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FINAL
FOCUSED FEASIBILITY STUDY REPORT
OPERABLE UNIT 1 - SOIL

Hexagon Laboratories
Site No. 2-03-003

Work Assignment Number
D003060-13.3A

Prepared by

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APPENDICES

EXECUTIVE SUMMARY

A Focused Feasibility Study (FFS) of remedial alternatives for the Hexagon Laboratories Site, located in the Eastchester Section of Bronx County, New York, was performed for the New York State Department of Environmental Conservation (NYSDEC) by TAMS Consultants, Inc. under the TAMS/NYSDEC Superfund Standby Contract Work Assignment No. D003060-13.3A.

Hexagon Laboratories operated under several different owners as a manufacturer of various medicinals, pharmaceuticals, and industrial organic chemicals from 1946 until the plant closed in May 1988. NYSDEC and the New York City Department of Environmental Protection (NYCDEP) inspected this site several times as early as the 1980s as a result of complaints about dumping by Hexagon Laboratories. A site inspection report prepared in 1988 included a "NFRAP" (no further remedial action planned) recommendation. The hazard ranking system (HRS) scoring for the site was 3.48; a score of 28.5 is the minimum for a site to be listed on the federal National Priorities List (*i.e.*, as a Superfund site).

In 1990, the New York City Police Department Bomb Squad removed a number of explosives and reactives from the site, and in 1992, the United States Environmental Protection Agency (USEPA) initiated an emergency removal action which included removal of hazardous wastes and substances from drums and tanks and obvious waste piles on the floors of buildings. The emergency removal action was completed in 1993.

In July 1997, an Interim Remedial Measure (IRM) was performed at the site as a precursor to the remedial investigation (RI) due to concerns over the structural stability of several buildings on site. The IRM consisted of demolition of four of the seven buildings on site (Old Plant, New Plant, Hydrotherm No. 2, and Cylinder House), asbestos abatement of these structures and the yard areas, removal of 47 above ground storage tanks/reactor vessels, and removal of 31 underground storage tanks (USTs). This work was completed in January 1998.

TAMS completed a RI of the Hexagon Laboratories Site in October 1998 which included collection and analysis of groundwater, surface soil, and subsurface soil samples. Observed contamination at the site consists primarily of benzene, toluene, ethylbenzene, and xylenes (BTEX compounds), chlorinated volatile organics, phenolic compounds, polycyclic aromatic hydrocarbons (PAHs), and PCBs. Elevated concentrations of some metals including antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, thallium, and zinc were also observed.

As part of the RI, a limited human health risk assessment was performed. The limited human health risk assessment examined current and future exposure scenarios to determine if contaminants present in the surface soil at the site pose unacceptable carcinogenic or noncarcinogenic risks to potentially exposed populations (*i.e.*, trespassers, site workers, and construction workers). Carcinogenic risks were determined to exceed target risk levels for the high end, future-use exposure scenarios examined for site workers due to the presence of benzo(a)pyrene in the surface soil. Noncarcinogenic risks were not calculated due to the lack of quantitative toxicity values for the contaminants of concern.

However, for nonresidential lead risks, the USEPA-recommended methodology relating soil lead uptake to blood lead concentrations in women of childbearing age to derive risk-based remediation goals (RBRG) was used. The 95 percent upper confidence level concentration of lead in the surface soil exceeded the RBRG for construction workers. The average concentration of lead in the soil also exceeded the RBRG for construction workers. Unidentified SVOCs (*i.e.*, tentatively identified compound [TICs]) may also contribute to human health risks, but were not quantitatively evaluated due to the lack of quantitative toxicity values for TICs.

An ecological assessment was also performed as part of the RI. The primary objective of the ecological assessment was to evaluate the adverse ecological impacts of contaminants at the Hexagon Laboratories Site on site biota. Because of the highly developed nature of the site, and as a result, the negligible amounts of vegetation present at the site, there does not appear to be an impact on site vegetation by contamination present at the site. In addition, since the Hexagon Laboratories Site itself is essentially devoid of vegetation, and it does not feature wetlands or open water, there is insufficient natural habitat available to support any threatened or endangered species. Thus, the impact of site contamination on threatened or endangered species on site is considered to be negligible. No environmental samples were collected off site as part of the remedial investigation and, therefore, the presence of site-related contamination off site and an assessment such site-related contamination on off-site biota would be inconclusive. However, it is important to note the highly developed, industrial nature of the Hexagon Laboratories Site and its immediate vicinity and the corresponding lack of significant vegetation.

In collaboration with NYSDEC, nine remedial action alternatives were identified for the Hexagon Laboratories Site. These alternatives are listed below.

- Alternative 1: No Action
- Alternative 2A: Containment - Asphalt Cap
- Alternative 2B: Containment - Concrete Cap
- Alternative 2C: Containment - RCRA Multimedia Cap
- Alternative 3: In-Situ Treatment of Organic Compound Contamination/Ex-Situ Treatment of Metals Contamination/On-Site Disposal
- Alternative 4A: Excavation/Off-Site Disposal
- Alternative 4B: Excavation/Off-Site Treatment/Off-Site Disposal
- Alternative 5A: Limited Excavation/Off-Site Disposal/Asphalt Cap
- Alternative 5B: Limited Excavation/Off-Site Treatment/Off-Site Disposal/Asphalt Cap

Alternative 1 is the No Action alternative and includes long-term groundwater monitoring to assess the natural attenuation of site contamination. Alternatives 2A, 2B, and 2C are all containment alternatives. In each case, the cap will prevent direct human contact with the contaminated soil and minimize the vertical migration of contamination from the unsaturated overburden by minimizing the infiltration of precipitation. Because contamination will not be removed or destroyed as part of these containment alternatives, these alternatives include long-term groundwater monitoring to assess the effectiveness of the cap in reducing contaminant migration.

Alternative 3 is a treatment-based alternative. As part of this alternative, the organic contaminants of concern will be oxidized to non-toxic by-products using Fenton's reaction-based in-situ oxidation. Upon completion of the organics treatment, the metals-contaminated soil will be treated ex-situ using solidification/stabilization. The solidification/stabilization process encapsulates the metal COCs, thereby reducing the toxicity and mobility of the metals in the soil. However, since the metals will not be removed or destroyed as part of this process, long-term monitoring is necessary to assess the long-term effectiveness of this alternative in minimizing metals migration.

In both Alternatives 4A and 4B, contaminated soil will be excavated and transported off site. In Alternative 4A, non-hazardous material will be disposed of at a non-hazardous waste landfill and hazardous material (if any) will be treated and disposed of at a hazardous waste disposal facility. In Alternative 4B, non-hazardous material will be treated at an off-site facility and subsequently reused off site (*e.g.*, as road base material). Hazardous material (if any) will be treated and disposed of at a hazardous waste disposal facility. Because the contaminated soil will be removed from the site, no long-term monitoring is necessary as part of these alternatives.

Alternatives 5A and 5B are identical to Alternatives 4A and 4B, respectively, with the exception that only the top two feet of contaminated soil will be removed from the East Yard; approximately 1,500 cy of contaminated soil will remain on site. The remaining contaminated soil will be capped in place to prevent direct human contact with the contaminated soil and to minimize the vertical migration of contamination from the unsaturated soil by minimizing the infiltration of precipitation. Because contaminated soil will remain in place, these alternatives include long-term groundwater monitoring to assess combined impact of soil removal and cap placement on site contamination.

As part of this FFS, each of the alternatives was evaluated using the seven criteria as defined in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) No. HWR-4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites (revised May 15, 1990). These criteria are consistent with the first seven of the nine criteria identified in the USEPA guidance for performing Feasibility Studies under CERCLA and the NCP. These criteria are as follows:

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs)
- Overall Protection of Human Health and the Environment;
- Short-term Impacts and Effectiveness;
- Long-term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility, or Volume;
- Implementability; and
- Cost

Of the nine alternatives evaluated, only Alternatives 4A and 4B, which involve excavation and off-site treatment or disposal of contaminated material, will meet the New York State chemical-specific SCGs for the COCs. In the remaining alternatives, contaminated soil will remain on site and, therefore, none of these alternatives will achieve compliance with the chemical-specific SCGs. (In Alternative 3, the organic COCs will be destroyed, but the stabilized metal COCs will remain on site.) Each of the alternatives evaluated is considered to be in compliance with action-specific SCGs; all permits (*e.g.*, building permits) and approvals necessary for implementing these alternatives will be obtained prior to initiating the remedial action. No location-specific SCGs were identified.

None of the alternatives will allow for unrestricted site use upon completion of the remedial action since contaminated groundwater and associated saturated soil will remain on site. This contamination will be addressed as part of a separate feasibility study. Until these media are remediated, institutional controls (*e.g.*, deed restrictions) will be necessary to prevent future site uses which could result in exposure to the contamination.

Excluding the contaminated groundwater and saturated soil, Alternatives 3, 4A, and 4B are considered to be protective of human health and the environment since, in each case, the contaminated unsaturated soil will be either treated on site or removed and treated/disposed of off site. Alternatives 2A, 2B, 2C, 5A, and 5B are considered to be largely protective of human health and the environment since the presence of a cap will act as a physical barrier against human contact with the soil and will minimize the vertical migration of the COCs by reducing the infiltration of precipitation. Alternatives 5A and 5B are considered to be more protective than Alternatives 2A, 2B, and 2C since, as part of these alternatives, approximately 75 percent of the contaminated soil will be removed in addition to cap placement over the remaining contamination. None of the caps will impact the lateral migration of contamination due to groundwater flow. The No Action alternative (Alternative 1) is not considered to be protective of human health or the environment.

There are no significant short-term risks to the community or to the environment anticipated in the implementation of Alternatives 1, 2A, 2B, and 2C since there will be only minor intrusive activities associated with these alternatives. Similarly, there are no significant short-term risks anticipated for the organics treatment phase of Alternative 3. Short-term impacts (*e.g.*, fugitive dust formation, fugitive contaminants emissions) are anticipated for Alternatives 4A, 4B, 5A, and 5B and for the metals treatment phase of Alternative 3 since each will involve significant excavation of contaminated soil. However, these potential impacts will be easily controlled.

Excluding long-term monitoring activities, all of the alternatives can be implemented fairly quickly (13 months or less) once necessary approvals and permits are acquired. However, upon completion of the remediation, only Alternatives 4A and 4B will have met the preliminary remediation goals. Thus, for Alternatives 1, 2A, 2B, 2C, 3, 5A, and 5B, a duration of 30 years (the maximum time period specified for evaluation under the USEPA FS guidance [USEPA, 1988]) was assumed.

Alternatives 3 and 4B are considered to be permanent remedies since, in both cases, the contaminated soil will undergo treatment. Alternative 4A is also considered to be a permanent remedy since the contaminated soil will be removed from the site and disposed of off site. However, since most of the excavated soil will not be treated prior to off-site disposal (hazardous soil will be treated off site prior to disposal) in Alternative 4A, it is considered to be less permanent than Alternatives 3 and 4B. The soil removal components of Alternatives 5A and 5B are considered permanent since, as with Alternatives 4A and 4B, contaminated soil will be removed and treated/disposed off site. However, approximately 25 percent of the contaminated soil volume will remain on site upon completion of the remediation. Therefore, overall, these remedies are not considered to be permanent. Alternatives 1, 2A, 2B, and 2C are not considered to be permanent remedies since contaminated soil will not be removed or treated as part of these alternatives.

Alternative 4B is considered to be the most effective in reducing the toxicity, mobility and volume of contaminants at the Hexagon Laboratories Site since, as part of this alternative, the contaminated soil will be removed from the site and treated prior to off-site reuse or disposal. While the contaminated soil will also be removed from the site as part of Alternative 4A, this alternative does not include treatment of the non-hazardous contaminated soil prior to disposal; the contamination will no longer be a concern at the site, but the contaminants will not be destroyed or stabilized. Alternatives 5A and 5B are also considered to be effective in reducing the toxicity, mobility, and volume of contaminants at the site since, as part of these alternatives, approximately 75 percent of the contaminated soil volume will be removed and transported off site for treatment/disposal. The toxicity and mobility of the remaining contaminated soil will be addressed by the placement of an asphalt cap which will act as a barrier, thereby preventing direct exposure to the soil and reducing vertical migration of contaminants by minimizing infiltration of precipitation. The cap will not impact the lateral migration of contaminants due to groundwater flow.

Alternative 3 is considered to be effective in reducing the toxicity, mobility, and volume of contaminants since the organic COCs will be destroyed via in-situ oxidation using Fenton's reaction, and the metal COCs will be encapsulated via solidification/stabilization. Containment alternatives (2A, 2B, and 2C) will have no impact on the volume of contaminants at the site. However, as described for Alternatives 5A and 5B, each of these alternatives will reduce the vertical mobility of the contaminants from the unsaturated overburden to the groundwater by minimizing the infiltration of precipitation; none of these alternatives will impact the lateral migration of contaminants due to groundwater flow. In addition, each of these alternatives will indirectly reduce the toxicity of the contamination by preventing direct exposure to the contaminated soil. Alternative 1 (No Action) will not reduce the volume, mobility, or toxicity of the site soil contaminants.

Alternatives 1, 2A, 2B, and 2C are considered to be readily implementable. Execution of the work items that form these alternatives will not require sophisticated equipment, technology, or specialists. There are no specific problems anticipated associated with obtaining permits or approvals from various New York City agencies and adjacent property owners for implementing these alternatives. However, implementation of the containment alternatives may limit future groundwater remedial options at the site since any type of intrusive construction (*e.g.*, installation of extraction or injection wells) will compromise the integrity of the capping system.

Alternatives 4A, 4B, 5A, and 5B are considered to be implementable; both will use standard excavation methods and equipment, and necessary materials and services are readily available. However, there may be some difficulty in the installation of temporary shoring at the perimeter of the excavations and around existing buildings due to the presence of buried concrete or debris. Buried materials encountered during the excavation process may also result in unanticipated schedule delays. It is important to note that these alternatives are expected to enhance potential future groundwater remedial actions at the site since the permeability of the subsurface in the upper site will be greatly increased. However, for Alternatives 5A and 5B, the presence of a cap may limit groundwater remediation options since, as noted for containment Alternatives 2A, 2B, and 2C, intrusive construction activities in the East Yard will compromise the integrity of the cap.

Of the nine alternatives evaluated, Alternative 3 is considered to be the least implementable due primarily to the uncertainty in the effectiveness of Fenton's reaction-based in-situ oxidation and solidification/stabilization in treating the COCs. Both technologies will undergo bench-scale testing to verify effectiveness prior to full-scale implementation at the site. In addition, there are only a few vendors who provide Fenton's reaction-based in-situ oxidation and, as a result, a competitive bid for this service may not be possible. Further, because in-situ oxidation is an innovative technology, there may be some administrative difficulties in obtaining permits or approvals from the various New York City and State agencies.

As a result of the solidification/stabilization treatment, the consistency of the treated soil may range from a workable soil to a concrete-like solid, depending on the type and quantity of binding agent necessary to meet the treatment goals. If the treated soil is concrete-like, it may limit the future treatment options for the remaining contaminated groundwater and saturated soil (to be addressed as part of a separate feasibility study).

Total costs (capital, O&M, and total present worth) were calculated for each of the nine alternatives evaluated. Alternative 3, which includes in-situ oxidation of the organic COCs followed by ex-situ solidification/stabilization of the metal COCs, has the highest capital cost ($3,180,685) and the highest total present worth (approximately $3,357,000), assuming a 30-year period and a discount rate of five percent. The containment alternatives (2A, 2B, and 2C), which include cap maintenance as well as long-term groundwater monitoring, have the highest annual O&M cost ($23,600).

Alternatives 1, 2A, 2B, 2C, 3, 5A, and 5B do not include removal of all contamination and, therefore, long-term monitoring of the site contamination will be necessary. For evaluative purposes, these alternatives were considered to have a duration of 30 years, which is the maximum duration to be considered in the detailed analysis as specified in TAGM No. HWR-4030 (NYSDEC 1990). For Alternatives 4A and 4B, contaminated soil will be removed from the site and, as a result, no long-term monitoring will be required. These alternatives were considered to have a duration of six months. For each alternative, a discount rate of five percent was assumed in the calculation of total present worth.

1.0 INTRODUCTION

1.1 Purpose and Organization of Report

This report represents the findings of the Focused Feasibility Study (FFS) of remedial alternatives for the remediation of soil contamination at the Hexagon Laboratories Site located in the Eastchester Section of Bronx County, New York (Figure 1-1). This site is listed in the New York State Department of Environmental Conservation (NYSDEC) Registry of Inactive Hazardous Waste Sites, Site No. 2-03-003. The FFS was conducted in accordance with the United States Environmental Protection Agency (USEPA) Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, October 1988), which is in agreement with the NYSDEC Guidelines for Remedial Investigations/Feasibility Studies, Technical and Administrative Guidance Memorandum (TAGM) #4025 (March 31, 1989) and Selection of Remedial Activities at Inactive Hazardous Waste Sites, TAGM #4030 (September 11, 1989, Revised May 15, 1990). The work was performed under the TAMS/NYSDEC Superfund Standby Contract Work Assignment No. D003060-13.3A.

The remedial investigation (RI) documents extensive soil contamination and groundwater contamination at the Hexagon Laboratories Site. Only unsaturated soil contamination (Operable Unit 1) is being addressed by this FFS. Groundwater contamination and associated saturated soil contamination (Operable Unit 2) will be addressed separately. Based on a limited human health risk assessment of surface soils at the site, it was determined that exposure to the surface soil presents an unacceptable human health risk. Contamination levels in the subsurface soil suggest that the subsurface soil represents an unacceptable human health risk as well. The overall objective of this FFS is the recommendation of a remedy for this soil contamination so that public health and the environment will be protected. To accomplish this goal, the following specific objectives were established for the FFS:

- Identify levels of remediation required in order to provide protection of public health and the environment;
- Identify, in collaboration with NYSDEC, remedial action alternatives for remediation of site soils;
- Perform a detailed analysis of the remedial action alternatives; and
- Identify the most promising remedial alternative and provide sufficient information to justify recommendation.

This report consists of six chapters. Site background information is provided in Chapter 1. This includes a description of the site, a brief outline of the history of events at the site, interpretation of the site geology and hydrogeology based on data collected as part of the RI, evaluation of the nature and extent of contamination and its fate and transport, a summary of the human health risk assessment for surface soil, and a summary of the ecological assessment.

Chapter 2 identifies the contaminants of concern (COCs) and establishes the remedial action objectives. In addition, the potentially applicable Standards, Criteria, and Guidelines (SCGs) are identified. Determination of the volume of contaminated soil is also described in this chapter.

In Chapter 3, the remedial action alternatives, selected in collaboration with NYSDEC, are described. The detailed analysis of these alternatives is documented in Chapter 4. The detailed analysis of each alternative involves evaluation of short-term and long-term effectiveness; reduction of toxicity, mobility, and volume; implementability; cost; compliance with standards; and overall protection. In Chapter 5, alternatives are compared in order to provide sufficient information to justify selection of the most environmentally sound and cost effective remedial action alternative. References are provided in Chapter 6.

1.2 Background Information

1.2.1 Site Description

The Hexagon Laboratories Site is an approximately 0.9-acre (1.1 acres including the previously leased property southeast of the site formerly referred to as the "Bergio Property" and now owned by Bilgrei) inactive chemical manufacturing facility located at 3536 Peartree Avenue in the Eastchester section of Bronx County, New York. The site is bounded on the northwest by Boston Road (also referred to as Boston Post Road; US Route 1); on the northeast by Tufo's Wholesale Dairy and parking area (these two properties being the former Bronx Auto Wrecking and Salvage) and Heathcote Avenue; on the southeast by Marbo Used Auto Parts and an unnamed construction equipment and materials storage yard (formerly referred to as the "Bergio Property"); and on the southwest by Peartree Avenue.

The surrounding area is generally a densely populated urban area. The northern edge of Co-op City, a New York City housing project, is approximately 2,000 feet south of the site, and the New England Thruway (Interstate Route 95) is about 250 feet southeast of the site. Pelham Bay Park is located less than one mile east of the site, on the east side of the Hutchinson River. Two tidal marsh areas are located in the Pelham Bay Park as is the Thomas Pell Wildlife Refuge and Sanctuary. At its nearest point, the Hutchinson River is less than 1,000 feet northeast of the site.

Prior to the Interim Remedial Measure (IRM) performed at the site, the Hexagon Laboratories facility consisted of three principal buildings (referred to as the Old Plant, New Plant, and Office/Warehouse [New Wing]), several smaller structures (referred to as the Hydrotherm No. 1, Hydrotherm No. 2, Cylinder House, and Cinder Block building), and three main open areas (referred to as the North Yard, South Yard, and East (Vapor Phase) Yard.

The site was almost entirely covered by structures or pavement; however, the extent of paving was difficult to verify due to the presence of large amounts of debris (largely consisting of tires and auto parts, but including construction debris and other miscellaneous wastes and trash) covering much of the open areas.

1.2.2 Site History

Hexagon Laboratories operated under several different owners as a manufacturer of various medicinals, pharmaceuticals, and industrial organic chemicals from 1946 until the plant closed in May 1988. The site functioned primarily as a contractor facility, where the chemicals manufactured depended on client requests. However, pharmaceuticals and pharmaceutical intermediates appear to have been the primary focus of the Hexagon Laboratories manufacturing work. On-site manufacturing processes included reaction, separation, and purification processes such as hydrogenation, chlorination, distillation, crystallization, centrifugation, grinding, and drying. Products were manufactured primarily in batch quantities, using batch reactors and distillation units.

NYSDEC and the New York City Department of Environmental Protection (NYCDEP) inspected this site several times as early as the 1980s as a result of complaints about dumping by Hexagon Laboratories. A site inspection report prepared in 1988 included a "NFRAP" (no further remedial action planned) recommendation. The hazard ranking system (HRS) scoring for the site was 3.48; a score of 28.5 is the minimum for a site to be listed on the federal National Priorities List (*i.e.*, as a Superfund site).

In 1990, the New York City Police Department Bomb Squad removed a number of explosives and reactives from the site, and in 1992, the United States Environmental Protection Agency (USEPA) initiated an emergency removal action. The removal action, completed in April 1993, included removal of hazardous wastes and substances from drums and tanks (including process vessels and fuel oil tanks), as well as smaller containers (pails and laboratory chemicals) and obvious waste piles on the floors of buildings. USEPA also attempted to pump out (drain) the sumps, but they were apparently being recharged and could not be emptied.

In 1996, TAMS was tasked by NYSDEC to perform a RI/FFS of the Hexagon Laboratories Site. As a preliminary step in the RI, TAMS conducted a structural evaluation of the Hexagon Laboratories buildings. The results of this evaluation suggested that, for safety-related reasons, several of the buildings should be demolished prior to initiating the planned intrusive investigative activities in and around these buildings. The RI/FFS tasks were put on hold and an IRM, consisting of demolition of four of the seven buildings on site (Old Plant, New Plant, Hydrotherm No. 2, and Cylinder House), asbestos abatement of these structures and the yard areas, removal of 47 above ground storage tanks/reactor vessels, and removal of 30 USTs, was performed by Trade-Winds Environmental Restoration, Inc. (Trade-Winds). This IRM began in July 1997 and was completed in January 1998.

Phase I RI field activities were initiated in November 1997 and were completed in April 1998. The following Phase I RI activities were conducted: topographic survey; geophysical survey; collection of surface soil and miscellaneous (oily material) samples; drilling of exploratory borings and collection of subsurface soil samples; collection of UST excavation sidewall samples; installation and sampling of groundwater monitoring wells; and an ecological investigation. A Phase II RI, consisting of additional surface and subsurface soil sampling in the East Yard, was performed in October 1998 to supplement the earlier sampling effort. Installation of six additional monitoring wells is also planned as part of the Phase II RI.

1.2.3 Physical Characteristics

The Hexagon Laboratories Site is located in the northeast corner of Bronx County, New York approximately 700 feet southwest of the Hutchinson River. The geology of Bronx County includes near-surface glacial deposits, and metamorphic and sedimentary bedrock (Perlmutter and Arnow, 1953). The unconsolidated deposits beneath the site consist of Upper Pleistocene glacial till which was deposited directly from melting ice in an extensive ground moraine. The till, which covers most of Bronx County, is poorly sorted and consists of brown, unsaturated clay, sand, and boulders. The eastern two-thirds of Bronx County, including the Hexagon Laboratories Site, is underlain by the Manhattan Schist, a dark-green to black, micaceous metamorphic rock. The geologic structure of the Manhattan Schist is complex. The formation is intensely folded and metamorphosed, with well-developed foliation.

A site topographic base map having a horizontal scale of 1 inch equals 20 feet and a contour interval of one foot was prepared by YEC, Inc. (Valley Cottage, New York), a New York State licensed surveyor, and is provided as Figure 1-2. Ancillary site features, including the topography of adjacent roadways and locations of water and sewer lines are also shown on this figure. In addition, approximate locations of the former North Yard, Old Plant, New Plant, South Yard, and East Yard are indicated. These location designations are used throughout this report.

As part of the Phase I RI field investigation, 15 exploratory soil borings were drilled on site (MW-1 through MW-6, B-7 through B-13, B-15, and B-16; refer to Figure 1-3 for the RI sampling locations). Each of these borings were drilled to the top of bedrock. In addition, core runs were collected at five of six monitoring well locations; rock core was collected at only one (MW-2) of the co-located shallow and deep monitoring wells (MW-1/MW-2) installed in the East Yard.

As indicated in Figure 1-4, depth to bedrock is very shallow across most of the site. Bedrock is closest to the surface near the Office/Warehouse building at MW-6 where it was encountered at a depth of one foot below ground surface (bgs). Depth to bedrock along Peartree Avenue appears to be approximately five to six feet bgs. As illustrated in Figure 1-5 (cross-section A-A'), the bedrock surface beneath the North Yard and the Old Plant appears to rise to the north towards Tufo's Wholesale Dairy to a depth of two to three feet bgs (B-13 and B-11, respectively). However, in the East Yard (cross-section B-B'), the bedrock surface appears to drop off steeply as evidenced by the bedrock elevation at MW-1 and MW-2 of 11 feet NGVD, 20 feet lower than encountered at MW-3 in the South Yard as shown on cross-section B-B'. Given the close proximity of the Hutchinson River to the site, it is possible that the steep drop-off in bedrock surface can be attributed to erosion from a former paleochannel of the river.

Based on the topography of the site, it appears that surface water runoff from the site is diverted to the combined sanitary/storm sewers which extend along Hollers Avenue and Boston Post Road. The combined sewers transport storm water runoff to a wastewater treatment plant during periods of low flow. However, during high flow storm events, the combined storm water/sanitary sewers discharge directly to the Hutchinson River.

Groundwater elevation data collected as part of the RI indicate that groundwater is present in the overburden soils across the entire site with the exception of MW-6. An isopach map indicating the thickness of the unsaturated overburden, derived from boring data and groundwater elevation data collected as part of the RI, is provided in Figure 1-6.

Groundwater at MW-6 is first encountered at a depth of approximately two to three feet below the top of bedrock suggesting that the groundwater table at the site crosses the soil/bedrock interface between MW-5 and MW-6. In addition, it appears that horizontal groundwater flow is generally in an easterly direction across the site. However, the groundwater elevation data also indicate groundwater flow to the northwest at the northern end of the site, suggesting the possible presence of a groundwater divide in the vicinity of monitoring well MW-5 separating groundwater flow at the site. The presence of a groundwater divide cannot be confirmed based on the limited number of sampling points. Comparison of groundwater elevations in the co-located shallow (overburden) and deep (bedrock) monitoring wells in the East Yard indicates that groundwater within the bedrock is hydraulically connected to the overburden aquifer.

1.2.4 Nature and Extent of Contamination

As noted in Section 1.1, the results of the RI sampling effort indicate extensive soil contamination and groundwater contamination at the Hexagon Laboratories Site (refer to Figure 1-3 for sampling locations). While only unsaturated soil contamination (Operable Unit 1) is being addressed by this FFS, the nature and extent of the contamination observed in the soil and the groundwater are provided below in order to fully represent the contamination at the site.

Nature of Contamination

Surface Soil

Surface soil contamination consists primarily of semivolatile organics (SVOCs), in particular polycyclic aromatic hydrocarbons (PAHs). Chrysene is the most pervasive of the PAHs, being detected in nine of the 16 surface and shallow subsurface soil samples at concentrations greater than the NYSDEC recommended soil cleanup objectives (RSCOs; provided in NYSDEC Technical and Administrative Guidance Memorandum HWR-94-4046, January 1994). The highest concentrations of PAHs were observed in a shallow subsurface soil sample collected beneath the floor slab of Hydrotherm No. 1 in the vicinity of an apparent oil spill. Phenolic compounds were detected in one of the 16 samples at concentrations greater than NYSDEC RSCOs. Volatile organics (VOCs) were also detected, and, in one sample, toluene, ethylbenzene, and xylenes (BTEX compounds), trichloroethene, tetrachloroethene, acetone and chlorobenzene exceeded NYSDEC RSCOs. Acetone was also detected at a concentration greater than the NYSDEC RSCO in one other shallow subsurface soil sample. Significant concentrations of unidentified VOCs and SVOCs (*i.e.*, tentatively identified compounds [TICs]) were also reported.

One pesticide, aldrin, was detected in two of the nine surface and shallow subsurface soil samples analyzed for pesticides at concentrations greater than the NYSDEC RSCO (Phase II RI soil samples were not analyzed for pesticides). However, due to matrix interference and analytical problems, there is a high probability that the detected pesticides are false positives and do not accurately represent site conditions. PCBs were detected in one surface soil sample and in one shallow subsurface soil sample at concentrations greater than the NYSDEC RSCO.

Various metals were detected at concentrations greater than the evaluation criteria (*i.e.*, the greater of the applicable background concentration and NYSDEC RSCOs). Nickel appears to be the most pervasive of the metals with exceedances in seven of the 16 surface and shallow subsurface soil samples. Both antimony and nickel appear to be pervasive in the East Yard with exceedances detected in four of the six surface and shallow subsurface soil samples collected there.

Total organic carbon (TOC) concentrations vary significantly in the nine surface and shallow subsurface soil samples ranging from approximately 0.33% to 5.1% TOC. Total petroleum hydrocarbon (TPHC) concentrations also vary significantly ranging from 0.03% to 2.8% TPHC. The 2.8% TPHC detection corresponds to a shallow subsurface soil sample collected beneath the floor slab of Hydrotherm No. 1 in the vicinity of the apparent oil spill.

<u>Subsurface Soil</u>

Subsurface soil contaminants consist predominantly of VOCs, primarily BTEX compounds (especially toluene), chlorinated aliphatics, and chlorobenzene, although other VOCs were also detected. SVOCs, primarily PAHs, were also detected in subsurface soil samples at varying concentrations. PAHs were detected at lower frequency and generally at lower concentrations than detected in the surface soil samples. Phenolic compounds were detected in 11 of the 27 subsurface soil samples analyzed for SVOCs (excluding three off-site subsurface soil background samples). Phthalates were detected in one subsurface soil sample at concentrations greater than the corresponding NYSDEC RSCOs. Other SVOCs, including

4-chloroaniline, 1,2-dichlorobenzene, dibenzofuran, and carbazole, were detected sporadically. Significant concentrations of VOC and SVOC TICs were also reported. Both VOCs and SVOCs exceed applicable NYSDEC RSCOs in many samples.

Pesticides were reported as detected in many samples. Concentrations were generally low but still exceeded NYSDEC RSCOs in seven of the 24 on-site subsurface soil samples analyzed for pesticides. However, due to matrix interference and analytical problems, there is a high probability that the detected pesticides are false positives and do not accurately represent site conditions. PCBs were detected in several samples but were, with one exception, less than the applicable NYSDEC RSCO.

Various metals were detected at concentrations greater than the evaluation criteria. Cadmium was detected at concentrations above background in six of the 27 on-site subsurface soil samples, and chromium and nickel were each detected at concentrations above background in five of the 27 on-site subsurface soil samples.

TOC concentrations were generally low, ranging from approximately 0.05% to 2.6% TOC, and the data suggest a trend of decreasing TOC with depth. A TPHC concentration of 0.12% was detected in the one on-site subsurface soil sample analyzed for this parameter.

Groundwater

Groundwater contaminants detected at the site are similar to those detected in the surface and subsurface soils. VOC contamination consists primarily of BTEX compounds, chlorinated aliphatics, acetone, and chlorobenzene. While the presence of SVOCs is less significant in the groundwater as compared to the surface and subsurface soils, several SVOCs (primarily phenolic compounds and 1,2-dichlorobenzene) were detected at concentrations greater than the NYSDEC Class GA groundwater standards (ambient water quality standards provided in NYSDEC Division of Water Technical and Operational Guidance Series 1.1.1, October 1993). Pesticides were detected sporadically and at low concentrations, although exceeding NYSDEC Class GA groundwater standards in seven of the 12 groundwater samples. However, as noted previously, there is a high probability that the detected pesticides are false positives and do not accurately represent site conditions. PCBs were detected in two of the 12 groundwater samples at concentrations well above the NYSDEC Class GA groundwater standard.

Various metals in the total metals samples were detected at concentrations greater than the NYSDEC Class GA groundwater standards. However, most were less than the NYSDEC Class GA groundwater standards in the corresponding filtered samples. Metals, including antimony, beryllium, chromium, copper, lead, thallium, and zinc, were detected at elevated concentrations in eight of the 12 total metals samples. However, in the filtered samples, only antimony (one of 12 samples), chromium (four of 12 samples) and zinc (one of 12 samples) were detected at concentrations greater than the NYSDEC Class GA groundwater standards.

TOC concentrations vary greatly, ranging from 16.6 mg/L (approximately 0.0017% TOC) to 2,720 mg/L (approximately 0.27% TOC). Concentrations of total suspended solids (TSS) and total dissolved solids (TDS) also vary greatly, ranging from 26 mg/L to 1,200 mg/L and 440 mg/L to 1,500 mg/L, respectively.

Extent of Contamination

Surface Soil

Significant VOC and SVOC contamination, excluding PAHs, was detected in only one sample, collected immediately adjacent to the South Yard UST excavation. It is likely that the South Yard USTs are the source of the contamination in this sample. PAHs were detected at concentrations in excess of NYSDEC RSCOs in 10 of the 16 surface and shallow subsurface soils across the site. The pervasive presence of the PAH contamination across the site is expected due to the proximity of the site to three major highways (US Route 1, Interstate 95, and the New York State Thruway). Particularly high concentrations of PAHs in the sample collected beneath the floor slab in Hydrotherm No. 1 are also expected due to the presence of an oil spill in the immediate vicinity of the soil sampling location.

Pesticides were detected sporadically; these detections are considered suspect due to significant matrix interference. PCBs were detected in one sample from the South Yard and one sample from the East Yard at concentrations greater than the NYSDEC RSCO. The source of the PCB contamination is unknown; PCBs may have been a component of the heat transfer oil used in manufacturing processes at the site. Metals were detected across the site at concentrations in excess of the evaluation criteria. The most exceedances (*e.g.*, antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, thallium, and zinc) were reported for a surface soil sample collected within the footprint of the former New Plant and a shallow subsurface soil sample collected in the central portion of the East Yard. The fewest exceedances were observed in a sample collected from beneath the floor slab of Hydrotherm No. 1.

Subsurface Soil

Significant VOC contamination, in particular BTEX compounds, chlorinated aliphatics, acetone, and chlorobenzene, was detected in subsurface soil boring samples collected beneath the floor slabs of the former Old Plant and New Plant as well as in samples collected in the East Yard and South Yard and from the sidewalls of the South Yard and New Plant UST excavations. PAHs were detected in samples collected from all parts of the site but at less frequency and generally lower concentrations than observed in the surface soils. Various other SVOCs, including phenolic compounds, were detected at concentrations greater than NYSDEC RSCOs in samples collected beneath the floor slabs of the former Old Plant and New Plant as well as in subsurface soil samples collected in the East Yard and in sidewall samples collected from the South Yard and New Plant UST excavations. In general, relatively low concentrations of VOCs and SVOCs were detected in samples collected from the East Yard, South Yard (excluding the UST excavation), and North Yard.

Pesticides were detected sporadically; these detections are considered suspect due to significant matrix interference. PCBs were detected in one sample, collected from beneath the floor slab of the former New Plant, at a concentration greater than the NYSDEC RSCO. As noted previously, the source of the PCB contamination is unknown; PCBs may have been a component of the heat transfer oil used in manufacturing processes at the site.

Metals were detected across the site at concentrations in excess of the evaluation criteria. Frequent exceedances were reported for samples collected from beneath the floor slab of the former Old Plant as well as in the East Yard and North Yard.

<u>Groundwater</u>

VOCs were detected at concentrations greater than the NYSDEC Class GA groundwater standards in all six of the monitoring wells. However, highest concentrations were observed in monitoring well MW-3 (South Yard), monitoring well MW-4 (New Plant), and monitoring well MW-5 (Old Plant). Concentrations of VOCs detected in deep monitoring well MW-2, located in the East Yard, are generally either greater than or comparable to VOC concentrations detected in the co-located shallow monitoring well MW-1. Relatively low concentrations of VOCs were detected in presumed upgradient monitoring well MW-6. As with VOCs, the highest concentrations of SVOC contamination were observed in monitoring wells MW-3, MW-4, and MW-5. Relatively low levels of SVOCs were detected in monitoring wells MW-1, MW-2, and MW-6.

Pesticides were detected sporadically; these detections are considered suspect due to significant matrix interference. PCBs were detected in both samples collected from New Plant monitoring well MW-4 at concentrations well above the NYSDEC Class GA groundwater standard.

Metals were detected in the total metals samples from each monitoring well at concentrations in excess of NYSDEC Class GA groundwater standards. However, in the dissolved metals samples, only antimony, chromium and zinc were detected at concentrations greater than the NYSDEC Class GA groundwater standards. Antimony was detected at an elevated concentration in one filtered sample collected from monitoring well MW-5 (Old Plant), and zinc was detected at an elevated concentration in one filtered sample collected from monitoring well MW-1 (East Yard). Chromium was detected at elevated concentrations in the filtered samples collected during both sampling rounds from monitoring well MW-4 (New Plant) and monitoring well MW-5 (Old Plant).

There is no significant difference in the TDS concentrations measured in deep well MW-2 as compared to the co-located shallow monitoring well MW-1. However, the TSS concentrations appear to be consistently lower in the deep well than in the shallow well.

1.2.5 Contaminant Fate and Transport

Observed contamination at the Hexagon Laboratories Site consists primarily of BTEX compounds, chlorinated VOCs, phenolic compounds, PAHs, and PCBs. Elevated concentrations of some metals including antimony, arsenic, cadmium, chromium, copper, mercury, nickel, selenium, thallium, and zinc were also observed. Cyanide was also detected at elevated concentration in groundwater samples collected from one monitoring well.

Contaminants in each of the environmental media studied (surface soil, subsurface soil, and groundwater) have the potential for off-site migration via physical transport and leaching of contaminants. Subsurface soils do not have the potential for migration by physical transport unless exposed by excavation.

The mobility of organic contaminants in the environment, other than by physical processes such as erosion and deposition, is controlled primarily by four chemical characteristics: vapor pressure; Henry's Law Constant; aqueous solubility; and the organic carbon - water partition coefficient (K_{oc}).

The principal mechanism for the removal of VOCs is through volatilization, as indicated by high vapor pressures and Henry's Law Constants. Based on moderate aqueous solubility and low to moderate K_{oc} values, BTEX compounds are fairly mobile in soil. However, the environmental half-life of the BTEX compounds is fairly short in soil. Any BTEX compound reaching the groundwater would be expected to be fairly persistent and mobile. The chlorinated VOCs would exhibit a fate and transport pattern similar to the BTEX compounds. The environmental half-life of chlorinated VOCs is longer, however, indicating less rapid natural attenuation of these substances in soil and groundwater. Therefore, the chlorinated VOCs are expected to be fairly persistent, especially in groundwater.

Phenolic compounds are similar to BTEX compounds in that they are moderately soluble in water and have low to moderate K_{oc} values. As a result, phenolic compounds are relatively mobile in soil and subject to leaching to groundwater. However, the environmental half-life of the phenolic compounds is fairly short in both soil and groundwater. Therefore, fairly rapid natural attenuation of these compounds is expected.

PAHs are persistent in the environment due to their low aqueous solubility, low volatility, and high K_{oc} values; PAHs tend to stay adsorbed to soils and are fairly immobile. The mobility of the PAHs is inversely related to molecular weight; low molecular weight PAHs, such as naphthalene, are more mobile and sorb less strongly to soil than higher molecular weight PAHs. This is consistent with site data in that only naphthalene was detected in groundwater at a concentration greater than the corresponding NYSDEC Class GA groundwater standard.

Because PAHs tend to be fairly immobile, off-site transport of PAHs via leaching from site soils into groundwater is not expected to be significant.

PCBs tend to sorb strongly to soil, are not subject to volatilization, and leaching and biodegradation occur slowly or not at all. PCBs have very low solubility in water; however, PCBs can exist in water at concentrations exceeding health-based criteria. PCBs are persistent in soil and significant reductions in concentration are not expected. Ordinarily, PCBs would not be expected at significant concentrations in groundwater. However, PCBs were detected at a maximum concentration of 17 µg/L in monitoring well MW-4. The detected concentrations of PCBs in MW-4 may be a result of co-solvency (*i.e.*, the PCBs are dissolved in and transported or leached with other solvents [BTEX, chlorinated aliphatics] which were also detected in MW-4).

The presence of several metals were detected at concentrations greater than the regulatory criteria. Many metals have an affinity for soils (particularly clay particles and organic matter in soils) which reduce their mobility. However, under low pH conditions, most metals can be rendered mobile. Significant leaching of metals from site soils did not occur under TCLP test conditions and, therefore, off-site migration of metals contamination from soils is not expected to be significant.

Without historic data with which to compare (and evaluate trends), the future behavior of contaminants at the site is difficult to predict. However, based on knowledge of site conditions and site history, current conditions, and the physical properties of the contaminants at the site, a few general observations can be made.

