene value is used
[ ] Exceeds TAGM 4046
J Estimated Value
ND Not detected

All Values are stated in UG/KG (ppb)
G:\Aproj\IR\219.03\Task10\Table 3- soil tableREV\SVOC

Table 4. Vacuum Enhanced Pumping Pilot Test Results, D.C. Rollforms/Ingersoll-Rand Site, Jamestown, New York.

Elapsed Time (min)	Flow Rate (gpm)	Applied Vacuum (IWC)	Blower Air Flow (SCFM)	Induced Vacuum (IWC)					Drawdown at Wells (ft.)					
				OW-1	OW-2	PW-2	ESI-1	ESI-2	OW-2	PW-2	ESI-1	ESI-2	PW-1	OW-1
0	0								0	0	0	0	0	0
15	4.412								0.39	0.04	0.06	0.04	3.08	0.21
30	3.896								0.38	0.07	0.1	0.05	3.18	0.3
45	4.000								0.45	0.1	0.13	0.08	3.1	0.37
60	3.704								0.47	0.13	0.15	0.09	3.39	0.44
75	3.614								0.52	0.15	0.16	0.11	3.32	0.49
90	3.571								0.53	0.16	0.17	0.12	3.51	0.54
105	3.797								0.51	0.18	0.18	0.14	2.82	0.56
120	3.529								0.59	0.19	0.19	0.14	3.51	0.6
150									0.59	0.22	0.2	0.17	3.27	0.63
180	3.488								0.66	0.24	0.22	0.19	3.44	0.7
210	3.797								0.71	0.26	0.24	0.21	3.42	0.74
240	3.704								0.74	0.27	0.25	0.22	3.46	0.76
260	2.609	37	43.611		0.05	0	0		0.72	0.32	0.28	0.25		0.74
275	2.885	57	43.611	0.08	0.05	0.01	0		0.73	0.33	0.28	0.26		0.83
290	3.061	58.5		0.11	0.05	0.01	0		0.71	0.33	0.29	0.27		0.81
305	2.830	59.5	26.167	0.14	0.06	0.01	0	0	0.77	0.34	0.3	0.28		0.85
335	2.542	63	26.167	0.11	0.07	0.01	0	0	0.8	0.37	0.3	0.29		0.87
365	4.167	64	23.986	0.35	0.17	0.02	0	0	0.87	0.38	0.33	0.34		0.95
395	4.167	64	23.986	0.43	0.165	0.01	0	0	0.96	0.44	0.37	0.36		1.05
425	4.110	63	23.986	0.42	0.16	0.02	0	0	1.01	0.47	0.4	0.4		1.1
455	4.110	63	23.986	0.42	0.16	0	0	0	1.04	0.51	0.42	0.41		1.14
485		63	22.896	0.42	0.165	0.01	0	0	1.07	0.53	0.44	0.43		1.15



NOTES:

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NO.	DATE	REVISION DESCRIPTION	BY	CKD

ARCADIS
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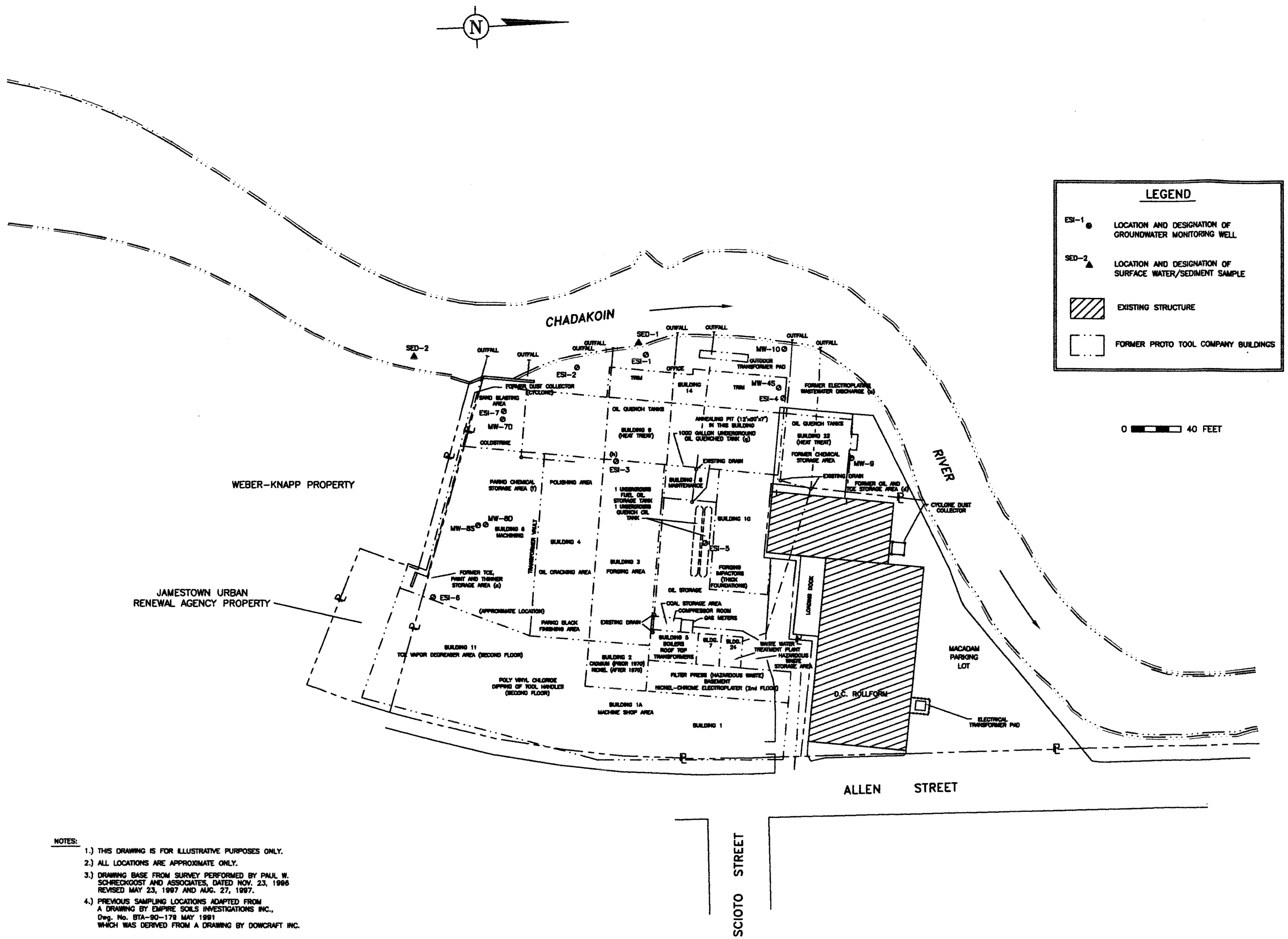
SITE MAP