1. Overland Transport - Overland transport is not expected to be a significant transport route. SVOCs, which are present in the site surface soils at significant concentrations, may be subject to entrainment and subsequent off-site transport during rain events. This runoff would be collected in the local combined sewer (sanitary and storm), treated, and subsequently discharged to the Hutchinson River. The limited amount of contaminated sediment transported from the site to the sewer system is unlikely to be a problem for the wastewater treatment plant. However, during significant storms (*i.e.*, when the treatment plant is allowed to let some of the combined storm water/sanitary flow bypass treatment), the sediments (along with untreated wastes from other sources) would be discharged directly to the Hutchinson River.

2. Groundwater Transport - Groundwater transport is likely to be the most significant pathway for off-site migration of contaminants from the site. Contamination migrating by this pathway is expected to be primarily VOCs; SVOCs and PCBs are expected to stay adsorbed to site soils. The small of amounts of the SVOCs and PCBs which enter the groundwater will migrate slowly in the overburden and more rapidly in bedrock.

3. Volatilization - Volatilization is no longer expected to be significant at the site unless VOC-contaminated subsurface soils are exposed to the ambient air. It is likely that volatilization played a significant role in the past, reducing the concentration of VOCs in the surface soil.

1.2.6 Summary of the Human Health Risk Assessment

The limited human health risk assessment for the Hexagon Laboratories Site examined current and future exposure scenarios to determine if contaminants present in the surface soil at the site pose unacceptable carcinogenic or noncarcinogenic risks to potentially exposed populations. Ingestion of and dermal exposure to the two identified compounds of concern (lead and benzo(a)pyrene) were examined. Three populations (trespassers, site workers, and construction workers) were considered to have complete exposure pathways. Trespassers were evaluated for current- and future-use exposure while site workers and construction workers were evaluated for future-use exposure only.

Carcinogenic risks were determined to exceed target risk levels for the high end, future-use exposure scenarios examined for site workers due to the presence of benzo(a)pyrene in the surface soil. Noncarcinogenic risks were not calculated due to the lack of quantitative toxicity values for the COCs. However, for nonresidential lead risks, the USEPA-recommended methodology relating soil lead uptake to blood lead concentrations in women of childbearing age to derive risk-based remediation goals (RBRG) was used (USEPA, 1996). The 95 percent upper confidence limit concentration of lead in the surface soil exceeded the RBRG for construction workers (95 mg/kg). The average concentration of lead in the soil also exceeded the RBRG for construction workers.

SVOC TICs may also contribute to human health risks, but were not quantitatively evaluated due to the lack of quantitative toxicity values for TICs.

Only surface soil exposure was evaluated in this limited human health risk assessment, although other media (*e.g.*, subsurface soil and groundwater) at the Hexagon Laboratories Site are also known to be contaminated. The limited scope of this risk assessment may result in an underestimation of the potential risks to receptors at the Hexagon Laboratories Site.

1.2.7 Summary of the Ecological Assessment

The primary objective of the ecological assessment was to evaluate the adverse ecological impacts of contaminants at the Hexagon Laboratories Site on site biota. The potential impact of site contamination on off-site biota was not evaluated as part of this limited ecological assessment. As part of the ecological assessment, an evaluation of the existing ecological conditions at the Hexagon Laboratories Site was conducted through review of available background information and a field reconnaissance.

Because of the highly developed nature of the site, and as a result, the negligible amounts of vegetation present at the site, there does not appear to be an impact on site vegetation by contamination present at the site. In addition, since the Hexagon Laboratories Site is essentially devoid of vegetation, and it does not feature wetlands or open water, there is insufficient natural habitat available to support any threatened or endangered species. Thus, the impact of site contamination on threatened or endangered species on site is considered to be negligible.

No environmental samples were collected off site as part of the RI and, therefore, the presence of site-related contamination off-site and an assessment of such site-related contamination on off-site biota would be inconclusive. However, it is important to note the highly developed, industrial nature of the Hexagon Laboratories Site and its immediate vicinity and the corresponding lack of significant vegetation.

2.0 IDENTIFICATION OF SCGs AND REMEDIAL ACTION OBJECTIVES

2.1 Introduction

Remedial actions at the Hexagon Laboratories Site must, as a minimum, achieve overall protection of human health and the environment and comply with New York State Standards, Criteria, and Guidelines (SCGs) as well as federal applicable or relevant and appropriate requirements (*e.g.*, CERCLA Section 121(d), as amended by SARA) and local standards which are more stringent than their federal counterparts. Laws and regulations identified as SCGs are either applicable or, alternatively, relevant and appropriate.

This chapter identifies potential SCGs for the Hexagon Laboratories FFS, Operable Unit 1 - Soil. These SCGs are identified as chemical-specific, location-specific, or action-specific. SCGs are used to create a framework for determining health- and risk-based limits for remedial action and developing remedial action alternatives, as outlined in the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988).

Initially, potential SCGs are compiled. After review of the potential SCGs, media-specific preliminary remediation goals are defined. Remedial action objectives are then developed which specify the contaminants of concern (COCs), exposure routes and receptors, and acceptable contaminant levels for each exposure route (preliminary remediation goals). Ultimately, it is necessary to demonstrate that the final remedy addresses all pathways and COCs, not just those that trigger the need for remedial action.

At the Hexagon Laboratories Site, contamination is present in both the soil and groundwater. Remediation of unsaturated soil contamination (Operable Unit 1) is being addressed as part of this FFS. Remediation of saturated soil and groundwater contamination will be addressed as a separate operable unit (Operable Unit 2) and is not included in this FFS.

The remedial action alternatives evaluated as part of this FFS must attain New York State and local (New York City) environmental standards. In addition, federal environmental laws and regulations, standards, goals, guidelines or other criteria may be applicable to specific site concerns resulting from the soil contamination at the Hexagon Laboratories Site. In determining chemical-specific, location-specific, and action-specific remedial objectives for treatment of the contaminated soil, the state, local, and federal regulatory requirements listed below were considered.

2.2 Potentially Applicable Guidelines, Regulations, and Other Criteria

Potential SCGs are broken down into three groups:

1. Chemical-specific SCGs;
2. Location-specific SCGs; and
3. Action-specific SCGs;

Each of these groups of SCGs is described below. In addition, other criteria to be considered (TBC), which are not enforceable standards but may be technically or otherwise appropriate for consideration in the development of remedial alternatives, are described below. A summary of the potential SCGs and TBCs is provided in Table 2-1.

2.2.1 Chemical-Specific SCGs

Chemical-specific SCGs are defined as those which specify achievement of a particular cleanup level for specific chemicals or classes of chemicals. These standards usually take the form of health- or risk-based numerical limits that restrict concentrations of various chemical substances to a specified level. Potentially applicable guidelines and regulations include those promulgated by the City of New York, the State of New York, as well as those of the U.S. Government.

2.2.1.1 Local Standards and Guidelines (New York City)

No potentially applicable or relevant and appropriate chemical-specific regulations or guidelines were identified.

2.2.1.2 New York Standards and Guidelines

New York State chemical-specific recommended cleanup objectives exist for soil. These cleanup objectives are provided in:

- NYSDEC Technical and Administrative Guidance Memorandum (TAGM) HWR-94-4046 (Revised January 1994).

While the NYSDEC recommended soil cleanup objectives (RSCOs) are not promulgated standards, they provide soil cleanup objectives which are based on consideration of human health risk, protection of groundwater and drinking water, background concentrations of contaminants, and analytical detection limits. Various literature values, summarized in Table 2-2, were considered along with site-specific background sample data for those inorganic constituents for which the NYSDEC RSCOs specify background concentration as the cleanup objective. A summary of the COC concentrations detected in the surface and subsurface soil is provided in Tables 2-3 through 2-5, and a summary of the NYSDEC RSCOs for the COCs is provided in Table 2-6.

2.2.1.3 Federal Standards and Guidelines

Federal guidance for the cleanup of lead is provided in:

- Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (Office of Solid Waste and Emergency Response Directive #9355.4-12, July 1994).

A summary of the federal guidance for the cleanup of lead is provided in Table 2-6. No other potentially applicable chemical-specific SCGs were identified for soil. New York and RCRA criteria for identification of hazardous waste were included as action-specific SCGs since these SCGs only become applicable once contaminated soil have been removed.

2.2.2 Location-Specific SCGs

Location-specific SCGs are those which are applicable due to the location of the site or area to be remediated. No location-specific considerations (*e.g.*, wetlands, floodplains, wild and scenic rivers, historical places, archaeological significance, endangered species) which are impacted by the presence of contaminated soil or would be impacted by remedial actions at the site were identified.

2.2.3 Action-Specific SCGs

Action-specific SCGs are those which are applicable to particular remedial actions, technologies, or process options. As such, these do not define site cleanup levels or remedial action objectives, but affect the implementation of specific types of remediation. For example, although air has not been identified in the RI as a contaminated medium of concern, air quality SCGs are listed below, since some potential remedial actions may result in air emissions of toxic or hazardous substances. As such, these SCGs are not considered in the development of the remedial action objectives; these action-specific SCGs are considered in the screening and evaluation of remedial alternatives in subsequent chapters of this report.

2.2.3.1 Local Standards and Guidelines (New York City)

<u>General - Site Remediation</u>

- Allowable Noise Emission from Construction Equipment (NYC Administrative Code, Title 24, Chapter 2, Subchapter 5).

- Property Line Noise Limits (NYC Administrative Code, Title 24, Chapter 2, Subchapter 6).

- Limitations on Nuisance Noise and Vibration (NYC Zoning Resolution).

- Placement of Materials or Equipment on New York City Streets (Regulated by New York City Department of Transportation).

- Street Closures Associated with Construction Work (Regulated by New York City Department of Transportation).

- Building Alterations and Demolition (NYC Building Code, Sections 27-161, 162, 167, and 171).

<u>Discharge of Stormwater Runoff</u>

- Site Connection Proposal for New Stormwater Connection to New York City Sewer System (Regulated by the New York City Department of Environmental Protection).

<u>Emissions Control</u>

- Limitations on Emissions of Air Pollutants (NYC Administrative Code, Title 24, Chapter 1).

- Limitations on Dust and Odors (NYC Zoning Resolution).

<u>Disposal of Remediation-Derived Wastes</u>

- Regulation of Waste Haulers within New York City (New York City Waste Trade Commission).

2.2.3.2 New York State Standards and Guidelines

<u>General - Site Remediation</u>

- Noise from Heavy Motor Vehicles (6 NYCRR 450).

<u>Discharge of Stormwater Runoff</u>

- New York State Pollution Discharge Elimination System (6 NYCRR 750 - 758).

Emissions Control

- Prevention and Control of Air Contaminants and Air Pollution (6 NYCRR 200 - 202).

- Air Quality Classifications and Standards (6 NYCRR 256, 257, and 288).

Disposal of Remediation-Derived Wastes

- Regulations relating to the definition, treatment, storage, transportation and disposal of hazardous wastes (6 NYCRR 370 - 376).

- Regulations relating to the operation of solid waste management facilities (6 NYCRR 360).

2.2.3.3 Federal Standards and Guidelines

General - Site Remediation

- National Contingency Plan (40 CFR 300, Subpart E).

- OSHA Worker Protection (29 CFR 1904, 1910, 1926).

Discharge of Stormwater Runoff

- National Pollution Discharge Elimination System (40 CFR 122, 125).

Subsurface Reagent Injection

- Underground Injection Control Program Technical Criteria and Standards (40 CFR 144 and 146).

Emissions Management

- National Primary and Secondary Ambient Air Quality Standards (40 CFR 50).

- National Emission Standards for Hazardous Air Pollutants (40 CFR 61).

Disposal of Remediation-Derived Wastes

- Toxic Substances Control Act (TSCA) - Rules for Controlling PCBs (40 CFR 761), especially Subpart D (Storage and Disposal Requirements) and Subpart F (PCB Spill Cleanup Policy).

- Criteria for Municipal Solid Waste Landfills (40 CFR 258).

- RCRA Regulations Relating to the Definition, Treatment, Storage, Transportation and Disposal of Hazardous Wastes (40 CFR 260-264, 268).

2.2.4 Other Criteria to be Considered (TBC)

TBC criteria are not enforceable standards but may be technically or otherwise appropriate to consider in developing site- or media-specific remedial action objectives or cleanup goals.

- Literature data on background soil concentrations of metals (data from sources reviewed by TAMS).

NYSDEC RSCOs list "background" as a cleanup level for metals contamination. To this end, typical background concentrations of metals obtained from various literature sources, listed in Table 2-2, were considered in combination with the analytical data obtained from the three background subsurface soil samples collected as part of the RI.

2.3 Remedial Action Objectives

Remedial action objectives are medium-specific goals for protecting human health and the environment. The process followed in developing remedial action objectives consists of identification of COCs, identification of potentially applicable federal and state regulations and other guidance, and, finally, selection of the most appropriate or applicable of the regulatory or guidance values. Generally, where a chemical-specific SCG exists, it provides the basis for the remedial action objective.

2.3.1 Contaminants of Concern

As directed by NYSDEC, COCs were identified as those contaminants which exceed the NYSDEC RSCOs by greater than a factor of four. The RSCOs are based on a soil exposure scenario involving children ages one to six with an average weight of 16 kg ingesting 0.2 gram/day of soil for a five-year exposure period; this age class exhibits the greatest tendency to ingest soil. However, residential use of the Hexagon Laboratories Site is not considered probable since the site is not currently used for housing and the site is zoned as an M2 District, which is defined as zoned for general industrial use with performance characteristics less desirable than those permitted in M1 (light industrial) districts as well as for most commercial uses (New York City Department of City Planning, 1998). Therefore, the RSCOs are considered to represent an unrealistically conservative exposure scenario. According to NYSDEC, scaling of the RSCOs by a factor of four provides a rough estimate of acceptable exposure in a commercial/industrial setting. Specifically, because a person spends approximately one-quarter of his time at work (40 hours in a 168 hour week), acceptable exposure to contaminants in the work place is theoretically approximately four times greater than that for a residential exposure scenario.

By screening contaminant concentrations detected in surface and subsurface soil at the Hexagon Laboratories Site against the scaled (4 x) RSCOs, the site-specific COCs were identified. Aluminum, calcium, iron, magnesium, potassium, and sodium were not considered in the selection of COCs since these essential nutrients are major soil components. The COCs are listed below with the maximum concentration detected for each COC noted in parentheses. A summary of the COC concentrations detected in the surface and subsurface soil is provided in Tables 2-3 through 2-5.

- Benzene (55,000 μg/kg)
- Toluene (21,000,000 μg/kg)
- Ethylbenzene (770,000 μg/kg)
- Total Xylenes (3,400,000 μg/kg)
- Methylene Chloride(26,000 μg/kg)
- 1,1-Dichloroethane (27,000 μg/kg)
- 1,2-Dichloroethene (3,700 μg/kg)
- 1,2-Dichloroethane (5,100,000 μg/kg)
- 1,1,1-Trichloroethane (570,000 μg/kg)
- Trichloroethylene (880,000 μg/kg)
- Tetrachloroethylene (1,100,000 μg/kg)
- Acetone (9,200 μg/kg)
- Chlorobenzene (200,000 μg/kg)
- Total VOCs (33,230,000 μg/kg)
- Phenol (5,100 μg/kg)
- 2-Methylphenol (4,600 μg/kg)
- 4-Methylphenol (6,400 μg/kg)
- Benzo(a)anthracene (690 μg/kg)
- Chrysene (300,000 μg/kg)
- Benzo(a)pyrene (3,200 μg/kg)
- Dibenzo(a,h)anthracene (94 μg/kg)
- 4-Chloroaniline (2,700 μg/kg)
- 1,2-Dichlorobenzene (140,000 μg/kg)
- Diethylphthalate (38,000 μg/kg)
- Total SVOCs (2,895,720 μg/kg)
- Aldrin (970 μg/kg)
- Antimony (29.7 mg/kg)
- Arsenic (63.8 mg/kg)
- Cadmium (31.5 mg/kg)
- Copper (3,720 mg/kg)
- Lead (3,850 mg/kg)
- Mercury (11.9 mg/kg)
- Selenium (8.6 mg/kg)
- Zinc (12,000 mg/kg)

2.3.2 Preliminary Remediation Goals

Contaminant-specific NYSDEC soil cleanup objectives exist for all of the COCs identified in Section 2.3.1. A federal screening level exists for lead. Among these standards and guidelines, those which were selected and used as preliminary remediation goals for the site remediation are listed in Table 2-6. In all cases, the preliminary remediation goals are the stricter of the state and federal criteria.

2.3.3 Identification of Remedial Action Objectives

Contaminated unsaturated soil is the medium of concern addressed in this FFS. The remedial action objectives for the unsaturated soil are listed below:

- Prevent ingestion of and direct contact with soil which has contaminant of concern concentrations which exceed the preliminary remediation goals.

- Minimize potential for off-site migration of soil with contaminant of concern concentrations which exceed the preliminary remediation goals.

- Provide for long-term effectiveness of the remedial action through operation and maintenance of the implemented remedial action.

2.4 Identification of Contaminated Media

Soil contamination in excess of the NYSDEC soil cleanup objectives was detected across the entire Hexagon Laboratories Site, although, in general, the highest concentrations were observed in the upper site (North Yard, Old Plant, New Plant, and South Yard). Similarly, the COCs were detected at concentrations in excess of the preliminary remediation goals in both the East Yard and in the upper site. Although there are a few specific areas with particularly high levels of contamination (*e.g.*, beneath the former Old Plant and New Plant floor slabs), the contamination is generally pervasive throughout the site. Therefore, it was not considered effective or efficient to address the site contamination in terms of remediation of hot spots.

2.5 Calculation of Areas and Volumes of Contaminated Soil

As noted in Section 2.4, unacceptable concentrations of the COCs were considered to be present across the entire site. In order to facilitate the calculation of the volume of the contaminated soil, the site was divided into 12 rectangular sub-areas (see Figure 2-1). For the purposes of this FFS, the vertical extent of contamination in the upper site was considered to be to the top of bedrock or a maximum depth of six feet bgs. The six feet bgs limit was chosen somewhat arbitrarily for the two sub-areas at the eastern end of the South Yard since the overburden in these sub-areas is relatively thick compared to the remainder of the upper site; six feet bgs corresponds to the depth to bedrock in adjacent sub-areas. In the East Yard, the vertical extent of contamination was considered to be to the top of the groundwater table. The contaminated saturated soil remaining in the two eastern South Yard sub-areas (*e.g.*, soil at a depth greater than six feet bgs) and in the East Yard will be addressed along with groundwater contamination as part of a separate feasibility study.

Depth to bedrock in the upper site was determined using the overburden thickness contours developed from boring logs as part of the RI (see Figure 1-4). Unsaturated overburden thickness in East Yard sub-area was determined using the unsaturated overburden thickness contours developed from boring logs and groundwater elevation data collected as part of the RI (see Figure 1-6). The calculated volume of soil for each of the sub-areas is provided in Table 2-7. Note that during the IRM, contaminated soil was removed from both the South Yard and New Plant UST excavations. The UST excavations were backfilled with clean fill material and, therefore, the soil from these areas is not considered to be contaminated and was not included in the calculation of contaminated soil volume at the site. As indicated in Table 2-7, the total volume of contaminated soil is estimated to be approximately 6,400 cubic yards.

3.0 IDENTIFICATION OF REMEDIAL ACTION ALTERNATIVES

3.1 General Response Actions

General response actions are broad categories of remediation that may be applicable to a specific site. Because this feasibility study is focused, the list of general response actions considered was not intended to be exhaustive but was instead intended to identify those response actions that are most appropriate for this site. General response actions considered for contaminated soil at the Hexagon Laboratories Site are listed in Table 3-1 and are discussed below.

3.1.1 No Action

No action was carried through the FFS process for comparison purposes as required by the National Contingency Plan (NCP). No action is a possible response to soil contamination if it is demonstrated that the contamination is below action levels or that natural processes or attenuation will reduce the contamination to acceptable levels. This option does not include institutional controls.

3.1.2 Containment

For the Hexagon Laboratories Site, the containment option evaluated consisted of capping the entire site as a means of addressing the soil contamination. A containment alternative reduces or eliminates direct contact exposure, migration of fugitive dust and may also reduce or eliminate vertical contaminant transport (*i.e.*, leaching of contaminants into the groundwater).

3.1.3 In-Situ Treatment

The in-situ treatment option considered for this site consists of treatment of the contaminated soil in place (without removal) to reduce the toxicity by destroying organic contaminants. For the Hexagon Laboratories Site, in-situ treatment was considered in conjunction ex-situ treatment for metals contamination.

3.1.4 Ex-Situ Treatment

The ex-situ treatment option considered for this site consists of stabilizing the metals contamination by combining the contaminated soil, ex-situ, with a physical binding agent (*e.g.*, portland-type cements and pozzolanic materials) to form a crystalline, glassy, or polymeric framework surrounding the metals. Ex-situ stabilization/solidification of the metals contamination will be performed following in-situ treatment of the organics contamination.

3.1.5 Removal

As noted in Section 2.4, contamination is pervasive across the site, and, therefore, it was not considered effective or efficient to address the site contamination in terms of remediation of hot spots. Thus, removal of all contaminated unsaturated soil was considered as a remedial alternative for the Hexagon Laboratories Site. A limited soil removal (top two feet) coupled with capping was also considered for the site. Contaminated soil removed may require treatment prior to disposal.

3.1.6 Off-Site Treatment

This option consists of treating/stabilizing excavated soil at an off-site commercial facility so that contaminant concentrations or mobility are reduced to acceptable levels. Treated soil is then disposed or reused off-site. Off-site treatment was considered for soil removed from the site as part of the remediation.

3.1.7 On-Site Disposal

This option was considered for disposal of metals-contaminated soil following solidification/stabilization treatment. Following excavation of the metals-contaminated soil and ex-situ addition of the binding agent to the soil, the treated (stabilized) soil will be used to backfill the excavation.

3.1.8 Off-Site Disposal

This option consists of off-site disposal of contaminated soil. Disposal will be by landfilling in a facility permitted under RCRA Subtitle C (for wastes identified as hazardous under RCRA) or RCRA Subtitle D (for wastes not identified as hazardous under RCRA); RI sampling results suggest the potential for the presence of a relatively small volume (< 100 cubic yards) of hazardous materials at the Hexagon Laboratories Site requiring treatment or disposal. Off-site disposal was considered for soil removed from the site as part of the remediation.

3.1.9 Institutional Controls

This option consists of restricting exposure to contaminated soil by such means as deed restrictions, fencing, or warning signs. Deed restrictions to prevent future site uses which may create unacceptable exposure to the soil contamination were considered in combination with other remedial actions at the site.

3.2 Remedial Action Alternatives

In collaboration with NYSDEC, nine remedial action alternatives were identified for the Hexagon Laboratories Site. These alternatives are listed in Table 3-2 and are described below.

3.2.1 Alternative 1 - No Action

The No Action alternative was carried through the FFS process for comparison purposes as required by the NCP. No action is a possible response to soil contamination if it is demonstrated that the contamination is below the remedial action objectives or that natural processes or attenuation will reduce the contamination to acceptable levels. This option includes annual monitoring of groundwater; it does not include institutional controls (*e.g.*, access or deed restrictions).

3.2.2 Alternatives 2A, 2B, and 2C - Containment

For the Hexagon Laboratories Site, the containment alternative selected consists of capping the contaminated areas of the site. Containment options reduce or eliminate direct contact exposure, migration of fugitive dust, and may also reduce or eliminate vertical contaminant transport (*i.e.*, leaching of contaminants into the groundwater). The containment alternatives considered include placement of an asphalt cap (Alternative 2A), placement of a concrete cap (Alternative 2B), and placement of a RCRA multimedia cap (Alternative 2C). In each case, institutional controls (*e.g.*, deed restrictions) will be implemented in combination with the cap installation in order to prevent future uses of the site which would compromise the integrity of the capping system.

3.2.3 Alternative 3 - In-situ Treatment of Organic Compound Contamination/Ex-situ Treatment of Metals Contamination/On-Site Disposal

In-situ treatment consists of various measures for treating contaminated soil in place (without removal) to reduce the toxicity (by destroying the contaminants) or reduce their mobility. The in-situ treatment alternative selected for this FFS involves in-situ treatment of the organic compound-contaminated soil at the site by a technology based on Fenton's oxidative chemistry. The Fenton's reaction involves combination of an oxidant (hydrogen peroxide) and catalyst (ferrous iron) to generate a free hydroxyl radical which oxidizes organic compounds in soil (and groundwater). The primary intermediate compounds of the reaction are non-hazardous (generally carboxylic acids); final products are carbon dioxide and water, plus chloride for chlorinated compounds.

While Fenton's reaction is effective in remediation of organic compound contamination in the soil, it has no effect on the metals contamination. Ex-situ solidification/stabilization was selected as a means of immobilizing the metals contamination in the soil to prevent human exposure via such means as direct ingestion and fugitive dust inhalation, as well as to minimize the potential for the metals to leach into the groundwater. In-situ solidification/stabilization was not considered to be practical at this site due to the extensive presence of concrete floor slabs, pavement, and footings. Solidification/stabilization involves the addition of a binding agent to the contaminated soil which forms a crystalline, glassy, or polymeric framework around the contaminant. Treatment is typically accomplished using inorganic binders such as portland-type cement and pozzolanic materials. As part of this alternative, metals-contaminated soil will be excavated and treated on-site prior to use as on-site backfill. Concrete floor slabs and footers removed as part of site preparation for the solidification/stabilization process will be decontaminated prior to disposal off site.

Treatment of soil within the South Yard UST excavation and the New Plant UST excavation was not included as part of this alternative since, in both of these areas, contaminated soil was removed and replaced with clean fill as part of the IRM. In addition, in-situ treatment and subsequent solidification/stabilization of soil located beneath existing site structures (Office/Warehouse, Hydrotherm No. 1, and Concrete Block Building) was not included as part of this alternative since temporary support of these structures would be very difficult to implement and demolition of these structures is not planned as part of the site remediation. During solidification/stabilization, temporary shoring of the excavation will be constructed in areas where the excavation exceeds four feet in depth and in all excavated areas along existing buildings as a preventative measure against settlement and subsequent damage to the adjacent buildings or property.

3.2.4 Alternatives 4A and 4B: Excavation/Off-Site Disposal

Because of the pervasive nature of the soil contamination across the site, Alternatives 4A and 4B involve excavation of contaminated soil that exceeds the remedial action objectives for the COCs down to the top of bedrock or a maximum depth of six feet bgs in the upper site (North Yard, Old Plant, New Plant, and South Yard); this represents the entire overburden for much of the upper site. In the East Yard, contaminated soil will be removed down to the groundwater table (*i.e.*, all unsaturated soil). Soil within the South Yard UST excavation and the New Plant UST excavation was not included as part of these alternatives since, in both of these areas, contaminated soil was removed and replaced with clean fill as part of the IRM. In addition, removal of soil located beneath existing site structures (Office/Warehouse, Hydrotherm No. 1, and Concrete Block Building) was not included as part of these alternatives since temporary support of these structures would be very difficult to implement and demolition of these structures is not planned as part of the site remediation. Temporary shoring of the excavation in areas where the excavation exceeds four feet in depth and in all excavated areas along existing buildings is considered to be necessary as a preventative measure against settlement and subsequent damage to the adjacent buildings or property.

For both Alternatives 4A and 4B, the excavated material will be containerized, sampled, and transported/disposed off site. In Alternative 4A, non-hazardous material will be disposed of at a non-hazardous waste landfill and hazardous material (if any) will be treated/disposed of at a hazardous waste disposal facility. In Alternative 4B, non-hazardous material will be treated at an off-site facility and subsequently reused off site (*e.g.*, as road base material). Hazardous material (if any) will be treated/disposed of at a hazardous waste disposal facility. For both alternatives, temporary facilities may be required for storage of contaminated material after excavation. Clean fill will be used to backfill the excavated areas.

3.2.5 Alternatives 5A and 5B: Limited Excavation/Off-Site Disposal/Asphalt Cap

Alternatives 5A and 5B also involve excavation of contaminated soil that exceeds the remedial action objectives for the COCs down to the top of bedrock or a maximum depth of six feet bgs in the upper site (North Yard, Old Plant, New Plant, and South Yard); this represents the entire overburden for much of the upper site. However, only the top two feet of contaminated soil will be removed from the East Yard. Soil within the South Yard UST excavation and the New Plant UST excavation was not included as part of these alternatives since, in both of these areas, contaminated soil was removed and replaced with clean fill as part of the IRM. In addition, removal of soil located beneath existing site structures (Office/Warehouse, Hydrotherm No. 1, and Concrete Block Building) was not included as part of these alternatives since temporary support of these structures would be very difficult to implement and demolition of these structures is not planned as part of the site remediation. Temporary shoring of the excavation in areas where the excavation exceeds four feet in depth and in all excavated areas along existing buildings is considered to be necessary as a preventative measure against settlement and subsequent damage to the adjacent buildings or property.

For both Alternatives 5A and 5B, the excavated material will be containerized, sampled, and transported/disposed off site. In Alternative 5A, non-hazardous material will be disposed of at a non-hazardous waste landfill and hazardous material (if any) will be treated/disposed of at a hazardous waste disposal facility. In Alternative 5B, non-hazardous material will be treated at an off-site facility and subsequently reused off site (*e.g.*, as road base material). Hazardous material (if any) will be treated/disposed of at a hazardous waste disposal facility. For both alternatives, temporary facilities may be required for storage of contaminated material after excavation. Clean fill will be used to backfill the excavated areas. In addition, an asphalt cap will be placed across the site to prevent exposure to remaining contaminated soil in the East Yard and to facilitate use of the site for vehicle parking.

4.0 DETAILED ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

4.1 Introduction

In this chapter, a detailed analysis is provided for each of the nine alternatives developed for remediation of the contaminated surface and subsurface soil at the Hexagon Laboratories Site. A description of each of the alternatives is given and the associated work quantities and duration of work are estimated. To the extent possible, areas of remediation are defined. Items requiring further investigation or delineation are identified. Components of the alternatives are identified, and specific work items associated with these components are defined.

Each of the alternatives is evaluated using the seven criteria as defined in New York State Department of Environmental Conservation (NYSDEC) Technical and Administrative Guidance Memorandum (TAGM) No. HWR-4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites (revised May 15, 1990). These criteria are consistent with the first seven of the nine criteria identified in the USEPA guidance for performing Feasibility Studies under CERCLA and the NCP. These criteria are as follows:

- Compliance with New York State Standards, Criteria, and Guidelines;
- Overall Protection of Human Health and the Environment;
- Short-term Impacts and Effectiveness;
- Long-term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility, or Volume;
- Implementability; and
- Cost

A description of these criteria is presented below. The definitions and relative scoring weights presented herein are taken from the NYSDEC TAGM HWR-4030.

4.2 Description of Evaluation Criteria

4.2.1 Compliance with Applicable or Relevant and Appropriate New York State SCGs

This criterion is used to evaluate whether each alternative will meet the applicable or relevant and appropriate New York State SCGs. The detailed evaluation considers which SCGs are applicable or relevant and appropriate to each of the specific alternatives, and describes how the alternatives meet the SCGs. These include chemical-specific, location-specific, and action-specific SCGs. The final determination of applicable or relevant and appropriate SCGs is made by the NYSDEC in consultation with the New York State Department of Health (NYSDOH). For the purposes of evaluative scoring, this criterion is given a relative weight of 10.

4.2.2 Overall Protection of Human Health and the Environment

This criterion provides a final evaluation of each alternative to assess whether it achieves adequate protection of human health and the environment. This overall assessment is based on other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, compliance with SCGs, and attainment of remedial action objectives.

This criterion evaluates the extent to which an alternative achieves adequate protectiveness and describes how risks through each pathway are eliminated, reduced, or controlled through treatment, engineering, or institutional controls. This criterion considers any unacceptable short-term or synergistic (*e.g.*, cross-media) effects posed by an alternative. For the purposes of evaluative scoring, this criterion is given a relative weight of 20.

4.2.3 Short-Term Impacts and Effectiveness

This criterion evaluates the effects of the alternative during the construction and implementation phase of the alternative. The main factors addressed in this evaluation are: (a) protection of the community during remedial actions; (b) potential adverse environmental impacts resulting from construction and implementation; (c) time until remedial response objectives are met; and (d) protection of workers during remedial actions. For the purposes of evaluative scoring, this criterion is given a relative weight of 10.

4.2.4 Long-Term Effectiveness and Permanence

This criterion evaluates the results of a remedial alternative subsequent to its implementation in terms of the risk remaining at the site. The primary components of this are: (a) permanence of the remedial alternative; (b) magnitude of remaining risk; (c) adequacy of controls; and (d) reliability of controls. For the purposes of evaluative scoring, this criterion is given a relative weight of 15.

4.2.5 Reduction of Toxicity, Mobility, or Volume

This criterion addresses the NYSDEC's policy preference for remedial alternatives which utilize technologies that permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances as their principal element. This criterion focuses on the reduction in volume of contaminated media, the degree to which the treatment is irreversible, and the type and quantity of treatment residuals that will remain following treatment. For the purposes of evaluative scoring, this criterion is given a relative weight of 15.

4.2.6 Implementability

This criterion addresses the technical and administrative feasibility of the alternative, and the availability of services and materials required for its implementation. The specific components of this criterion are described below.

Technical feasibility includes: (a) construction and operation, including technical difficulties and unknowns associated with the technologies included in the alternative; (b) reliability of the technologies; (c) ease of undertaking additional remedial actions (more significant at sites for which an interim action is being conducted); and (d) monitoring considerations.

Administrative feasibility refers primarily to the necessary coordination with other offices and agencies regarding such issues as permit acquisition.

Availability of services and materials includes assessment of the availability of the treatment, storage, and disposal services necessary to implement the alternative, the availability of the technologies, and the availability of additional equipment or specialists. For the purposes of evaluative scoring, this criterion is given a relative weight of 15.

4.2.7 Cost

Cost is divided into four categories of (1) capital costs; (2) operation and maintenance (O&M) costs; (3) future capital costs; and (4) future land use costs. Capital costs include (a) direct capital costs, such as construction, equipment, land and site development, buildings and services, and disposal costs; (b) indirect capital costs, such as engineering expenses, license and permit costs, startup and shakedown costs; and (c) contingency allowances. O&M costs include (a) operating labor costs; (b) maintenance material and labor; (c) auxiliary materials and energy; (d) residue disposal; (e) purchased services; (f) administrative costs; (g) insurance, taxes, and licensing costs; (h) equipment rehabilitation or replacement cost; and (i) cost of periodic site reviews. Future capital costs are included when there is reasonable likelihood that a major component of the remedial alternative will fail and require replacement to prevent significant exposure to contaminants. Cost for future land use considers the economic loss associated with restricted use of the site and the decrease in value for property surrounding the site. Cost for future land use is determined only when deemed appropriate and significant for the site. For the purposes of this FFS, mobilization and demobilization costs are included as capital costs.

A present-worth analysis is used to evaluate expenditures that occur over different time periods. For these analyses, it is assumed that the resources and activities required to perform operation and maintenance will remain constant over the period of remediation. A discount rate of five percent is assumed. Capital and one-time O&M costs (*e.g.*, treatment and excavation) are calculated in 1999 dollars and not discounted; only ongoing (30 years or the duration of the remediation, if less than 30 years) O&M is discounted for the net present worth analysis. For the purposes of evaluative scoring, the alternative with the lowest present worth is assigned a score of 15. Other alternatives are assigned the cost score inversely proportional to their present worth.

4.3 Detailed Evaluation of Alternatives

The detailed evaluation of the remedial alternatives developed for contaminated soil at the Hexagon Laboratories Site is presented below. A summary of the major components of each alternative, with respect to the seven evaluation criteria, is presented in Tables 4-1 through 4-7. The evaluation scoring results for each alternative, prepared in accordance with TAGM No. HWR-4030 (NYSDEC, 1990), are presented in Appendix B.

4.3.1 Alternative 1: No Action

As discussed previously, this alternative was retained for comparison purposes as required by the NCP. This alternative does not include any remedial action nor does it include institutional controls (*e.g.*, access or deed restrictions). This alternative does include yearly groundwater sampling from the six existing monitoring wells as well as from six monitoring wells proposed for installation as part of the Phase II Remedial Investigation at the site. Samples will be analyzed for VOCs, SVOCs, PCBs, and target analyte list (TAL) metals. A brief report (e.g., data tabulation) summarizing the groundwater sampling data will also be prepared. Proposed sampling locations are indicated in Figure 4-1.

Compliance with Applicable or Relevant and Appropriate New York State SCGs

This alternative will not comply with the chemical-specific New York State SCGs for the contaminants of concern (refer to preliminary remediation goals listed in Table 2-6). The contaminant levels in the surface and subsurface soil are not expected to decrease appreciably over time. As noted in Section 1.2.5, volatilization is no longer expected to be significant at the site unless VOC-contaminated subsurface soil are exposed to the ambient air. It is likely that volatilization played a significant role in the past, reducing the concentration of VOCs in the surface soil. In order to assess the impact of natural attenuation on site contamination, groundwater monitoring will be conducted on an annual basis.

Action-specific SCGs (*e.g.*, OSHA regulations) will be met during all sampling activities. No location-specific SCGs were identified.

Overall Protection of Human Health and the Environment

This alternative is not protective of human health and the environment. As part of the human health risk assessment performed for surface soil exposure as part of the RI, carcinogenic risks were determined to exceed target risk levels for the high end future-use exposure scenarios examined for site workers due to the presence of benzo(a)pyrene in the surface soil. In addition, the average concentration of lead detected in site surface soil was found to exceed the risk-based remediation goal (RBRG) for construction workers as determined using USEPA-recommended methodology relating soil lead uptake to blood lead concentrations in women of childbearing age (USEPA, 1996). A quantitative human health risk assessment was not performed for the subsurface soil. However, there are likely additional human health risks associated with contamination in the subsurface soil. As part of this alternative, groundwater samples will be collected annually in order to assess the impact of natural attenuation on site contamination; natural attenuation is not expected to reduce contaminant concentrations significantly.

Short-Term Impacts and Effectiveness

No short-term impacts are anticipated during the implementation of this alternative since there are no construction activities involved. Workers who perform the groundwater sampling at the site will wear appropriate personnel protective equipment to avoid health risks due to exposure to contaminants and physical hazards. In addition, equipment used during sampling activities will be decontaminated prior to leaving the site as necessary to prevent off-site transport of contaminants.

Because this alternative does not include source removal or treatment, it will not likely meet the preliminary remediation goals. The duration of natural cleanup of soil contamination will depend on the rate of volatilization of contaminants and downward flushing of contamination during precipitation events. Volatilization and downward flushing may be important mechanisms in the reduction of VOCs and some SVOCs, but not as important for PAHs and metals. Natural biodegradation of the VOCs and SVOCs may occur, although the extent is likely to be low. Due to uncertainties in the rate and interaction of the various natural attenuation processes, no attempt was made to define the length of time required for natural cleanup or attenuation of soil contamination as part of this FFS. Therefore, a duration of 30 years (the maximum time period specified for evaluation under the USEPA FS guidance (USEPA, 1988) was assumed for this alternative.

Long-Term Effectiveness and Permanence

Because this alternative does not involve removal or treatment of the contaminated soil, the volume of contaminants in the soil, the risks associated with direct contact with the soil, and the migration of the contaminants to groundwater will remain essentially the same. Annual collection of groundwater samples will be performed to assess the natural attenuation of the contamination. However, given the volume of contaminants remaining at the site, any reduction in risk associated with natural attenuation is expected to be minimal. Therefore, while the reliability of the No Action alternative is high, the adequacy of this alternative in addressing the risk at the site is low.

Reduction of Toxicity, Mobility, or Volume

This alternative does not involve removal or treatment of the source of contamination. Therefore, the toxicity, mobility, and volume of the contamination are not expected to be significantly reduced. Natural volatilization, degradation, and flushing may reduce the levels of contamination in soil over time. However, this reduction is not expected to be significant within any reasonable amount of time given the high concentrations of contaminants detected in the site soil.

Implementability

There is no technical difficulty associated with the implementation of the No Action alternative. Groundwater sampling can be performed without sophisticated equipment, and the equipment and services necessary to perform the sampling are readily available. However, there may be some administrative difficulties in implementing this alternative as a result of community resistance to No Action given the existing human health risk associated with exposure to site soil.

Cost

The costs associated with this alternative, estimated for comparison purposes, are presented in Table A-1 (Appendix A). For costing purposes, it is assumed that groundwater will be sampled annually. No capital costs are anticipated for this alternative. The operation and maintenance (O & M) costs are estimated to total $22,200 per year over a period of 30 years. The total present worth of this alternative, based on a 30-year period and a discount rate of five percent, is $341,000.

4.3.2 Alternatives 2A, 2B, and 2C - Containment

These alternatives consist of containment of the contaminated soil exceeding the preliminary remediation goals by covering the contaminated soil with a cap. For the Hexagon Laboratories Site, three types of caps were evaluated: an asphalt cap (Alternative 2A), a concrete cap (Alternative 2B), and a RCRA multimedia cap (Alternative 2C). As discussed in Section 2.5, unacceptable concentrations of the COCs are considered to be present across the entire site, with the exception of the South Yard UST excavation and the New Plant UST excavation. (During the IRM, contaminated soil was removed from the South Yard and New Plant UST excavations and both areas were backfilled with clean fill.) However, in order to facilitate implementation and effectiveness of the capping alternatives, each cap was considered to be placed across the entire site, including the South Yard and New Plant UST excavation areas. A plan view and cross section of the proposed cap placement are provided in Figures 4-2 and 4-3, respectively.

A detailed breakdown of the various components common to the placement of each of the caps is provided below:

a. Mobilization/Temporary Facilities

- Mobilization for the general contractor will consist of the preparation of initial plans (*e.g.*, Work Plan, QA\QC Plan, Health and Safety Plans, Work Schedules, and other submissions) required by the specifications. Once the contractor receives the notice to proceed, he will begin to mobilize his equipment, personnel, offices, and temporary storage trailers to the site, construct decontamination and sanitation facilities, and delineate work zones including exclusion zones, contamination reduction zones, and support areas.

b. Site Preparation/Cap Construction

- Elevated sections of existing concrete will be removed and transported off site for subsequent recycling. All concrete in direct contact with site soil will be decontaminated (*i.e.*, pressure washed) prior to removal from the site.

- A trench (approximately 6 inches deep and 15 inches wide) will be constructed along the perimeter at locations where cap curb/retaining wall will be constructed. Soil removed in this process will be graded over the site. Concrete debris removed in this process will be decontaminated and disposed of off site. This trench will be backfilled with 6 inches of New York State Department of Transportation (NYSDOT) Item No. 4 crushed stone to act as a leveling course during curb/retaining wall construction.

- Two catch basins will be installed along the western perimeter of the upper site to facilitate connection of the stormwater runoff control system to existing 8-inch diameter sewer connections. One catch basin will be installed near the gated opening in the East Yard to facilitate discharge of stormwater runoff from the stormwater runoff control system to the curbing along Heathcote Avenue for subsequent discharge to the catch basin at the intersection of Heathcote and Hollers Avenues. Soil excavated during catch basin installation will be graded over the site. Concrete debris removed in this process will be decontaminated and disposed of off site.

- The site will be graded and a geotextile will be placed over the ground surface. The purpose of the geotextile is to provide reinforcement to the cap, to minimize migration of the fines component of overlying fill, and to act as a separation layer between the contaminated soil and the uncontaminated cap materials. The provision of reinforcement and minimization of fines migration both prevent differential settlement of the cap which could result in cracking, thereby compromising the integrity of the capping system.

- A 4-inch layer (minimum) of NYSDOT Item No. 4 crushed stone will be placed over the geotextile to provide a suitable base foundation for the cap.

- The cap will be sloped at a one percent grade to promote stormwater run-off and to minimize surface ponding.

- A perimeter drain will be installed along the western edge of the site to collect stormwater run-off from the upper site (North Yard, Old Plant, New Plant, and South Yard) and discharge it to the existing storm sewer along Peartree Avenue.

- A perimeter drain will be installed along the gated opening in the East Yard to collect stormwater runoff from the East Yard and discharge it to Heathcote Avenue where it will be directed to the existing catch basin at the intersection of Heathcote Avenue and Hollers Avenue.

- The sidewalk and curbing will be extended from the northeast corner of the East Yard along Heathcote Avenue to Hollers Avenue in order to direct stormwater runoff from the East Yard perimeter drain to the existing catch basin at the intersection of Heathcote Avenue and Hollers Avenue.

- A curb/retaining wall will be constructed around the perimeter of the cap as necessary to contain contaminated materials exposed at the edges of the cap and to direct stormwater to the stormwater collection system. This curb/retaining wall will be constructed using Versa-Lok masonry blocks, or equivalent; due to the potential presence of significant amounts of concrete and debris in the subsurface, Versa-Lok masonry blocks were selected for curb/retaining wall construction to avoid the need for the construction of footers.

c. Long-Term Monitoring

- Long-term effectiveness of the cap in reducing migration of contaminants from the unsaturated overburden to the groundwater will be monitored indirectly by annual sampling of the six existing monitoring wells and six monitoring wells proposed for installation as part of the Phase II Remedial Investigation of the site. Samples will be analyzed for VOCs, SVOCs, PCBs, and TAL metals.

A breakdown of components specific to each of the cap types is provided below:

Alternative 2A - Asphalt Cap

- The asphalt portion of the capping system will consist of a 2-inch thick binder course overlain by a 2-inch thick wearing course. A geogrid will be placed between the binder course and the wearing course to provide additional reinforcement to the asphalt cap in order to minimize crack formation. A typical cross-section of the proposed asphalt cap is provided in Figure 4-4. The asphalt cap preliminary design is based on a typical parking lot pavement design as specified in Means Site Work & Landscape Cost Data, 1996.

Alternative 2B - Concrete Cap

- The concrete portion of the capping system will consist of an 8-inch thick concrete slab (4,000 psi) reinforced with welded wire mesh to minimize crack formation. A typical cross-section of the proposed concrete cap is provided in Figure 4-5. The concrete cap preliminary design is based on an H-15 vehicle loading (30,000 lbs. total, 24,000 lbs at heaviest axle).

Alternative 2C - RCRA Multimedia Cap

- A 6-inch clean fill layer will be placed on top of the crushed stone base course to provide a cushion for the geosynthetic components of the cap.

- A geosynthetic clay liner (GCL) will be placed over the clean fill layer. The purpose of the GCL is to protect the overlying geomembrane from puncture and to provide a low permeability layer directly beneath the geomembrane in order to minimize infiltration of water into the underlying soil. A GCL consists of a layer of bentonite sandwiched between two layers of geotextile which are needle-punched together; the needle-punching helps to keep the bentonite powder in place. Bentonite is a clay that swells upon contact with water and, as a result, has an extremely low permeability. The permeability of a GCL is on the order of 1×10^{-10} cm/sec. The GCL is a cost-effective replacement for the three feet thick clay layer usually specified for RCRA multimedia caps.

- A geomembrane will be placed over the GCL to prevent infiltration. The GCL acts as a backup low-permeability layer to the geomembrane; if a tear develops in the geomembrane, the GCL will seal the leak.

- A geonet will be placed on top of the geomembrane to facilitate the drainage of surface infiltration away from the geomembrane.

- A 9-inch thick fill (NYSDOT item No. 4) layer will be placed on top of the geonet and geomembrane to protect these layers from puncture and tearing.

- The final layer of the RCRA multimedia cap system will consist of asphalt (2-inch binder course and 2-inch wearing course) as described above for Alternative 2A. While topsoil is usually used as the cap surface, it is not compatible with the industrial/commercial future use scenarios envisioned for this site. A typical cross-section of the proposed RCRA multimedia cap is provided in Figure 4-6.

Compliance with Applicable or Relevant and Appropriate New York State SCGs

None of the capping alternatives will comply with the chemical-specific New York State SCGs (refer to preliminary remediation goals listed in Table 2-6) since contamination will remain on site in each case. While natural attenuation is not expected to reduce contaminant concentrations appreciably over time, groundwater samples will be collected annually in order to assess the impact of natural attenuation on site contamination and to assess the effectiveness of the cap in reducing vertical migration of contaminants from the unsaturated soil to the groundwater.

Action-specific SCGs (*e.g.*, building permits, discharge permits, noise limitations, and OSHA regulations) will be complied with as part of the cap construction process and long-term groundwater monitoring activities. No location-specific SCGs were identified.

Overall Protection of Human Health and the Environment

Although contamination will remain on site and, as a result, these alternatives will not meet the preliminary remediation goals, each of the capping alternatives is considered to be protective of human health since capping of the site will eliminate potential human exposure pathways. Carcinogenic risks that were determined to exceed target risk levels will be reduced to acceptable levels since there will be no complete exposure pathways. Each of the capping alternatives is considered to be largely protective of the environment since installation of the capping system will minimize infiltration of rainwater into the subsurface and the subsequent migration of contaminants from the unsaturated overburden into the groundwater. However, none of the caps will reduce the lateral migration of contaminants due to groundwater flow. Annual groundwater monitoring will be performed in order to assess the combined impact of the capping system and natural attenuation on site contamination.

In order to maintain the protection of human health and the environment, these alternatives must be combined with institutional controls (*e.g.*, deed restrictions) which will ensure that future uses of the site are consistent with the intent of the cap (*i.e.*, to prevent exposure to the contaminated soil). For example, the deed restrictions may include prohibition of any construction on site which compromises the integrity of the capping system.

Short-Term Impacts and Effectiveness

Each of the capping alternatives can be implemented without significant risk to the community, environment, or worker safety. While there may be minor adverse air impacts due to fugitive dust or volatile emissions during the placement of the initial base course, air monitoring of organic vapor and particulates will be conducted during these operations to protect the surrounding community. Action levels will be established prior to intrusive activities such that exceedance of an action level during construction triggers a corrective action (*e.g.*, wetting agents may be used to control dust). Workers who perform the site preparation and cap construction at the site will wear appropriate personnel protective equipment to avoid health risks due to exposure to contaminants and physical hazards. In addition, vehicles and equipment used within the exclusion zone will be decontaminated prior to leaving the site as necessary to prevent off-site transport of contaminants.

Because of the highly developed, industrial nature of the Hexagon Laboratories Site and its immediate vicinity, implementation of this alternative is not expected to significantly impact the environment in terms of affecting habitat or vegetation.

Because these alternatives do not include treatment or removal of site contamination, the preliminary remediation goals will not be met. For the purposes of this FFS, a duration of 30 years (the maximum time period specified for evaluation under the USEPA FS guidance (USEPA, 1988) was assumed for these alternatives. Installation of the cap, including installation of the stormwater runoff control system, is estimated to be complete within approximately four months of initiation.

Long-Term Effectiveness and Permanence

With proper inspection and periodic maintenance (*e.g.*, patching and sealing), each of the capping systems can be considered both adequate and reliable. However, none of these alternatives is considered to be permanent since contaminated soil will be left in place, and, as such, it remains a potential source of contamination in the future. While the capping systems will minimize infiltration of precipitation, thereby reducing vertical migration of the contaminants from the unsaturated soil to the groundwater, none of the capping systems will reduce the lateral migration of contaminants due to groundwater flow.

The presence of the contamination in the subsurface limits the long-term effectiveness of these alternatives in that site useage patterns cannot be changed without possible health or environmental impacts. In order to ensure that future site useage is consistent with the intent of the capping system, institutional controls (*e.g.*, deed restrictions) will be invoked.

It is important to note that, of the three capping alternatives, the RCRA multimedia cap likely provides the best protection against potential future vertical migration of contamination from the unsaturated overburden to groundwater due to the presence of the geomembrane and GCL low permeability layers.

Reduction of Toxicity, Mobility, or Volume

Since the contaminated soil will not be removed under any of the capping alternatives, it will continue to provide a source of contamination. Contamination remaining on site is expected to remain fairly constant; with the installation of a cap, very little natural attenuation due to leaching or volatilization is expected to occur. While the volume of contamination will not be reduced in any of these capping alternatives, capping is expected to reduce the mobility of the contamination as a result of the decrease in infiltration of precipitation to the site soil. However, none of the capping alternatives will impact the lateral migration of contaminants due to groundwater flow. For each of the capping alternatives, the toxicity of site contamination will be reduced indirectly since the cap will prevent direct exposure to the contaminated soil.

Implementability

Each of the capping alternatives is considered to be readily implementable from a technical perspective. Capping has been used successfully to contain hazardous wastes on numerous sites. Execution of the work items that form these alternatives will not require sophisticated equipment, technology, or specialists. Installation of each of the capping systems and long-term groundwater monitoring are easily implementable using readily available materials and services. However, installation of a cap may limit the implementation of potential future remedial alternatives selected for remediation of site groundwater since any type of on-site well construction (extraction or injection) will compromise the integrity of the cap.

While none of the capping alternatives is conducive to subsequent soil sampling as part of a monitoring program (collection of samples would compromise the integrity of the cap), the existing monitoring wells and the monitoring wells proposed for installation as part of the Phase II Remedial Investigation of the site can be used to monitor the effectiveness of the capping system by monitoring contamination levels in the groundwater.

Installation of a capping system, specifically installation of the stormwater runoff control measures, will require coordination with and approval by New York City agencies (*e.g.*, Sewer Department and the Department of Transportation) as well as coordination with adjacent property owners. However, from an administrative perspective, each of the capping options is considered to be readily implementable. That is, there are no specific problems anticipated in obtaining permits or approvals from the various New York City agencies and adjacent property owners.

Cost

The quantities, unit costs, and subtotal costs for the various work items in these alternatives, estimated for comparison purposes, are presented in Tables A-2A through A-2C (Appendix A). For Alternative 2A (asphalt cap), the capital costs are estimated to total $768,125, and the O&M costs are estimated to total $23,600 per year over a period of 30 years. The total present worth of this alternative, based on a 30-year period and a discount rate of five percent, is $1,131,000.

For Alternative 2B (concrete cap), the capital costs are estimated to total $981,335, and the O&M costs are estimated to total $23,600 per year over a period of 30 years. The total present worth of this alternative, based on a 30-year period and a discount rate of five percent, is $1,344,000.

For Alternative 2C (RCRA multimedia cap), the capital costs are estimated to total $999,825, and the O&M costs are estimated to total $23,600 per year over a period of 30 years. The total present worth of this alternative, based on a 30-year period and a discount rate of five percent, is $1,363,000.

4.3.3 Alternative 3 - In-situ Treatment of Organic Compound Contamination/Ex-situ Treatment of Metals Contamination/On-site Disposal

The first phase of Alternative 3 involves in-situ oxidation of the organic COCs in soil at the Hexagon Laboratories Site using a technology based on Fenton's reaction. Fenton's reaction involves combination of an oxidant (hydrogen peroxide) and catalyst (ferrous iron) to generate a free hydroxyl radical which, in turn, oxidizes organic compounds in the contacted soil and groundwater. The primary intermediate compounds of the reaction are non-hazardous (generally carboxylic acids); final products are carbon dioxide and water, plus chloride for chlorinated compounds. A Fenton's reaction treatment process typically involves injection of oxidant, catalysts, viscosity enhancers, mobility agents and/or other reagents as appropriate into the subsurface via single or multiple injection points or trenches.

Sixteen horizontal 4-inch diameter, approximately 90-feet long PVC injection trenches will be installed in the upper site. The trenches will be installed 15 feet apart and at a depth of approximately one to two feet bgs. Chemical addition and distribution is primarily accomplished by gravity feed. Treatment of contaminated soil above the trenches will occur through capillary action of the injected reagents; a slight pressure (20 to 30 psi) may be applied as required to achieve more effective distribution of the reagents. In the East Yard, where the overburden thickness is greater, injection well points instead of horizontal trenches will be installed for more effective distribution of reagents. Sixteen vertical 4-inch diameter PVC injection points will be installed in the East Yard (assuming radius of influence of 15 feet). These injection points will be screened from the bedrock interface to approximately one to two feet bgs.

The Fenton's reaction-based in-situ oxidation process developed by In-Situ Oxidative Technologies, Inc. (Isotec - Lawrenceville, New Jersey) involves injection of the iron catalyst followed by injection of hydrogen peroxide. According to Isotec, this reaction takes place at neutral pH, and no pH change is expected over the course of the treatment. Therefore, no increase in mobilization of metals is expected as a result of the in-situ oxidation. Isotec proposes to add the reagents over two injection events; approximately one half of the reagents estimated by Isotec to be required for complete treatment will be applied during each injection event, with a waiting period of approximately three to four weeks between injection events. If soil monitoring data collected after the second injection event indicates treatment goals have not been achieved, a subsequent application (*i.e.*, two additional injection events) will be conducted. The subsequent treatment will not be applied site-wide as in the initial application; rather, reagents will be injected only in areas where analytical data indicates that treatment goals have not been met.

If free-phase product is encountered over a large area at a thickness greater than 0.25 inches, the product will be removed prior to treatment as feasible to avoid the need for excessive reagent application as would be required to treat the free-phase product.

Bench-scale testing will be conducted prior to full-scale implementation of Fenton's reaction technology at the site in order to determine the treatment effectiveness of full-scale remediation.

Once the site soil is determined to have met the treatment goals for the organic COCs, the second phase of Alternative 3, ex-situ remediation of metals-contaminated soil will proceed. As with the organics contamination, the metals contamination is pervasive across the site. In order to minimize the health and environmental risk associated with the metals contamination, a physical binding agent will be added to the contaminated soil to encapsulate the metals, thereby minimizing the potential for direct exposure to the metals and leaching of the metals into the groundwater. The solidification/stabilization will be accomplished by excavating the contaminated soil and mixing the soil with the binding agent in an on-site pug mill. All concrete (*e.g.*, floor slabs, vaults, and secondary containment slabs) removed during the excavation process will be separated from the soil and decontaminated prior to off-site transport and disposal as non-hazardous construction and demolition debris. The treated soil will be used to backfill the excavation.

A detailed breakdown of the components of this alternative is presented below. The proposed layout for the in-situ oxidation injection wells and trenches is indicated in Figure 4-7, and the proposed layout of temporary shoring is indicated in Figure 4-8. The proposed layout of the stormwater runoff control system is provided in Figures 4-9 and 4-10. Note that separate contractors will be required for the in-situ oxidation of organics contamination, the site preparation/concrete removal activities, and the ex-situ solidification/stabilization of metals contamination. In addition, the in-situ oxidation contractor will not perform the injection well and injection trench installation. For the purposes of this FFS, it is assumed that one general contractor will be responsible for implementation of this alternative. The general contractor will install the injection trenches and well points, perform the site preparation/concrete removal operations, and install the stormwater runoff control system. Subcontractors will perform the in-situ oxidation of the organics contamination and the solidification/stabilization of the metals contamination.

a. Bench Tests

- Samples of soil from the site with detectable levels of the organic COCs will be collected for laboratory bench-scale testing by the contractor conducting the in-situ oxidation. The bench-scale tests will evaluate whether or not the selected Fenton's reaction-based process is effective for treating site soil and, if effective, will determine the optimum dosage of reagent for treatment.

- Samples of soil from the site with detectable levels of the metal COCs will be collected for laboratory bench-scale testing by the contractor performing the solidification/stabilization. The bench-scale tests will evaluate the effectiveness of solidification/stabilization on reducing the leaching of metals into the groundwater and will determine the necessary blend of the soil and binding agent to yield the desired level of stabilization. Solidified/stabilized soil will be analyzed using neutral aqueous shake extraction (ASTM D3987) and the synthetic precipitation leaching procedure (SW-846 Method 1312) in order to approximate leachate concentrations resulting from direct contact of the solidified/stabilized soil with groundwater and infiltrated precipitation. In each case, the contractor must demonstrate that the maximum leachate concentration does not exceed the NYSDEC Class GA groundwater standards.

b. Mobilization/Temporary Facilities

- Mobilization for the contractors will consist of the preparation of project plans (*i.e.*, Work Plan, QA/QC Plan, Health and Safety Plans, Work Schedules, and other submissions) required by the specifications. Once the contractors receive notice to proceed, they will begin to mobilize their respective equipment, personnel, offices, and temporary storage trailers to the site, construct necessary decontamination and sanitation facilities, and delineate work zones including exclusion zones, contamination reduction zones, and support area.

c. Installation of Reagent Injection System

- Sixteen 4-inch diameter PVC injection wells will be installed in the East Yard as part of the vertical well injection system. Proposed locations are indicated in Figure 4-7. Wells will be screened from the overburden-bedrock interface to just below the ground surface.

- Sixteen trenches (2 feet wide by 3 feet deep by 90 feet long) will be constructed and 4-inch diameter slotted PVC pipe will be installed within each of the trenches at a depth of one to two feet bgs as part of the horizontal injection system in the upper site. Existing concrete in the areas of horizontal trench excavations will be removed and disposed of off site. All concrete in direct contact with contaminated soil will be decontaminated (*i.e.*, pressure washed) to remove residual soil prior to off-site disposal. Proposed locations of the trenches are indicated in Figure 4-7.

- Approximately 220 cubic yards of soil will be excavated during the horizontal trench installation.

- Approximately 210 cubic yards of gravel will be installed as pipe bedding material from the bottom of the trench to approximately one foot bgs.

- The top foot of each trench will be backfilled with the material from the trench excavation.

- Contaminated soil cuttings resulting from installation of the vertical wells and residual native material from the horizontal trench construction will be characterized for disposal. It is assumed that this material will be disposed of off site as non-hazardous waste.

d. In-situ Oxidation Soil Treatment System

- The in-situ oxidation contractor will supply all materials and equipment associated with the Fenton's reaction-based treatment process, including but not limited to, chemical reagents (oxidants and catalysts), reagent application/ injection system, and system monitoring equipment. As noted above, the in-situ oxidation contractor will not install the injection wells or trenches.

e. In-situ Oxidation Treatment Process Monitoring

- Treatment verification monitoring will include collection of subsurface soil samples from 20 random locations across the site. The monitoring program includes baseline (prior to treatment) sampling and sampling after each round of treatment using Fenton's reagent. All samples will be analyzed for VOCs, SVOCs, pesticides and PCBs. Results from the monitoring program will determine whether or not additional rounds of reagent application are required to meet the treatment objectives.

f. Site Restoration/Demobilization following In-Situ Oxidation

- After verification monitoring indicates treatment goals have been achieved for the organics contamination, demobilization will begin. All in-situ oxidation-related equipment, personnel, temporary structures, and decontamination facilities will be moved off site. The horizontal injection trenches will be left on site. The vertical injection wells will be properly abandoned.

g. Excavation of Metals-Contaminated Soil

- Remnant concrete slabs and asphalt paving will be removed prior to soil excavation. Broken concrete and asphalt will be disposed of/recycled off site as non-hazardous construction and demolition debris. All concrete and asphalt in direct contact with contaminated soil will be decontaminated (*i.e.*, pressure-washed) prior to transport off site.

- Temporary shoring will be constructed around the perimeter of excavations exceeding four feet in depth and will be constructed around all buildings adjacent to an excavation. The shoring is a preventative measure against settlement and subsequent failure of or damage to adjacent structures and property. Proposed shoring layout is indicated in Figure 4-8.

- Excavation will be conducted using conventional construction equipment such as backhoes and front-end loaders. Soil within the upper site, excluding soil beneath existing site structures (Office/Warehouse, Hydrotherm No. 1) and from within the limits of the New Plant and South Yard UST excavations, will be excavated to the top of bedrock or to a maximum depth of six feet bgs. Soil within the East Yard, excluding soil beneath the existing Cinder Block Building, will be excavated to the top of the groundwater table.

- During excavation, existing on-site shallow monitoring wells will be removed. Existing on-site deep monitoring wells will be supported and protected as necessary to prevent damage. The removed shallow monitoring wells will be replaced upon completion of the site backfill operations to facilitate long-term monitoring of the effectiveness of the stabilization treatment.

h. Solidification/Stabilization

- Excavated soil will be loaded into the feed hopper of a screening plant, where material larger than 1.5 inches in diameter will be removed. The material retained on the screen will be replaced on site without treatment.

- Material smaller than 1.5 inches in diameter will be conveyed to the soil feed hopper of the solidification/stabilization plant (*i.e.*, pug mill). The solidification/stabilization plant is a mobile plant consisting of a soil feeder, mixer, silo, measurement system, and discharge conveyor. The screened material is fed into the front end of the pug mill via a variable speed belt conveyor. A programmable logic controller (PLC) controls the throughput rate of the soil as well as the feed rate of reagent(s) which are fed from the reagent feed hopper. The PLC also controls the volume of hydration water (if required) pumped to the pug mill from a separate holding tank (*e.g.*, Frac Tank). The soil, treatment reagent(s), and water are mixed within the pug mill.

Upon completion of the mixing process, the stabilized soil is discharged from the stabilization plant and replaced on site.

- The type and quantity of stabilization treatment reagent(s) necessary for treatment of the site soil will be determined in a treatability study prior to implementation on site. Based on available information, STC Remediation has proposed a preliminary treatment process which consists of the addition of a co-precipitating reagent and a pH buffer reagent. The reagents would be added in dry powdered or granular form at approximately three to eight percent by weight. Due to the low stabilization reagent percent addition, the volume increase for the treated soil is expected to be minimal (two percent).

i. Backfill/On-site Disposal

- Treated soil will be used as backfill at the site. Depending on the type and quantity of binding agent needed to meet the treatment goals, the treated soil may have a consistency ranging from a workable soil to a concrete-like solid. However, at a minimum, the top six inches of the treated soil will be a concrete-like solid to reduce the potential for human exposure via ingestion or inhalation. This is necessary since the metals contamination is encapsulated, not destroyed or removed, in this treatment process.

- The treated soil surface will be graded at a one percent slope to facilitate control of stormwater runoff.

- A perimeter drain and two catch basins will be installed along the western edge of the upper site to collect stormwater run-off from the upper site and discharge it to the existing storm sewer along Peartree Avenue. See Figures 4-9 and 4-10 for the proposed layout of the stormwater runoff control system.

- A perimeter drain and one catch basin will be installed along the gated opening in the East Yard to collect stormwater runoff from the East Yard and discharge it to Heathcote Avenue where it will be directed to the existing catch basin at the intersection of Heathcote Avenue and Hollers Avenue. See Figures 4-9 and 4-10 for the proposed layout of the stormwater runoff control system.

- The sidewalk and curbing will be extended from the northeast corner of the East Yard along Heathcote Avenue to Hollers Avenue in order to direct stormwater runoff from the East Yard perimeter drain to the existing catch basin at the intersection of Heathcote Avenue and Hollers Avenue.

j. Site Restoration/Demobilization following Solidification/Stabilization

- Upon completion of site backfill operations, four on-site shallow monitoring wells removed during excavation will be replaced to facilitate long-term monitoring of the effectiveness of the stabilization treatment.

- Once the site has been backfilled, the stormwater runoff control measures (*e.g.*, perimeter drain, sidewalk/curb extension) have been implemented, and the monitoring wells have been installed, demobilization will begin. All equipment, personnel, temporary structures, decontamination and sanitation facilities will be moved off site.

k. Long-Term Monitoring

- Long-term effectiveness of the metals stabilization will be monitored indirectly by annual sampling of the six existing (includes four replaced wells) monitoring wells and six monitoring wells proposed for installation as part of the Phase II Remedial Investigation of the site. Samples will be analyzed for TAL metals.

Compliance with Applicable or Relevant and Appropriate New York State SCGs

This alternative will meet the chemical-specific SCGs for the organic COCs (refer to preliminary remediation goals listed in Table 2-6) since the organic contaminants will be effectively destroyed using the in-situ Fenton's reaction-based oxidation process. It is important to note that treatment by this process will address contamination in areas beyond the scope of this FFS. Specifically, as a result of implementation of the Fenton's reaction-based treatment, the organics contamination in the saturated soil and associated groundwater will be destroyed.

This alternative will not meet the chemical-specific SCGs for the metal COCs since the metals will not be destroyed or removed as part of the solidification/stabilization process. While there may be some dilution effect associated with the addition of the binding agent and mixing of the soil, this dilution is not expected to significantly reduce the metal concentrations. However, because the metals will be encapsulated, the associated toxicity and mobility will be effectively eliminated. In order to monitor the effectiveness of the solidification/stabilization in reducing metals mobility, groundwater samples will be collected annually and analyzed for TAL metals.

Applicable action-specific SCGs (*e.g.*, building permits, noise limitations, OSHA regulations) will be complied with during the treatment and long-term monitoring phases of this alternative. No location-specific SCGs were identified.

Overall Protection of Human Health and the Environment

This alternative is considered to be protective of human health and the environment. By implementing the first phase of this alternative (in-situ oxidation), the organic COCs in the soil will be oxidized to non-toxic byproducts. Because these contaminants will be destroyed, this part of Alternative 3 eliminates the risk associated with direct exposure to them as well as the potential for their migration into the groundwater. By implementing the second phase of this alternative (solidification/stabilization), the metal COCs will be encapsulated by a non-toxic physical binding agent. Although these metals will not be destroyed in the solidification/stabilization process, the risks associated with direct exposure to them and with their migration into the groundwater at unacceptable concentrations (*i.e.*, concentrations greater than the NYSDEC Class GA groundwater standards) will be eliminated. In order to assess the long-term effectiveness of the solidification/stabilization on reducing the mobility of the metal COCs, annual groundwater monitoring will be conducted.

Remaining contaminated groundwater and saturated soil will be addressed as part of a separate feasibility study. Until remediation of these media is complete, institutional controls (*e.g.*, deed restrictions) which prevent exposure to contaminants in the saturated soil and groundwater will be necessary.

Short-term Impacts and Effectiveness

There are several potential short-term impacts to the community (*e.g.*, noise, dust, and fugitive contaminant emissions) that may arise during construction of the in-situ oxidation injection system. There is an even greater potential for short-term impacts to the community (*e.g.*, noise and fugitive dust) during the excavation and subsequent treatment of the metals-contaminated soil. To minimize these impacts, site access will be restricted during construction and remediation activities. Continuous air monitoring of both organic vapor and particulates will also be conducted during these operations to protect the surrounding community. Action levels will be set prior to any intrusive activities, and, if these action levels are exceeded, an appropriate corrective action will be implemented (*e.g.*, wetting agents may be used to control dust).

Temporary shoring will be used as a preventative measure against settlement and subsequent damage to adjacent buildings or property during the excavation of the metals-contaminated soil. Temporary shoring will be constructed along the sides of all excavations which exceed a depth of four feet bgs. In addition, temporary shoring will be constructed along the perimeter of all buildings adjacent to an excavation, regardless of depth. This shoring will be removed as the excavations are backfilled and compacted.

Vehicles and equipment used within the exclusion zone will be decontaminated prior to leaving the site as necessary to prevent off-site transport of contaminants. Personnel performing construction, remediation, and monitoring activities will use appropriate personnel protection equipment and health and safety procedures to minimize contact with contaminants. Because of the highly developed, industrial nature of the Hexagon Laboratories site and its immediate vicinity, implementation of this alternative is not expected to significantly impact the environment in terms of affecting habitat or vegetation.

Byproducts formed as a result of the Fenton's reagent treatment are non-hazardous, (generally carboxylic acids, carbon dioxide, chloride, and water), and do not represent an adverse short-term impact for the alternative. No short-term impacts are expected during the Fenton's reagent application since all chemicals used in the Fenton's reagent method are non-hazardous. No hazardous byproducts are formed as a result of soil solidification/stabilization, and the binding agents used for solidification/stabilization are non-hazardous.

For the organic COCs, preliminary remediation goals will be met at the completion of the in-situ oxidation process; confirmatory sampling will be conducted to verify that these goals have been met. The time estimated to install the injection system and remediate the organics contamination is approximately 6.5 months, which includes mobilization, installation of injection wells, two reagent applications, and confirmatory sampling after remediation.

The preliminary remediation goals will not be met for the metal COCs upon completion of the solidification/stabilization treatment since this treatment does not destroy or remove the metals (*i.e.*, preliminary remediation goals for the metals will not be achieved). While there may be some dilution effect associated with the addition of the binding agent and mixing of the soil, this dilution is not expected to significantly reduce the metal concentrations. For the purposes of this FFS, a duration of 30 years (the maximum time period specified for evaluation under the USEPA FS guidance (USEPA, 1988) was assumed for this component of the alternative. The time estimated to complete the excavation, solidification/stabilization, on-site disposal of the metals-contaminated soil, installation of the stormwater runoff control system, and demobilization is approximately 6.5 months.

Long-Term Effectiveness and Permanence

Implementation of this alternative is considered to be a permanent remedy since the human health and environmental risks associated with the site soil are effectively eliminated by the oxidation of the organic contaminants and the solidification/stabilization of the metals. This alternative will eliminate the unsaturated soil (and saturated soil with respect to organics contamination) as a continuing source of contamination to the groundwater, and as a result, it is expected that the groundwater contamination will diminish over time. However, it is important to note that, because contaminated saturated soil (metals only) and groundwater will remain after remediation, institution controls (*e.g.*, deed restrictions) must be invoked to prevent exposure to these media; the saturated soil and groundwater contamination will be addressed as part of a separate feasibility study.

Fenton's reaction-based in-situ oxidation has been demonstrated to be effective in the removal of BTEX and chlorinated compounds in soil and groundwater at other sites. It is less effective at treating PAHs and PCBs and is not effective for treatment of metals. The effectiveness of this technology in treating site soil will be determined through bench-scale studies prior to full-scale implementation. Upon completion of the treatment, confirmatory sampling will be conducted to demonstrate achievement of the preliminary remediation goals for the organic COCs.

Solidification/stabilization is a conventional method for treatment of metals-contaminated soil. The effectiveness of the solidification/stabilization process in immobilizing the metals will be determined through bench-scale studies prior to full-scale implementation. Long-term effectiveness of the metals stabilization will be assessed indirectly through annual groundwater monitoring.

Reduction of Toxicity, Mobility, or Volume

The volume of the organic COCs will be greatly reduced due to the implementation of the Fenton's reaction-based in-situ oxidation treatment process. Similarly, the toxicity of these compounds will be greatly reduced since in-situ oxidation yields such non-hazardous byproducts as carboxylic acids, carbon dioxide, chloride, and water. Consequently, the toxicity and mobility of the organic COCs will cease to be a concern.

Solidification/stabilization of the metal COCs will not reduce the volume of the contaminants since these metals are not destroyed in the process. It does, however, effectively eliminate concerns over their toxicity since they are encapsulated and are, therefore, no longer accessible to direct exposure. Concerns over mobility of the metal COCs will also be effectively eliminated since the concentration of these metals leaching from the treated soil will not exceed the NYSDEC Class GA groundwater standards. Thus, by implementing this alternative, neither the organic nor the metal COCs in the unsaturated soil (nor the organic COCs in the saturated soil) will act as a continuing source of contamination to the groundwater.

Implementability

Standard construction methods and equipment will be used to construct the injection system; consequently, materials and services necessary for installation of the injection wells and trenches are readily available. Implementability of Fenton's reaction-based in-situ oxidation has been demonstrated at other sites. However, technical feasibility of implementing this technology at this site, which involves remediating a larger area than typical for the process, treatment of relatively shallow soil and soil above groundwater, and treatment of soil contaminated with various compounds including BTEX compounds, PAHs, chlorinated VOCs, and PCBs, can only be established with certainty through bench- and/or pilot-scale studies. The potential presence of free-phase product represents another unknown in the technical feasibility of this method. If not removed prior to treatment, free-phase product may significantly increase amount of oxidant (hydrogen peroxide) required for treatment, as well as require additional application/ injection events.

Confirmatory sampling of the soil will be performed upon completion of the in-situ treatment. Once sampling indicates that the preliminary remediation goals have been met for the organic COCs, no additional long-term monitoring for organic compound contamination in the soil will be performed.

Availability of vendors who provide Fenton's reaction-based in-situ oxidation is limited and a competitive bid may not be possible for this service. Some minor delay is anticipated in obtaining the necessary approvals/permits from the various New York City and State agencies for in-situ treatment using Fenton's reagent since it is an innovative technology.

The ex-situ solidification/stabilization component of this alternative is considered to be readily implementable from a technical perspective. Solidification/stabilization is a commercially available, established technology and there are several vendors who provide ex-situ solidification/stabilization. Standard excavation methods and equipment will be used to excavate and backfill the soil; consequently, materials and services necessary for soil handling are readily available. With proper planning, organization, and housekeeping practices, few technical difficulties are expected during soil removal and backfilling activities; there may be some difficulty in installation of the temporary shoring at the perimeter of the excavations and around existing buildings due to presence of buried concrete and, in the East Yard, buried debris.

While solidification/stabilization is considered to be a reliable treatment process, long-term monitoring of its effectiveness will be necessary since the metals contamination is not removed or destroyed. Long-term effectiveness of the process will be indirectly demonstrated by annual monitoring of metals concentrations in groundwater samples collected from the six existing monitoring wells and the six monitoring wells proposed for installation as part of the Phase II Remedial Investigation of the site. No technical difficulties are anticipated for the long-term groundwater monitoring; materials and services for this task are readily available.

As noted previously, the consistency of the solidified/stabilized soil may range from a workable soil to a concrete-like solid, depending on the type and quantity of binding agent necessary to meet the treatment goals. If the treated soil is concrete-like, it may limit the future treatment options for the remaining contaminated saturated soil and groundwater (to be addressed as part of a separate feasibility study). For example, it would be difficult to implement an air sparging/soil vapor extraction system with impermeable soil overlying the contaminated zone.

From an administrative perspective, the solidification/stabilization portion of this alternative is considered to be implementable. Installation of the stormwater runoff control measures will require coordination with and approval by New York City agencies (*e.g.*, Sewer Department and the Department of Transportation) as well as coordination with adjacent property owners. However, there are no specific problems anticipated associated with obtaining permits or approvals from the various New York City agencies and adjacent property owners.

Cost

The quantities, unit costs, and subtotal costs for the various work items in this alternative, estimated for comparison purposes, are presented in Table A-3 (Appendix A). The capital costs are estimated to total $3,180,685, and the O&M costs are estimated to total $11,500 per year over a period of 30 years. The total present worth of this alternative, based on a 30-year period and a discount rate of five percent, is $3,357,000.

4.3.4 Alternatives 4A and 4B: Excavation/Off-site Disposal

Alternatives 4A and 4B involve excavation of the contaminated unsaturated soil (and most of the contaminated saturated soil in the upper site) at the Hexagon Laboratories Site using conventional methods. For both alternatives, the excavated material will be containerized, sampled, and transported/disposed of off site. In Alternative 4A, non-hazardous material will be disposed of at a non-hazardous waste landfill and hazardous material, if any, will be disposed of at a hazardous waste disposal facility. In Alternative 4B, non-hazardous material will be treated at an off-site facility and subsequently reused off site (*e.g.*, as road base material). Hazardous material, if any, will be disposed of at a hazardous waste disposal facility. For both alternatives, temporary facilities may be required for storage of contaminated material after excavation. Clean fill will be used to backfill the excavated areas.

A detailed breakdown of the components common to both of these alternatives is presented below:

a. Mobilization/Temporary Facilities

- Mobilization for the general contractor will consist of the preparation of project plans (*i.e.*, Work Plan, QA/QC Plan, Health and Safety Plans, Work Schedules, and other submissions) required by the specifications. Once the contractor receives the notice to proceed, he will begin to mobilize equipment, personnel, offices, and temporary storage trailers to the site, construct decontamination and sanitation facilities, and delineate work zones including exclusion zones, contamination reduction zones, and support area.

b. Excavation Activities/Documentation Sampling

- Remnant concrete slabs and asphalt paving will be removed prior to soil excavation. Broken concrete and asphalt will be disposed of off site at a construction and demolition debris recycling facility. All concrete and asphalt in direct contact with contaminated soil will be decontaminated (*i.e.*, pressure-washed) prior to transport off site.

- A cement-bentonite slurry wall will be constructed along the eastern and southern perimeters of the upper site. This wall will extend from the southeast corner of Hydrotherm No. 1 to the southeast corner of the South Yard and will continue to approximately the mid-way point along the southern boundary of the South Yard (see Figures 4-11 and 4-12). This wall will be approximately three feet thick and will extend from the top of bedrock to an elevation of approximately 34 feet, NGVD. The objective of this slurry wall placement is to minimize short-term environmental impacts associated with drainage of highly contaminated groundwater (in part generated during the excavation activities) from the upper site to down gradient locations. The slurry wall will be constructed using conventional construction equipment.

- Temporary shoring will be constructed around the perimeter of excavations exceeding four feet in depth and will be constructed around all buildings adjacent to an excavation. The shoring is a preventative measure against settlement and subsequent failure of or damage to adjacent structures and property. The proposed placement of temporary shoring is indicated in Figure 4-13.

- Soil excavation will be conducted using conventional construction equipment such as backhoes and front-end loaders. Soil within the upper site, excluding soil beneath existing site structures (Office/Warehouse and Hydrotherm No. 1) and soil from within the limits of the New Plant and South Yard UST excavations, will be excavated to the top of bedrock or to a maximum depth of six feet bgs. Soil within the East Yard, excluding soil beneath the existing Cinder Block Building, will be excavated to the top of the groundwater table.

- Excavated soil will be placed in roll-off containers. These roll-offs will be sampled prior to transport off site for the parameters and at the frequency specified by the corresponding disposal facility.

- Bottom and sidewall samples will be collected to document the extent of contamination remaining on site as well as to provide information on the contamination that may have migrated off site. One bottom sample will be collected approximately every 2,500 square feet in those areas where soil has not been excavated to the top of bedrock. Sidewall samples will be collected approximately every 50 feet along the perimeter of the site. Documentation samples will be analyzed for VOCs, SVOCs, PCBs, and TAL metals.

c. Off-site Transportation

- Roll-offs will be loaded onto trucks and hauled to the appropriate disposal facilities. Non-hazardous waste will be transported to a landfill (Alternative 4A) or a treatment facility (Alternative 4B) approved for handling this material. Hazardous materials, if any, will be transported to an approved hazardous waste disposal facility.

d. Backfilling/Site Restoration

- In order to allow for good compaction of backfill in those areas of the excavation which are below the groundwater table, a gravel sub-base (screened gravel, size designation 1A [1/8" to 1/4"], NYSDOT Specifications, Table 703-4) will be placed. The gravel sub-base will extend from the bottom of the excavation to the top of the water table; the thickness of the gravel sub-base will vary across the site but will not be less than one foot. Note that no gravel will be placed in the East Yard since the bottom of the excavation in this area will not extend below the water table.

- In the upper site, a geotextile will be placed on top of the gravel sub-base in order to minimize migration of the fines component of overlying fill into the gravel sub-base. In the East Yard, a geotextile will be placed on top of the saturated overburden to act as a separation layer between the contaminated soil and the uncontaminated fill materials.

- The excavations will be backfilled with imported clean fill material. The backfill material will be compacted to the degree required to minimize post-construction settlement.

A breakdown of components specific to each of the alternatives is provided below:

Alternative 4A - Disposal of Non-Hazardous Soil at a Non-Hazardous Waste Landfill/ Disposal of Hazardous Soil at a Hazardous Waste Disposal Facility

- Hazardous soil, if any, will be disposed at a hazardous waste disposal facility. A facility in Detroit, Michigan has been identified as a potential receptor for this material. This facility requires one representative sample analyzed for VOCs, SVOCs, PCBs, and TCLP as a means of characterizing the material. Depending on the constituents and their concentrations in the soil, the facility may pretreat the soil by chemical oxidation, chemical fixation, or stabilization prior to landfilling the soil. The Detroit facility does not accept soil with PCB concentrations greater than 50 ppm. It is estimated that approximately 100 cubic yards of the excavated soil may be hazardous (primarily soil around soil boring B-11 and monitoring well MW-4).