D.C. ROLLFORMS/INGERSOLL-RAND
JAMESTOWN, NEW YORK

PROJECT MANAGER M. SANFORD	DRAWING NUMBER G319E
LEAD DESIGN PROF. E. ROBERTS	PROJECT NUMBER AY0002190004
CHECKED BY E. ROBERTS	FIGURE NUMBER 1
DATE DRAWN 07-11-03	



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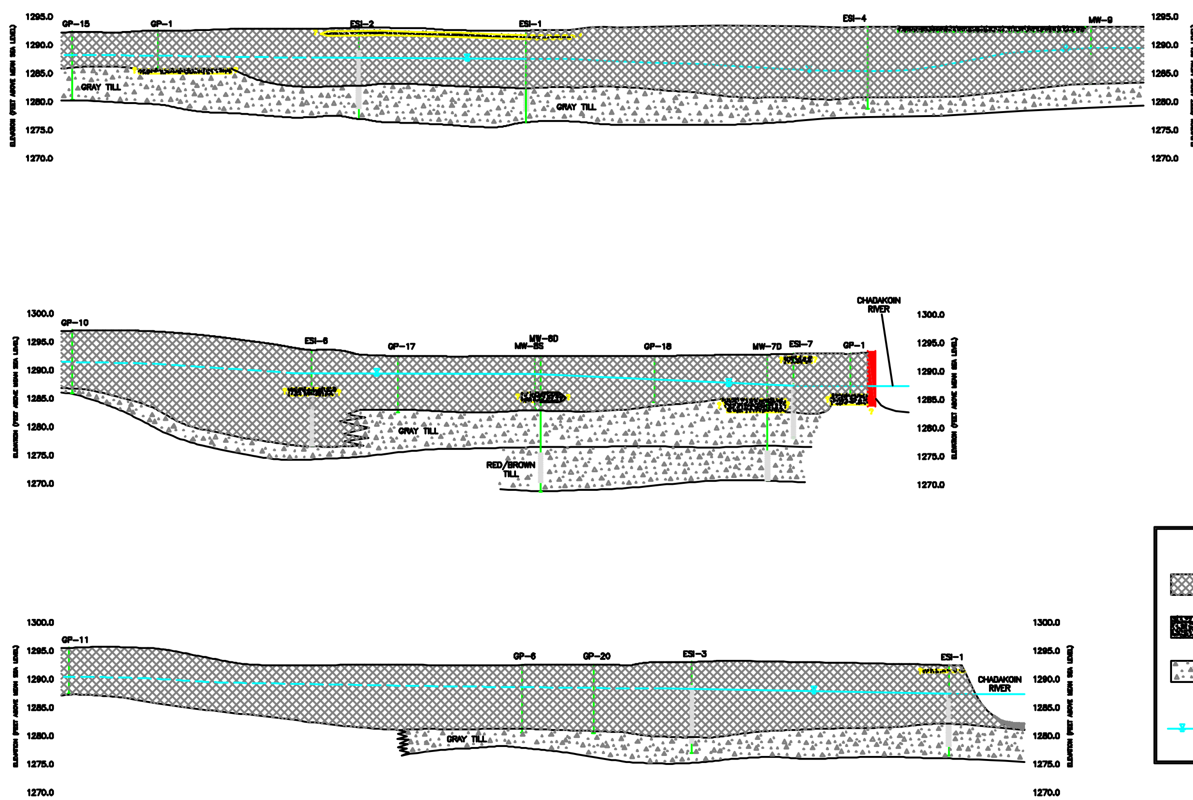
FORMER PROTO TOOL BUILDING LAYOUT