- Non-hazardous soil will be disposed of at a non-hazardous waste landfill. A landfill in Morrisville, Pennsylvania has been identified as a potential disposal site for this soil. This facility requires that soil be sampled at a frequency of one sample per 500 cubic yards and analyzed for PCBs, reactive cyanide and sulfide, ignitability, and TCLP. It is estimated that approximately 6,300 cubic yards of site soil is non-hazardous.

Alternative 4B - Disposal of Non-Hazardous Soil at a Treatment-Reuse Facility/ Disposal of Hazardous Soil at a Hazardous Waste Disposal Facility

- Hazardous soil, if any, will be disposed at a hazardous waste disposal facility. A facility in Detroit, Michigan has been identified as a potential receptor for this material. This facility requires one representative sample analyzed for VOCs, SVOCs, PCBs, and TCLP as a means of characterizing the material. Depending on the constituents and their concentrations in the soil, the facility may pretreat the soil by chemical oxidation, chemical fixation, or stabilization prior to landfilling the soil. The Detroit facility does not accept soil with PCB concentrations greater than 50 ppm. It is estimated that approximately 100 cubic yards of the excavated soil may be hazardous (primarily soil around soil boring B-11 and monitoring well MW-4).

- Non-hazardous soil will be disposed of at a treatment-reuse facility. A few facilities have been identified as potential receptors for this material. One such facility is located in Morrisville, Pennsylvania. This facility uses thermal treatment to remove organics from the soil, and as a result, renders the soil sterile. The soil is then used as fill dirt or mixed with other materials to form topsoil. This facility requires one sample, analyzed for metals, ignitability, corrosivity, reactivity, and PCBs, per 700 tons of soil. In addition, one sample, analyzed for TPHC and total organic halides, per 135 tons of soil is required. This facility will not accept soil with a PCB concentration in excess of 2 ppm. It is estimated that approximately 6,300 cubic yards of site soil is non-hazardous.

Compliance with Applicable or Relevant and Appropriate New York State SCGs

These alternatives will meet the chemical-specific SCGs at the site for the COCs (refer to preliminary remediation goals listed in Table 2-6) since all of the contaminated unsaturated soil and most of the saturated soil in the upper site will be removed. Remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study.

As part of Alternative 4A, non-hazardous soil removed from the site will be transported to a non-hazardous waste landfill for disposal without treatment. Hazardous soil will be transported to a hazardous waste landfill for treatment and subsequent disposal. While this alternative allows for unrestricted future use of the site, excluding use of the remaining contaminated saturated soil and groundwater, it does not entirely meet the CERCLA policy preference for alternatives which involve treatment as a primary component since the non-hazardous soil will not be treated prior to disposal.

In contrast, as part of Alternative 4B, non-hazardous soil removed from the site will be transported to a treatment/reuse facility. Hazardous soil will be transported to a hazardous waste landfill for treatment and subsequent disposal. This alternative allows for unrestricted future use of the site, excluding use of the remaining contaminated saturated soil and groundwater, and it complies with the CERCLA policy preference for alternatives which involve treatment as a primary component.

For both alternatives, applicable action-specific SCGs (*e.g.*, building permits, noise limitations, OSHA regulations) will be met. No location-specific SCGs were identified.

Overall Protection of Human Health and the Environment

These alternative are considered protective of human health and the environment since, in both cases, all of the contaminated unsaturated soil (and most of the saturated soil in the upper site) will be removed from the site and subsequently treated and/or contained in a landfill. Thus, this soil will no longer represent a source of contamination to the groundwater. Remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study. Prior to remediation, institutional controls (*e.g.*, deed restrictions) will be necessary to prevent unacceptable exposure to these remaining contaminated media.

In Alternative 4A, non-hazardous soil will be disposed of at a non-hazardous waste landfill and hazardous soil will be treated/disposed of at a hazardous waste disposal facility. It is assumed that the mobility of contaminants at these disposal sites will be within acceptable limits. In Alternative 4B, non-hazardous soil will be transported to a recycling facility for treatment (*e.g.*, thermal desorption) and reuse, and hazardous soil will be treated and disposed of at a hazardous waste disposal facility. It is assumed that waste streams generated during soil treatment will be handled appropriately by the facility and that resulting mobility of contaminants will be within acceptable limits.

Short-term Impacts and Effectiveness

There are several potential short-term impacts to the community (*i.e.*, noise, dust, and fugitive contaminant emissions) that may arise during excavation of the contaminated soil. To minimize these impacts, site access will be restricted during construction and remediation activities. Continuous air monitoring of both organic vapor and particulates will be conducted during these operations to protect the surrounding community. Action levels will be set prior to any intrusive activities, and, if these action levels are exceeded, an appropriate corrective action will be implemented (*e.g.*, wetting agents may be used to control dust).

Temporary shoring will be used as a preventative measure against settlement and subsequent damage to adjacent buildings or property during the excavation of the contaminated soil. Temporary shoring will be constructed along the sides of all excavations which exceed a depth of four feet bgs. In addition, temporary shoring will be constructed along the perimeter of all buildings adjacent to an excavation, regardless of depth. This shoring will be removed as the excavations are backfilled and compacted.

To minimize short-term environmental impacts associated with these alternatives, a cement-bentonite slurry wall will be constructed along the eastern perimeter of the Old Plant, New Plant and South Yard prior to initiation of soil removal activities in the upper site. This slurry wall will be continued to the midway point along the southern boundary of the South Yard (see Figures 4-11 and 4-12). The slurry wall will extend from the top of bedrock to approximately one foot above the groundwater table at any given location. The objective of the slurry wall is not to prevent groundwater flow from the upper site, but rather to restrict flow so that removal of the contaminated soil in the upper site does not drive contaminated groundwater (in part generated by the excavation operations) down gradient. Gravel will be used as a base course for backfilling the excavation in order to facilitate compaction of an overlying layer of common fill. It is anticipated that the horizontal flow of groundwater in the upper site will be increased through this permeable base course. To reduce the impact of this anticipated increased flow, the slurry wall will be left in place at the completion of the excavation process in order to continue retardation of down gradient flow from the upper site.

Vehicles and equipment used within the exclusion zone will be decontaminated prior to leaving the site as necessary to prevent off-site transport of contaminants. Personnel performing construction, remediation, and monitoring activities will use appropriate personnel protection equipment and health and safety procedures to minimize contact with contaminants. Because of the highly developed, industrial nature of the Hexagon Laboratories Site and its immediate vicinity, implementation of this alternative is not expected to significantly impact the environment in terms of affecting habitat or vegetation.

All off-site transport will be performed by a licensed hauler. While there is a risk of spills due to accidents during off-site transport of contaminated soil as part of both alternatives, this risk will be minimized by using closed and lined containers for transport.

Because these alternatives involve removal of the contaminated soil from the site and replacement with clean fill, the preliminary remediation goals will be achieved at the completion of this work. The time required to excavate and transport the contaminated soil to off-site treatment/disposal facilities and to backfill the excavation is estimated to be approximately 6 months.

Long-Term Effectiveness and Permanence

Removal and off-site treatment/disposal is considered to be an adequate, reliable, and permanent remedy since the contaminated unsaturated soil (and most of the saturated soil in the upper site) will no longer represent a human health risk nor will it act as a continuing source of contamination to the groundwater at the site. Remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study. Prior to their remediation, institutional controls (*e.g.*, deed restrictions) will be necessary to prevent unacceptable exposures to these remaining contaminated media.

As part of Alternative 4A, non-hazardous contaminated soil will be transported off site and disposed of without treatment. Because this soil is not treated prior to disposal, it will remain a risk to the environment. In contrast, non-hazardous contaminated soil generated as part of Alternative 4B will be transported to a recycling facility, treated, and subsequently reused. The treated soil will no longer represent an environmental risk and, therefore, this alternative is considered to be more permanent than Alternative 4A with regard to the disposal of non-hazardous soil. Hazardous soil generated as part of Alternatives 4A and 4B will be transferred to a hazardous waste disposal facility where it will be treated or stabilized prior to landfilling. Therefore, off-site disposal of the hazardous soil is considered to be equally permanent for these alternatives. For both alternatives, it is assumed that waste streams generated in the handling or treatment of the contaminated soil at the recycling or disposal facility will be handled appropriately and that the mobility of the contaminants will be within acceptable limits.

Reduction of Toxicity, Mobility, or Volume

Excavation and off-site treatment/disposal of the contaminated unsaturated soil (and most of the saturated soil in the upper site) will eliminate concern over the contaminants and their associated toxicity and mobility at the site. Remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study.

As discussed above under short-term impacts, there is a potential for an increase in the horizontal flow of groundwater from the upper site to down gradient locations during excavation and after placement of the backfill due to the removal of and subsequent replacement of the less permeable overburden with a permeable base course and clean fill. This increase in the horizontal groundwater gradient could result in increased transport of dissolved groundwater contamination. To minimize this potential increase in contaminant mobility, a slurry wall will be constructed prior to excavation and will be left in place at the completion of the excavation process in order to retard the down gradient flow of groundwater from the upper site. No soil will be excavated below the water table in the East Yard. Therefore, there is no expected change in the mobility of contaminants from the East Yard as a result of the remediation.

In Alternative 4A, non-hazardous soil will be disposed of at a non-hazardous waste landfill and hazardous soil will be treated/disposed of at a hazardous waste disposal facility. It is assumed that the mobility of contaminants at these disposal sites will be within acceptable limits. However, because the non-hazardous soil will not be treated prior to disposal, this alternative does not meet the CERCLA preference for alternatives which involve treatment as a primary component.

In Alternative 4B, non-hazardous soil will be transported to a recycling facility for treatment (*e.g.*, thermal desorption) and reuse. It is assumed that waste streams generated in this treatment process will be handled appropriately by the facility and that resulting mobility of contaminants will be within acceptable limits. Hazardous soil generated as part of this alternative will be treated and disposed of at a hazardous waste disposal facility. It is assumed that the mobility of contaminants at the disposal facility will also be within acceptable limits. Because both the non-hazardous and hazardous soil will be treated prior to reuse/disposal, this alternative meets the CERCLA preference for alternatives which involve treatment as a primary component.

Implementability

Standard excavation methods and equipment will be used for implementation of both alternatives; consequently, materials and services necessary for soil removal are readily available. With proper planning, organization, and housekeeping practices, few technical difficulties are expected during soil excavation activities; there may be some difficulty in installation of the temporary shoring at the perimeter of the excavations and around existing buildings due to presence of buried concrete and, in the East Yard, buried debris.

Both alternatives are expected to enhance potential future groundwater remedial actions at the site since the permeability of the overburden in the upper site will be greatly increased.

The transportation of the contaminated soil will be handled by a licensed waste handling firm. Coordination with the New York City and New York State Departments of Transportation and with affected communities along truck routes may be required since a relatively large volume of soil will be transported from the site.

Contaminated soil will be treated/disposed of at permitted off-site facilities. Several facilities have been identified which can accept the contaminated soil generated as part of these alternatives. At this time, no capacity or availability problems have been identified.

No delay is anticipated in obtaining the necessary approvals/permits from the various New York City and New York State agencies for implementation of these alternatives.

Cost

The quantities, unit costs, and subtotal costs for the various work items in these two alternatives, estimated for comparison purposes, are presented in Table A-4A and Table A-4B (Appendix A). For Alternative 4A, the capital costs are estimated to total \$2,266,205. For Alternative 4B, the capital costs are estimated to total \$2,202,380. There are no O & M costs anticipated for either alternative. The total present worth for Alternative 4A, based on a 30-year period and a discount rate of five percent, is calculated to be \$2,266,000. For Alternative 4B, the total present worth is calculated to be \$2,202,000.

4.3.5 Alternatives 5A and 5B: Limited Excavation/Off-site Disposal/Asphalt Cap

Alternatives 5A and 5B involve excavation of most of the contaminated soil (saturated and unsaturated) in the upper site and the top two feet of contaminated soil in the East Yard using conventional methods. For both alternatives, the excavated material will be containerized, sampled, and transported off site for treatment/disposal. In Alternative 5A, non-hazardous material will be disposed of at a non-hazardous waste landfill and hazardous material, if any, will be disposed of at a hazardous waste disposal facility. In Alternative 5B, non-hazardous material will be treated at an off-site facility and subsequently reused (*e.g.*, as road base material). Hazardous material, if any, will be disposed of at a hazardous waste disposal facility. For both alternatives, temporary facilities may be required for storage of contaminated material after excavation. Clean fill will be used to backfill the excavated areas. In addition, an asphalt cap will be installed across the site to prevent exposure to the remaining contaminated soil in the East Yard and to facilitate the use of the site for vehicle parking.

A detailed breakdown of the components common to both of these alternatives is presented below:

a. Mobilization/Temporary Facilities

- Mobilization for the general contractor will consist of the preparation of project plans (*i.e.*, Work Plan, QA/QC Plan, Health and Safety Plans, Work Schedules, and other submissions) required by the specifications. Once the contractor receives the notice to proceed, he will begin to mobilize equipment, personnel, offices, and temporary storage trailers to the site, construct decontamination and sanitation facilities, and delineate work zones including exclusion zones, contamination reduction zones, and support area.

b. Excavation Activities/Documentation Sampling

- Remnant concrete slabs and asphalt paving will be removed prior to soil excavation. Broken concrete and asphalt will be disposed of off site at a construction and demolition debris recycling facility. All concrete and asphalt in direct contact with contaminated soil will be decontaminated (*i.e.*, pressure-washed) prior to transport off site.

- A cement-bentonite slurry wall will be constructed along the eastern and southern perimeters of the upper site. This wall will extend from the southeast corner of Hydrotherm No. 1 to the southeast corner of the South Yard and will continue to approximately the mid-way point along the southern boundary of the South Yard (see Figures 4-11 and 4-12). This wall will be approximately three feet thick and will extend from the top of bedrock to an elevation of approximately 34 feet, NGVD. The objective of this slurry wall placement is to minimize short-term environmental impacts associated with drainage of highly contaminated groundwater (in part generated during the excavation activities) from the upper site to down gradient locations. The slurry wall will be constructed using conventional construction equipment.

- Temporary shoring will be constructed around the perimeter of excavations exceeding four feet in depth and will be constructed around all buildings adjacent to an excavation. The shoring is a preventative measure against settlement and subsequent failure of or damage to adjacent structures and property. The proposed placement of temporary shoring is indicated in Figure 4-14.

- Soil excavation will be conducted using conventional construction equipment such as backhoes and front-end loaders. Soil within the upper site, excluding soil beneath existing site structures (Office/Warehouse and Hydrotherm No. 1) and soil from within the limits of the New Plant and South Yard UST excavations, will be excavated to the top of bedrock or to a maximum depth of six feet bgs. The top two feet of soil within the East Yard, excluding soil beneath the existing Cinder Block Building, will also be excavated.

- During excavation, existing on-site shallow monitoring wells MW-3, MW-4, and MW-5 will be removed. Remaining monitoring wells will be supported and protected as necessary to prevent damage during excavation and backfilling operations.

- Excavated soil will be placed in roll-off containers. These roll-offs will be sampled prior to transport off site for the parameters and at the frequency specified by the corresponding disposal facility.

- Bottom and sidewall samples will be collected to document the extent of contamination remaining on site as well as to provide information on the contamination that may have migrated off site. One bottom sample will be collected for approximately every 2,500 square feet in those areas where soil has not been excavated to the top of bedrock. Sidewall samples will be collected approximately every 50 feet along the perimeter of the site. Documentation samples will be analyzed for VOCs, SVOCs, PCBs, and TAL metals.

c. Off-site Transportation

- Roll-offs will be loaded onto trucks and hauled to the appropriate disposal facilities. Non-hazardous waste will be transported to a landfill (Alternative 5A) or a treatment facility (Alternative 5B) approved for handling this material. Hazardous materials, if any, will be transported to an approved hazardous waste disposal facility.

d. Backfilling/Cap Placement

- Two catch basins will be installed along the western perimeter of the upper site to facilitate connection of the stormwater runoff control system to existing 8-inch diameter sewer connections. One catch basin will be installed near the gated opening in the East Yard to facilitate discharge of stormwater runoff from the stormwater runoff control system to the curbing along Heathcote Avenue for subsequent discharge to the catch basin at the intersection of Heathcote and Hollers Avenues.

- In order to allow for good compaction of backfill in those areas of the excavation which are below the groundwater table, a gravel sub-base (screened gravel, size designation 1A [1/8" to 1/4"], NYSDOT Specifications, Table 703-4) will be placed. The gravel sub-base will extend from the bottom of the excavation to the top of the water table; the thickness of the gravel sub-base will vary across the site but will not be less than one foot. Note that no gravel will be placed in the East Yard since the bottom of the excavation in this yard area will not extend below the water table.

- In the upper site, a geotextile will be placed on top of the gravel sub-base in order to minimize migration of the fines component of overlying fill into the gravel sub-base. In the East Yard, a geotextile will be placed at the bottom of the excavation to act as a separation layer between the remaining contaminated soil and the uncontaminated fill materials.

- The excavations will be backfilled with imported clean fill material. The backfill material will be compacted to the degree required to minimize post-construction settlement. Compacted clean fill will have a one percent slope to promote stormwater runoff and to minimize surface ponding.

- A perimeter drain will be installed along the western edge of the site to collect stormwater run-off from the upper site (North Yard, Old Plant, New Plant, and South Yard) and discharge it to the existing storm sewer along Peartree Avenue. See Figures 4-15 and 4-16 for the proposed layout of the stormwater runoff control system.

- A perimeter drain will be installed along the gated opening in the East Yard to collect stormwater runoff from the East Yard and discharge it to Heathcote Avenue where it will be directed to the existing catch basin at the intersection of Heathcote Avenue and Hollers Avenue. See Figures 4-15 and 4-16 for the proposed layout of the stormwater runoff control system.

- A 6-inch layer of NYSDOT Item No. 4 crushed stone will be placed on top of the clean fill to provide a suitable base foundation and drainage layer for the cap.

- The asphalt portion of the capping system will consist of a 2-inch thick binder course overlain by a 2-inch thick wearing course. A geogrid will be placed between the binder course and the wearing course to provide additional reinforcement to the asphalt cap in order to minimize crack formation. A typical cross-section of the proposed asphalt cap is provided in Figure 4-4. The preliminary asphalt cap design is based on a typical parking lot pavement design as specified in Means Site Work & Landscape Cost Data, 1996.

- A curb will be constructed around the perimeter of the cap as necessary to direct stormwater to the stormwater collection system.

- The sidewalk and curbing will be extended from the northeast corner of the East Yard along Heathcote Avenue to Hollers Avenue in order to direct stormwater runoff from the East Yard perimeter drain to the existing catch basin at the intersection of Heathcote Avenue and Hollers Avenue.

e. Long-Term Monitoring

The long-term impact of the soil removal and cap placement on site contamination will be monitored by annual sampling of the three remaining existing monitoring wells and three of the six monitoring wells proposed for installation as part of the Phase II Remedial Investigation of the site. Groundwater samples will be analyzed for VOCs, SVOCs, PCBs, and TAL metals.

A breakdown of components specific to each of the alternatives is provided below:

Alternative 5A - Disposal of Non-Hazardous Soil at a Non-Hazardous Waste Landfill/ Disposal of Hazardous Soil at a Hazardous Waste Disposal Facility

- Hazardous soil, if any, will be disposed at a hazardous waste disposal facility. A facility in Detroit, Michigan has been identified as a potential receptor for this material. This facility requires one representative sample analyzed for VOCs, SVOCs, PCBs, and TCLP as a means of characterizing the material. Depending on the constituents and their concentrations in the soil, the facility may pretreat the soil by chemical oxidation, chemical fixation, or stabilization prior to landfilling the soil. The Detroit facility does not accept soil with PCB concentrations greater than 50 ppm. It is estimated that approximately 100 cubic yards of the excavated soil may be hazardous (primarily soil around soil boring B-11 and monitoring well MW-4).

- Non-hazardous soil will be disposed of at a non-hazardous waste landfill. A landfill in Morrisville, Pennsylvania has been identified as a potential disposal site for this soil. This facility requires that soil be sampled at a frequency of one sample per 500 cubic yards and analyzed for PCBs, reactive cyanide and sulfide, ignitability, and TCLP. It is estimated that approximately 4,900 cubic yards of site soil is non-hazardous.

Alternative 5B - Disposal of Non-Hazardous Soil at a Treatment-Reuse Facility/ Disposal of Hazardous Soil at a Hazardous Waste Disposal Facility

- Hazardous soil, if any, will be disposed at a hazardous waste disposal facility. A facility in Detroit, Michigan has been identified as a potential receptor for this material. This facility requires one representative sample analyzed for VOCs, SVOCs, PCBs, and TCLP as a means of characterizing the material. Depending on the constituents and their concentrations in the soil, the facility may pretreat the soil by chemical oxidation, chemical fixation, or stabilization prior to landfilling the soil. The Detroit facility does not accept soil with PCB concentrations greater than 50 ppm. It is estimated that approximately 100 cubic yards of the excavated soil may be hazardous (primarily soil around soil boring B-11 and monitoring well MW-4).

- Non-hazardous soil will be disposed of at a treatment-reuse facility. A few facilities have been identified as potential receptors for this material. One such facility is located in Morrisville, Pennsylvania. This facility uses thermal treatment to remove organics from the soil, and as a result, renders the soil sterile. The soil is then used as fill dirt or mixed with other materials to form topsoil. This facility requires one sample, analyzed for metals, ignitability, corrosivity, reactivity, and PCBs, per 700 tons of soil. In addition, one sample, analyzed for TPHC and total organic halides, per 135 tons of soil is required. This facility will not accept soil with a PCB concentration in excess of 2 ppm. It is estimated that approximately 4,900 cubic yards of site soil is non-hazardous.

Compliance with Applicable or Relevant and Appropriate New York State SCGs

These alternatives will not meet the chemical-specific SCGs at the site for the COCs (refer to preliminary remediation goals listed in Table 2-6) since, although all of the contaminated unsaturated soil and most of the saturated soil will be removed from the upper site, only the top two feet of contaminated soil will be removed from the East Yard. It is estimated that approximately 25 percent of the total volume of contaminated unsaturated soil will remain upon completion of these alternatives. (Remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study.) Long-term groundwater monitoring will be conducted on an annual basis to assess the combined impact of soil removal and cap placement on site contamination levels.

As part of Alternative 5A, non-hazardous soil removed from the site will be transported to a non-hazardous waste landfill for disposal without treatment. Hazardous soil will be transported to a hazardous waste landfill for treatment and subsequent disposal. It does not entirely meet the CERCLA policy preference for alternatives which involve treatment as a primary component since the non-hazardous soil will not be treated prior to disposal.

In contrast, as part of Alternative 5B, non-hazardous soil removed from the site will be transported to a treatment/reuse facility, and hazardous soil will be transported to a hazardous waste landfill for treatment and subsequent disposal. This alternative complies with the CERCLA policy preference for alternatives which involve treatment as a primary component.

For both alternatives, applicable action-specific SCGs (*e.g.*, building permits, noise limitations, OSHA regulations) will be met. No location-specific SCGs were identified.

Overall Protection of Human Health and the Environment

These alternative are considered protective of human health since, in both cases, the contaminated unsaturated soil (and most of the saturated soil) will be removed from the upper site, and the top two feet of contaminated unsaturated soil will be removed from the East Yard. Excavated soil will be transported off site for treatment and/or disposal/reuse. The remaining contaminated soil will be capped, thereby eliminating potential human exposure pathways.

Each of these alternatives is considered to be largely protective of the environment since approximately 75 percent of the contaminated soil volume will be disposed of off site, and as such, will no longer represent a source of contamination to the groundwater. Installation of the capping system will minimize infiltration of rainwater into the subsurface and the subsequent migration of contaminants from the remaining contaminated unsaturated soil into the groundwater. However, the cap will not reduce the lateral migration of contaminants due to groundwater flow. Annual groundwater monitoring will be performed in order to assess the combined impact of the soil removal and cap placement on site contamination. (Note, remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study.)

In Alternative 5A, non-hazardous soil will be disposed of at a non-hazardous waste landfill and hazardous soil will be treated and disposed of at a hazardous waste disposal facility. It is assumed that the mobility of contaminants at these disposal sites will be within acceptable limits. In Alternative 5B, non-hazardous soil will be transported to a recycling facility for treatment (*e.g.*, thermal desorption) and reuse, and hazardous soil will be treated and disposed of at a hazardous waste disposal facility. It is assumed that waste streams generated during soil treatment will be handled appropriately by the facility and that resulting mobility of contaminants will be within acceptable limits.

In order to maintain the protection of human health and the environment, these alternatives must be combined with institutional controls (*e.g.*, deed restrictions) which will ensure that future uses of the site are consistent with the intent of the cap (*i.e.*, to prevent exposure to the remaining contaminated soil). For example, the deed restrictions may include prohibition of any construction on site which compromises the integrity of the capping system.

Short-term Impacts and Effectiveness

There are several potential short-term impacts to the community (*i.e.*, noise, dust, and fugitive contaminant emissions) that may arise during excavation of the contaminated soil. To minimize these impacts, site access will be restricted during construction and remediation activities. Continuous air monitoring of both organic vapor and particulates will be conducted during these operations to protect the surrounding community. Action levels will be set prior to any intrusive activities, and, if these action levels are exceeded, an appropriate corrective action will be implemented (*e.g.*, wetting agents may be used to control dust).

Temporary shoring will be used as a preventative measure against settlement and subsequent damage to adjacent buildings or property during the excavation of the contaminated soil. Temporary shoring will be constructed along the sides of all excavations which exceed a depth of four feet bgs. In addition, temporary shoring will be constructed along the perimeter of all buildings adjacent to an excavation, regardless of depth. This shoring will be removed as the excavations are backfilled and compacted.

To minimize short-term environmental impacts associated with these alternatives, a cement-bentonite slurry wall will be constructed along the eastern perimeter of the Old Plant, New Plant and South Yard prior to initiation of soil removal activities in the upper site. This slurry wall will be continued to the midway point along the southern boundary of the South Yard (see Figures 4-11 and 4-12). The slurry wall will extend from the top of bedrock to approximately one foot above the groundwater table at any given location. The objective of the slurry wall is not to prevent groundwater flow from the upper site, but rather to restrict flow so that removal of the contaminated soil in the upper site does not drive contaminated groundwater (in part generated by the excavation operations) down gradient. Gravel will be used as a base course for backfilling the excavation in order to facilitate compaction of an overlying layer of common fill. It is anticipated that the horizontal flow of groundwater in the upper site will be increased through this permeable base course. To minimize the impact of this anticipated increased flow, the slurry wall will be left in place at the completion of the excavation process in order to continue retardation of down gradient flow from the upper site.

Vehicles and equipment used within the exclusion zone will be decontaminated prior to leaving the site as necessary to prevent off-site transport of contaminants. Personnel performing construction, remediation, and monitoring activities will use appropriate personnel protection equipment and health and safety procedures to minimize contact with contaminants. Because of the highly developed, industrial nature of the Hexagon Laboratories site and its immediate vicinity, implementation of this alternative is not expected to significantly impact the environment in terms of affecting habitat or vegetation.

All off-site transport will be performed by a licensed hauler. While there is a risk of spills due to accidents during off-site transport of contaminated soil as part of both alternatives, this risk will be minimized by using closed and lined containers for transport.

Because approximately 25 percent of the contaminated soil will remain at the site upon completion of these alternatives, the preliminary remediation goals will not be met. For the purposes of this FFS, a duration of 30 years (the maximum time period specified for evaluation under the USEPA FS guidance (USEPA, 1988) was assumed for these alternatives. The time required to excavate and transport the contaminated soil to off-site treatment/disposal facilities, backfill the excavation, install the asphalt cap, and install the stormwater runoff control system is estimated to be approximately 6.5 months.

Long-Term Effectiveness and Permanence

These alternatives are considered to be adequate, reliable, and permanent remedies for the upper site since the contaminated unsaturated soil (and most of the saturated soil) in the upper site will be removed from the site and, as such, will no longer represent a human health risk nor will it act as a continuing source of contamination to the groundwater at the site. However, these alternatives are not considered permanent remedies for the East Yard since the remaining contaminated unsaturated soil in the East Yard represents a source for future groundwater contamination. (Note, remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study.) While the capping system will minimize infiltration of precipitation, thereby reducing vertical migration of the contaminants from the unsaturated overburden to the groundwater, the cap will not reduce the lateral migration of contaminants due to groundwater flow. With proper inspection and periodic maintenance (*e.g.*, patching and sealing), the cap can be considered both an adequate and reliable control measure.

As part of Alternative 5A, non-hazardous contaminated soil will be transported off site and disposed of without treatment. Because this soil is not treated prior to disposal, it will remain a risk to the environment. In contrast, non-hazardous contaminated soil generated as part of Alternative 5B will be transported to a recycling facility, treated, and subsequently reused off site. The treated soil will no longer represent an environmental risk and, therefore, this alternative is considered to be more permanent than Alternative 5A with regard to the disposal of non-hazardous soil. Hazardous soil generated as part of Alternatives 5A and 5B will be transferred to a hazardous waste disposal facility where it will be treated or stabilized prior to landfilling. Therefore, off-site disposal of the hazardous soil is considered to be equally permanent for these alternatives. For both alternatives, it is assumed that waste streams generated in the handling or treatment of the contaminated soil at the recycling or disposal facility will be handled appropriately and that the mobility of the contaminants will be within acceptable limits.

The presence of the contamination in the subsurface limits the long-term effectiveness of these alternatives in that site useage patterns cannot be changed without possible health or environmental impacts. In order to ensure that future site useage is consistent with the intent of the capping system, institutional controls (*e.g.*, deed restrictions) will be invoked.

Reduction of Toxicity, Mobility, or Volume

Excavation and off-site treatment/disposal of the contaminated unsaturated soil (and most of the saturated soil) in the upper site will eliminate these contaminants and their associated toxicity and mobility as a concern at the site. However, because only the top two feet of contaminated soil will be removed from the East Yard, the volume, toxicity, and mobility of the remaining contaminated soil represents a continued concern for the site. (Note, remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study.) The placement of a cap over the remaining contaminated soil is expected to reduce the mobility of the contamination as a result of the decrease in infiltration of precipitation to the site soil but will not impact the lateral migration of contaminants due to groundwater flow. The toxicity of the remaining contaminated soil will be reduced indirectly since the cap will prevent direct exposure to the contaminants.

As discussed above under short-term impacts, there is a potential for an increase in the horizontal flow of groundwater from the upper site to down gradient locations during excavation and after placement of the backfill due to the removal of and subsequent replacement of the less permeable overburden with a permeable base course and clean fill. This increase in the horizontal groundwater gradient could result in increased transport of dissolved groundwater contamination. To minimize this potential increase in contaminant mobility, a slurry wall will be constructed prior to excavation and will be left in place at the completion of the excavation process in order to retard the down gradient flow of groundwater from the upper site. No soil will be excavated below the water table in the East Yard. Therefore, there is no expected change in the mobility of contaminants from the East Yard as a result of the remediation.

In Alternative 5A, non-hazardous soil removed from the site will be disposed of at a non-hazardous waste landfill and hazardous soil will be treated and disposed of at a hazardous waste disposal facility. It is assumed that the mobility of contaminants at these disposal sites will be within acceptable limits. However, because the non-hazardous soil will not be treated prior to disposal, this alternative does not meet the CERCLA preference for alternatives which involve treatment as a primary component.

In Alternative 5B, non-hazardous soil removed from the site will be transported to a recycling facility for treatment (*e.g.*, thermal desorption) and reuse. It is assumed that waste streams generated in this treatment process will be handled appropriately by the facility and that resulting mobility of contaminants will be within acceptable limits. Hazardous soil generated as part of this alternative will be treated and disposed of at a hazardous waste disposal facility. It is assumed that the mobility of contaminants at the disposal facility will also be within acceptable limits. Because both the non-hazardous and hazardous soil will be treated prior to reuse or disposal, this alternative meets the CERCLA preference for alternatives which involve treatment as a primary component.

Implementability

Standard excavation methods and equipment will be used for implementation of both alternatives; consequently, materials and services necessary for soil removal are readily available. With proper planning, organization, and housekeeping practices, few technical difficulties are expected during soil excavation activities; there may be some difficulty in installation of the temporary shoring at the perimeter of the excavations and around existing buildings due to presence of buried concrete and, in the East Yard, buried debris.

In addition, capping has been used successfully to contain hazardous wastes on numerous sites. Installation of the cap and long-term groundwater monitoring to assess the effectiveness of the cap in reducing continued groundwater contamination will not require sophisticated equipment, technology, or specialists and are easily implementable using readily available materials and services.

Both alternatives are expected to enhance potential future groundwater remedial actions at the site since the permeability of the overburden in the upper site will be greatly increased. However, installation of a cap may limit the implementation of potential future remedial alternatives selected for remediation of site groundwater since any type of well construction (extraction or injection) will compromise the integrity of the cap.

The transportation of the contaminated soil will be handled by a licensed waste handling firm. Coordination with the New York City and New York State Departments of Transportation and with affected communities along truck routes may be required since a relatively large volume of soil is being transported from the site.

Contaminated soil will be treated/disposed of at permitted off-site facilities. Several facilities have been identified which can accept the contaminated soil generated as part of these alternatives. At this time, no capacity or availability problems have been identified.

Installation of a capping system, specifically installation of the stormwater runoff control measures, will require coordination with and approval by New York City agencies (*e.g.*, Sewer Department and the Department of Transportation) as well as coordination with adjacent property owners. However, from an administrative perspective, each of these remedial alternatives is considered to be readily implementable. That is, there are no specific problems anticipated in obtaining permits or approvals from the various New York City agencies and adjacent property owners.

Cost

The quantities, unit costs, and subtotal costs for the various work items in these two alternatives, estimated for comparison purposes, are presented in Table A-5A and Table A-5B (Appendix A). For Alternative 5A, the capital costs are estimated to total $2,166,615, and the O&M costs are estimated to be $15,200 per year. For Alternative 5B, the capital costs are estimated to total $2,117,740, and the O&M costs are estimated to be $15,200 per year. The total present worth for Alternative 5A, based on a 30-year period and a discount rate of five percent, is calculated to be $2,400,000. For Alternative 5B, the total present worth is calculated to be $2,351,000.

5.0 COMPARATIVE EVALUATION OF ALTERNATIVES

The comparative evaluation involves comparison of the strengths and weaknesses of the alternatives relative to one another with respect to each of the seven criteria described in Section 4.2. Both quantitative and qualitative differences are included in this comparative analysis. A summary of the evaluative scoring results used to compare alternatives is presented in Table 5-1. The scoring results for each alternative for each evaluation criteria are presented in Appendix B.

5.1 Compliance with Applicable or Relevant and Appropriate New York State SCGs

Of the nine alternatives evaluated, only Alternatives 4A and 4B will meet the New York State chemical-specific SCGs for the COCs. As part of these alternatives, all of the contaminated unsaturated soil will be removed from the site as will most of the contaminated saturated soil in the upper site; remaining contaminated groundwater and associated saturated soil will be addressed by a separate feasibility study. The excavated soil will be treated/disposed of off site and clean fill will be used to backfill the excavation. Alternatives 5A and 5B will meet chemical-specific SCGs in the upper site since the contaminated unsaturated soil (and most of the saturated soil) will be removed and treated/disposed of off site. These alternatives will not meet chemical-specific SCGs in the East Yard, however, since only the top two feet of contaminated soil will be removed; approximately 1,500 cy of contaminated unsaturated soil will remain in the East Yard upon completion of these alternatives. Alternative 3 will meet the chemical-specific SCGs for the organic COCs by destroying these compounds using the Fenton's reaction-based in-situ oxidation. However, it will not meet the chemical-specific SCGs for the metal COCs since the metals will not be destroyed or removed in the solidification/stabilization process. While there may be some dilution effect associated with the addition of the binding agent and mixing of the soil during the metals treatment, this dilution is not expected to significantly reduce the metal concentrations. None of the containment alternatives (Alternatives 2A, 2B, 2C) will meet the chemical-specific SCGs since the contaminated soil will remain on site without treatment. Similarly, Alternative 1 (No Action) will not achieve compliance with the chemical-specific SCGs.

Each of the alternatives evaluated is considered to be in compliance with action-specific SCGs; all permits (*e.g.*, building permits) and approvals necessary for implementing these alternatives will be obtained prior to initiating the remedial action. No location-specific SCGs were identified.

5.2 Protection of Human Health and the Environment

None of the alternatives allow for unrestricted site use upon completion of the remedial action since contaminated groundwater and saturated soil will remain on site. This contamination will be addressed as part of a separate feasibility study. Until these media are remediated, institutional controls (*e.g.*, deed restrictions) will be necessary to prevent future site uses which could result in exposure to the contamination. Three of the alternatives evaluated (Alternatives 3, 4A, and 4B) are considered to be protective of human health and the environment. In Alternative 3, the organic COCs will be destroyed using Fenton's reagent-based in-situ oxidation, and the metal COCs will be encapsulated. Thus, the toxicity and mobility of the COCs will cease to be a concern. In Alternatives 4A and 4B, the contaminated soil will be excavated and transported off site for subsequent treatment and/or disposal, and, as a result, the contamination will cease to be a concern at the site. It is assumed that contaminant mobility will be within acceptable limits at the off-site treatment and disposal facilities.

Alternatives 5A and 5B are considered to be largely protective of human health and the environment. In these alternatives, all of the contaminated unsaturated soil (and most of the saturated soil) will be removed from the upper site and treated/disposed of off site. However, only the top two feet of contaminated soil will be removed from the East Yard, leaving approximately 1,500 cy of contaminated unsaturated soil in place. An asphalt cap will be placed over the remaining contaminated soil; it will act as a physical barrier preventing human contact with the soil and will minimize the vertical migration of the COCs by reducing the infiltration of precipitation. The cap will not impact the lateral migration of contamination due to groundwater flow.

The containment alternatives (Alternatives 2A, 2B, 2C) are also considered to be largely protective of human health and the environment since, in each case, the presence of a cap will act as a physical barrier against human contact with the soil and will minimize the vertical migration of the COCs by reducing the infiltration of precipitation. However, none of the caps will impact the lateral migration of contamination due to groundwater flow. Of the three capping options, the RCRA multimedia cap likely provides the best protection against the infiltration of precipitation due to the presence of both a GCL and a geomembrane.

The No Action alternative (Alternative 1) is not considered to be protective of human health or the environment. This alternative does not reduce the potential for contact with unacceptable levels of contamination in the site soil nor does it reduce the potential environmental impact associated with off-site migration of the contamination.

5.3 Short-Term Effectiveness

There are no significant short-term risks to the community or to the environment anticipated in the implementation of containment Alternatives 2A, 2B, and 2C since, in each case, there will be minimal intrusive activities associated with cap installation; there may be minor adverse impacts due to dust formation during placement of the crushed stone base course.

Similarly, there are no significant short-term risks anticipated for Alternative 3. Intrusive activities during the organics treatment phase of this alternative will be limited to the installation injection trenches and injection wells. Formation of fugitive dust during these activities is expected to be minimal and easily controlled. Based on information provided by a Fenton's reagent process vendor (Isotec), operation of the in-situ oxidation system will not result in fugitive emissions of organic vapor.

There is some risk of short-term impacts (*e.g.*, noise, dust formation, and fugitive contaminant emissions) during the metals treatment phase of this alternative resulting from the soil excavation operations. These potential impacts are easily controlled. Site access will be restricted during the remediation activities and continuous air monitoring of particulates and organic vapor will be conducted during intrusive activities. Action levels will be set prior to any intrusive activities, and, if these action levels are exceeded, appropriate corrective measures will be implemented (*e.g.*, wetting agents may be used to control fugitive dust). Temporary shoring will be used as a preventative measure against settlement and subsequent damage to adjacent buildings or property during the excavation of the metals-contaminated soil.

Short-term impacts (*e.g.*, fugitive dust formation, fugitive contaminants emissions) are also anticipated for Alternatives 4A, 4B, 5A, and 5B since each will involve significant excavation of contaminated soil. As noted above for Alternative 3, this risk is easily controlled. Site access will be restricted during remediation, and continuous air monitoring of organic vapor and particulates will be performed during all intrusive activities. Action levels will be established such that, if the action levels are exceeded, an appropriate corrective action will be implemented (*e.g.*, wetting agents or spray foam may be used to control dust and contaminant emissions).

In order to reduce the potential for increased downgradient transport of contaminated groundwater (in part generated by the excavation activities) due to removal and replacement of the contaminated overburden in the upper site with a more permeable gravel base course and common fill, a slurry wall will be constructed along the eastern and southern perimeters of the upper site prior to excavation in the upper site. The objective of the slurry wall is not to prevent flow of groundwater from the upper site, but rather to restrict flow so that excavation activities in the upper site do not drive contaminated groundwater downgradient. Temporary shoring will also be used during the soil excavation activities as a preventative measure against settlement and subsequent damage to adjacent buildings or property. These control measures are reliable and easily implemented.

No significant short-term impacts associated with the Alternative 1 long-term groundwater monitoring are anticipated.

Excluding long-term monitoring activities, all of the alternatives can be implemented fairly quickly (13 months or less) once necessary approvals and permits are acquired. However, upon completion of the remediation, only Alternatives 4A and 4B will have met the preliminary remediation goals (see Table 2-6). Alternative 3 will have met the preliminary remediation goals for the organic COCs but not for the metal COCs since solidification/stabilization does not destroy or remove the metals contamination. Alternatives 5A and 5B will not meet the preliminary remediation goals since contaminated soil will remain in the East Yard. Similarly, the containment alternatives (Alternatives 2A, 2B, and 2C) and the No Action alternative (Alternative 1) will not meet the preliminary remediation goals since contaminated soil will not be treated or removed from the site as part of these alternatives. Thus, for Alternatives 1, 2A, 2B, 2C, 3, 5A, and 5B, a duration of 30 years (the maximum time period specified for evaluation under the USEPA FS guidance [USEPA, 1988]) was assumed.

5.4 Long-Term Effectiveness and Permanence

From the perspective of the site, Alternatives 3, 4A, and 4B are considered to be permanent remedies. In Alternative 3, the soil will be treated such that the organic COCs are destroyed and the metal COCs are encapsulated within a solid matrix. In Alternatives 4A and 4B, the contaminated soil will be excavated and subsequently treated and/or disposed off site. In Alternative 4A, the non-hazardous contaminated soil will be disposed of in an approved landfill without prior treatment whereas, in Alternative 4B, the non-hazardous contaminated soil will be treated and reused off site. Therefore, Alternatives 3 and 4B are considered to be more permanent than Alternative 4A since both of these alternatives involve treatment as a primary component. Remaining contaminated groundwater and saturated soil will be addressed as part of a separate feasibility study.

Alternatives 5A and 5B are not considered to be permanent remedies since approximately 1,500 cy of contaminated unsaturated soil will remain in the East Yard at the completion of the remediation. This remaining contaminated soil will be capped in place. With proper maintenance, the cap is considered to be both an adequate and reliable control measure.

With proper cap maintenance, the containment alternatives (2A, 2B, and 2C) are also considered to be both adequate and reliable. However, none of these alternatives is considered to be permanent since contaminated soil will remain in place without treatment and represents a potential source of groundwater contamination. Similarly, the No Action alternative is reliable but is not considered to be permanent since contaminated soil will not be removed or treated as part of this alternative.

5.5 Reduction in Toxicity, Mobility, and Volume

Alternative 4B is considered to be the most effective at reducing the toxicity, mobility and volume of contaminants at the Hexagon Laboratories Site since, as part of this alternative, the contaminated soil will be removed from the site and treated prior to off-site reuse or disposal. While the contaminated soil will also be removed from the site as part of Alternative 4A, this alternative does not include treatment of the non-hazardous contaminated soil prior to disposal. The contamination will no longer be a concern at the site, but the contaminants will not be destroyed or stabilized. Thus, Alternative 4A does not meet the CERCLA policy preference for alternatives which involve treatment as a primary component.

Alternatives 5A and 5B are considered to be effective in reducing the toxicity, mobility, and volume of contaminants at the site since, as part of these alternatives, approximately 75 percent of the contaminated soil volume will be removed and will no longer be a concern at the site. The remaining contaminated soil will be capped in place. The cap is expected to reduce the vertical mobility of the remaining contaminants by minimizing the infiltration of precipitation but will not impact their lateral mobility due to groundwater flow. The cap is also expected to indirectly reduce contaminant toxicity since it will act as a barrier preventing contact with the remaining contaminants. Soil removed as part of Alternative 5B will be treated off site prior to off-site reuse or disposal. In contrast, non-hazardous soil removed as part of Alternative 5A will not be treated prior to off-site disposal. Thus, Alternative 5A does not meet the CERCLA policy preference for alternatives which involve treatment as a primary component.

Alternative 3 is also considered to be effective at reducing the toxicity, mobility, and volume of contaminants. The organic COCs will be destroyed via in-situ oxidation using Fenton's reaction and, therefore, the associated toxicity and mobility will cease to be a concern. While solidification/stabilization will not impact the volume of metal contaminants, by encapsulating the metal COCs, this process will effectively eliminate the toxicity of the metal COCs and reduce mobility of these metals to acceptable levels (leachate will not exceed the NYSDEC Class GA groundwater standards for the metal COCs).

Containment alternatives (2A, 2B, and 2C) will have no impact on the volume of contaminants at the site. However, like the capping component of Alternatives 5A and 5B, each of these alternatives will reduce the vertical mobility of the contaminants from the unsaturated overburden to the groundwater by minimizing the infiltration of precipitation; none of these alternatives will impact the lateral migration of contaminants due to groundwater flow. In addition, each of these alternatives will indirectly reduce the toxicity of the contamination by reducing the potential for direct exposure to the contaminated soil.

Alternative 1 (No Action) will not reduce the volume, mobility, or toxicity of the site soil contaminants.

5.6 Implementability

The long-term monitoring associated with the No Action alternative (Alternative 1) is considered to be readily implementable. No sophisticated equipment is required, and the necessary services and materials are readily available. However, there may be some difficulty in the administrative feasibility of implementing this alternative due to anticipated public resistance to a No Action response to site contamination.

Alternatives 2A, 2B, and 2C are also considered to be readily implementable. Execution of the work items that form these alternatives will not require sophisticated equipment, technology, or specialists. Installation of the capping systems and the associated long-term monitoring will be easily implemented using available services and materials. There are no specific problems anticipated associated with obtaining permits or approvals from various New York City agencies and adjacent property owners for implementing these alternatives. However, implementation of these alternatives may limit future groundwater remediation options at the site since any type of intrusive construction (*e.g.*, installation of extraction or injection wells) will compromise the integrity of the capping system.

Alternatives 4A, 4B, 5A, and 5B are considered to be implementable, although there are some uncertainties associated with these alternatives which render them less implementable than the alternatives discussed above. Each alternative will use standard excavation methods and equipment. In addition, necessary materials and services are readily available. However, there may be some difficulty in the installation of temporary shoring at the perimeter of the excavations and around existing buildings due to the presence of buried concrete or debris. Buried materials encountered during the excavation process may also result in unanticipated schedule delays. It is important to note that each of these alternatives is expected to enhance potential future groundwater remedial actions at the site since the permeability of the overburden in the upper site will be greatly increased. However, for Alternatives 5A and 5B, the presence of a cap in the East Yard may limit future groundwater remediation options since, as noted for containment Alternatives 2A, 2B, and 2C, any type of intrusive construction will compromise the integrity of the capping system.

Of the nine alternatives evaluated, Alternative 3 is considered to be the least implementable due primarily to the uncertainty in the effectiveness of Fenton's reaction-based in-situ oxidation and solidification/stabilization in treating the COCs. Both technologies will undergo bench-scale testing to verify effectiveness prior to full-scale implementation at the site. Such unknowns as the potential presence of free-phase product may significantly increase the time and cost required for the in-situ oxidation.

Solidification/stabilization is considered to be a conventional technology for treating metals contamination, and there are several vendors who provide this service. In contrast, there are only a few vendors who provide Fenton's reaction-based in-situ oxidation and, as a result, a competitive bid for this service may not be possible. Further, because in-situ oxidation is an innovative technology, there may be some administrative difficulty in obtaining permits or approvals from the various New York City and State agencies.

It is also important to note that the consistency of the solidified/stabilized soil may range from a workable soil to a concrete-like solid, depending on the type and quantity of binding agent necessary to meet the treatment goals. If the treated soil is concrete-like, it may limit the future treatment options for the remaining contaminated groundwater and saturated soil (to be addressed as part of a separate feasibility study). For example, it would be difficult to implement an air sparging/soil vapor extraction system with impermeable soil overlying the contaminated zone.

5.7 Cost

The costs (capital, O&M, and total present worth) associated with implementation of each alternative are presented in Table 4-7. As indicated in this table, Alternative 3, which includes in-situ oxidation of the organic COCs followed by ex-situ solidification/stabilization of the metal COCs, has the highest capital cost ($3,180,685) and the highest total present worth (approximately $3,357,000), assuming a 30 year period and a discount rate of five percent. The containment alternatives (2A, 2B, and 2C), which require cap maintenance and long-term groundwater monitoring, have the highest annual O&M cost ($23,600).

As discussed in Section 5.3, Alternatives 1, 2A, 2B, 2C, 3, 5A, and 5B do not include removal of all contamination and, therefore, long-term monitoring of the site contamination is necessary. For evaluative purposes, these alternatives were considered to have a duration of 30 years, which is the maximum duration to be considered in the detailed analysis as specified in TAGM No. HWR-4030 (NYSDEC 1990). For Alternatives 4A and 4B, all of the contaminated soil will be removed from the site and, as a result, no long-term monitoring is required. These alternatives were considered to have a duration of six months. For each alternative, a discount rate of five percent was assumed in the calculation of total present worth.

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TABLES

TABLE 2-1
HEXAGON LABORATORIES RI/FFS
POTENTIALLY APPLICABLE SCGs

ACT/AUTHORITY	CRITERIA/ISSUES	CITATION	BRIEF DESCRIPTION	STATUS	COMMENTS
LOCAL CHEMICAL-SPECIFIC SCGs and TBCs					
None Identified					
STATE CHEMICAL-SPECIFIC SCGs and TBCs					
	Determination of Soil Cleanup Objectives and Cleanup Levels	NYSDEC TAGM HWR-94-4046 (January 1994)	Establishes Recommended Soil Cleanup Objectives (RSCOs) for soil	Applicable	RSCOs are based on residential exposure assumptions and may be conservative since the Hexagon Laboratories Site is located in an industrial/commercial zoned area
	Background Metals Concentrations	Various Literature Sources (See Table 2-2)	Literature sources listing typical background metals concentrations	To Be Considered	NYSDEC RSCOs list "background" as the cleanup level for metals. Literature values for typical background metals concentrations were considered along with site-specific background data in establishing appropriate RSCOs for the metals contamination
FEDERAL CHEMICAL-SPECIFIC SCGs and TBCs					
Comprehensive Environmental Responsibility Cleanup and Liability Act (CERCLA)	Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities	USEPA OSWER Directive #9355 4-12, Response, July 1994	USEPA-recommended residential screening level for lead (400 ppm, based on permissible exposure to children)	Applicable	USEPA (1996) also suggests somewhat higher levels (750 to 1500 ppm) acceptable for adults
LOCAL LOCATION-SPECIFIC SCGs and TBCs					
None Identified					
STATE LOCATION-SPECIFIC SCGs and TBCs					
None Identified					
FEDERAL LOCATION-SPECIFIC SCGs and TBCs					
None Identified					
LOCAL ACTION-SPECIFIC SCGs and TBCs					
	Maximum Permissible Sound Levels	NYC Administrative Code, Title 24, Chapter 2, Subchapters 5 and 6	Establishes allowable noise emissions from construction equipment and property line noise limits	Potentially Applicable	
	Nuisance Noise and Vibration Control	NYC Zoning Resolution	Sets limitations on certain nuisance noise and vibrations	Potentially Applicable	
	Construction-Related Street Closure and Placement of Equipment or Materials on Streets, Sidewalks,and Other Public Ways		Construction-related street closure and placement of equipment or material on New York City Streets is regulated by the New York City Department of Transportation	Potentially Applicable	
	Building Alteration/Demolition	NYC Building Code, Sections 27-161,162, 167, and171	Any demolition or alteration of buildings during implementation of a remedial action must be approved by the New York City Buildings Department	Potentially Applicable	No building alteration or demolition is planned at this time for any of the remedial actions. This SCG is included in the event that building alteration or demolition becomes necessary in order to safely and effectively implement an alternative
	New York City Sewer System Site Connection Proposal		A Site Connection Proposal must by filed with the New York City Department of Environmental Protection for any new stormwater connection to the New York City Sewer System.	Potentially Applicable	
	Air Pollution Control	NYC Administrative Code, Title 24, Chapter 1	Establishes limitations for emissions of various air pollutants such as combustion engine exhaust and particulates	Potentially Applicable	

TABLE 2-1
HEXAGON LABORATORIES RI/FFS
POTENTIALLY APPLICABLE SCGs

ACT/AUTHORITY	CRITERIA/ISSUES	CITATION	BRIEF DESCRIPTION	STATUS	COMMENTS
	Air Pollution Control	NYC Zoning Resolution	Establishes limitations for emissions of dust and odors	Potentially Applicable	
	Solid Waste		Waste haulers operating within New York City must be licensed by the New York City Waste Trade Commission	Potentially Applicable	Relevant to off-site tranport of remediation-derived wastes
STATE ACTION-SPECIFIC SCGs and TBCs					
New York State Vehicle and Traffic Law, Article 386, Environmental Conservation Law Articles 3 and 19.	Noise from Heavy Motor Vehicles	6 NYCRR 450	Defines maximum acceptable noise levels.	Potentially Applicable	Marginally applicable; appears to apply to over-the-road vehicles, not construction equipment
Environmental Conservation Law, Articles 3, 15, and 17	New York State Pollution Discharge Elimination System	6 NYCRR 750 - 758	Establishes permit requirements for point source discharges into state waters.	Potentially Applicable	Supercedes need to obtain NPDES permits since New York has an approved SPDES program. New York SPDES program does not require a permit for discharge of uncontrolled stormwater runoff as per 6 NYCRR 751.3(a)(7). Discharge to municipal sewers appears to be under local jurisdiction
Environmental Conservation Law, Articles 3 and 19.	Prevention and Control of Air Contaminants and Air Pollution	6 NYCRR 200 - 202	Establishes general provisions and requires construction and operation permits for emission of air pollutants.	Potentially Applicable	200.1 - Identifies NYC as non-attainment area for ozone, CO, and PM_{10}
Environmental Conservation Law, Article 15, also Public Health Law Articles 1271 and 1276 (Part 288 only)	Air Quality Classifications and Standards	6 NYCRR 256, 257, and 288	Establishes air quality classification system and air quality standards for various pollutants including particulates and non-methane hydrocarbons	Potentially Applicable	
Environmental Conservation Law, Articles 3, 19, 23, 27, and 70	Hazardous Waste Management System - General	6 NYCRR 370	Provides definition of terms and general standards applicable to 6 NYCRR 370 - 374, 376.	Potentially Applicable	
	Identification and Listing of Hazardous Waste	6 NYCRR 371	Identifies characteristic hazardous waste and lists specific wastes. PCB contmainated material with 50 ppm or greater PCBs is NY hazardous waste (B007)	Potentially Applicable	PCBs were not identified as contaminants of concern but are present at low levels in site soils
	Hazardous Waste Manifest System and Related Standards	6 NYCRR 372	Establishes manifest sytem and recordkeeping standards for generators and transporters of hazardous waste and for treatment, storage, and disposal facilities.	Potentially Applicable	Relevant to transportation and off-site treatment of hazardous waste
	Hazardous Waste Treatment, Storage, and Disposal Facility Permitting Requirements	6 NYCRR 373	Regulates treatment, storage, and disposal of hazardous waste	Potentially Applicable	Relevant to off-site treatment/disposal of hazardous waste
	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities	6 NYCRR 374	Subpart 374-1 establishes standards for the management of specific hazardous wastes. (Subpart 374-2 establsihes standards for the management of used oil.)	Potentially Applicable	
Environmental Conservation Law, Articles 1, 3, 27, and 52, Administrative Procedures Act Articles 301 and 305	Inactive Hazardous Waste Disposal Site	6 NYCRR 375	Identifies process for investigation and remedial action at state funded Registry site, provides exception from NYSDEC permits.	Potentially Applicable	
Environmental Conservation Law, Articles 3 and 27	Land Disposal Restrictions	6 NYCRR 376	Identifies hazardous wastes which are restricted from land disposal. Defines treatment standards for hazardous waste.	Potentially Applicable	
Environmental Conservation Law, Articles 1, 3, 8, 19, 23, 27, 52, 54, and 70	Solid Waste Management Facilities	6 NYCRR 360	360-1. General provisions, includes identification of "beneficial use" potentially applicable to non-hazardous oily waste/soil (360-1.15). 360-2. Regulates construction and operation of landfills, including construction & demolition (C&D) debris landfills. Establishes regulations and permitting requirments for landfills.	Potentially Applicable	May be applicable for establishing off-site treatment and disposal options for excavated contaminated non-hazardous soil and debris

TABLE 2-1
HEXAGON LABORATORIES RI/FFS
POTENTIALLY APPLICABLE SCGs

ACT/AUTHORITY	CRITERIA/ISSUES	CITATION	BRIEF DESCRIPTION	STATUS	COMMENTS
FEDERAL ACTION-SPECIFIC SCGs and TBCs					
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and Superfund Amendments and Reauthorization Act of 1986 (SARA)	National Contingency Plan	40 CFR 300, Subpart E	Outlines procedures for remedial actions and for planning and implementing off-site removal actions.	Potentially Applicable	
Occupational Safety and Health Act	Worker Protection	29 CFR 1904, 1910, and 1926	Specifies minimum requirements to maintain worker health and safety during hazardous waste operations. Includes training requirements and construction safety requirements.	Potentially Applicable	Under 40 CFR 300.38, requirements of OSHA apply to all activities which fall under jurisdiction of the National Contingency Plan
Clean Water Act	National Pollution Discharge Elimination System (NPDES)	40 CFR 122 and 125	Issues permits for discharge into navigable waters. Establishes criteria and standards for imposing treatment requirements on permits	Potentially Applicable	New York SPDES program incorporates the NPDES program by reference
Safe Drinking Water Act	Underground Injection Control Program	40 CFR 144	Establishes performance standards, well requirements, and permitting requirements for groundwater re-injection wells	Potentially Applicable	Potentially applicable for remedial alternatives utilizing Fenton's reagent chemistry in which non-hazardous reagents are introduced to the subsurface via injection wells
	Underground Injection Control Program Technical Criteria and Standards	40 CFR 146	Establishes technical criteria and standards that must be met in groundwater re-injection permits for Class V wells. Class V wells include wells used in experimental technologies.	Potentially Applicable	
Clean Air Act	National Primary and Secondary Ambient Air Quality Standards	40 CFR 50	Establishes emission limits for six pollutants (SO_2, PM_{10}, CO, O_3, NO_2, and Pb).	Potentially Applicable	
	National Emission Standards for Hazardous Air Pollutants	40 CFR 61	Provides emission standards for 8 contaminants including benzene and mercury. Identifies 25 additional contaminants, including TCE and PCE, as having serious health effects but does not provide emission standards for these contaminants.	Potentially Applicable	Both mercury and benzene have been identified as COCs for the site soils.
Toxic Substances Control Act	Rules for Controlling PCBs	40 CFR 761	Provides guidance on storage and disposal of PCB-contaminated materials.	Potentially Applicable	PCBs were not identified as contaminants of concern but are present at low levels in site soils
Resource Conservation and Recovery Act	Criteria for Municipal Solid Waste Landfills	40 CFR 258	Establishes minimum national criteria for management of non-hazardous waste	Potentially Applicable	Applicable for remedial alternatives which involve generation of non-hazardous waste. Non-hazardous waste must be hauled and disposed of in accordance with RCRA
	Hazardous Waste Management System - General	40 CFR 260	Provides definition of terms and general standards applicable to 40 CFR 260 - 265, 268.	Potentially Applicable	Applicable for remedial alternatives which involve generation of a hazardous waste (*e.g.*, contaminated soil). Hazardous waste must be handled and disposed of in
	Identification and Listing of Hazardous Waste	40 CFR 261	Identifies solid wastes which are subject to regulation as hazardous wastes.	Potentially Applicable	
	Standards Applicable to Generators of Hazardous Waste	40 CFR 262	Establishes requirements (e.g., EPA ID numbers and manifests) for generators of hazardous waste	Potentially Applicable	
	Standards Applicable to Transporters of Hazardous Waste	40 CFR 263	Establishes standards which apply to persons transporting manifested hazardous waste within the United States	Potentially Applicable	
	Standards Applicable to Owners and Operators of Treatment, Storage, and Disposal Facilities	40 CFR 264	Establishes the minimum national standards which define acceptable management of hazardous waste.	Potentially Applicable	
	Land Disposal Restrictions	40 CFR 268	Identifies hazardous wastes which are restricted from land disposal	Potentially Applicable	

TABLE 2-2
HEXAGON LABORATORIES RI/FFS
SUMMARY OF BACKGROUND METALS CONCENTRATIONS (mg/kg)

Element	New York Soils	New Jersey Soils[2]	Eastern U.S. Soils	U.S. Soils			
	NYSDEC[1]	NJDEPE[1]	Shacklette and Boerngen[4]	McClanahan[5]	Dragun[6]	Kabata-Pendias & Pendias[7]	
						Clay Soils	Sandy Soils
Aluminum	1,000 - 25,000 [8]		7,000 - 100,000	10,000 - 300,000	10,000 - 300,000		
Antimony		0.69		0.2 - 150	< 1 - 500		
Arsenic	3 - 12	48.9	< 0.1 - 73	0.1 - 194	5 - 15	1.7 - 27	0.1 - 30
Barium	15 - 600		10 - 1,500	100 - 3,000	100 - 3,500	150 - 1,500	20 - 1,500
Beryllium	0 - 1.75	4.09	< 1 - 7	0.01 - 40	< 1 - 7	1 - 15	1 - 3
Cadmium		2.36		0.01 - 7	0.01 - 7		
Calcium	130 - 35,000		100 - 280,000	< 150 - 500,000	100 - 400,000		
Chromium	1.5 - 40	24.6	1 - 1,000	5 - 3,000	10 - 80	20 - 100	3 - 200
Cobalt	2.5 - 60		< 0.3 - 70	0.05 - 5	< 3 - 70	3 - 30	0.4 - 20
Copper	< 1 - 15[8]	143	< 1 - 700	2 - 250	2 - 100	7 - 70	1 - 70
Iron	17,500 - 25,000[8]		100 - 100,000	100 - 550,000	7,000 - 550,000		
Lead	1 - 12.5[8]	617	< 10 - 300	< 1 - 888	3 - 30	10 - 70	< 10 - 70
Magnesium	1,700 - 6,000[8]		50 - 50,000	400 - 9,000	600 - 6,000		
Manganese	50 - 5,000	952	< 2 - 7,000	20 - 18,300	100 - 4,000	50 - 2,000	7 - 2,000
Mercury	0.042 - 0.066[8]	2.71	0.01 - 3.4	0.01 - 4.6	0.2 - 0.6	0.01 - 0.90	0.01 - 0.54
Nickel	0.5 - 25	53.8	< 5 - 700	0.1 - 1,530	4 - 30	5 - 50	5 - 70
Potassium	8,500 - 43,000		50 - 37,000	80 - 37,000	400 - 30,000		
Selenium	< 0.1 - 0.125[8]	0.15	< 0.1 - 3.9	0.1 - 38	0.1 - 2.0	0.1 - 1.9	0.005 - 3.5
Silver		1.53		0.01 - 8	0.1 - 5.0		
Sodium	6,000 - 8,000[8]		500 - 50,000	150 - 25,000	750 - 7,500		
Thallium		0.46					
Vanadium	25 - 60[8]	46.1	< 7 - 300	3 - 500	20 - 500	20 - 150	7 - 150
Zinc		789	< 5 - 2,900	1 - 2,000	10 - 300	20 - 220	< 15 - 164

Notes:

1. McGovern, E.C. New York State Department of Environmental Conservation (NYSDEC). "Background Concentrations of 20 Elements in Soils with Special Regard for New York State".
2. Maximum concentrations listed for a total of 19 urban sites throughout New Jersey.
3. New Jersey Department of Environmental Protection & Energy (NJDEPE). 1993. "A Summary of Selected Soil Constituents and Contaminants at Background Locations in New Jersey".
4. Shacklette, H.T. and Boerngen, J.G. 1984. "Elemental Concentrations in Soils and Other Surficial Materials of the Conterminous United States".
   U.S. Geological Survey Professional Paper 1270. Reported in "Background Concentrations of 20 Elements in Soils with Special Regard for New York State Soils".
   E. Carol McGovern. New York State Department of Environmental Conservation.
5. McClanahan. 1986. Median Elemental Composition of Soils. Agency for Toxic Substances and Disease Registry (ATSDR)
6. Dragun, J. 1988. The Soil Chemistry of Hazardous Materials. The Hazardous Materials Control Research Institute. Silver Springs, Maryland.
7. Kabata-Pendias, A. and Pendias, H. 1984. Trace Elements in Soils and Plants. CRC Press. Boca Raton, Florida.
8. Albany, New York area.

TABLE 2-3
HEXAGON LABORATORIES RI/FFS
SURFACE SOIL ANALYTICAL DATA SUMMARY FOR CONTAMINANTS OF CONCERN

Sample Location	EAST YARD								
Field Sample ID	HX-SS1	HX-SS2	HX-SS6	HX-SS7	HX-SS8	HX-SS9	HX-SS10	HXB18	HXB19
Sample Interval (feet bgs)	0 - 0.5	0 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.9 - 1	0.25 - 0.5	1.6 - 1.9	1.3 - 1.7
Date Sampled	12/18/97	12/18/97	10/1/98	10/1/98	10/1/98	10/2/98	10/2/98	10/2/98	10/1/98
Volatile Organics (ug/kg)									
Benzene	11 UJ	11 UJ	10 U	11 U	11 U	11 U	11 U	11 U	11 J
Toluene	45 J	11 UJ	10 U	11 U	11 U	2 J	1 J	2 J	9 J
Ethylbenzene	1 J	11 UJ	10 U	11 U	11 U	11 U	11 U	4 J	14 J
Xylene(total)	10 J	11 UJ	10 U	11 U	11 U	11 U	11 U	18	38 J
Methylene Chloride	11 UJ	11 UJ	3 J	4 J	11	5 J	2 J	1 J	32
1,1-Dichloroethane	11 UJ	11 UJ	10 U	11 U	11 U	11 U	11 U	11 U	29 U
1,2-Dichloroethene (total)	11 UJ	11 UJ	10 U	11 U	11 U	11 U	11 U	11 U	29 U
1,2-Dichloroethane	19 J	8 J	10 U	11 U	11 U	11 U	11 U	11 U	29 U
1,1,1-Trichloroethane	11 UJ	11 UJ	10 U	11 U	11 U	11 U	11 U	11 U	29 U
Trichloroethene	2 J	11 UJ	10 U	11 U	11 U	11 U	11 U	11 U	29 U
Tetrachloroethene	4 J	2 J	2 J	11 U	11 U	5 J	37	9 J	29 UJ
Acetone	24 J	11 UJ	2 J	11 U	11 U	20	11 U	140	210
Chlorobenzene	11 UJ	11 UJ	10 U	11 U	11 U	11 U	11 U	11 U	29 UJ
Total VOCs	110 J	10 J	7 J	4 J	11 J	98 J	52 J	916 J	5272 J
Semivolatile Organics (ug/kg)									
Phenol	R	R	1700 U	1100 U	1100 U	370 U	350 U	R	730 U
2-Methylphenol (o-cresol)	R	R	1700 U	1100 U	1100 U	370 U	350 U	R	730 U
4- Methylphenol	R	R	1700 U	1100 U	1100 U	370 U	350 U	R	730 U
Benzo(a)anthracene	630	390 U	1700 U	1100 U	1100 U	370 U	350 U	350 U	280 J
Chrysene	1400 JN	2000 JN	1700 U	1100 U	560 J	370 U	130 J	110 J	510 J
Benzo(a)pyrene	480 J	80 JN	1700 U	1100 U	1100 U	370 U	350 U	350 U	300 J
Dibenz(a,h)anthracene	94 J	R	1700 U	1100 U	1100 U	370 U	350 U	350 U	730 U
4-Chloroaniline	370 UJ	390 U	1700 U	1100 U	1100 U	370 U	350 U	350 U	730 U
1,2-Dichlorobenzene	370 U	390 U	1700 U	1100 U	1100 U	370 U	350 U	350 UJ	730 U
Diethylphthalate	370 U	390 U	1700 U	1100 U	1100 U	370 UJ	350 U	20 J	93 J
Total SVOC Concentration	149206 J	44670 J	20560 J	30360 J	33920 J	2935 J	18245 J	27649 J	21375 J
Pesticides (ug/kg)									
Aldrin	8.5 J	67 DJN	NA	NA	NA	NA	NA	NA	NA
Inorganics (mg/kg)									
Antimony	0.60 UJ	0.48 UJ	0.79 U	1.0 U	11.8 J	3.4 J	2.5 J	0.83 U	24.3 J
Arsenic	4.9	3.9	2.5	3.2	6.5 J	5.7 J	3.9	5.1 J	27.5 J
Cadmium	0.22	1.6	0.62 J	0.90 J	7.7 J	7.2 J	0.79 J	1.1 J	31.5 J
Copper	14.4 J	57.9 J	49.6 J	73.4 J	266 J	380 J	75.1 J	65.4 J	3720 J
Lead	32.8 J	144 J	52.0 J	111 J	856 J	928 J	286 J	99.9 J	1400 J
Mercury	0.09 J	0.58 J	0.10 U	0.10 U	0.56	0.21	0.10 U	0.17	1.1
Selenium	3.5 J	0.87 UJ	0.85	1.0 U	0.96 U	1.3	0.96 U	0.8 U	8.6
Zinc	64.8	545	269 J	296 J	3020 J	6890 J	381 J	265 J	8100 J

Notes:
1. Recommended soil cleanup levels obtained from the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) HWR-94-4046.
2. Recommended soil cleanup level corresponds to trans 1,2-dichloroethene.
3. Maximum concentration listed for urban New Jersey soils as reported by NJDEPE in "A Summary of Selected Soil Constituents and Contaminants at Background Locations in New Jersey", 1993.
4. Maximum background concentration for New York State soils as reported by E.C. McGovern, NYSDEC, in "Background Concentrations of 20 Elements in Soils with Special Regard for New York State", undated.
5. Maximum concentration detected in site-specific background sample.
6. As indicated in NYSDEC TAGM HWR-94-4046, average background levels of lead in metropolitan or suburban areas or near highways typically range as high as 500 ppm.
7. U = Not detected; J = Estimated value; R = Rejected value; N = Presumptive evidence of presence; D = Diluted sample; NC = No criterion; NA = Not analyzed; BKGD = Site background concentration; ND = Non detect.
8. Shading indicates exceedance of 4 times the NYSDEC TAGM Levels.

TABLE 2-3
HEXAGON LABORATORIES RI/FFS
SURFACE SOIL ANALYTICAL DATA SUMMARY FOR CONTAMINANTS OF CONCERN
Page 2 of 2

Sample Location	SOUTH YARD	OLD PLANT	NEW PLANT		BOS. POST RD.	OFFICE/WARE	HYDROTHERM 1	NYSDEC TAGM Levels (1)	Background Concentrations
Field Sample ID	HX-SS3	HX-SS5	HX-SS4	HXB10S1	HXB6S1	HXB16S1	HXB13S1		
Sample Interval (feet bgs)	0 - 0.5	0 - 0.5	0 - 0.5	0 - 2	1 - 2	0 - 2	0 - 2		
Date Sampled	12/18/97	12/18/97	12/18/97	11/12/97	1/16/98	12/9/97	12/9/97		
Volatile Organics (ug/kg)									
Benzene	58 UJ	11 UJ	71 UJ	13000 UJ	11 UJ	11 UJ	110 UJ	60	--
Toluene	230 J	35 J	260 J	610000 DJ	11 UJ	2 J	110 UJ	1500	--
Ethylbenzene	41 J	2 J	14 J	98000 J	2 J	11 UJ	110 UJ	5500	--
Xylene(total)	160 J	12 J	150 J	590000 DJ	17 J	0.9 J	110 UJ	1200	--
Methylene Chloride	58 UJ	11 UJ	71 UJ	13000 UJ	11 UJ	11 UJ	110 UJ	100	--
1,1-Dichloroethane	58 UJ	11 UJ	71 UJ	13000 UJ	11 UJ	11 UJ	110 UJ	200	--
1,2-Dichloroethene (total)	58 UJ	11 UJ	71 UJ	13000 UJ	11 UJ	11 UJ	110 UJ	300 (2)	--
1,2-Dichloroethane	29 J	12 J	44 J	13000 UJ	11 UJ	11 UJ	110 UJ	100	--
1,1,1-Trichloroethane	58 UJ	11 UJ	71 UJ	13000 UJ	11 UJ	11 UJ	110 UJ	800	--
Trichloroethene	6 J	1 J	71 UJ	2900 J	11 UJ	11 UJ	110 UJ	700	--
Tetrachloroethene	29 J	4 J	71 UJ	13000 J	11 UJ	0.6 J	110 UJ	1400	--
Acetone	11 J	4 J	11 J	6100 J	15 J	20 J	34 J	200	--
Chlorobenzene	110 J	11 UJ	71 UJ	24000 J	11 UJ	11 UJ	110 UJ	1700	--
Total VOCs	2016 J	91 J	479 J	1533000 J	4563 J	32 J	12132 J	10000	--
Semivolatile Organics (ug/kg)								*	
Phenol	390 U	R	R	180 JN	370 U	480 U	4900 U	30	--
2-Methylphenol (o-cresol)	390 U	370 U	380 U	1100	370 U	480 U	4900 U	100	--
4- Methylphenol	390 U	R	380 U	1800	370 U	480 U	4900 U	900	--
Benzo(a)anthracene	390 UJ	370 UJ	R	70 J	490	75 J	4900 U	224	--
Chrysene	7400 DJN	4900 DJN	4400 DJN	130 J	490	130 J	300000 D	400	--
Benzo(a)pyrene	630 J	R	R	63 J	440	50 J	3200 J	61	--
Dibenz(a,h)anthracene	R	R	R	390 U	88 J	480 U	4900 UJ	14	--
4-Chloroaniline	390 UJ	370 UJ	380 UJ	390 U	370 UJ	480 UJ	4900 UJ	220	--
1,2-Dichlorobenzene	740	150 J	500	83 J	370 U	480 U	4900 U	7900	--
Diethylphthalate	390 U	370 U	380 U	5000 D	370 U	480 U	4900 U	7100	--
Total SVOC Concentration	27650 J	16370 J	40960 J	227156 J	14179 J	25786 J	2895720 J	500000	--
Pesticides (ug/kg)									
Aldrin	180 DJN	1.9 U	22 JN	8.0 U	3.5 J	R	0.50 U	41	--
Inorganics (mg/kg)									
Antimony	0.83 J	0.54 UJ	0.62 UJ	0.55 U	0.61 UJ	0.51 UJ	0.53 UJ	BKGD	0.69 (3)
Arsenic	9.5	4.2	63.8	1.3	3.2	4.8 J	5.6 J	7.5 or BKGD	12 (4)
Cadmium	2.1	1.9	11.7	0.29	2.5	0.5	0.26	1 or BKGD	2.36 (3)
Copper	95.1 J	80.1 J	1050 J	61.6	57.7 J	75.5 J	53.7 J	25 or BKGD	196 (5)
Lead	206 J	185 J	1040 J	8.8	53.3 J	90.3	54.5	BKGD	500 (6)
Mercury	7.3 J	3.7 J	6.7 J	0.16	1.1 J	0.33 J	2.3 J	0.1 or BKGD	2.71 (3)
Selenium	3.0 J	2.4 J	0.96 UJ	0.91 U	R	0.85 UJ	0.89 UJ	2 or BKGD	0.125 (4)
Zinc	482	327	1270	87.7 J	166 J	225 J	162 J	20 or BKGD	1100 (5)

Notes:

1. *Recommended soil cleanup levels obtained from the* NYSDEC Technical and Administrative Guidance Memorandum (TAGM) HWR-94-4046.
2. Recommended soil cleanup level corresponds to trans 1,2-dichloroethene.
3. Maximum concentration listed for urban New Jersey soils as reported by NJDEPE in "A Summary of Selected Soil Constituents and Contaminants at Background Locations in New Jersey", 1993.
4. Maximum background concentration for New York State soils as reported by E.C. McGovern, NYSDEC, in "Background Concentrations of 20 Elements in Soils with Special Regard for New York State", undated.
5. Maximum concentration detected in site-specific background sample.
6. As indicated in NYSDEC TAGM HWR-94-4046, average background levels of lead in metropolitan or suburban areas or near highways typically range as high as 500 ppm.
7. U = Not detected; J = Estimated value; R = Rejected value; N = Presumptive evidence of presence; D = Diluted sample; NC = No criterion; NA = Not analyzed; BKGD = Site background concentration; ND = Non detect.
8. Shading indicates exceedance of 4 times the NYSDEC TAGM Levels.

TABLE 2-4
HEXAGON LABORATORIES RI/FFS
SUBSURFACE BORING ANALYTICAL DATA SUMMARY FOR CONTAMINANTS OF CONCERN

Sample Location	EAST YARD							SOUTH YARD			
Field Sample ID	HXB1S3	HXB1S7	HXB7S2	HXB7S4	HXB17	HXB20	HXB21	HXB3S2	HXB8S4	HXB9S3	HXB9S5
Sample Interval (feet bgs)	4 - 6	11 - 13	2 - 4	6 - 8	2 - 2.5	2.2 - 2.3	2 - 2.5	2 - 4	6 - 7	4 - 6	8 - 10
Date Sampled	11/19/97	11/19/97	11/11/97	11/11/97	10/1/98	10/2/98	10/2/98	11/11/97	11/17/97	11/11/97	11/11/97
Volatile Organics (ug/kg)											
Benzene	2 J	11 U	110 UJ	1 J	330	2 J	22	11 UJ	11 UJ	30 J	1400 UJ
Toluene	130	11 U	360 J	78 J	10 J	4 J	54	88 J	11 UJ	75 J	1400 UJ
Ethylbenzene	3 J	11 U	390 J	2 J	380	2 J	26	11 J	41 J	650 J	2200 J
Xylene(total)	22	11 U	2400 J	12 J	130	6 J	200	99 J	240 J	880 J	3000 J
Methylene Chloride	0.8 J	6 J	110 UJ	1 J	12 J	2 J	2 J	1 J	11 UJ	120 UJ	570 J
1,1-Dichloroethane	12 U	11 U	110 UJ	11 UJ	56 U	12 U	12 U	11 UJ	11 UJ	120 UJ	1400 UJ
1,2-Dichloroethene (total)	12 U	11 U	110 UJ	11 UJ	56 U	12 U	12 U	11 J	11 UJ	120 UJ	1400 UJ
1,2-Dichloroethane	34	24	65 J	34 J	56 U	12 U	12 U	30 J	11 UJ	36 J	1400 UJ
1,1,1-Trichloroethane	12 U	11 U	110 UJ	1 J	56 U	12 U	12 U	11 UJ	11 UJ	120 UJ	1400 UJ
Trichloroethene	4 J	0.9 J	12 J	9 J	56 U	12 U	12 U	19 J	11 UJ	120 UJ	1400 UJ
Tetrachloroethene	6 J	11 U	110 UJ	5 J	56 U	18	12 J	51 J	11 UJ	120 UJ	1400 UJ
Acetone	12 J	30	200 J	30 J	240	36	140	38 J	11 UJ	250 J	1400 UJ
Chlorobenzene	12 U	3 J	12 J	2 J	84	12 U	12 U	11 UJ	25 J	34 J	400 J
Total VOCs	242 J	111 J	16709 J	180 J	12837 J	538 J	3432 J	421 J	1874 J	73455 J	272470 J
Semivolatile Organics (ug/kg)											
Phenol	550 UJ	530 UJ	740 UJ	380 U	1100 U	760 U	160 J	R	1500 UJ	750 UJ	720 UJ
2-Methylphenol (o-cresol)	550 UJ	530 UJ	740 UJ	380 U	1100 U	760 U	140 J	R	1500 UJ	750 UJ	720 UJ
4- Methylphenol	550 UJ	530 UJ	740 UJ	380 U	1100 U	760 U	800	R	1500 UJ	750 UJ	720 UJ
Benzo(a)anthracene	230 J	530 UJ	140 JN	380 U	220 J	440 J	690 J	380 U	1500 UJ	750 U	64 J
Chrysene	290 J	530 UJ	250 J	380 U	460 J	760	1200	380 U	1500 UJ	150 J	720 U
Benzo(a)pyrene	190 J	530 UJ	210 J	380 U	210 J	340 J	720 J	380 U	1500 UJ	750 U	720 U
Dibenz(a,h)anthracene	550 UJ	530 UJ	740 UJ	380 U	1100 U	760 U	780 U	380 U	1500 UJ	750 U	720 U
4-Chloroaniline	550 UJ	530 UJ	740 U	380 U	1100 U	760 U	780 U	380 U	1500 UJ	750 U	720 U
1,2-Dichlorobenzene	550 UJ	530 UJ	740 U	380 U	1100 U	760 U	780 U	380 U	1500 UJ	750 U	720 U
Diethylphthalate	550 UJ	530 UJ	740 U	380 U	1100 U	760 U	140 J	380 U	1500 UJ	750 U	720 U
Total SVOC Concentration	45,896 J	2,094 J	12,711 J	0 J	52,110 J	23,173 J	58,490 J	3,392 J	55,940 J	147,530 J	160,214 J
Pesticides (ug/kg)											
Aldrin	0.56 U	0.54 U	6.8 JN	2.0 U	NA	NA	NA	1.9 U	220 DJN	1.9 U	1.8 U
Inorganics (mg/kg)											
Antimony	0.63 U	0.55 U	0.57 U	0.58 U	3.6 J	9.0 J	29.7 J	0.61 U	0.49 U	0.61 U	0.51 U
Arsenic	4.7	3.4	3.6	2.7	5.8 J	5.0 J	18.4 J	3.0	3.3 J	2.5	1.9
Cadmium	5.7	0.11 U	1.5	0.31	4.2 J	6.4 J	28.2 J	1.2	0.10 U	0.58	0.26
Copper	185 J	52.1 J	36.5	35.6	139 J	125 J	509 J	45.1	16.7 J	38.0	42.3
Lead	182 J	8.2 J	121	41.6	515 J	3850 J	3360 J	265	0.69	32.6	2.8
Mercury	0.28	0.04	0.29	0.03 U	0.23	0.19	0.78	0.07	0.03 U	0.16	0.03 U
Selenium	1.1 U	0.91 U	0.95 U	0.97 U	3.2	2.0	7.1	1.1	0.81 U	1.0 U	0.85 U
Zinc	1290	124	219 J	116 J	1350 J	1390 J	12000 J	279 J	69.1 J	153 J	96.4 J

Notes:

1. Recommended soil cleanup levels obtained from the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) HWR-94-4046.
2. Recommended soil cleanup level corresponds to trans 1,2-dichloroethene.
3. Maximum concentration listed for urban New Jersey soils as reported by NJDEPE in "A Summary of Selected Soil Constituents and Contaminants at Background Locations in New Jersey", 1993.
4. Maximum background concentration for New York State soils as reported by E.C. McGovern, NYSDEC, in "Background Concentrations of 20 Elements in Soils with Special Regard for New York State", undated.
5. Maximum concentration detected in site-specific background sample.
6. As indicated in NYSDEC TAGM HWR-94-4046, average background levels of lead in metropolitan or suburban areas or near highways typically range as high as 500 ppm.
7. U = Not detected; J = Estimated value; R = Rejected value; N = Presumptive evidence of presence; D = Diluted sample; NC = No criterion; NA = Not analyzed. BKGD = Site background concentration; ND = Non detect.
8. Shading indicates exceedance of 4 times the NYSDEC TAGM Levels.