D.C. ROLLFORMS/INGERSOLL-RAND
JAMESTOWN, NEW YORK

PROJECT MANAGER M. SANFORD	DRAWING NUMBER G319B
LEAD DESIGN PROF. E. ROBERTS	PROJECT NUMBER AY0002190004
CHECKED BY E. ROBERTS	FIGURE NUMBER
DATE DRAWN 07-11-03	2



LEGEND

	FILL	Gray and brown clayey silt with fine sand, gravel, brick, concrete and wood.
	CONCRETE	
	TILL	Gray and red/brown dense clayey silt, trace to some fine to medium sand and gravel.
	WATER-LEVEL ELEVATION 2/2/98 (DASHED WHERE INFERRED)	

SCALE
Horiz. 1"= 80'
Vert. 1"= 10'

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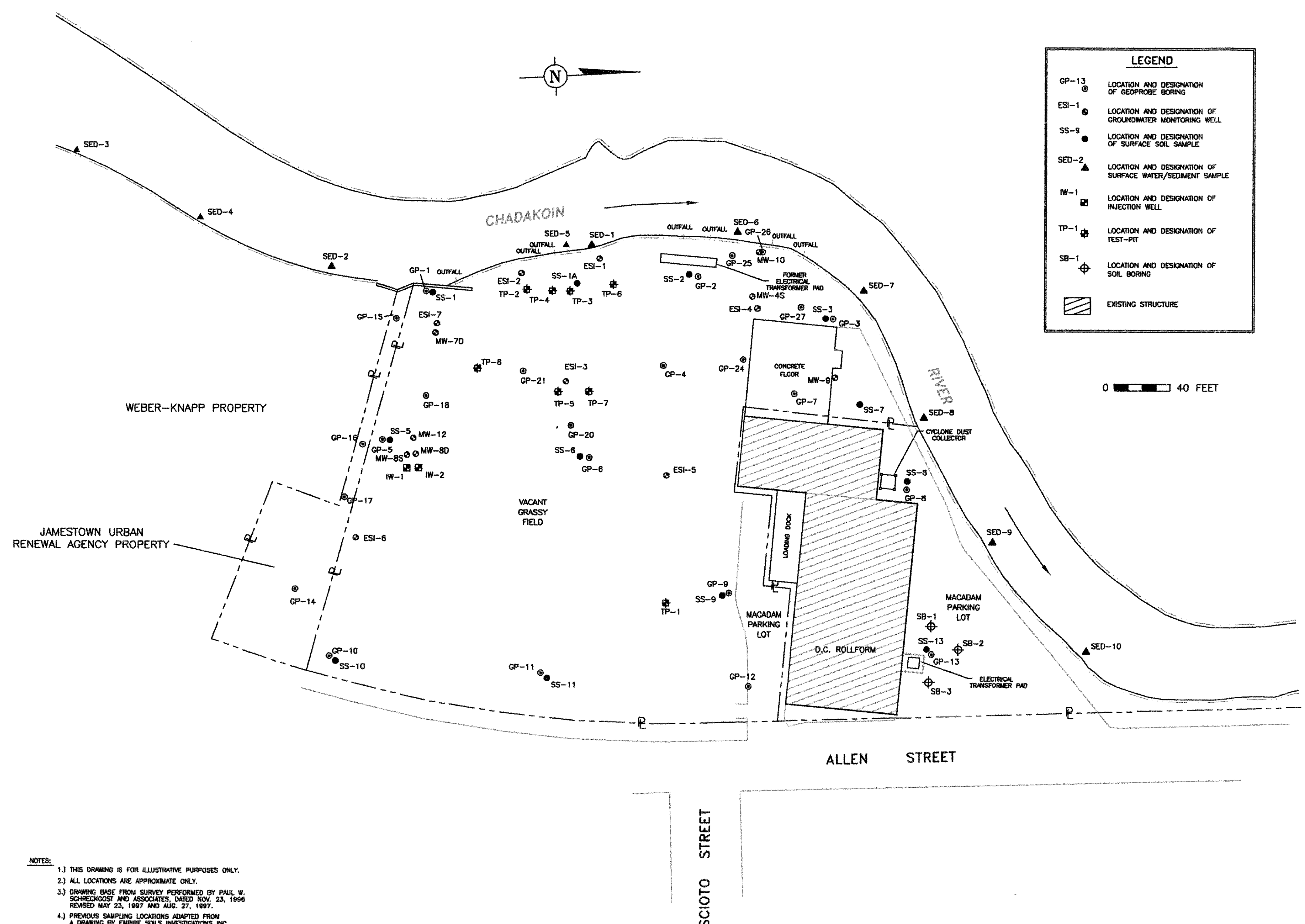
GEOLOGIC CROSS SECTIONS A-A', B-B' AND C-C'

D.C. ROLLFORMS/INGERSOLL-RAND
JAMESTOWN, NEW YORK

PROJECT MANAGER M. SANFORD	DRAWING NUMBER IR-11
LEAD DESIGN PROF. E. ROBERTS	PROJECT NUMBER AY00002190004
CHECKED BY E. ROBERTS	FIGURE NUMBER 3
DRAWN BY FJF/Adecco DATE 7/11/03	



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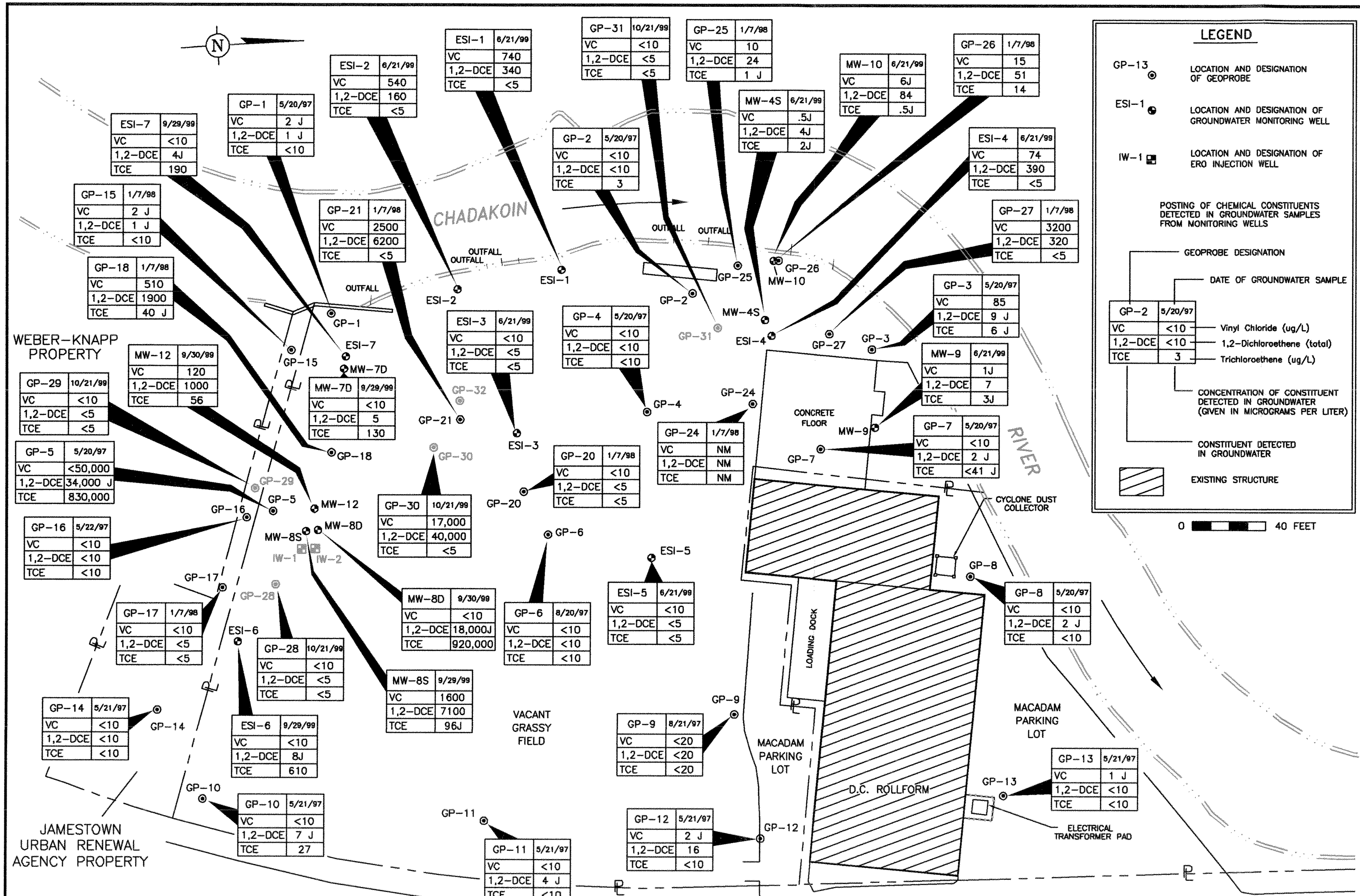
SAMPLE LOCATIONS DURING THE RI AND PREVIOUS INVESTIGATIONS

D.C. ROLLFORMS/INGERSOLL-RAND
JAMESTOWN, NEW YORK

PROJECT MANAGER M. SANFORD	DRAWING NUMBER G254Z
LEAD DESIGN PROF. E. ROBERTS	PROJECT NUMBER AY0000219.0004
CHECKED BY E. ROBERTS	FIGURE NUMBER 4
DRAWN BY FJF/Adecco — DATE 7/11/03	