TABLE 2-4
HEXAGON LABORATORIES RI/FFS
SUBSURFACE BORING ANALYTICAL DATA SUMMARY FOR CONTAMINANTS OF CONCERN
Page 2 of 2

Sample Location	NORTH YARD	OLD PLANT			NEW PLANT	TUFO'S	HOLLERS AVE.	PEARTREE AVE.		
Field Sample ID	HXB15S1	HXB5S2	HXB11S2	HXB12S2	HXB4S2	HXBK1	HXBK2	HXBK3		
Sample Interval (feet bgs)	2.5 - 4.5	2 - 4	4 - 5	2 - 4	2 - 4	2.5 - 4.5	2.5 - 4.5	2.5 - 4.5	NYSDEC	Background
Date Sampled	11/19/97	11/14/97	11/12/97	11/12/97	11/18/97	11/17/97	11/17/97	11/17/97	TAGM Levels (1)	Concentrations
Volatile Organics (ug/kg)										
Benzene	0.6 J	5600 U	28000 JN	6900 UJ	140000 U	12 UJ	11 UJ	11 UJ	60	--
Toluene	28	340000 D	21000000 DJ	150000 DJ	3200000 D	9 J	11 UJ	11 UJ	1500	--
Ethylbenzene	0.9 J	47000	770000 J	7700 J	490000	12 UJ	11 UJ	11 UJ	5500	--
Xylene(total)	6 J	220000	3400000 DJ	48000 J	3300000	12 UJ	11 UJ	11 UJ	1200	--
Methylene Chloride	0.6 J	5600 U	26000 J	6900 UJ	140000 U	12 UJ	11 UJ	11 UJ	100	--
1,1-Dichloroethane	10 U	5600 U	27000 J	6900 UJ	140000 U	12 UJ	11 UJ	11 UJ	200	--
1,2-Dichloroethene (total)	10 U	5600 U	69000 UJ	6900 UJ	140000 U	12 UJ	11 UJ	11 UJ	300 (2)	--
1,2-Dichloroethane	36	5600 U	5100000 DJN	6900 UJ	68000 J	12 UJ	11 UJ	11 UJ	100	--
1,1,1-Trichloroethane	10 U	5600 U	570000 J	6900 UJ	15000 J	12 UJ	11 UJ	11 UJ	800	--
Trichloroethene	0.9 J	410 J	880000 J	840 J	150000	9 J	11 UJ	11 UJ	700	--
Tetrachloroethene	1 J	5600 U	310000 J	5100 J	1100000	2 J	11 UJ	11 UJ	1400	--
Acetone	4 J	4700 J	69000 UJ	6900 UJ	140000 U	89 J	2 J	4 J	200	--
Chlorobenzene	10 U	5600 U	200000 J	2900 J	140000 U	12 UJ	11 UJ	11 UJ	1700	--
Total VOCs	99 J	641110 J	33230000 J	288140 J	8546000 J	4299 J	2 J	4 J	10000	--
Semivolatile Organics (ug/kg)										
Phenol	490 UJ	370 U	5100 DJN	360 JN	1500 UJ	R	1500 UJ	1400 UJ	30	--
2-Methylphenol (o-cresol)	490 UJ	820	4600 DJN	55 JN	1500 UJ	R	1500 UJ	1400 UJ	100	--
4- Methylphenol	490 UJ	480	1000 DJ	350 J	1400 J	R	1500 UJ	1400 UJ	900	--
Benzo(a)anthracene	490 UJ	370 U	1800 U	88 JN	1500 UJ	4900 J	1500 UJ	1400 UJ	224	--
Chrysene	490 UJ	60 J	1800 U	190 J	1500 UJ	6600 J	1500 UJ	1400 UJ	400	--
Benzo(a)pyrene	490 UJ	370 U	1800 U	120 JN	1500 UJ	1500 J	1500 UJ	1400 UJ	61	--
Dibenz(a,h)anthracene	490 UJ	370 U	1800 U	370 U	1500 UJ	480 J	1500 UJ	1400 UJ	14	--
4-Chloroaniline	490 UJ	370 U	1800 U	660	1500 UJ	1600 UJ	1500 UJ	1400 UJ	220	--
1,2-Dichlorobenzene	490 UJ	180 J	1800 U	130 J	9400 J	1600 UJ	1500 UJ	1400 UJ	7900	--
Diethylphthalate	490 UJ	53 J	38000 D	56 J	1500 UJ	1600 UJ	1500 UJ	1400 UJ	7100	--
Total SVOC Concentration	2,875 J	65,583 J	922,120 J	109,500 J	1,029,600 J	117,700 J	400 J	1,240 J	500000	--
Pesticides (ug/kg)										
Aldrin	0.73	1.8 U	9.3 U	7.5 U	970 DJN	R	2.6 UJ	370 DJN	41	--
Inorganics (mg/kg)										
Antimony	0.54 U	0.86	0.47 U	0.55 U	0.45 U	0.66 U	0.57 U	0.62 U	BKGD	0.69 (3)
Arsenic	4.8	4.4 J	1.1	1.9	1.8	9.0 J	3.2	2.4	7.5 or BKGD	12 (4)
Cadmium	5.6	0.12 U	0.09 U	0.24	0.09 U	1.3	0.11 U	0.12 U	1 or BKGD	2.36 (3)
Copper	151 J	46.8	10.6	467	31.1 J	196 J	33.5 J	19.1 J	25 or BKGD	196 (5)
Lead	180 J	4.0	2.5	23.4	7.6 J	455	8.1	10.1	BKGD	500 (6)
Mercury	0.03 U	0.06	11.9	0.63	0.16	0.07	0.04 U	0.04 U	0.1 or BKGD	2.71 (3)
Selenium	0.90 U	0.99 U	0.78 U	0.92 U	0.75 U	1.1 U	0.95 U	1.0 U	2 or BKGD	0.125 (4)
Zinc	1070	81.9	37.6 J	124 J	21.3	1100 J	61.2 J	52.8 J	20 or BKGD	1100 (5)

Notes:

1. Recommended soil cleanup levels obtained from the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) HWR-94-4046.
2. Recommended soil cleanup level corresponds to trans 1,2-dichloroethene.
3. Maximum concentration listed for urban New Jersey soils as reported by NJDEPE in "A Summary of Selected Soil Constituents and Contaminants at Background Locations in New Jersey", 1993.
4. Maximum background concentration for New York State soils as reported by E.C. McGovern, NYSDEC, in "Background Concentrations of 20 Elements in Soils with Special Regard for New York State", undated.
5. *Maximum concentration detected in site-specific background sample.*
6. As indicated in NYSDEC TAGM HWR-94-4046, average background levels of lead in metropolitan or suburban areas or near highways typically range as high as 500 ppm.
7. U = Not detected; J = Estimated value; R = Rejected value; N = Presumptive evidence of presence; D = Diluted sample; NC = No criterion; NA = Not analyzed. BKGD = Site background concentration; ND = Non detect.
8. Shading indicates exceedance of 4 times the NYSDEC TAGM Levels.

TABLE 2-5
HEXAGON LABORATORIES RI/FFS
SUBSURFACE UST ANALYTICAL DATA SUMMARY FOR CONTAMINANTS OF CONCERN
Page 1 of 2

Sample Location	EAST YARD				SOUTH YARD				
Field Sample ID	EYT34-1	EYT35-1	EYT36-1	EYT37-1	SYTN-1	SYTS-1	SYTE-1	SYTW-1	SYTC-1
Sample Interval (feet bgs)	0 - 6	0 - 6	0 - 6	0 - 6	2.5 - 4.5	2.5 - 4.5	2.5 - 4.5	2.5 - 4.5	2.5 - 4.5
Date Sampled	8/29/97	8/29/97	8/29/97	8/29/97	12/4/97	12/4/97	12/4/97	12/4/97	12/4/97
Volatile Organics (ug/kg)									
Benzene	12 U	11 U	11 U	12 U	760 J	33000 UJ	5700 UJ	140000 UJ	NA
Toluene	12 U	11 U	11 U	70	190000 DJ	240000 J	66000 J	320000 J	NA
Ethylbenzene	12 U	11 U	11 U	12 U	6400 J	33000 UJ	6600 J	140000 UJ	NA
Xylene(total)	12 U	11 U	11 U	12 U	30000 J	24000 J	60000 J	140000 UJ	NA
Methylene Chloride	12 U	11 U	11 U	12 U	3300 UJ	33000 UJ	5700 UJ	140000 UJ	NA
1,1-Dichloroethane	12 U	11 U	11 U	12 U	3300 UJ	33000 UJ	5700 UJ	140000 UJ	NA
1,2-Dichloroethene (total)	12 U	11 U	11 U	12 U	3300 UJ	33000 UJ	5700 UJ	140000 UJ	NA
1,2-Dichloroethane	12 U	11 U	11 U	12 U	5000 J	33000 UJ	5700 UJ	140000 UJ	NA
1,1,1-Trichloroethane	12 U	11 U	11 U	4 J	370 J	33000 UJ	5700 UJ	140000 UJ	NA
Trichloroethene	12 U	11 U	11 U	12 U	3200 J	33000 UJ	5700 UJ	140000 UJ	NA
Tetrachloroethene	12 U	11 U	11 U	12 U	5900 J	7600 J	1700 J	140000 UJ	NA
Acetone	21 UJ	27 UJ	12 UJ	16 UJ	9200 J	33000 UJ	5700 UJ	140000 UJ	NA
Chlorobenzene	12 U	11 U	11 U	2 J	10000 J	33000 UJ	75000 J	140000 UJ	NA
Total VOCs	0 J	24 J	0 J	76 J	273830 J	271600 J	615020 J	320000 J	NA
Semivolatile Organics (ug/kg)									
Phenol	400 U	360 U	360 U	390 U	NA	NA	NA	NA	R
2-Methylphenol (o-cresol)	400 U	360 U	360 U	390 U	NA	NA	NA	NA	2900 U
4- Methylphenol	400 U	360 U	360 U	390 U	NA	NA	NA	NA	2300 J
Benzo(a)anthracene	400 U	140 J	360 U	390 U	NA	NA	NA	NA	2900 U
Chrysene	400 U	360 U	360 U	390 U	NA	NA	NA	NA	40000 DJ
Benzo(a)pyrene	400 U	360 U	360 U	390 U	NA	NA	NA	NA	R
Dibenz(a,h)anthracene	400 U	360 U	360 U	390 U	NA	NA	NA	NA	2900 U
4-Chloroaniline	400 U	360 U	360 U	390 U	NA	NA	NA	NA	2900 UJ
1,2-Dichlorobenzene	400 U	360 U	360 U	390 U	NA	NA	NA	NA	140000 D
Diethylphthalate	400 U	360 U	360 U	390 U	NA	NA	NA	NA	2900 U
Total SVOC Concentration	140 J	9482 J	1980 J	1851 J	NA	NA	NA	NA	539070 J
Pesticides (ug/kg)									
Aldrin	2.0 U	1.8 U	1.8 U	2.0 U	NA	NA	NA	NA	180 JN
Inorganics (mg/kg)									
Antimony	0.58 U	0.58 U	0.59 U	0.52 U	NA	NA	NA	NA	0.67 UJ
Arsenic	1.7	0.70	0.39 U	0.56	NA	NA	NA	NA	2.3
Cadmium	0.12 U	0.12 U	0.12 U	0.10 U	NA	NA	NA	NA	0.60
Copper	2.5	3.1	4.3	2.3	NA	NA	NA	NA	55.5 J
Lead	1.5	3.3	2.8	1.4	NA	NA	NA	NA	44.8
Mercury	0.27	0.56	0.04 U	0.07	NA	NA	NA	NA	4.1 J
Selenium	0.97 U	0.96 U	0.98 U	0.87 U	NA	NA	NA	NA	1.1 UJ
Zinc	5.9 J	43.8 J	72.4 J	8.2 J	NA	NA	NA	NA	169 J

Notes:

1. Sample SYTEX-1 represents excavated material that was removed from the site during the IRM.
2. Recommended soil cleanup levels obtained from the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) HWR-94-4046.
3. Recommended soil cleanup level corresponds to trans 1,2-dichloroethene.
4. Maximum concentration listed for urban New Jersey soils as reported by NJDEPE in "A Summary of Selected Soil Constituents and Contaminants at Background Locations in New Jersey", 1993.
5. Maximum background concentration for New York State soils as reported by E.C. McGovern, NYSDEC, in "Background Concentrations of 20 Elements in Soils with Special Regard for New York State", undated.
6. Maximum concentration detected in site-specific background sample.
7. As indicated in NYSDEC TAGM HWR-94-4046, average background levels of lead in metropolitan or suburban areas or near highways typically range as high as 500 ppm.
8. U = Not detected; J = Estimated value; R = Rejected value; N = Presumptive evidence of presence; D = Diluted sample; NC = No criterion; NA = Not analyzed. BKGD = Site background concentration; ND = Non detect.
9. Shading indicates exceedance of 4 times the NYSDEC TAGM Levels.

TABLE 2-5
HEXAGON LABORATORIES RI/FFS
SUBSURFACE UST ANALYTICAL DATA SUMMARY FOR CONTAMINANTS OF CONCERN

Sample Location	SOUTH YARD	NORTH YARD		NEW PLANT					
Field Sample ID	SYTEX-1 (1)	NYT-1	NYT-2	NPT-1	NPT-2	NPT-3	NPT-4	NYSDEC TAGM Levels (2)	Background Concentrations
Sample Interval (feet bgs)	0 - 6	5.5 - 6	5.5 - 6	3 - 3.5	3 - 3.5	3 - 3.5	3 - 3.5		
Date Sampled	12/4/97	11/14/97	11/14/97	11/19/97	11/19/97	11/19/97	11/19/97		
Volatile Organics (ug/kg)									
Benzene	2900 UJ	15 J	4 J	1700 J	4800 J	7800 J	55000	60	--
Toluene	3400 J	720	28 J	37000	1700000 D	1200000 D	1700000 D	1500	--
Ethylbenzene	3800 J	200	30 J	560 J	55000	15000	33000	5500	--
Xylene(total)	6400 J	1200	17 J	24000	300000	1500000 D	200000	1200	--
Methylene Chloride	2900 UJ	120 U	14 J	820 J	12000 U	1500 J	11000 U	100	--
1,1-Dichloroethane	2900 UJ	120 U	26 UJ	3400 U	12000 U	12000 U	11000 U	200	--
1,2-Dichloroethene (total)	2900 UJ	120 U	26 UJ	280 J	830 J	1200 J	3700 J	300 (3)	--
1,2-Dichloroethane	330 J	130	26 UJ	6300	38000	43000	29000	100	--
1,1,1-Trichloroethane	2900 UJ	120 U	26 UJ	3400 U	12000 U	12000 U	11000 U	800	--
Trichloroethene	2900 UJ	30 J	26 UJ	460 J	46000	12000	1200 J	700	--
Tetrachloroethene	1400 J	29 J	26 UJ	440 J	100000	12000	690 J	1400	--
Acetone	13000 J	65 J	230 J	1000 J	12000 U	3200 J	11000 U	200	--
Chlorobenzene	6700 J	120 U	7 J	470 J	12000	12000 U	5000 J	1700	--
Total VOCs	38990 J	81889 J	7718 J	73030 J	2450730 J	2842400 J	2319090 J	10000	--
Semivolatile Organics (ug/kg)									
Phenol	530 U	2000 U	420 U	1200 J	2600 UJ	310 J	520 UJ	30	--
2-Methylphenol (o-cresol)	R	2000 U	130 J	510 J	2800 J	2600 U	520 UJ	100	--
4- Methylphenol	80 JN	2000 U	420 U	3600 J	2600 UJ	630 J	6400 DJ	900	--
Benzo(a)anthracene	530 U	2000 U	140 JN	640 UJ	2600 UJ	2600 UJ	680 JN	224	--
Chrysene	840	2000 U	200 J	640 UJ	2600 UJ	1900 J	780 JN	400	--
Benzo(a)pyrene	58 J	2000 U	180 J	640 UJ	2600 UJ	2600 UJ	220 JN	61	--
Dibenz(a,h)anthracene	530 U	2000 U	420 U	640 UJ	2600 UJ	2600 UJ	520 UJ	14	--
4-Chloroaniline	530 UJ	2000 U	420 U	640 UJ	2700 J	2600 UJ	520 UJ	220	--
1,2-Dichlorobenzene	110 J	2000 U	420 U	69 J	27000 DJ	2200 J	680 JN	7900	--
Diethylphthalate	86 J	2000 U	420 UJ	640 UJ	2600 UJ	2600 UJ	520 UJ	7100	--
Total SVOC Concentration	91775 J	212160 J	97804 J	35173 J	727370 J	239450 J	428700 J	500000	--
Pesticides (ug/kg)									
Aldrin	330 JN	1.7 U	1.8 U	3.3 U	350 DJN	350 JN	2.7 U	41	--
Inorganics (mg/kg)									
Antimony	0.59 UJ	0.48 U	0.64 U	0.66 U	0.53 U	0.64 U	0.52 U	BKGD	0.69 (4)
Arsenic	4.0 J	2.8	5.2 J	4.5	3.4	4.4	3.1	7.5 or BKGD	12 (5)
Cadmium	0.91	0.29	2.6	0.13 U	0.11 U	0.13 U	0.10 U	1 or BKGD	2.36 (4)
Copper	65.2 J	28.5	127	36.1 J	95.3 J	44.6 J	31.8 J	25 or BKGD	196 (6)
Lead	74.3	28.0	410	44.4 J	8.5 J	49.4 J	16.1 J	BKGD	500 (7)
Mercury	2.6 J	0.04 U	4.2	0.78	0.87	0.69	0.03 U	0.1 or BKGD	2.71 (4)
Selenium	0.98 UJ	0.81	1.1	1.1 U	0.89 U	1.1 U	0.87 U	2 or BKGD	0.125 (5)
Zinc	234 J	71.4	912	118	74.3	102	63.5	20 or BKGD	1100 (6)

Notes:

1. Sample SYTEX-1 represents excavated material that was removed from the site during the IRM.
2. Recommended soil cleanup levels obtained from the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) HWR-94-4046.
3. Recommended soil cleanup level corresponds to trans 1,2-dichloroethene.
4. Maximum concentration listed for urban New Jersey soils as reported by NJDEPE in "A Summary of Selected Soil Constituents and Contaminants at Background Locations in New Jersey", 1993.
5. Maximum background concentration for New York State soils as reported by E.C. McGovern, NYSDEC, in "Background Concentrations of 20 Elements in Soils with Special Regard for New York State", undated.
6. Maximum concentration detected in site-specific background sample.
7. As indicated in NYSDEC TAGM HWR-94-4046, average background levels of lead in metropolitan or suburban areas or near highways typically range as high as 500 ppm.
8. U = Not detected; J = Estimated value; R = Rejected value; N = Presumptive evidence of presence; D = Diluted sample; NC = No criterion; NA = Not analyzed. BKGD = Site background concentration; ND = Non detect.
9. Shading indicates exceedance of 4 times the NYSDEC TAGM Levels.

TABLE 2-6
HEXAGON LABORATORIES SITE RI/FFS
PRELIMINARY REMEDIATION GOALS

Contaminant of Concern	NYSDEC Soil Cleanup Objective (1) (ug/kg)	Federal Criteria (ug/kg)	Background Concentration (ug/kg)	Preliminary Remediation Goal (ug/kg)
VOLATILE ORGANICS				
Benzene	60	--	--	60
Toluene	1500	--	--	1500
Ethylbenzene	5500	--	--	5500
Xylenes (Total)	1200	--	--	1200
Methylene Chloride	100	--	--	100
1,1-Dichloroethane	200	--	--	200
cis-1,2-Dichloroethylene	NC	--	--	NC
trans-1,2-Dichloroethylene	300	--	--	300
1,2-Dichloroethane	100	--	--	100
1,1,1-Trichloroethane	800	--	--	800
Trichloroethylene	700	--	--	700
Tetrachloroethylene	1400	--	--	1400
Acetone	200	--	--	200
Chlorobenzene	1700	--	--	1700
Total VOCs	10,000	--	--	10,000
SEMIVOLATILE ORGANICS				
Phenol	30	--	--	30
2-Methylphenol (o-cresol)	100	--	--	100
4-Methylphenol (p-cresol)	900	--	--	900
Benzo(a)anthracene	224	--	--	224
Chrysene	400	--	--	400
Benzo(a)pyrene	61	--	--	61
Dibenzo(a,h)anthracene	14	--	--	14
4-Chloroaniline	220	--	--	220
1,2-Dichlorobenzene	7900	--	--	7900
Diethylphthalate	7100	--	--	7100
Total SVOCs	50,000	--	--	50,000
PESTICIDES/PCBs				
Aldrin	41	--	--	41
INORGANICS	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**
Antimony	BKGD		0.69(3)	0.69
Arsenic	7.5 or BKGD		12(4)	12
Cadmium	1 or BKGD		2.36(3)	2.36
Copper	25 or BKGD		196(5)	196
Lead	BKGD	400(2)	500(6)	400
Mercury	0.1 or BKGD		2.71(3)	2.71
Selenium	2 or BKGD		0.125(4)	2
Zinc	20 or BKGD		1,100(5)	1,100

Notes:
1. NYSDEC Technical and Administrative Guidance Memorandum (TAGM) HWR-94-4046 (January 1994).
2. Preliminary remediation goal based on Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, OSWER Directive #9355.4-12, July 1994.
3. Maximum concentration listed for urban New Jersey soils as reported by NJDEPE in "A Summary of Selected Soil Constituents and Contaminants at Background Locations in New Jersey", 1993.
4. Maximum background concentration for New York State soils as reported by E.C. McGovern, NYSDEC, in "Background Concentrations of 20 Elements in Soils with Special Regard for New York State", undated.
5. Maximum concentration detected in site-specific background sample.
6. As indicated in NYSDEC TAGM HWR-94-4046, average background levels of lead in metropolitan or suburban areas or near highways typically range as high as 500 ppm.

TABLE 2-7
HEXAGON LABORATORIES RI/FFS
ESTIMATE OF CONTAMINATED SOIL VOLUME

Contamination Sub-Area Designation[1]	Dimensions Length (Feet)	Width (Feet)	Depth [2] [3] (Feet)	Soil Volume (Cubic Feet)	Soil Volume (Cubic Yards)	Weight of Soil [4] (Tons)
North Yard	39	80	4	12,480	462	693
Old Plant #1	70	20	6	8,400	311	467
Old Plant #2	70	30	5	10,500	389	583
Old Plant #3	70	30	4	8,400	311	467
Old Plant #4	70	20	4	5,600	207	311
New Plant #1 [5]	--	--	--	32,400	1,200	1,800
-- Total New Plant #1 (inc. UST Excavation)	55	100	6	--	--	--
-- New Plant UST Excavation	10	12	5	--	--	--
New Plant #2	24	76	6	10,944	405	608
South Yard #1	25	29	5	3,625	134	201
South Yard #2	20	25	6	3,000	111	167
South Yard #3	50	22	6	6,600	244	367
South Yard #4	74	24	6	10,656	395	592
East Yard	100	100	6	60,000	2,222	3,333
Total				**172,605**	**6,393**	**9,589**
					Assume 6,400	

Notes:
1. Refer to Figure 2-1 for locations of Contamination Sub-Areas.
2. Depth of soil contamination is generally considered to be to the top of bedrock in the upper site (North Yard, Old Plant, New Plant, and South Yard). In the South Yard #3 and South Yard #4 sub-areas, the depth of soil contamination is considered to be a maximum depth of 6 feet bgs, corresponding to the depth to bedrock in adjacent sub-areas.
3. Depth of soil contamination in the East Yard is considered to be to the top of the groundwater table.
4. A soil specific gravity of 1.5 tons per cubic yard was assumed in calculating soil weight.
5. New Plant soil volume estimate does not include the New Plant UST excavation area since contaminated soil was removed from this area (and replaced with clean fill material) as part of the IRM.
6. The South Yard UST excavation is not included in the contaminated soil volume estimate since contaminated soil was removed from this area (and replaced with clean fill material) as part of the IRM.
7. Contamination Sub-Area subdivisions were approximated as rectangular blocks for the purposes of calculating soil volumes. Actual soil volumes may vary based on subsurface conditions.

TABLE 3-1
HEXAGON LABORATORIES RI/FFS
GENERAL RESPONSE ACTIONS FOR CONTAMINATED SOIL

A. NO ACTION

B. CONTAINMENT

C. IN-SITU TREATMENT

D. EX-SITU TREATMENT

E. REMOVAL

F. OFF-SITE TREATMENT

G. ON-SITE DISPOSAL

H. OFF-SITE DISPOSAL

I. INSTITUTIONAL CONTROLS

TABLE 3-2
HEXAGON LABORATORIES RI/FFS
SUMMARY OF REMEDIAL ALTERNATIVES

ALTERNATIVE	MAJOR ELEMENTS OF ALTERNATIVE
1	<u>No action</u> • Monitor soil and groundwater contamination by periodic soil and groundwater sampling
2A	<u>Containment - Asphalt Cap</u> • Remove elevated sections of existing concrete • Install asphalt cap • Install stormwater runoff control measures (perimeter drain; curb and sidewalk extension) • Implement institutional controls to protect cap • Sample groundwater annually to assess cap effectiveness
2B	<u>Containment - Concrete Cap</u> • Remove elevated sections of existing concrete • Install concrete cap • Install stormwater runoff control measures (perimeter drain; curb and sidewalk extension) • Implement institutional controls to protect cap • Sample groundwater annually to assess cap effectiveness
2C	<u>Containment - RCRA Multimedia Cap</u> • Remove elevated sections of existing concrete • Install RCRA multimedia cap • Install stormwater runoff control measures (perimeter drain; curb and sidewalk extension) • Implement institutional controls to protect cap • Sample groundwater annually to assess cap effectiveness
3	<u>In-situ Oxidation/Ex-situ Solidification/Stabilization/On-Site Disposal</u> • Conduct bench scale testing of Fenton's reaction-based in-situ oxidation and solidification/stabilization processes with site soils • Install injection trenches and wells • Apply Fenton's Reagent; Technology involves a combination of an oxidant and catalyst to generate free hydroxyl radicals to oxidize organic compounds • Conduct confirmatory sampling to verify RAOs for organic COCs • Excavate metals-contaminated soil • Solidify/stabilize soil using on-site continuous feed pug mill to add binding agent to soil • Install stormwater runoff control measures (perimeter drain; curb and sidewalk extension) • Backfill excavation using treated soil • Implement institutional controls to prevent contact with contaminated groundwater and saturated soil (to be addressed in separate feasibility study) • Sample groundwater annually to monitor effectiveness of solidification/stabilization on minimizing metal COC mobility
4A	<u>Soil Excavation/Off-site Disposal</u> • Install slurry wall in Upper Site to minimize mobility of contaminated groundwater during excavation • Excavate contaminated soil • Characterize soil for off-site disposal • Transport to treatment and/or landfill facility • Dispose of non-hazardous soil at non-hazardous waste disposal facility • Dispose of hazardous soil at hazardous waste disposal facility • Backfill with clean fill • Implement institutional controls to prevent contact with groundwater and saturated soil (to be addressed in separate feasibility study)

TABLE 3-2
HEXAGON LABORATORIES RI/FFS
SUMMARY OF REMEDIAL ALTERNATIVES

ALTERNATIVE	MAJOR ELEMENTS OF ALTERNATIVE
4B	Soil Excavation/Off-site Treatment/Off-site Disposal • Install slurry wall in Upper Site to minimize mobility of contaminated groundwater during excavation • Excavate contaminated soil • Characterize soil for off-site treatment/disposal • Transport to treatment facility • Dispose of non-hazardous soil at treatment-reuse facility • Dispose of hazardous soil at hazardous waste treatment/disposal facility • Backfill with clean fill • Implement institutional controls to prevent contact with contaminated groundwater and saturated soil (to be addressed in separate feasibility study)
5A	Limited Soil Excavation/Off-site Disposal/Asphalt Cap • Install slurry wall in Upper Site to minimize mobility of contaminated groundwater during excavation • Excavate contaminated soil from Upper Site and top two feet of contaminated soil from the East Yard • Characterize soil for off-site disposal • Transport to treatment and/or landfill facility • Dispose of non-hazardous soil at non-hazardous waste disposal facility • Dispose of hazardous soil at hazardous waste disposal facility • Backfill with clean fill • Install asphalt pavement over entire site to act as a cap in the East Yard and to facilitate use of site for vehicle parking • Implement institutional controls to protect East Yard cap and to prevent contact with contaminated groundwater and saturated soil (to be addressed in separate feasibility study) • Sample groundwater annually to assess cap effectiveness
5B	Limited Soil Excavation/Off-site Treatment/Off-site Disposal/Asphalt Cap • Install slurry wall in Upper Site to minimize mobility of contaminated groundwater during excavation • Excavate contaminated soil from Upper Site and top two feet of contaminated soil from the East Yard • Characterize for off-site treatment/disposal • Transport to treatment facility • Dispose of non-hazardous soil at treatment-reuse facility • Dispose of hazardous soil at hazardous waste treatment/disposal facility • Backfill with clean fill • Install asphalt pavement over entire site to act as a cap in the East Yard and to facilitate use of site for vehicle parking • Implement institutional controls to protect East Yard cap and to prevent contact with contaminated groundwater and saturated soil (to be addressed in separate feasibility study) • Sample groundwater annually to assess cap effectiveness

TABLE 4-1
HEXAGON LABORATORIES RI/FFS
COMPLIANCE WITH NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
1	■ No Action ■ Groundwater Monitoring	■ Chemical-Specific SCGs – Alternative will not achieve New York State SCGs for the contaminants of concern. – Contaminant levels are not expected to decrease appreciably over time. – Groundwater will be sampled annually in order to assess the extent of natural attenuation of the site contamination. ■ Location-Specific SCGs – None identified; assume compliance. ■ Action-Specific SCGs – Alternative will be designed to meet action-specific SCGs.
2A	■ Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Chemical-Specific SCGs – Does not comply; contaminants remain on-site. – Contaminant levels not expected to decrease appreciably over time. – Groundwater will be sampled annually in order to assess the impact of the cap on site contamination. ■ Location-Specific SCGs – None identified; assume compliance. ■ Action-Specific SCGs – Alternative will be designed to meet action-specific SCGs.
2B	■ Concrete Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Chemical-Specific SCGs – Does not comply; contaminants remain on-site. – Contaminant levels not expected to decrease appreciably over time. – Groundwater will be sampled annually in order to assess the impact of the cap on site contamination. ■ Location-Specific SCGs – None identified; assume compliance. ■ Action-Specific SCGs – Alternative will be designed to meet action-specific SCGs.
2C	■ RCRA Multimedia Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Chemical-Specific SCGs – Does not comply; contaminants remain on-site. – Contaminant levels not expected to decrease appreciably over time. – Groundwater will be sampled annually in order to assess the impact of the cap on site contamination. ■ Location-Specific SCGs – None identified; assume compliance. ■ Action-Specific SCGs – Alternative will be designed to meet action-specific SCGs.

TABLE 4-1
HEXAGON LABORATORIES RI/FFS
COMPLIANCE WITH NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
3	■ In-Situ Treatment of Organic Contaminants – Bench-Scale Testing – Application of Reagent – Confirmatory Sampling ■ Solidification/Stabilization of Metal Contaminants – Excavation – Process with Binding Agent – Backfill with Treated Soil – Install Storm Water Runoff Control Measures ■ Institutional Controls ■ Groundwater Monitoring	■ Chemical-Specific SCGs – Alternative will comply with New York State SCGs for organic COCs. – Alternative will not comply with New York State SCGs for metal COCs since metals will not be removed or destroyed in the treatment process. However, related toxicity and mobility of the metals will be effectively eliminated. – Groundwater will be sampled annually in order to assess the effectiveness of solidification/stabilization in minimizing the mobility of the metal COCs. ■ Location-Specific SCGs – None identified; assume compliance. ■ Action-Specific SCGs – Alternative will be designed to meet action-specific SCGs.
4A	■ Excavation ■ Off-site Disposal – Non-hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Chemical-Specific SCGs – Alternative will comply with the New York State SCGs at the site since contaminated soil will be removed from the site for off-site disposal. – Does not meet CERCLA policy preference for alternatives which involve treatment as a primary component. ■ Location-Specific SCGs – None identified; assume compliance. ■ Action-Specific SCGs – Alternative will be designed to meet action-specific SCGs.
4B	■ Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Chemical-Specific SCGs -- Alternative will comply with the New York State SCGs at the site since contaminated soil will be removed from the site for off-site disposal. -- Meets CERCLA policy preference for alternatives which involve treatment as a primary component. ■ Location-Specific SCGs -- None identified; assume compliance. ■ Action-Specific SCGs -- Alternative will be designed to meet action-specific SCGs.

TABLE 4-1
HEXAGON LABORATORIES RI/FFS
COMPLIANCE WITH NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
5A	■ Limited Excavation ■ Off-site Disposal – Non-hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Chemical-Specific SCGs – Alternative will not comply with the New York State SCGs since 25 percent of the contaminated soil will remain on site. – Does not meet CERCLA policy preference for alternatives which involve treatment as a primary component. ■ Location-Specific SCGs – None identified; assume compliance. ■ Action-Specific SCGs – Alternative will be designed to meet action-specific SCGs.
5B	■ Limited Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Chemical-Specific SCGs -- Alternative will not comply with the New York State SCGs since 25 percent of the contaminated soil will remain on site. -- Meets CERCLA policy preference for alternatives which involve treatment as a primary component. ■ Location-Specific SCGs -- None identified; assume compliance. ■ Action-Specific SCGs -- Alternative will be designed to meet action-specific SCGs.

TABLE 4-2
HEXAGON LABORATORIES RI/FFS
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
1	■ No Action ■ Groundwater Monitoring	■ Not protective of human health and the environment. ■ Surface soil was determined to represent unacceptable human health risk for site worker future-use exposure scenario; there are likely additional health risks associated with contamination in subsurface soils. ■ Contamination will persist in soil and will act as a continuing source of contamination to the groundwater. ■ Groundwater will be sampled annually in order to assess the extent of natural attenuation of the site contamination.
2A	■ Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Alternative is largely protective of human health and the environment. ■ Cap will eliminate potential human exposure to contaminated soil. ■ Cap will minimize infiltration of precipitation and, thereby, minimize vertical migration of soil contamination to groundwater. ■ Cap will not prevent partitioning of contaminants from soil to groundwater and subsequent lateral migration of the contamination due to groundwater flow. ■ Groundwater will be monitored as a means of evaluating the cap effectiveness in reducing contaminant migration. ■ Institutional controls are necessary to ensure that future site useage is consistent with the intent of the cap.
2B	■ Concrete Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Alternative is largely protective of human health and the environment. ■ Cap will eliminate potential human exposure to contaminated soil. ■ Cap will minimize infiltration of precipitation and, thereby, minimize vertical migration of soil contamination to groundwater. ■ Cap will not prevent partitioning of contaminants from soil to groundwater and subsequent lateral migration of the contamination due to groundwater flow. ■ Groundwater will be monitored as a means of evaluating the cap effectiveness in reducing contaminant migration. ■ Institutional controls are necessary to ensure that future site useage is consistent with the intent of the cap.
2C	■ RCRA Multimedia Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Alternative is largely protective of human health and the environment. ■ Cap will eliminate potential human exposure to contaminated soil. ■ Cap will minimize infiltration of precipitation and, thereby, minimize vertical migration of soil contamination to groundwater. ■ Cap will not prevent partitioning of contaminants from soil to groundwater and subsequent lateral migration of the contamination due to groundwater flow. ■ Groundwater will be monitored as a means of evaluating the cap effectiveness in reducing contaminant migration. ■ Institutional controls are necessary to ensure that future site useage is consistent with the intent of the cap.

TABLE 4-2
HEXAGON LABORATORIES RI/FFS
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
3	■ In-Situ Treatment of Organic Contaminants – Bench-Scale Testing – Application of Reagent – *Confirmatory Sampling* ■ Solidification/Stabilization of Metal Contaminants – Excavation – Process with Binding Agent – Backfill with Treated Soil – Install Storm Water Runoff Control Measures ■ Institutional Controls ■ Groundwater Monitoring	■ Alternative is protective of human health and the environment. ■ Organic COCs in soil and shallow groundwater will be destroyed by Fenton's reaction-based in-situ oxidation. ■ Metal COCs in unsaturated soil (and most of saturated soil in the upper site) will be encapsulated by a non-toxic *physical binding agent, thereby preventing direct human exposure.* ■ Solidification/stabilization will prevent migration of metal COCs from the treated soil at concentrations greater than the NYSDEC Class GA groundwater criteria. ■ Institutional controls are necessary to prevent exposure to contamination in the remaining saturated soil and groundwater; these media will be addressed as part of a separate feasibility study. ■ Groundwater will be sampled annually in order to assess the effectiveness of solidification/stabilization in minimizing the migration of the metal COCs.
4A	■ Excavation ■ Off-site Disposal – Non-hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Alternative is protective of human health and the environment. ■ Contaminated unsaturated soil (and most of the saturated soil in the upper site) will be removed and disposed of off site. ■ It is assumed that mobility of contaminants at the disposal facilities will be within acceptable limits. ■ Future release of contaminants from the unsaturated soil to the groundwater will be eliminated. ■ Institutional controls are necessary to prevent exposure to contamination in the remaining saturated soil and groundwater; these media will be addressed as part of a separate feasibility study.
4B	■ Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Alternative is protective of human health and the environment. ■ Contaminated unsaturated soil (and most of the saturated soil in the upper site) will be removed and disposed of off site. ■ Contaminated soil will be treated prior to reuse or disposal. ■ It is assumed that mobility of contaminants at the treatment/disposal facilities will be within acceptable limits. ■ Future release of contaminants from the unsaturated soil to the groundwater will be eliminated. ■ Institutional controls are necessary to prevent exposure to contamination in the remaining saturated soil and groundwater; these media will be addressed as part of a separate feasibility study.

TABLE 4-2
HEXAGON LABORATORIES RI/FFS
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
5A	■ Limited Excavation ■ Off-site Disposal – Non-hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Alternative is protective of human health and the environment. ■ Contaminated unsaturated soil (and most of the saturated soil) in the upper site will be removed and disposed of off site. The top two feet of contaminated soil will be removed from the East Yard. ■ It is assumed that mobility of contaminants at the disposal facilities will be within acceptable limits. ■ Cap will eliminate potential human exposure to contaminated soil in the East Yard. ■ Cap will minimize infiltration of precipitation and, thereby, minimize vertical migration of soil contamination to groundwater. ■ Cap will not prevent partitioning of contaminants from soil to groundwater and subsequent lateral migration of the remaining East Yard contamination due to groundwater flow. ■ Groundwater will be monitored as a means of evaluating the cap effectiveness in reducing contaminant migration from the East Yard soil. ■ Institutional controls are necessary to ensure that future site useage is consistent with the intent of the East Yard cap as well as to prevent exposure to contamination in the remaining saturated soil and groundwater; the saturated soil and groundwater will be addressed as part of a separate feasibility study.
5B	■ Limited Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Alternative is protective of human health and the environment. ■ Contaminated unsaturated soil (and most of the saturated soil) in the upper site will be removed and disposed of off site. The top two feet of contaminated soil will be removed from the East Yard. ■ Contaminated soil removed from the site will be treated prior to reuse or disposal. ■ It is assumed that mobility of contaminants at the treatment/disposal facilities will be within acceptable limits. ■ Cap will eliminate potential human exposure to contaminated soil in the East Yard. ■ Cap will minimize infiltration of precipitation and, thereby, minimize vertical migration of soil contamination to groundwater. ■ Cap will not prevent partitioning of contaminants from soil to groundwater and subsequent lateral migration of the remaining East Yard contamination due to groundwater flow. ■ Groundwater will be monitored as a means of evaluating the cap effectiveness in reducing contaminant migration from the East Yard soil. ■ Institutional controls are necessary to ensure that future site useage is consistent with the intent of the East Yard cap as well as to prevent exposure to contamination in the remaining saturated soil and groundwater; the saturated soil and groundwater will be addressed as part of a separate feasibility study.

TABLE 4-3
HEXAGON LABORATORIES RI/FFS
SHORT-TERM EFFECTIVENESS

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
1	■ No Action ■ Groundwater Monitoring	■ Protection of the Community during Remedial Actions – No short-term impacts to the community since no remedial actions will be performed. ■ Protection of Site Workers during Remedial Actions – Site workers will wear appropriate PPE during the groundwater sampling associated with the long-term monitoring of site contamination. ■ Time to Achieve Remedial Action Objectives – This alternative does not involve any remedial action and, therefore, it will not meet preliminary remediation goals. – A duration of 30 years, the maximum time period specified for evaluation under USEPA FS guidance, was assumed for this alternative. ■ Environmental Impacts due to Remedial Action – No environmental impacts due to long-term monitoring activities are anticipated.
2A	■ Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Protection of the Community during Remedial Actions – Capping can be performed without significant risk to the community. – Short-term adverse impacts such as fugitive dust or volatile emissions may arise during placement of the base course. Continuous air monitoring will be performed and action levels will be established to minimize impact to the surrounding community. Vehicles and equipment used in the exclusion zone will be decontaminated prior to leaving the site. ■ Protection of Site Workers during Remedial Actions – Site workers will wear appropriate PPE to minimize health risks due to physical hazards and exposure to the soil contamination. ■ Time to Achieve Remedial Action Objectives – It is estimated that cap construction can be completed in approximately 3.5 months. – Because this alternative does not include treatment or removal of the soil contamination, it will not meet the preliminary remediation goals. – A duration of 30 years, the maximum time period specified for evaluation under USEPA FS guidance, was assumed for this alternative. ■ Environmental Impacts due to Remedial Action – No significant impacts to habitat or vegetation resulting from installation of a cap system are expected due to the highly developed, industrial nature of the site and its immediate vicinity.