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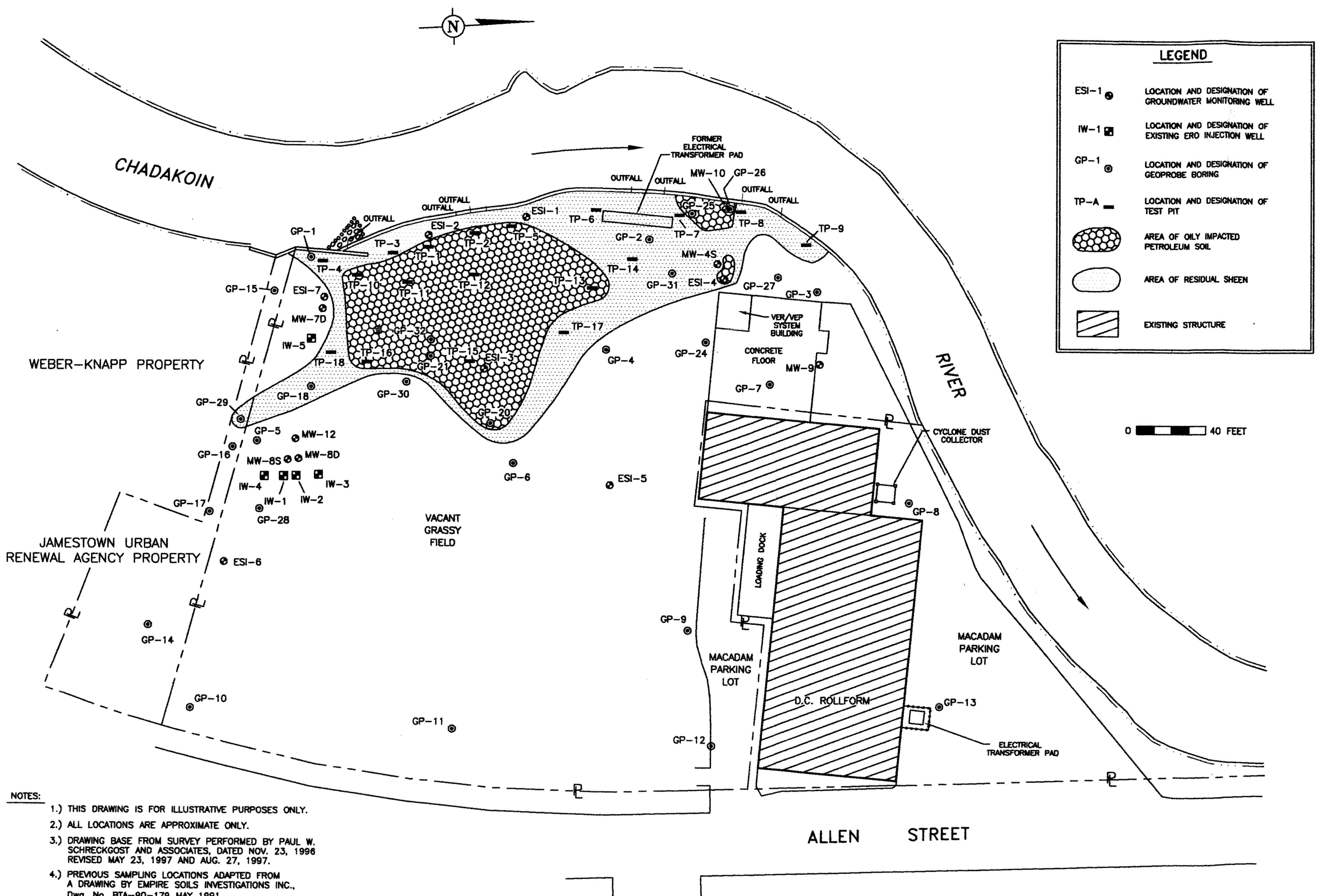
DISTRIBUTION OF CHLORINATED VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER

D.C. ROLLFORMS/INGERSOLL-RAND
JAMESTOWN, NEW YORK

PROJECT MANAGER N. SANFORD	DRAWING NUMBER G254G
LEAD DESIGN PROF. E. ROBERTS	PROJECT NUMBER AY000219.0004
CHECKED BY E. ROBERTS	FIGURE NUMBER 5
DRAWN BY FJF/Adecco DATE 7/11/03	



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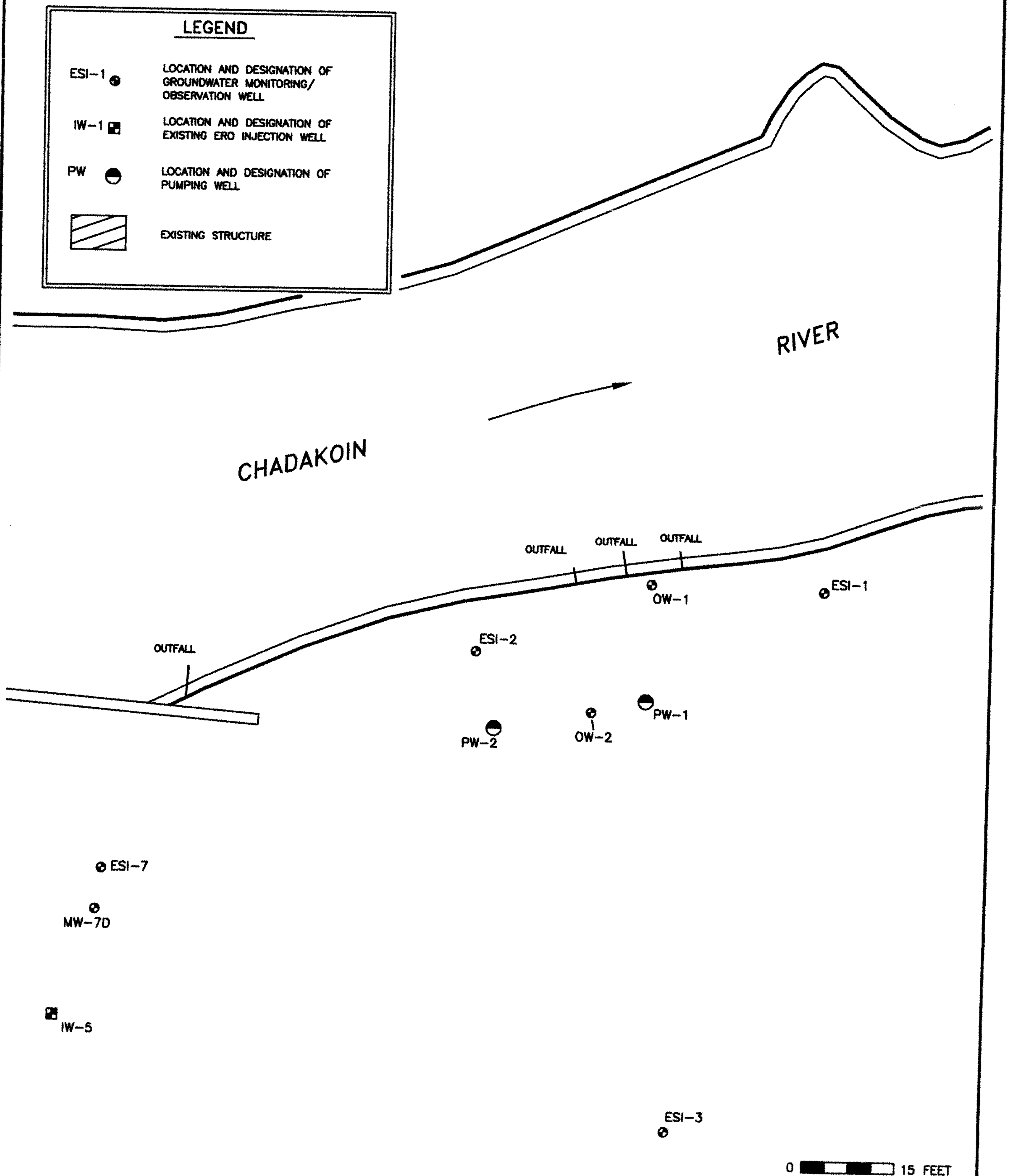
ESTIMATED AREAS OF PETROLEUM IMPACTED SOILS

D.C. ROLLFORMS/INGERSOLL-RAND
JAMESTOWN, NEW YORK

PROJECT MANAGER M. SANFORD	DRAWING NUMBER G319A
LEAD DESIGN PROF. E. ROBERTS	PROJECT NUMBER AY0002190004
CHECKED BY E. ROBERTS	FIGURE NUMBER 6
DATE DRAWN 07-11-03	



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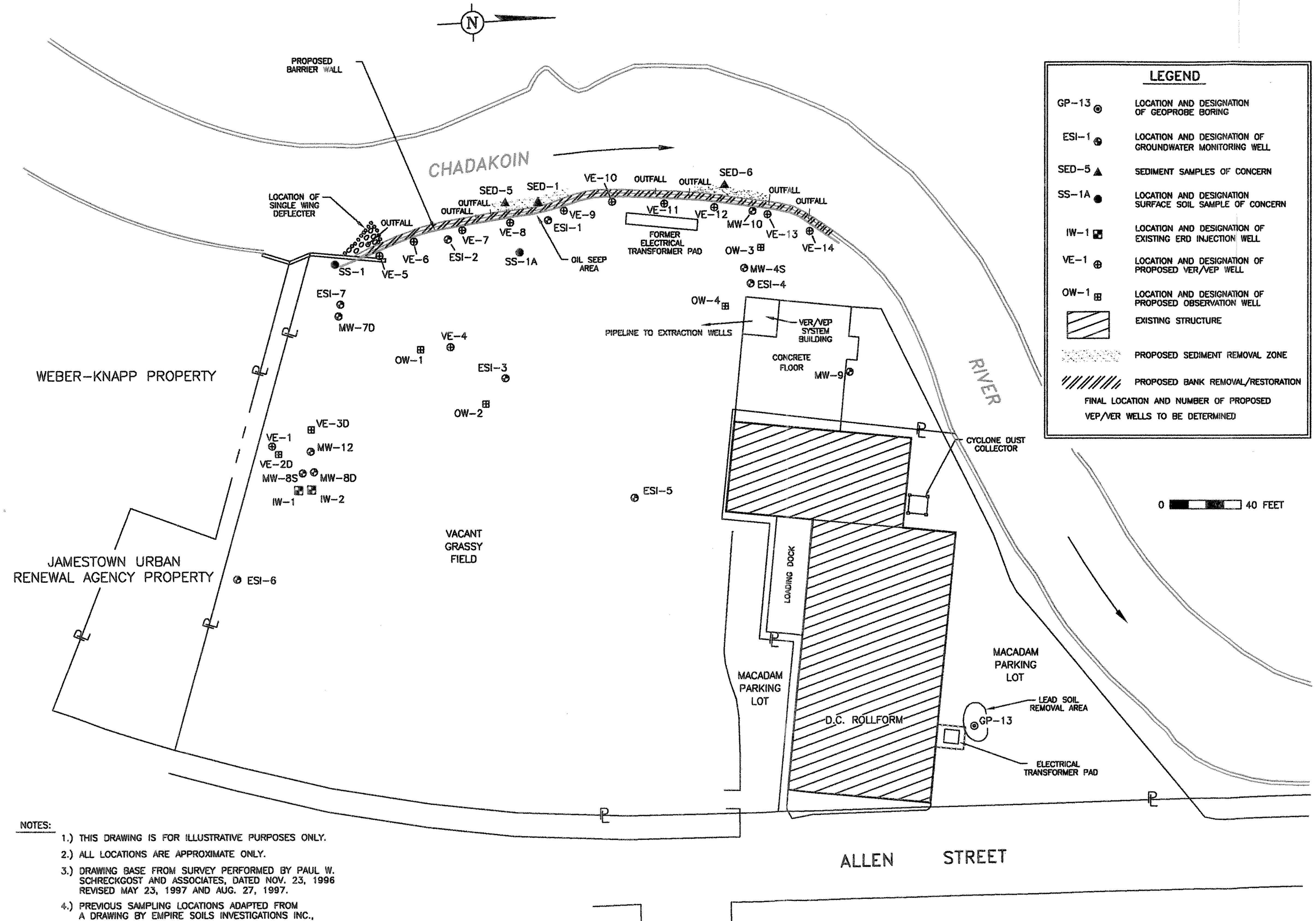
VEP PILOT TEST LAYOUT