TABLE 4-3
HEXAGON LABORATORIES RI/FFS
SHORT-TERM EFFECTIVENESS

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
2B	■ Concrete Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Protection of the Community during Remedial Actions – Capping can be performed without significant risk to the community. – Short-term adverse impacts such as fugitive dust or volatile emissions may arise during placement of the base course. Continuous air monitoring will be performed and action levels will be established to minimize impact to the surrounding community. Vehicles and equipment used in the exclusion zone will be decontaminated prior to leaving the site. ■ Protection of Site Workers during Remedial Actions – Site workers will wear appropriate PPE to minimize health risks due to physical hazards and exposure to the soil contamination. ■ Time to Achieve Remedial Action Objectives – It is estimated that cap construction can be completed in approximately 4 months. – Because this alternative does not include treatment or removal of the soil contamination, it will not meet the *preliminary remediation* goals. – A duration of 30 years, the maximum time period specified for evaluation under USEPA FS guidance, was assumed for this alternative. ■ Environmental Impacts due to Remedial Action – No significant impacts to habitat or vegetation resulting from installation of a cap system are expected due to the highly developed, industrial nature of the site and its immediate vicinity.
2C	■ RCRA Multimedia Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Protection of the Community during Remedial Actions – Capping can be performed without significant risk to the community. – Short-term adverse impacts such as fugitive dust or volatile emissions may arise during placement of the base course. Continuous air monitoring will be performed and action levels will be established to minimize impact to the surrounding community. Vehicles and equipment used in the exclusion zone will be decontaminated prior to leaving the site. ■ Protection of Site Workers during Remedial Actions – Site workers will wear appropriate PPE to minimize health risks due to physical hazards and exposure to the soil contamination. ■ Time to Achieve Remedial Action Objectives – It is estimated that cap construction can be completed in approximately 4.25 months. – Because this alternative does not include treatment or removal of the soil contamination, it will not meet the preliminary remediation goals. – A duration of 30 years, the maximum time period specified for evaluation under USEPA FS guidance, was assumed for this alternative. ■ Environmental Impacts due to Remedial Action – No significant impacts to habitat or vegetation resulting from installation of a cap system are expected due to the highly developed, industrial nature of the site and its immediate vicinity.

TABLE 4-3
HEXAGON LABORATORIES RI/FFS
SHORT-TERM EFFECTIVENESS

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
3	■ In-Situ Treatment of Organic Contaminants – Bench-Scale Testing – Application of Reagent – Confirmatory Sampling ■ Solidification/Stabilization of Metal Contaminants – Excavation – Process with Binding Agent – Backfill with Treated Soil – Install Storm Water Runoff Control Measures ■ Institutional Controls ■ Groundwater Monitoring	■ Protection of the Community during Remedial Actions – In-situ oxidation and solidification/stabilization can be performed without significant risk to the community. – Short-term adverse impacts such as fugitive dust or volatile emissions may arise during installation of the in-situ oxidation injection system and during excavation and solidification/stabilization of the metals-contaminated soil. Continuous air monitoring will be performed and action levels will be established to minimize impact to the surrounding community. Vehicles and equipment used in the exclusion zone will be decontaminated prior to leaving the site. – Temporary shoring will be constructed along sides of excavations which exceed four feet in depth and along the perimeter of all buildings adjacent to an excavation, regardless of depth, to prevent settlement and subsequent damage to adjacent buildings and property. ■ Protection of Site Workers during Remedial Actions – Site workers will wear appropriate PPE to minimize health risks due to physical hazards and exposure to the soil contamination. ■ Time to Achieve Remedial Action Objectives – It is estimated that the in-situ oxidation can be completed in 6.5 months. – Preliminary remediation goals for the organic COCs will be met upon completion of the in-situ oxidation. – It is estimated that solidification/stabilization can be completed in 6.5 months. – Preliminary remediation goals will not be met for the metal COCs since these contaminants are not destroyed or removed as a result of the solidification/stabilization. – A duration of 30 years, the maximum time period specified for evaluation under USEPA FS guidance, was assumed for the solidification/stabilization component of this alternative. ■ Environmental Impacts due to Remedial Action – No significant environmental impacts due to implementation of this alternative are expected due to the highly developed, industrial nature of the site and its immediate vicinity.

TABLE 4-3
HEXAGON LABORATORIES RI/FFS
SHORT-TERM EFFECTIVENESS

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
4A	■ Excavation ■ Off-site Disposal – Non-Hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Protection of the Community during Remedial Actions – Short-term adverse impacts such as fugitive dust or volatile emissions may arise during excavation of contaminated soil. Continuous air monitoring will be performed and action levels will be established to minimize impact to the surrounding community. Vehicles and equipment used in the exclusion zone will be decontaminated prior to leaving the site. – Temporary shoring will be constructed along the sides of excavations which exceed four feet in depth and along the perimeter of all buildings adjacent to an excavation, regardless of depth, to prevent settlement and subsequent damage to adjacent buildings and property. ■ Protection of Site Workers during Remedial Actions – Site workers will wear appropriate PPE to minimize health risks due to physical hazards and exposure to the soil contamination. ■ Time to Achieve Remedial Action Objectives – It is estimated that soil removal can be completed in approximately 6 months. – Preliminary remediation goals will be achieved upon completion of soil removal activities. ■ Environmental Impacts due to Remedial Action – No significant impacts to habitat or vegetation due to implementation of this alternative are expected due to the highly developed, industrial nature of the site and its immediate vicinity. – A slurry wall will be constructed along the eastern and southern perimeters of the upper site prior to excavation of the contaminated soil to restrict the flow of contaminated groundwater (in part generated by the excavation activities) down gradient.
4B	■ Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Protection of the Community during Remedial Actions – Short-term adverse impacts such as fugitive dust or volatile emissions may arise during excavation of contaminated soil. Continuous air monitoring will be performed and action levels will be established to minimize impact to the surrounding communlty. Vehicles and equipment used in the exclusion zone will be decontaminated prior to leaving the site. – Temporary shoring will be constructed along the sides of excavations which exceed four feet in depth and along the perimeter of all buildings adjacent to an excavation, regardless of depth, to prevent settlement and subsequent damage to adjacent buildings and property. ■ Protection of Site Workers during Remedial Actions – Site workers will wear appropriate PPE to minimize health risks due to physical hazards and exposure to the soil contamination. ■ Time to Achieve Remedial Action Objectives – It is estimated that soil removal can be completed in approximately 6 months. – Preliminary remediation goals will be achieved upon completion of soil removal activities. ■ Environmental Impacts due to Remedial Action – No significant impacts to habitat or vegetation due to implementation of this alternative are expected due to the highly developed, industrial nature of the site and its immediate vicinity. – A slurry wall will be constructed along the eastern and southern perimeters of the upper site prior to excavation of the contaminated soil to restrict the flow of contaminated groundwater (in part generated by the excavation activities) down gradient.

TABLE 4-3
HEXAGON LABORATORIES RI/FFS
SHORT-TERM EFFECTIVENESS

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
5A	■ Limited Excavation ■ Off-site Disposal – Non-Hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Protection of the Community during Remedial Actions – Short-term adverse impacts such as fugitive dust or volatile emissions may arise during excavation of contaminated soil. Continuous air monitoring will be performed and action levels will be established to minimize impact to the surrounding community. Vehicles and equipment used in the exclusion zone will be decontaminated prior to leaving the site. – Temporary shoring will be constructed along the sides of excavations which exceed four feet in depth and along the perimeter of all buildings adjacent to an excavation, regardless of depth, to prevent settlement and subsequent damage to adjacent buildings and property. ■ Protection of Site Workers during Remedial Actions – Site workers will wear appropriate PPE to minimize health risks due to physical hazards and exposure to the soil contamination. ■ Time to Achieve Remedial Action Objectives – It is estimated that soil removal, backfill, and cap placement can be completed in approximately 6.5 months. – Preliminary remediation goals will be not be achieved upon completion of the remediation since approximately 25 percent of the contaminated soil will remain on site. – A duration of 30 years, the maximum time period specified for evaluation under USEPA FS guidance, was assumed for this alternative. ■ Environmental Impacts due to Remedial Action – No significant impacts to habitat or vegetation due to implementation of this alternative are expected due to the highly developed, industrial nature of the site and its immediate vicinity. – A slurry wall will be constructed along the eastern and southern perimeters of the upper site prior to excavation of the contaminated soil to restrict the flow of contaminated groundwater (in part generated by the excavation activities) down gradient.

TABLE 4-3
HEXAGON LABORATORIES RI/FFS
SHORT-TERM EFFECTIVENESS

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
5B	■ Limited Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Protection of the Community during Remedial Actions – Short-term adverse impacts such as fugitive dust or volatile emissions may arise during excavation of contaminated soil. Continuous air monitoring will be performed and action levels will be established to minimize impact to the surrounding community. Vehicles and equipment used in the exclusion zone will be decontaminated prior to leaving the site. – Temporary shoring will be constructed along the sides of excavations which exceed four feet in depth and along the perimeter of all buildings adjacent to an excavation, regardless of depth, to prevent settlement and subsequent damage to adjacent buildings and property. ■ Protection of Site Workers during Remedial Actions – Site workers will wear appropriate PPE to minimize health risks due to physical hazards and exposure to the soil contamination. ■ Time to Achieve Remedial Action Objectives – It is estimated that soil removal, backfill, and cap placement can be completed in approximately 6.5 months. – Preliminary remediation goals will be not be achieved upon completion of the remediation since approximately 25 percent of the contaminated soil will remain on site. – A duration of 30 years, the maximum time period specified for evaluation under USEPA FS guidance, was assumed for this alternative. ■ Environmental Impacts due to Remedial Action – No significant impacts to habitat or vegetation due to implementation of this alternative are expected due to the highly developed, industrial nature of the site and its immediate vicinity. – A slurry wall will be constructed along the eastern and southern perimeters of the upper site prior to excavation of the contaminated soil to restrict the flow of contaminated groundwater (in part generated by the excavation activities) down gradient.

TABLE 4-4
HEXAGON LABORATORIES RI/FFS
LONG-TERM EFFECTIVENESS & PERMANENCE

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
1	■ No Action ■ Groundwater Monitoring	■ Permanence of Remedial Alternative – Alternative is not considered to be permanent since contaminants are not treated or removed. ■ Magnitude of Remaining Risk – Surface soil was determined to represent unacceptable human health risk for site work future-use exposure scenario; subsurface soil likely represents additional human health risk. – Groundwater will be sampled annually in order to assess the extent of natural attenuation of the site contamination. ■ Adequacy of Controls – Alternative does not provide adequate protection of human health or the environment. ■ Reliability of Controls – No action is considered to be a reliable but inadequate alternative.
2A	■ Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Permanence of Remedial Alternative – Alternative is not considered to be permanent since contaminants are not treated or removed. ■ Magnitude of Remaining Risk – Cap will act as a physical barrier in preventing direct human contact with the contaminated soil. Therefore, risk associated with direct contact will be effectively eliminated. – Cap will reduce environmental risk by minimizing infiltration of precipitation and, as a result, will reduce the vertical migration of contaminants from the unsaturated soil to the groundwater. – Cap will not reduce lateral migration of contaminants due to groundwater flow. – Institutional controls must be invoked to ensure future site use does not compromise the capping system. ■ Adequacy of Controls – With proper maintenance, the cap alternative is considered to be an adequate control measure. ■ Reliability of Controls – With proper maintenance, the cap alternative is considered to be a reliable control measure.
2B	■ Concrete Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Permanence of Remedial Alternative – Alternative is not considered to be permanent since contaminants are not treated or removed. ■ Magnitude of Remaining Risk – Cap will act as a physical barrier in preventing direct human contact with the contaminated soil. Therefore, risk associated with direct contact will be effectively eliminated. – Cap will reduce environmental risk by minimizing infiltration of precipitation and, as a result, will reduce the vertical migration of contaminants from the unsaturated soil to the groundwater. – Cap will not reduce lateral migration of contaminants due to groundwater flow. – Institutional controls must be invoked to ensure future site use does not compromise the capping system. ■ Adequacy of Controls – With proper maintenance, the cap alternative is considered to be an adequate control measure. ■ Reliability of Controls – With proper maintenance, the cap alternative is considered to be a reliable control measure.

TABLE 4-4
HEXAGON LABORATORIES RI/FFS
LONG-TERM EFFECTIVENESS & PERMANENCE

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
2C	■ RCRA Multimedia Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Permanence of Remedial Alternative – Alternative is not considered to be permanent since contaminants are not treated or removed. ■ Magnitude of Remaining Risk – Cap will act as a physical barrier in preventing direct human contact with the contaminated soil. Therefore, risk associated with direct contact will be effectively eliminated. – Cap will reduce environmental risk by minimizing infiltration of precipitation and, as a result, will reduce the vertical migration of contaminants from the unsaturated soil to the groundwater. – Cap will not reduce lateral migration of contaminants due to groundwater flow. – Institutional controls must be invoked to ensure future site use does not compromise the capping system. ■ Adequacy of Controls – With proper maintenance, the cap alternative is considered to be an adequate control measure. – Of the capping alternatives, the RCRA multimedia cap provides the best protection against vertical contaminant migration from the unsaturated soil to the groundwater due to the presence of the geomembrane and GCL low-permeability layers. ■ Reliability of Controls – With proper maintenance, the cap alternative is considered to be a reliable control measure.
3	■ In-Situ Treatment of Organic Contaminants – Bench-Scale Testing – Application of Reagent – Confirmatory Sampling ■ Solidification/Stabilization of Metal Contaminants – Excavation – Process with Binding Agent – Backfill with Treated Soil – Install Storm Water Runoff Control Measures ■ Institutional Controls ■ Groundwater Monitoring	■ Permanence of Remedial Alternative – Alternative is considered to be permanent since organic COCs are destroyed and metal COCs are encapsulated in a solid matrix. ■ Magnitude of Remaining Risk – The risk associated with the organic COCs will be eliminated since the contaminants will be oxidized to non-toxic byproducts. – The metal COCs will not be removed, but the human health risk associated with these contaminants will be eliminated since the contaminants will be encapsulated in a solid matrix, thereby preventing direct contact. The environmental risk will also be effectively eliminated since the mobility of the metals will be greatly reduced; the maximum leachate concentration will not exceed the NYSDEC Class GA groundwater standards. – Institutional controls must be invoked to prevent activities which may result in exposure to the remaining saturated soil and groundwater contamination (to be addressed as part of a separate feasibility study). ■ Adequacy of Controls – The effectiveness of the Fenton's reaction-based in-situ oxidation will be established by bench-scale testing prior to full-scale implementation at the site. Confirmatory soil sampling will be performed to demonstrate achievement of the preliminary remediation goals for the organic COCs. – Effectiveness of solidification/stabilization will be established by bench-scale testing prior to full-scale implementation at the site. ■ Reliability of Controls – In-situ oxidation of the organic COCs is considered to be reliable since the contaminants will be destroyed, and this destruction will be documented by post-treatment confirmatory sampling. – Solidification/stabilization is a conventional method for treatment of metals contaminated soil and is considered to be reliable. The long-term effectiveness of solidification/stabilization will be assessed indirectly by annual groundwater monitoring.

TABLE 4-4
HEXAGON LABORATORIES RI/FFS
LONG-TERM EFFECTIVENESS & PERMANENCE

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
4A	■ Excavation ■ Off-site Disposal – Non-Hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Permanence of Remedial Alternative – Alternative is considered to be a permanent remedy since the unsaturated soil (and most of the saturated soil in the upper site) will be removed from the site and, as a result, will no longer represent a continuing source of contamination to the groundwater. ■ Magnitude of Remaining Risk – Contaminated soil will be removed from the site and will, therefore, no longer represent a risk at the site. – Non-hazardous soil will be disposed of in a non-hazardous waste landfill without treatment. Because the soil *will not be treated prior to disposal, there is potential risk associated with this soil. It is assumed that the mobility* of contaminants at the disposal facility will be within acceptable limits. – Hazardous soil will be transferred to a hazardous waste disposal facility for treatment and subsequent disposal. Soil treatment prior to disposal will eliminate the risk associated with this soil. – Institutional controls must be invoked to prevent activities which may result in exposure to the remaining saturated soil and groundwater contamination (to be addressed as part of a separate feasibility study). ■ Adequacy of Controls – Removal of contamination from the site is considered to be an adequate control measure since the soil will no longer represent an unacceptable human health or environmental risk at the site. ■ Reliability of Controls – Removal of contaminants from the site is considered to be a reliable control measure.
4B	■ Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Permanence of Remedial Alternative – Alternative is considered to be a permanent remedy since the unsaturated soil (and most of the saturated soil in the upper site) will be removed from the site and, as a result, will no longer represent a continuing source of contamination to the groundwater. ■ Magnitude of Remaining Risk – Contaminated soil will be removed from the site and will, therefore, no longer represent a risk at the site. – Non-hazardous soil will be transported to a recycling facility for treatment and reuse. Soil treatment prior to reuse will eliminate the risk associated with this soil. – Hazardous soil will be transferred to a hazardous waste disposal facility for treatment and subsequent disposal. Soil treatment prior to disposal will eliminate the risk associated with this soil. – Institutional controls must be invoked to prevent activities which may result in exposure to the remaining saturated soil and groundwater contamination (to be addressed as part of a separate feasibility study). ■ Adequacy of Controls – Removal of contamination from the site is considered to be an adequate control measure since the soil will no longer represent an unacceptable human health or environmental risk at the site. ■ Reliability of Controls – Removal of contaminants from the site is considered to be a reliable control measure.

TABLE 4-4
HEXAGON LABORATORIES RI/FFS
LONG-TERM EFFECTIVENESS & PERMANENCE

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
5A	■ Limited Excavation ■ Off-site Disposal – Non-Hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Permanence of Remedial Alternative – Alternative is considered to be a permanent remedy in the upper site since the unsaturated soil (and most of the saturated soil) will be removed from the upper site and, as a result, will no longer represent a continuing source of contamination to the groundwater. – Alternative is not considered to be a permanent remedy in the East Yard since only the top two feet of contaminated soil will be removed; approximately 1,500 cy of contaminated soil will remain. ■ Magnitude of Remaining Risk – Contaminated soil will be removed from the upper site and will, therefore, no longer represent a risk at the site. – The top two feet of contaminated soil will be removed from the East Yard and will no longer represent a risk at the site. – Remaining contaminated soil in the East Yard will be capped. The cap will act as a physical barrier in preventing direct human contact with the remaining contaminated soil. – East Yard cap will reduce environmental risk by minimizing infiltration of precipitation and, as a result, will reduce the vertical migration of contaminants from the unsaturated soil to the groundwater. – East Yard cap will not reduce lateral migration of contaminants due to groundwater flow. – Non-hazardous soil removed from the site will be disposed of in a non-hazardous waste landfill without treatment. Because the soil is not treated prior to disposal, there is potential risk associated with this soil. It is assumed that the mobility of contaminants at the disposal facility will be within acceptable limits. – Hazardous soil removed from the site will be transferred to a hazardous waste disposal facility for treatment and subsequent disposal. Soil treatment prior to disposal will eliminate the risk associated with this soil. – Institutional controls must be invoked to ensure future site use does not compromise the East Yard capping system and to prevent activities which may result in exposure to the remaining saturated soil and ground-water contamination (to be addressed as part of a separate feasibility study). ■ Adequacy of Controls – Removal of contamination from the site is considered to be an adequate control measure since the soil will no longer represent an unacceptable human health or environmental risk at the site. – With proper maintenance, the East Yard cap is considered to be an adequate control measure. ■ Reliability of Controls – Removal of contaminants from the site is considered to be a reliable control measure. – With proper maintenance, the East Yard cap is considered to be a reliable control measure.

TABLE 4-4
HEXAGON LABORATORIES RI/FFS
LONG-TERM EFFECTIVENESS & PERMANENCE

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
5B	■ Limited Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Permanence of Remedial Alternative – Alternative is considered to be a permanent remedy in the upper site since the unsaturated soil (and most of the saturated soil) will be removed from the upper site and, as a result, will no longer represent a continuing source of contamination to the groundwater. – Alternative is not considered to be a permanent remedy in the East Yard since only the top two feet of contaminated soil will be removed; approximately 1,500 cy of contaminated soil will remain. ■ Magnitude of Remaining Risk – Contaminated soil will be removed from the upper site and will, therefore, no longer represent a risk at the site. – The top two feet of contaminated soil will be removed from the East Yard and will no longer represent a risk at the site. – Remaining contaminated soil in the East Yard will be capped. The cap will act as a physical barrier in preventing direct human contact with the remaining contaminated soil. – East Yard cap will reduce environmental risk by minimizing infiltration of precipitation and, as a result, will reduce the vertical migration of contaminants from the unsaturated soil to the groundwater. – East Yard cap will not reduce lateral migration of contaminants due to groundwater flow. – Non-hazardous soil will be transported to a recycling facility for treatment and reuse. Soil treatment prior to reuse eliminates the risk associated with this soil. – Hazardous soil removed from the site will be transferred to a hazardous waste disposal facility for treatment *and subsequent disposal. Soil treatment prior to disposal eliminates the risk associated with this soil.* – Institutional controls must be invoked to ensure future site use does not compromise the East Yard capping system and to prevent activities which may result in exposure to the remaining saturated soil and groundwater contamination (to be addressed as part of a separate feasibility study). ■ Adequacy of Controls – Removal of contamination from the site is considered to be an adequate control measure since the soil will no longer represent an unacceptable human health or environmental risk at the site. – With proper maintenance, the East Yard cap is considered to be an adequate control measure. ■ Reliability of Controls – Removal of contaminants from the site is considered to be a reliable control measure. – With proper maintenance, the East Yard cap is considered to be a reliable control measure.

TABLE 4-5
HEXAGON LABORATORIES RI/FFS
REDUCTION OF TOXICITY, MOBILITY, AND VOLUME

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
1	■ No Action ■ Groundwater Monitoring	■ Toxicity – Alternative does not reduce toxicity of contaminants. ■ Mobility – Alternative does not impact the mobility of the contaminants. ■ Volume – Alternative does not reduce the volume of contaminants. Natural attenuation of contaminants is not expected to be significant given the high concentrations of contaminants detected in the soil.
2A	■ Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Toxicity – Alternative does not reduce toxicity of contaminants. However, the capping system does act as a physical barrier preventing direct contact with the contaminated soil and, as a result, reducing the human health risk associated with contaminant toxicity. ■ Mobility – Cap reduces infiltration of precipitation and, thereby, reduces the vertical migration of contaminants from the unsaturated soil to the groundwater. – Cap does not impact the lateral migration of contaminants due to groundwater flow. ■ Volume – Alternative does not reduce the volume of contaminants. Natural attenuation of contaminants is not expected to be significant given the high concentrations of contaminants detected in the soil.
2B	■ Concrete Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Toxicity – Alternative does not reduce toxicity of contaminants. However, the capping system does act as a physical barrier preventing direct contact with the contaminated soil and, as a result, reducing the human health risk associated with contaminant toxicity. ■ Mobility – Cap reduces infiltration of precipitation and, thereby, reduces the vertical migration of contaminants from the unsaturated soil to the groundwater. – Cap does not impact the lateral migration of contaminants due to groundwater flow. ■ Volume – Alternative does not reduce the volume of contaminants. Natural attenuation of contaminants is not expected to be significant given the high concentrations of contaminants detected in the soil.
2C	■ RCRA Multimedia Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Toxicity – Alternative does not reduce toxicity of contaminants. However, the capping system does act as a physical barrier preventing direct contact with the contaminated soil and, as a result, reducing the human health risk associated with contaminant toxicity. ■ Mobility – Cap reduces infiltration of precipitation and, thereby, reduces the vertical migration of contaminants from the unsaturated soil to the groundwater. – Cap does not impact the lateral migration of contaminants due to groundwater flow. ■ Volume – Alternative does not reduce the volume of contaminants. Natural attenuation of contaminants is not expected to be significant given the high concentrations of contaminants detected in the soil.

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
3	■ In-Situ Treatment of Organic Contaminants – Bench-Scale Testing – Application of Reagent – Confirmatory Sampling ■ Solidification/Stabilization of Metal Contaminants – Excavation – Process with Binding Agent – Backfill with Treated Soil – Install Storm Water Runoff Control Measures ■ Institutional Controls ■ Groundwater Monitoring	■ Toxicity – Toxicity of soil contamination will be greatly reduced by implementation of the in-situ oxidation; the Fenton's reaction-based in-situ oxidation is irreversible and breaks down organic contaminants to such non-hazardous byproducts as carboxylic acids, carbon dioxide, chloride, and water. – Solidification/stabilization does not reduce toxicity of the metals contamination. However, the solidification/ stabilization process will encapsulate the metal COCs within a solid matrix, thereby preventing direct contact with these metals and, as a result, reducing the human health risk associated with contaminant toxicity. ■ Mobility – The Fenton's reaction-based in-situ oxidation will destroy the organic COCs and, as a result, will eliminate concern over migration of these contaminants. – Solidification/stabilization will significantly reduce the mobility of the metal COCs; concentration of these metals leaching from the treated soil will not exceed the NYSDEC Class GA groundwater standards. ■ Volume – In-situ oxidation will destroy the organic COCs and, as a result, will greatly reduce the volume of these contaminants. – Solidification/stabilization will not destroy or remove the metal COCs and, therefore, the volume of these contaminants will not be reduced.
4A	■ Excavation ■ Off-site Disposal – Non-Hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Toxicity – Excavation and off-site disposal of contaminated soil will eliminate contaminant toxicity as a concern at the site. – Non-hazardous soil will not be treated prior to off-site disposal. Therefore, contaminant toxicity will not be reduced. – Hazardous soil will be treated off site prior to disposal off site. The degree of reduction in contaminant toxicity is dependent on the treatment method used by the hazardous waste disposal facility. ■ Mobility – Excavation and off-site disposal of contaminated soil will eliminate contaminant mobility as a concern at the site. – A slurry wall will be constructed along the down gradient perimeter of the upper site to minimize the potential increase in contaminant mobility from the upper site as a result of replacement of the overburden with a permeable base course and clean fill. – Non-hazardous soil will be disposed of, without treatment, at a non-hazardous waste facility. It is assumed that mobility of contaminants at this disposal site will be within acceptable limits. – Hazardous soil will be treated and disposed of at an off-site hazardous waste disposal facility. It is assumed that waste streams generated in the treatment process will be handled appropriately by the facility and that resulting mobility of contaminants will be within acceptable limits. ■ Volume – Excavation and off-site disposal will eliminate the volume of contaminants in the unsaturated soil (and most of the saturated soil in the upper site) at the site. Remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study.

TABLE 4-5
HEXAGON LABORATORIES RI/FFS
REDUCTION OF TOXICITY, MOBILITY, AND VOLUME

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
4B	■ Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Toxicity – Excavation and off-site disposal of contaminated soil will eliminate contaminant toxicity as a concern at the site. – Non-hazardous soil will be treated off site prior to off-site reuse. The degree of reduction in contaminant toxicity is dependent on the treatment method used by the recycling facility. – Hazardous soil will be treated off site prior to disposal off site. The degree of reduction in contaminant toxicity is dependent on the treatment method used by the hazardous waste disposal facility. ■ Mobility – Excavation and off-site disposal of contaminated soil will eliminate contaminant mobility as a concern at the site. – A slurry wall will be constructed along the down gradient perimeter of the upper site to minimize the potential increase in contaminant mobility from the upper site as a result of replacement of the overburden with a permeable base course and clean fill. – Non-hazardous soil will be transported to a recycling facility for treatment prior to reuse. It is assumed that waste streams generated in the treatment process will be handled appropriately by the facility and that resulting mobility of contaminants will be within acceptable limits. – Hazardous soil will be treated and disposed of at an off-site hazardous waste disposal facility. It is assumed that waste streams generated in the treatment process will be handled appropriately by the facility and that resulting mobility of contaminants will be within acceptable limits. ■ Volume – Excavation and off-site disposal will eliminate the volume of contaminants in the unsaturated soil (and most of the saturated soil in the upper site) at the site. Remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study.

TABLE 4-5
HEXAGON LABORATORIES RI/FFS
REDUCTION OF TOXICITY, MOBILITY, AND VOLUME

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
5A	■ Limited Excavation ■ Off-site Disposal – Non-Hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Toxicity – Excavation and off-site disposal of contaminated soil will eliminate contaminant toxicity of this soil as a concern at the site. – Toxicity of remaining contaminated soil in the East Yard will not be reduced. However, the capping system will act as a physical barrier preventing direct contact with the contaminated soil, and, as a result, will reduce the human health risk associated with contaminant toxicity. – Non-hazardous soil will not be treated prior to off-site disposal. Therefore, contaminant toxicity will not be reduced. – Hazardous soil will be treated off site prior to disposal off site. The degree of reduction in contaminant toxicity is dependent on the treatment method used by the hazardous waste disposal facility. ■ Mobility – Excavation and off-site disposal of contaminated soil will eliminate contaminant mobility from this soil as a concern at the site. – The cap placed over remaining contaminated soil in the East Yard will reduce infiltration of precipitation and, thereby, reduce the vertical migration of contaminants from the unsaturated soil to the groundwater. – Cap will not impact the lateral migration of contaminants due to groundwater flow. – A slurry wall will be constructed along the down gradient perimeter of the upper site to minimize the potential increase in contaminant mobility from the upper site as a result of replacement of the overburden with a permeable base course and clean fill. – Non-hazardous soil will be disposed of, without treatment, at a non-hazardous waste facility. It is assumed that mobility of contaminants at this disposal site will be within acceptable limits. – Hazardous soil will be treated and disposed of at an off-site hazardous waste disposal facility. It is assumed that waste streams generated in the treatment process will be handled appropriately by the facility and that resulting mobility of contaminants will be within acceptable limits. ■ Volume – Excavation and off-site disposal will eliminate approximately 75 percent of the contaminated soil at the site. – Cap will not reduce the volume of contaminants in the remaining contaminated soil; natural attenuation is not expected to be significant. – Remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study.

TABLE 4-5
HEXAGON LABORATORIES RI/FFS
REDUCTION OF TOXICITY, MOBILITY, AND VOLUME

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
5B	■ Limited Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Toxicity – Excavation and off-site disposal of contaminated soil will eliminate contaminant toxicity of this soil as a concern at the site. – Toxicity of remaining contaminated soil in the East Yard will not be reduced. However, the capping system will act as a physical barrier preventing direct contact with the contaminated soil, and, as a result, will reduce the human health risk associated with contaminant toxicity. – Non-hazardous soil will be treated off site prior to off-site reuse. The degree of reduction in contaminant toxicity is dependent on the treatment method used by the recycling facility. – Hazardous soil will be treated off site prior to disposal off site. The degree of reduction in contaminant toxicity is dependent on the treatment method used by the hazardous waste disposal facility. ■ Mobility – Excavation and off-site disposal of contaminated soil will eliminate contaminant mobility from this soil as a concern at the site. – The cap placed over remaining contaminated soil in the East Yard will reduce infiltration of precipitation and, thereby, reduce the vertical migration of contaminants from the unsaturated soil to the groundwater. – Cap will not impact the lateral migration of contaminants due to groundwater flow. – A slurry wall will be constructed along the down gradient perimeter of the upper site to minimize the potential increase in contaminant mobility from the upper site as a result of replacement of the overburden with a permeable base course and clean fill. – Non-hazardous soil will be transported to a recycling facility for treatment prior to reuse. It is assumed that waste streams generated in the treatment process will be handled appropriately by the facility and that resulting mobility of contaminants will be within acceptable limits. – Hazardous soil will be treated and disposed of at an off-site hazardous waste disposal facility. It is assumed that waste streams generated in the treatment process will be handled appropriately by the facility and that resulting mobility of contaminants will be within acceptable limits. ■ Volume – Excavation and off-site disposal will eliminate approximately 75 percent of the contaminated soil at the site. – Cap will not reduce the volume of contaminants in the remaining contaminated soil; natural attenuation is not expected to be significant. – Remaining contaminated saturated soil and groundwater will be addressed as part of a separate feasibility study.

TABLE 4-6
HEXAGON LABORATORIES RI/FFS
IMPLEMENTABILITY

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
1	■ No Action ■ Groundwater Monitoring	■ Technical Feasibility – Long-term groundwater monitoring can be performed without sophisticated equipment. ■ Administrative Feasibility – May be difficult to gain community approval of the No Action response. ■ Availability of Services and Materials – Services and materials necessary for long-term groundwater monitoring are readily available.
2A	■ Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Technical Feasibility – Capping is a conventional technology for containment of contaminated materials. – None of the work items require sophisticated equipment, technology, or specialists. – Capping may limit implementation of potential future remedial alternatives for groundwater since any type of on-site intrusive construction will compromise the integrity of the capping system. ■ Administrative Feasibility – Installation of a capping system, including surface water runoff control measures, will require coordination with and approval from New York City agencies including the Sewer Department and the Department of Transportation (sidewalk extension), and coordination with adjacent property owners. ■ Availability of Services and Materials – Services and materials necessary for cap installation and long-term groundwater monitoring are readily available.
2B	■ Concrete Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Technical Feasibility – Capping is a conventional technology for containment of contaminated materials. – None of the work items require sophisticated equipment, technology, or specialists. – Capping may limit implementation of potential future remedial alternatives for groundwater since any type of on-site intrusive construction will compromise the integrity of the capping system. ■ Administrative Feasibility – Installation of a capping system, including surface water runoff control measures, will require coordination with and approval from New York City agencies including the Sewer Department and the Department of Transportation (sidewalk extension), and coordination with adjacent property owners. ■ Availability of Services and Materials – Services and materials necessary for cap installation and long-term groundwater monitoring are readily available.
2C	■ RCRA Multimedia Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Technical Feasibility – Capping is a conventional technology for containment of contaminated materials. – None of the work items require sophisticated equipment, technology, or specialists. – Capping may limit implementation of potential future remedial alternatives for groundwater since any type of on-site intrusive construction will compromise the integrity of the capping system. ■ Administrative Feasibility – Installation of a capping system, including surface water runoff control measures, will require coordination with and approval from New York City agencies including the Sewer Department and the Department of Transportation (sidewalk extension), and coordination with adjacent property owners. ■ Availability of Services and Materials – Services and materials necessary for cap installation and long-term groundwater monitoring are readily available.

TABLE 4-6
HEXAGON LABORATORIES RI/FFS
IMPLEMENTABILITY

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
3	■ In-Situ Treatment of Organic Contaminants – Bench-Scale Testing – Application of Reagent – Confirmatory Sampling ■ Solidification/Stabilization of Metal Contaminants – Excavation – Process with Binding Agent – Backfill with Treated Soil – Install Storm Water Runoff Control Measures ■ Institutional Controls ■ Groundwater Monitoring	■ Technical Feasibility – Standard construction methods and equipment will be used to construct the in-situ oxidation injection system. – Fenton's reaction-based in-situ oxidation has been demonstrated at other sites. Technical feasibility of implementing this technology at this site, which involves a larger area than typical for this process, treatment of relatively shallow soil and soil above the groundwater table, and treatment of soil with PAH and PCB contamination in addition to BTEX and chlorinated compounds, can only be established through bench- and/or pilot-scale testing. – The potential presence of free-phase product in the subsurface represents another unknown in the technical feasibility of this technology; free-phase product may significantly increase the volume of reagents necessary for treatment as well as require additional injection events. – Solidification/stabilization is a commercially available, established technology for treating metals-contaminated soil. – Standard excavation methods and equipment will be used to handle the soil, and standard construction methods and equipment will be used to construct temporary shoring and the surface water runoff control devices. There may be some difficulty in constructing the temporary shoring due to the presence of buried concrete and debris. – Solidification/stabilization may limit future options for remediation of the remaining saturated soil and groundwater contamination due to the presence of impermeable soil overlying the contaminated media. – Long-term groundwater monitoring does not require sophisticated equipment. ■ Administrative Feasibility – May be time consuming to obtain approval from New York City agencies (*e.g.*, NYCDEP) for implementation of an innovative technology such as Fenton's reaction-based in-situ oxidation. – Installation of surface water runoff control measures will require coordination with and approval from New York City agencies including the Sewer Department and the Department of Transportation (sidewalk extension), and coordination with adjacent property owners. ■ Availability of Services and Materials – Services and materials necessary for injection system installation and long-term groundwater monitoring are readily available. – The availability of vendors capable of implementing the in-situ oxidation component of this alternative is very limited; a competitive bid may not be possible for this service. – Services and materials necessary for solidification/stabilization of the metals-contaminated soil are readily available.
4A	■ Excavation ■ Off-site Disposal – Non-Hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Technical Feasibility – Standard excavation methods and equipment will be used to handle the soil. – Standard construction methods and equipment will be used to construct temporary shoring. There may be some difficulty in constructing the temporary shoring due to the presence of buried concrete and debris. – Alternative is expected to enhance potential future groundwater remedial actions at the site since the permeability of the overburden in the upper site will be greatly increased. ■ Administrative Feasibility – Implementation will likely require coordination with New York City Department of Transportation and affected communities along the truck route due to the large volume of soil being removed from the site. ■ Availability of Services and Materials – Services and materials necessary for excavation and handling of contaminated soil are readily available. – Several facilities have been identified which can accept the contaminated soil. No capacity or availability problems have been identified.

TABLE 4-6
HEXAGON LABORATORIES RI/FFS
IMPLEMENTABILITY

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
4B	■ Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Technical Feasibility – Standard excavation methods and equipment will be used to handle the soil. – Standard construction methods and equipment will be used to construct temporary shoring. There may be some difficulty in constructing the temporary shoring due to the presence of buried concrete and debris. – Alternative is expected to enhance potential future groundwater remedial actions at the site since the permeability of the overburden in the upper site will be greatly increased. ■ Administrative Feasibility – Implementation will likely require coordination with New York City Department of Transportation and affected communities along the truck route due to the large volume of soil being removed from the site. ■ Availability of Services and Materials – Services and materials necessary for excavation and handling of contaminated soil are readily available. – Several facilities have been identified which can accept the contaminated soil. No capacity or availability problems have been identified.
5A	■ Limited Excavation ■ Off-site Disposal – Non-Hazardous Soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Technical Feasibility – Standard excavation methods and equipment will be used to handle the soil. – Standard construction methods and equipment will be used to construct temporary shoring. There may be some difficulty in constructing the temporary shoring due to the presence of buried concrete and debris. – Standard construction methods will be used for installation of the cap. – Excavation/backfill components of this alternative are expected to enhance potential future groundwater remedial actions at the site since the permeability of the overburden in the upper site will be greatly increased. – Cap may limit implementation of future remedial alternatives for groundwater since any type of intrusive construction within the East Yard will compromise the integrity of the cap. ■ Administrative Feasibility – Hauling of contaminated soil off site will likely require coordination with New York City Department of Transportation and affected communities along the truck route due to the large volume of soil being removed. – Installation of the capping system, including surface water runoff control, will require coordination with and approval from New York City agencies including the New York City Sewer Department and the New York City Department of Transportation (sidewalk extension), and adjacent property owners. ■ Availability of Services and Materials – Services and materials necessary for excavation, handling of contaminated soil, cap installation, and long-term monitoring are readily available. – Several facilities have been identified which can accept the contaminated soil. No capacity or availability problems have been identified.

TABLE 4-6
HEXAGON LABORATORIES RI/FFS
IMPLEMENTABILITY

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
5B	■ Limited Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Technical Feasibility – Standard excavation methods and equipment will be used to handle the soil. – Standard construction methods and equipment will be used to construct temporary shoring. There may be some difficulty in constructing the temporary shoring due to the presence of buried concrete and debris. – Standard construction methods will be used for installation of the cap. – Excavation/backfill components of this alternative are expected to enhance potential future groundwater remedial actions at the site since the permeability of the overburden in the upper site will be greatly increased. – Cap may limit implementation of future remedial alternatives for groundwater since any type of intrusive construction within the East Yard will compromise the integrity of the cap. ■ Administrative Feasibility – Hauling of contaminated soil off site will likely require coordination with New York City Department of Transportation and affected communities along the truck route due to the large volume of soil being removed. – Installation of the capping system, including surface water runoff control, will require coordination with and approval from New York City agencies including the New York City Sewer Department and the New York City Department of Transportation (sidewalk extension), and adjacent property owners. ■ Availability of Services and Materials – Services and materials necessary for excavation, handling of contaminated soil, cap installation, and long-term monitoring are readily available. – Several facilities have been identified which can accept the contaminated soil. No capacity or availability problems have been identified.