D.C. ROLLFORMS/INGERSOLL-RAND
JAMESTOWN, NEW YORK

PROJECT MANAGER M. SANFORD	DRAWING NUMBER G319C
LEAD DESIGN PROF. E. ROBERTS	PROJECT NUMBER AY0002190004
CHECKED BY E. ROBERTS	FIGURE NUMBER 7
DATE DRAWN 07-11-03	



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ENGINEERING DESIGN:
ALL PROFESSIONAL ENGINEERING SERVICES ON THIS DRAWING HAVE BEEN PERFORMED FOR ARCADIS G&M INC. BY ARCADIS ENGINEERS & ARCHITECTS OF NEW YORK, P.C. A PROFESSIONAL CORPORATION QUALIFIED TO PERFORM SUCH SERVICES IN THE STATE OF NEW YORK.

NO.	DATE	REVISION DESCRIPTION	BY / CKD

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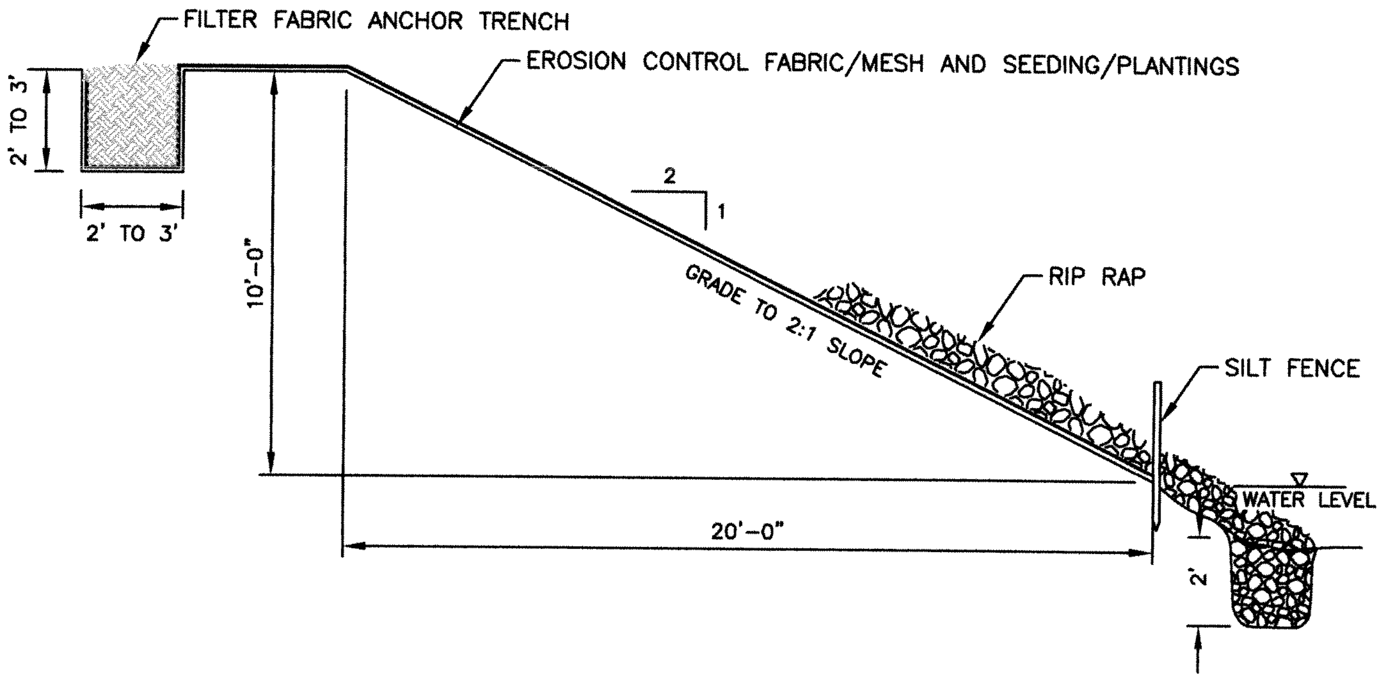
PROPOSED LOCATIONS OF REMEDIATION SYSTEMS

D.C. ROLLFORMS/INGERSOLL-RAND
JAMESTOWN, NEW YORK

PROJECT MANAGER M. SANFORD	DRAWING NUMBER G319F
LEAD DESIGN PROF. E. ROBERTS	PROJECT NUMBER AY000219.0004
CHECKED BY E. ROBERTS	FIGURE NUMBER 8
DATE DRAWN 07-11-03	



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PROPOSED RIVER BANK STABILIZATION/EROSION CONTROLS

D.C. ROLLFORMS/INGERSOLL-RAND
JAMESTOWN, NEW YORK

PROJECT MANAGER M. SANFORD	DRAWING NUMBER G319G
LEAD DESIGN PROF. E. ROBERTS	PROJECT NUMBER AY0002190004
CHECKED BY E. ROBERTS	FIGURE NUMBER 9
DATE DRAWN 07-11-03	

Appendix A

VEP Pumping Test Data

Appendix B

Permit Applications

Appendix C

List of Construction Drawings

Preliminary List of Construction Drawings

- Cover Sheet
- Location Maps, General Notes, List of Drawings, Abbreveiations and Legend
- Existing Site Plan
- Hazardous Area Classification Diagram
- Barrier Wall Plan and Profile
- Riverbank Excavation Plan
- Riverbank Stabilization / Erosion and Sediment Control Plan
- Erosion and Sediment Control Notes and Details
- Temporary Dam Plan and Details
- Civil Sections and Details
- Recovery System Plan
- Recovery System Details
- Treatment System Plan and Sections
- Piping and Instrumentation Diagram Legend
- Piping and Instrumentation Diagram
- Electrical Details
- Site Restoration Plan
- Site Restoration Sections and Details
- Miscellaneous Details

Appendix D

List of Technical Specifications

Preliminary List of Technical Specifications

DIVISION 1 – GENERAL REQUIREMENTS

Section 01010 - Summary of Work
Section 01012 - Special Conditions
Section 01014 - Work Sequence
Section 01040 - Control and Inspection
Section 01050 - Field Engineering
Section 01060 - Regulatory Requirement and Responsibility to the Public
Section 01090 - Reference Standards
Section 01150 - Measurement and Payment
Section 01200 - Project Meetings
Section 01300 - Submittals
Section 01400 - Quality Control
Section 01415 - Inspections and Tests
Section 01430 - Environmental Protection
Section 01450 - Pipe Testing
Section 01500 - Temporary Facilities and Controls
Section 01600 - Materials and Equipment
Section 01700 - Contract Closeout
Section 01740 - Warranties and Bonds

DIVISION 2 – SITEWORK

Section 02110 - Site Clearing
Section 02200 - Earthwork
Section 02232 - Granular Materials
Section 02250 - Transportation and Disposal of Materials
Section 02290 - Erosion and Sediment Control
Section 02310 - Drilling Services
Section 02452 - Barrier Wall
Section 02711 - Geotextile
Section 02713 - Geomembrane
Section 02831 - Fence and Gates
Section 02901 - Miscellaneous Work and Site Cleanup
Section 02936 - Seeding and Landscaping

Preliminary List of Technical Specifications - Continued

DIVISION 3 – CONCRETE

Section 03200 - Concrete reinforcement
Section 03300 - Cast-In-Place Concrete
Section 03400 - Precast Concrete Products

DIVISION 5 – METALS

Section 05500 - Metal Fabrications

DIVISION 9 – COATINGS

Section 09805 - Coatings

DIVISION 11 – EQUIPMENT

Section 01131 - Pumps

DIVISION 15 – MECHANICAL

Section 15000 - Process Piping and Accessories
Section 15050 - Process-Mechanical Piping system
Section 15099 - Valves and Appurtenances
Section 15200 - High Density Polyethylene Pipe

DIVISION 16 – ELECTRICAL

Section 16010 - General Electrical Requirements
Section 16050 - Basic Electrical Materials and Methods
Section 16110 - Raceways
Section 16120 - Wires and Cables
Section 16135 - Cabinets, Boxes and Fittings
Section 16170 - Disconnects
Section 16050 - Basic Electrical Materials and Methods
Section 16470 - Panelboards
Section 16910 - Instrumentation
Section 16920 - Control Panels

Appendix E

Quality Assurance Project Plan

Appendix F

Field Sampling Plan

Appendix G

Site Health and Safety Plan