TABLE 4-7
HEXAGON LABORATORIES RI/FFS
COST

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
1	■ No Action ■ Groundwater Monitoring	■ Capital Cost: $0 ■ Annual Operations and Maintenance (O&M) Cost: $22,200 ■ Total Present Worth (30-year duration, 5 percent discount rate): $341,000
2A	■ Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Capital Cost: $768,125 ■ Annual Operations and Maintenance (O&M) Cost: $23,600 ■ Total Present Worth (30-year duration, 5 percent discount rate): $1,131,000
2B	■ Concrete Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Capital Cost: $981,335 ■ Annual Operations and Maintenance (O&M) Cost: $23,600 ■ Total Present Worth (30-year duration, 5 percent discount rate): $1,344,000
2C	■ RCRA Multimedia Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Capital Cost: $999,825 ■ Annual Operations and Maintenance (O&M) Cost: $23,600 ■ Total Present Worth (30-year duration, 5 percent discount rate): $1,363,000
3	■ In-Situ Treatment of Organic Contaminants – Bench-Scale Testing – Application of Reagent – Confirmatory Sampling ■ Solidification/Stabilization of Metal Contaminants – Excavation – Process with Binding Agent – Backfill with Treated Soil – Install Storm Water Runoff Control Measures ■ Institutional Controls ■ Groundwater Monitoring	■ Capital Cost: $3,180,685 ■ Annual Operations and Maintenance (O&M) Cost: $11,500 ■ Total Present Worth (30-year duration, 5 percent discount rate): $3,357,000

TABLE 4-7
HEXAGON LABORATORIES RI/FFS
COST

ALTERNATIVE	BRIEF DESCRIPTION	COMMENTS
4A	■ Excavation ■ Off-site Disposal – Non-hazardous soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Capital Cost: \$2,266,205 ■ Annual Operations and Maintenance (O&M) Cost: \$0 ■ Total Present Worth (30-year duration, 5 percent discount rate): \$2,266,000
4B	■ Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Institutional Controls	■ Capital Cost: \$2,202,380 ■ Annual Operations and Maintenance (O&M) Cost: \$0 ■ Total Present Worth (30-year duration, 5 percent discount rate): \$2,202,000
5A	■ Limited Excavation ■ Off-site Disposal – Non-hazardous soil to Non-hazardous Waste Landfill for Disposal – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Capital Cost: \$2,166,615 ■ Annual Operations and Maintenance (O&M) Cost: \$15,200 ■ Total Present Worth (30-year duration, 5 percent discount rate): \$2,400,000
5B	■ Limited Excavation ■ Off-site Disposal – Non-hazardous soil to Recycling Facility for Treatment and Reuse – Hazardous Soil to Hazardous Waste Disposal Facility for Treatment and Disposal ■ Backfill with Clean Fill ■ Install Asphalt Cap ■ Institutional Controls ■ Groundwater Monitoring	■ Capital Cost: \$2,117,740 ■ Annual Operations and Maintenance (O&M) Cost: \$15,200 ■ Total Present Worth (30-year duration, 5 percent discount rate): \$2,351,000

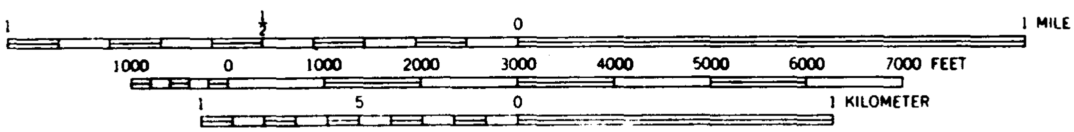
TABLE 5-1
HEXAGON LABORATORIES RI/FFS
SUMMARY OF EVALUATION SCORING [1]

ALTERNATIVE	COMPLIANCE WITH SCGs	PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	SHORT TERM EFFECTIVENESS	LONG-TERM EFFECTIVENESS AND PERMANENCE	REDUCTION OF TOXICITY, MOBILITY, OR VOLUME	IMPLEMENT-ABILITY	COST [2]	TOTAL SCORE
1	6	5	10	0	2	14	15	52
2A	6	11	10	6	2	14	5	54
2B	6	11	10	6	2	14	4	53
2C	6	11	10	6	2	14	4	53
3	6	16	9	13	13	9	2	68
4A	10	16	8	12	4	12	2	64
4B	10	16	8	13	15	12	2	76
5A	6	14	8	8	4	12	2	54
5B	6	14	8	9	14	12	2	65
Maximum Possible Score	**10**	**20**	**10**	**15**	**15**	**15**	**15**	**100**

Notes:

1. Scoring results for each of the evaluation criteria (excluding cost) are provided in Appendix B.
2. The alternative with the lowest present worth is assigned the maximum cost score of 15. Other alternatives are assigned the cost score inversely proportional to their present worth.

FIGURES



QUADRANGLE LOCATION

SOURCE: USGS 7.5 MINUTE SERIES TOPOGRAPHIC MAP: NEW YORK;
MOUNT VERNON QUADRANGLE, 1966 – PHOTOREVISED 1979.

Prepared by:	Prepared for:
TAMS CONSULTANTS, Inc. 300 Broadacres Drive, Bloomfield, New Jersey 07003	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

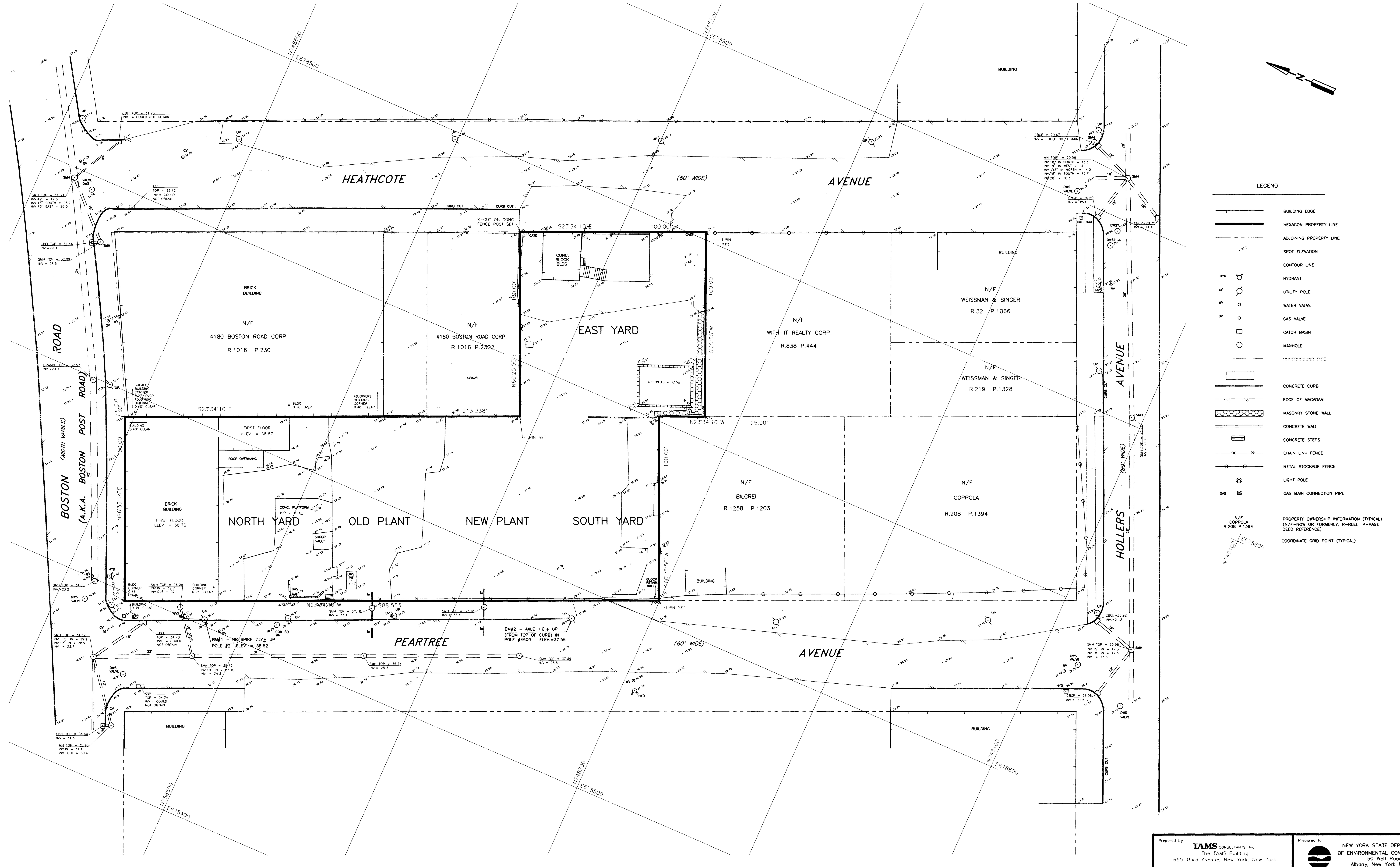
HEXAGON LABORATORIES SITE

BRONX COUNTY, NEW YORK

SITE LOCATION MAP

DATE:	SCALE:	DRAWING NO.:
MAY 1999	AS SHOWN	1-1

U:\PROJECT.33\JOB\5859\DRAWINGS Filename: SITEBORD.dwg / Date: 2-19-97 / User: PDP



REFERENCES:

1. INFORMATION ON FILE AT THE BRONX BOROUGH HALL.
2. DEEDS OF RECORD.
3. VERTICAL DATUM: NGVD 1929.
4. HORIZONTAL DATUM: NEW YORK STATE PLANE COORDINATE SYSTEM, EAST ZONE, NAD 1983 FROM NEW YORK STATE DEPARTMENT OF TRANSPORTATION SURVEY INFORMATION.

NOTES:

1. BASED ON SURVEY OF HEXAGON LABORATORIES SITE PREPARED BY YEC, INC., VALLEY COTTAGE, NEW YORK.
2. HEXAGON LABORATORIES PROPERTY:
   TAX LOT: 17-5283-43
   RECORD DEED: REEL 460, PAGE 601
   AREA: 38,845 S.F. (0.892 AC.)
3. SITE FEATURE DESIGNATIONS (E.G., NORTH YARD, OLD PLANT, NEW PLANT, SOUTH YARD, AND EAST YARD) ARE BASED ON SITE CONDITIONS PRIOR TO THE IRM DEMOLITION AND TANK REMOVAL ACTIVITIES.

SCALE 20 10 0 20 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY

DRAWN BY

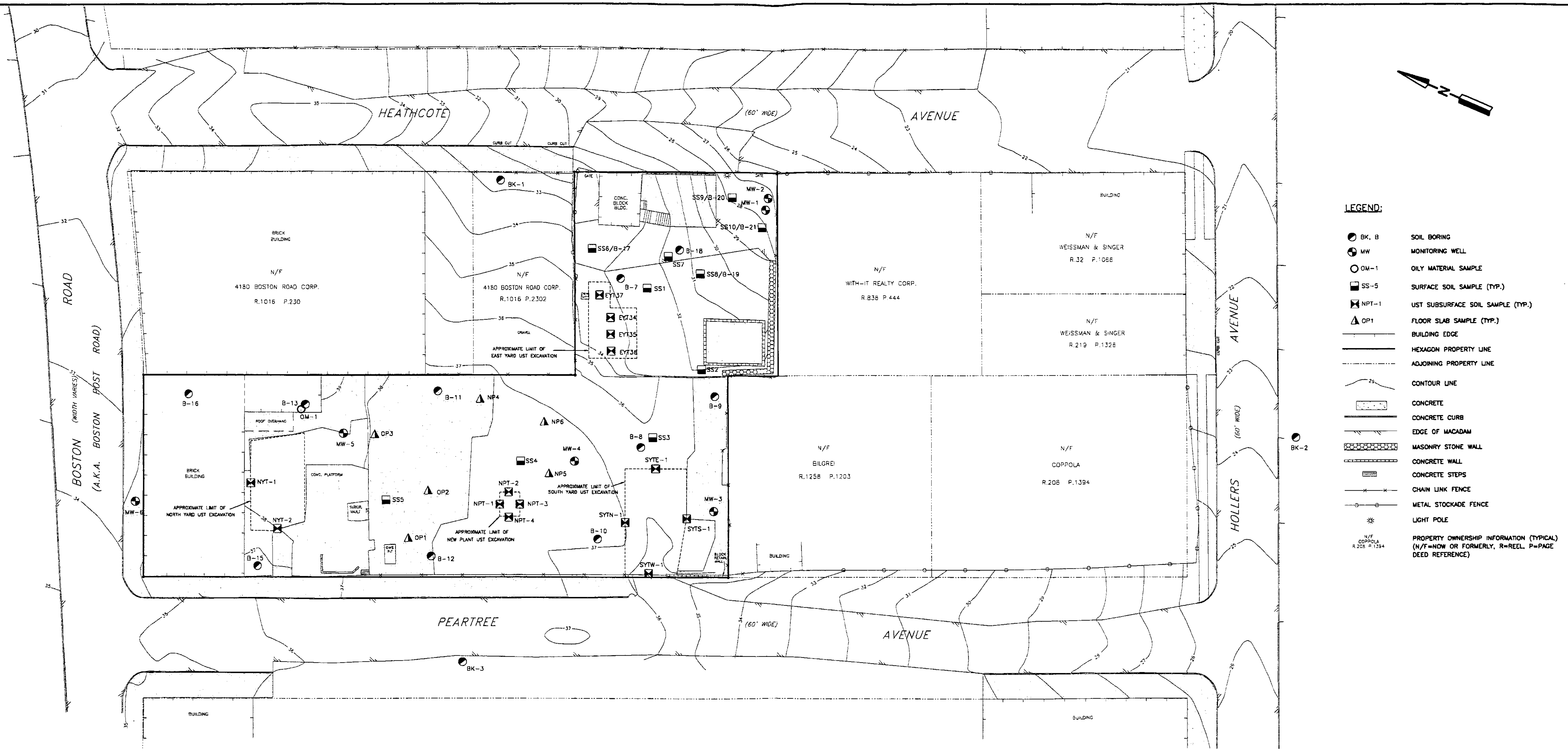
CHECKED BY

HEXAGON LABORATORIES SITE

City of New York
Bronx County, New York

TOPOGRAPHIC BASE MAP

SUBMITTED BY	DATE	SCALE	DRAWING NO.
PDP	MAY 1999	1" = 20'	1-2



NOTES:

1. SITE LAYOUT BASED ON SURVEY OF HEXAGON LABORATORIES PERFORMED BY YEC, INC., VALLEY COTTAGE, NEW YORK (JANUARY 1998).
2. ALL MONITORING WELL LOCATIONS AND BORING B-9, B-11, B-12, B-15, BK-1, BK-2, AND BK-3 LOCATIONS WERE SURVEYED BY YEC, INC. ALL OTHER SAMPLING LOCATIONS ARE APPROXIMATE BASED ON TAMS FIELD NOTES.
3. FLOOR SLAB SAMPLES WERE COLLECTED BY TRADE-WINDS ENVIRONMENTAL RESTORATION, INC. AS PART OF THE IRM.
4. ONE SAMPLE OF SOIL EXCAVATED FROM THE SOUTH YARD UST EXCAVATION WAS COLLECTED BY TAMS. THIS EXCAVATED SOIL SAMPLE, SYTEX-1, IS NOT INCLUDED IN THIS FIGURE FOR CLARITY PURPOSES.
5. SIX SAMPLES OF SOIL EXCAVATED FROM THE SOUTH YARD UST EXCAVATION WERE COLLECTED BY TRADE-WINDS ENVIRONMENTAL RESTORATION, INC. OVER THE COURSE OF THE IRM. THESE SAMPLES (LD1-2-3, SYA, #1-2-3, SYS1, SYS2, AND SYS3) ARE NOT INCLUDED IN THIS FIGURE FOR CLARITY PURPOSES.
6. FOUR SAMPLES OF SOIL EXCAVATED FROM THE NEW PLANT UST EXCAVATION WERE COLLECTED BY TRADE-WINDS ENVIRONMENTAL RESTORATION, INC. OVER THE COURSE OF THE IRM. THESE SAMPLES (FOT#1, FOT#2, FO1, AND FO2) ARE NOT INCLUDED IN THIS FIGURE FOR CLARITY PURPOSES.
7. SAMPLE SYTC-1 IS A COMPOSITE IN-SITU SIDEWALL SAMPLE OF SYTN-1, SYTS-1, SYTE-1, AND SYTW-1.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by : TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for : NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

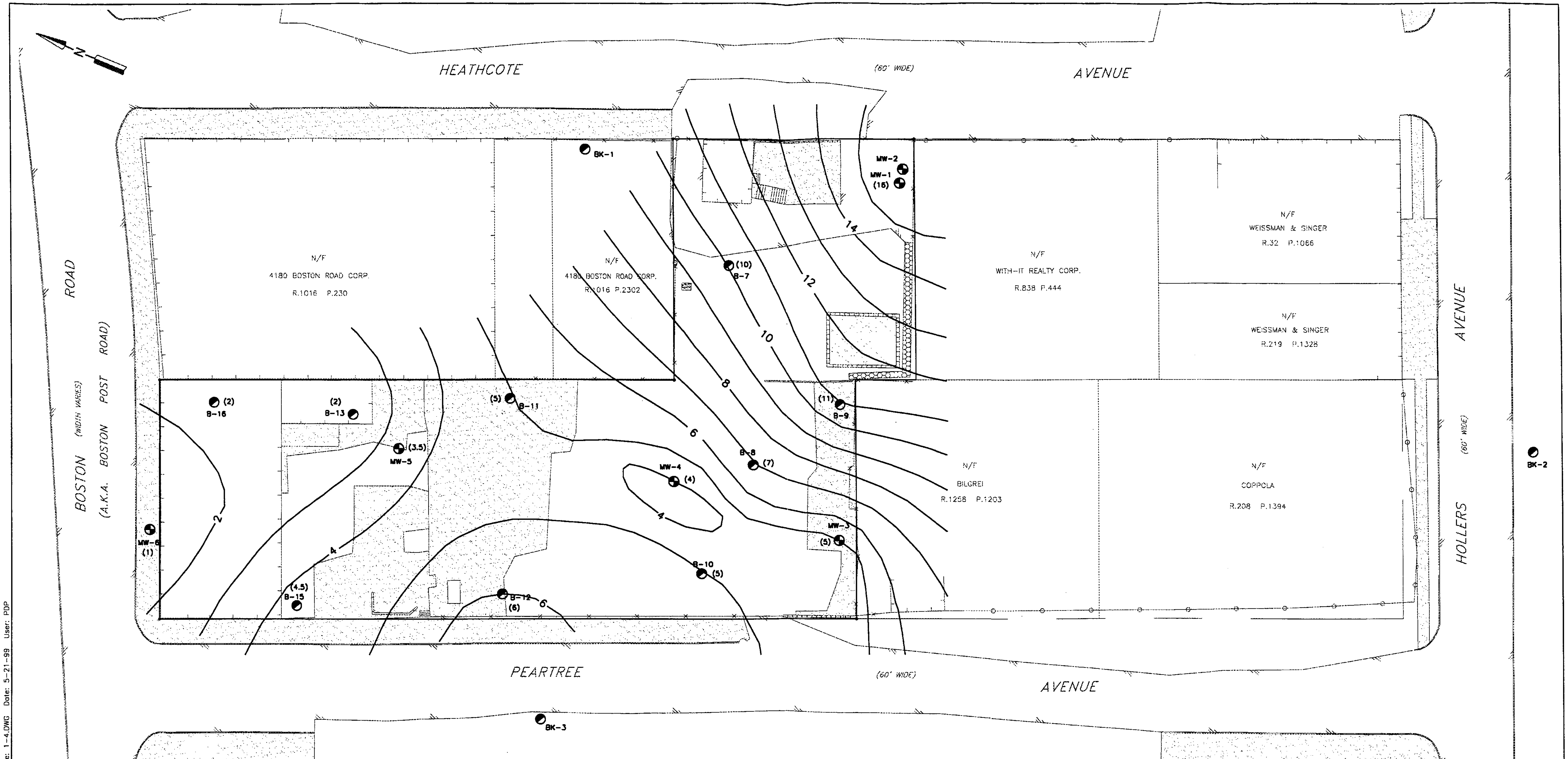
DESIGNED BY : PDP
DRAWN BY : PDP
CHECKED BY : PK
SUBMITTED BY : PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

RI SAMPLING LOCATIONS

DATE : MAY 1999
SCALE : AS SHOWN
DRAWING NO. : 1-3



LEGEND

BK, B	SOIL BORING		CONCRETE WALL
MW	MONITORING WELL		CONCRETE STEPS
	BUILDING EDGE		CHAIN LINK FENCE
	HEXAGON PROPERTY LINE		METAL STOCKADE FENCE
	ADJOINING PROPERTY LINE	N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	CONCRETE	(3.5)	OVERBURDEN THICKNESS IN FEET (TYP.)
	CONCRETE CURB	4	OVERBURDEN THICKNESS ISOPACH (TYP.), 1 FT. CONTOUR INTERVAL
	EDGE OF MACADAM		
	MASONRY STONE WALL		

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED

REVISIONS

Prepared by :
TAMS CONSULTANTS, Inc.
The TAMS Building
655 Third Avenue, New York, New York

Prepared for :
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233

DESIGNED BY : PK
DRAWN BY : PDP
CHECKED BY : MT
SUBMITTED BY : PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

OVERBURDEN ISOPACH MAP

DATE : MAY 1999
SCALE : AS SHOWN
DRAWING NO. : 1-4

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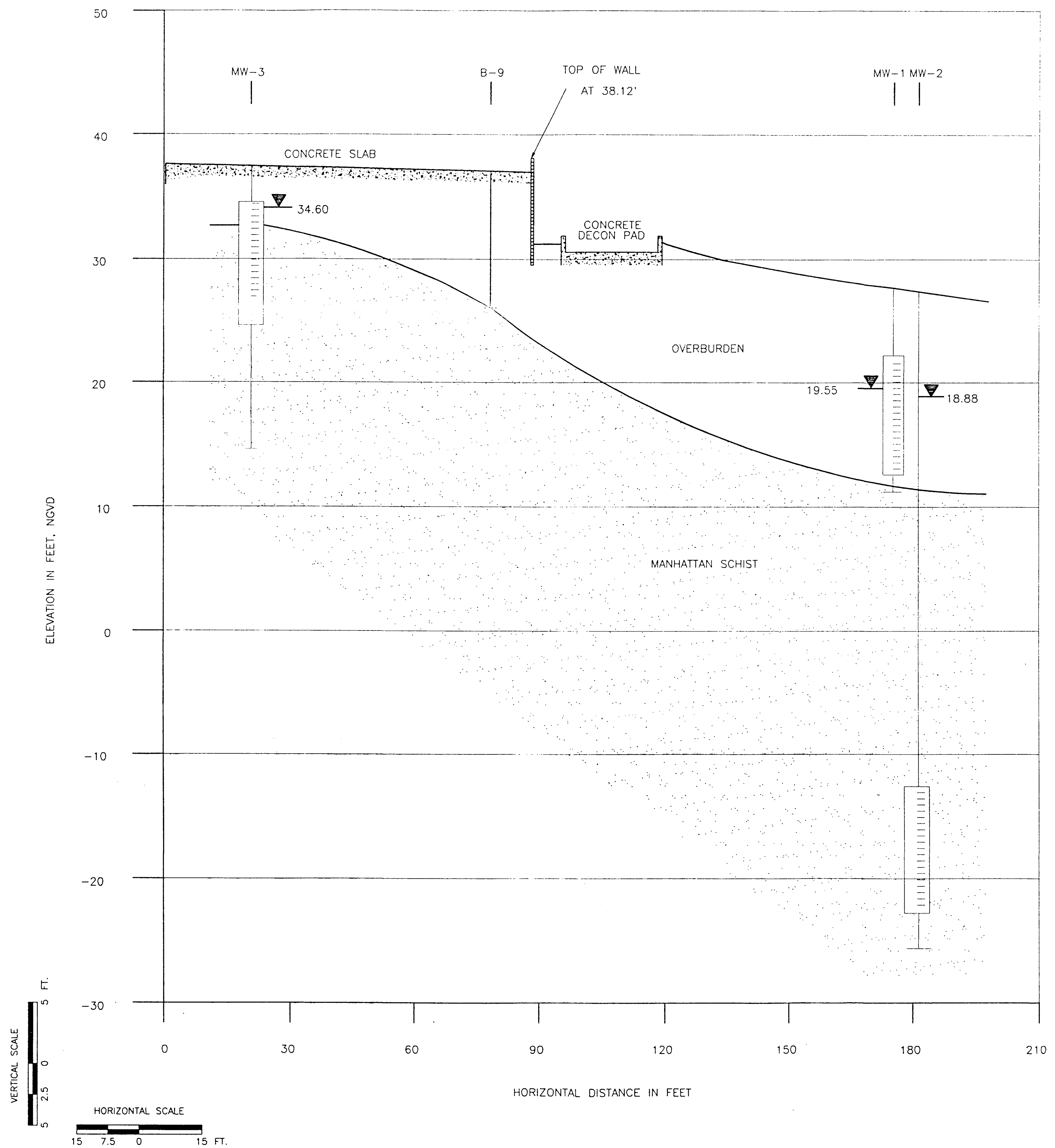
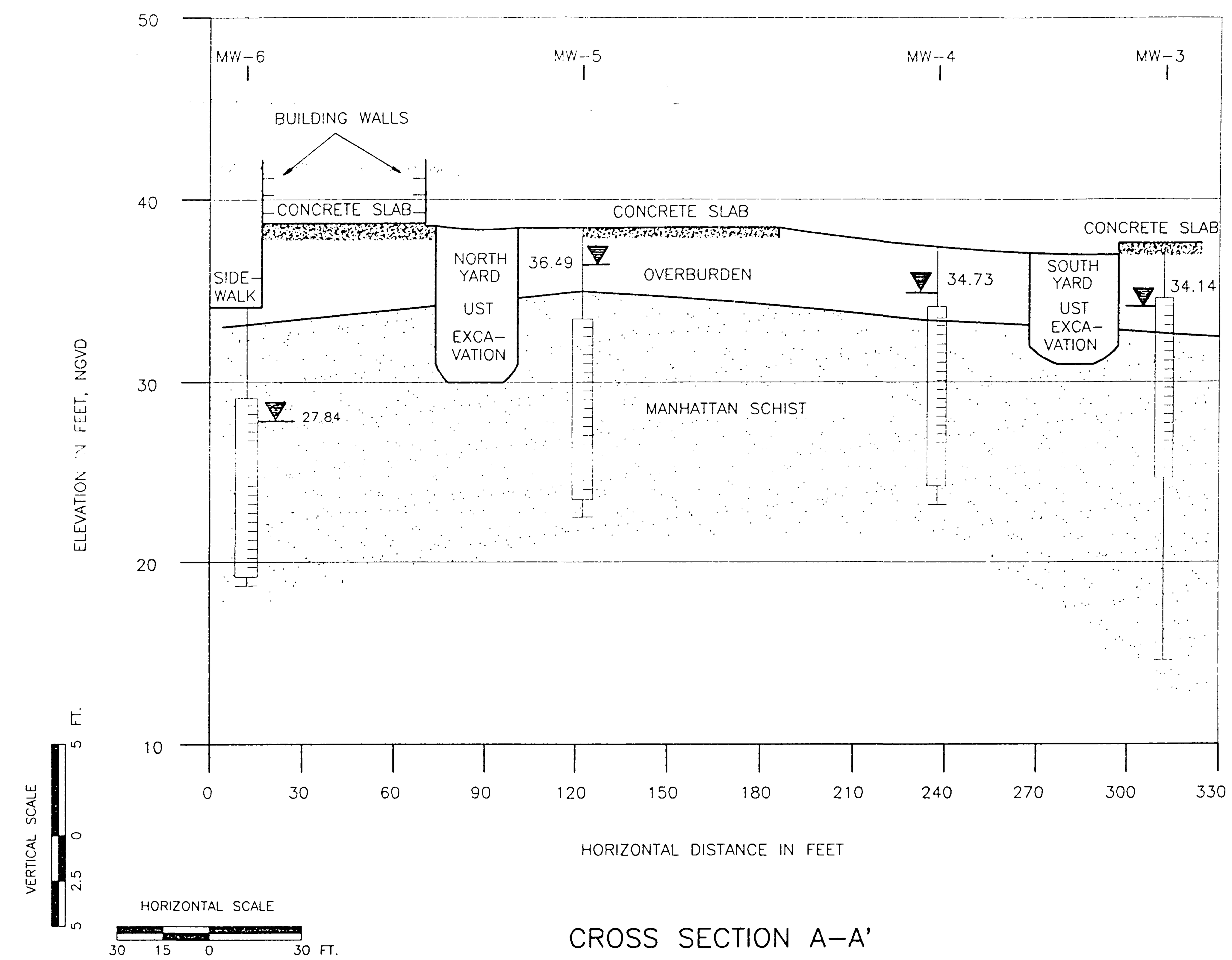
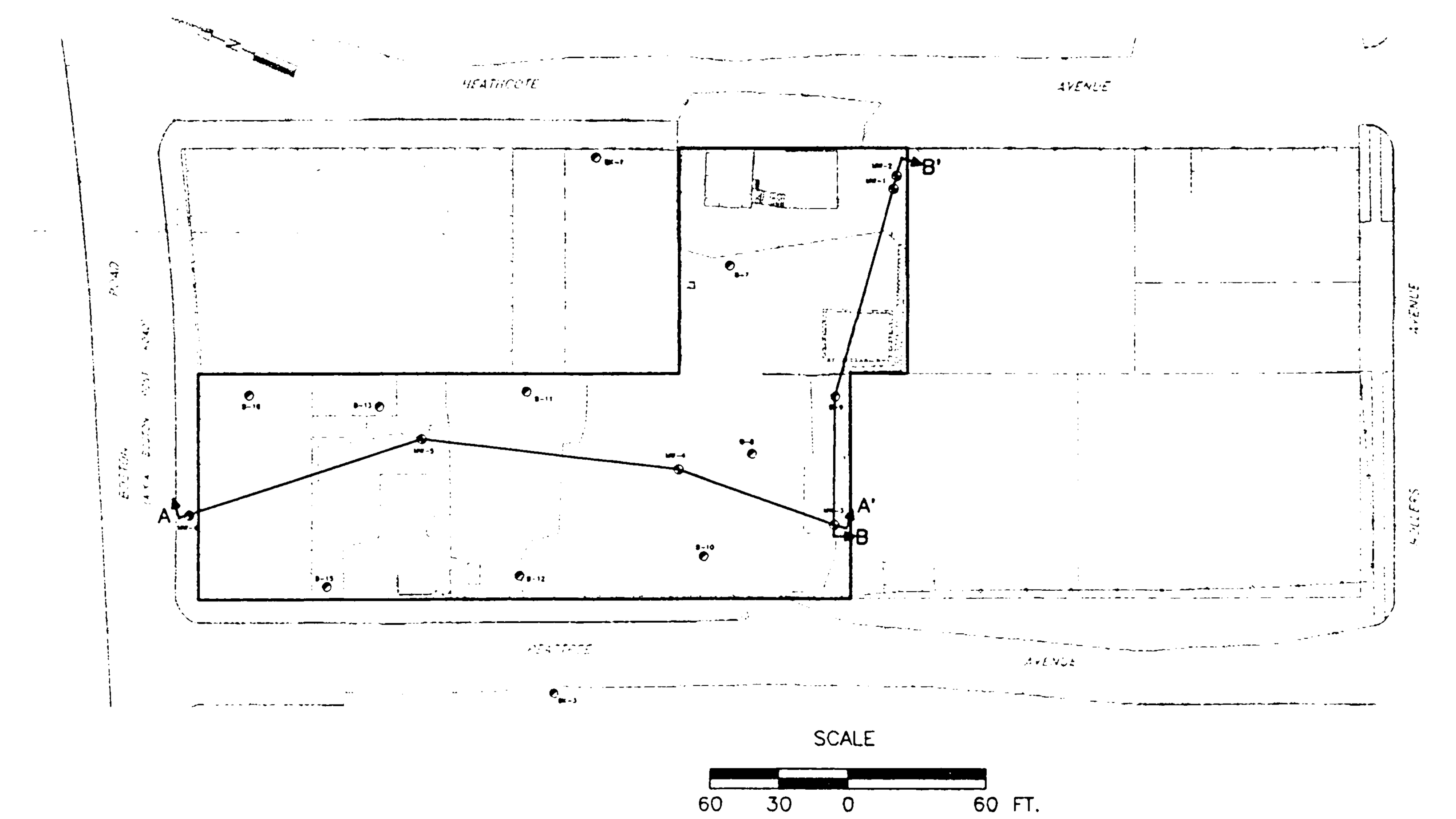


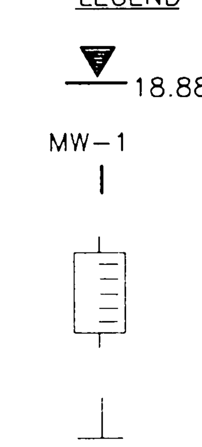
CROSS SECTION B–B'



CROSS SECTION A–A'



LEGEND



18.88	GROUNDWATER ELEVATION IN FEET, NGVD (TYP.)
MW-1	MONITORING WELL/BORING DESIGNATION (TYP.)
	MONITORING WELL SCREENED INTERVAL
	MAXIMUM DEPTH OF BORING

NOTE: GROUNDWATER ELEVATIONS MEASURED ON MARCH 5, 1998.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building, 655 Third Avenue, New York, New York

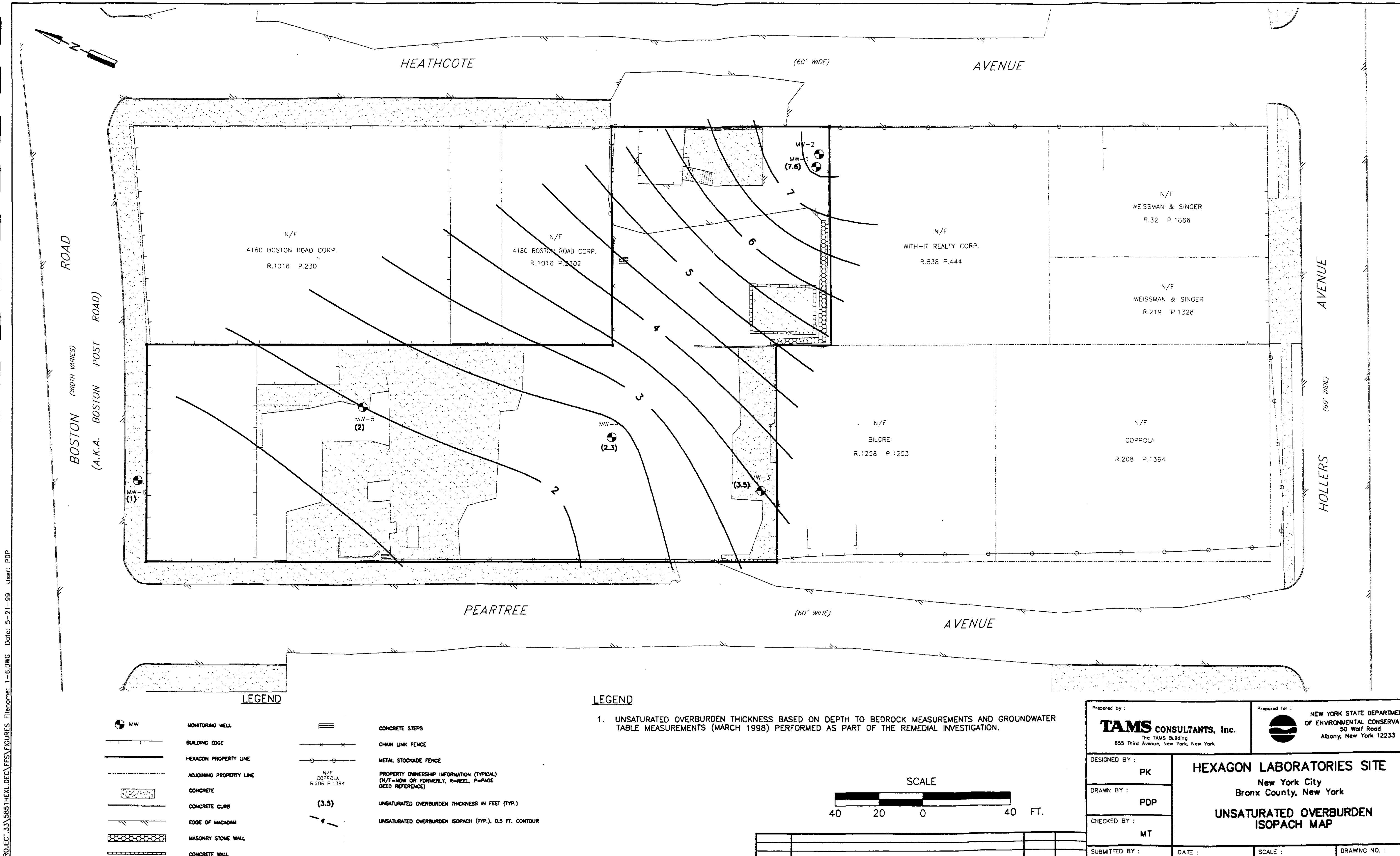
Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, 50 Wolf Road, Albany, New York 12233

HEXAGON LABORATORIES SITE

City of New York
Bronx County, New York

GEOLOGIC CROSS SECTIONS

DESIGNED BY:	PK
DRAWN BY:	PDP
CHECKED BY:	MT
SUBMITTED BY:	PDP
DATE:	MAY 1999
SCALE:	AS SHOWN
DRAWING NO.:	1-5



LEGEND

1. UNSATURATED OVERBURDEN THICKNESS BASED ON DEPTH TO BEDROCK MEASUREMENTS AND GROUNDWATER TABLE MEASUREMENTS (MARCH 1998) PERFORMED AS PART OF THE REMEDIAL INVESTIGATION.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by : TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for : NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY : PK
DRAWN BY : PDP
CHECKED BY : MT
SUBMITTED BY : PDP

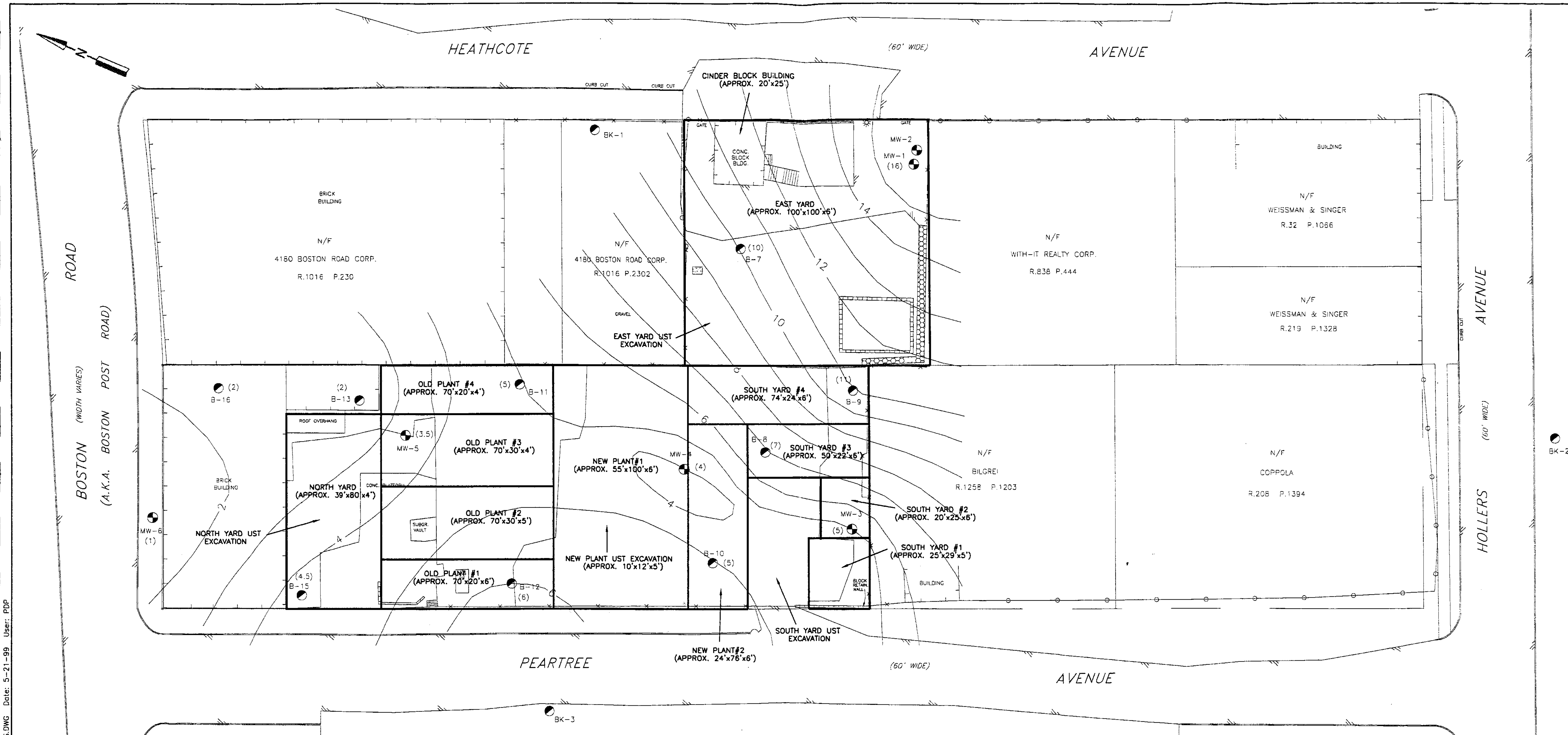
HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

UNSATURATED OVERBURDEN ISOPACH MAP

DATE : MAY 1999
SCALE : AS SHOWN
DRAWING NO. : 1-6

U:\PROJECT.33\5851HEXL.DEC\FFS\FIGURES Filename: 1-6.DWG Date: 5-21-99 User: PDP



SCALE

40 20 0 40 FT.

LEGEND

BK, B	SOIL BORING
MW	MONITORING WELL
	BUILDING EDGE
	HEXAGON PROPERTY LINE
	ADJOINING PROPERTY LINE
	CONCRETE
	CONCRETE CURB
	EDGE OF MACADAM
	MASONRY STONE WALL
	CONCRETE WALL
	CONCRETE STEPS
	CHAIN LINK FENCE
	METAL STOCKADE FENCE
N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
(3.5)	OVERBURDEN THICKNESS IN FEET (TYP.)
36	OVERBURDEN THICKNESS ISOPACH (TYP.), 1 FT. CONTOUR INTERVAL
	AREA OF CONTAMINATION

NOTES

1. CONTAMINATION AREA SUBDIVISIONS ARE APPROXIMATED AS RECTANGULAR BLOCKS FOR THE PURPOSES OF CALCULATING SOIL VOLUMES. ACTUAL SOIL VOLUMES MAY VARY BASED ON SUBSURFACE CONDITIONS.
2. DURING THE IRM, CONTAMINATED SOIL WAS REMOVED FROM THE SOUTH YARD AND NEW PLANT UST EXCAVATIONS AND REPLACED WITH CLEAN FILL. THESE AREAS ARE CONSIDERED TO BE CLEAN AND ARE NOT INCLUDED IN THE ESTIMATE OF CONTAMINATED SOIL VOLUME.
3. THE VERTICAL EXTENT OF SOIL CONTAMINATION IN THE UPPER SITE (NORTH YARD, OLD PLANT, NEW PLANT, AND SOUTH YARD) IS GENERALLY CONSIDERED TO BE TO THE TOP OF BEDROCK. IN SOUTH YARD #3 AND SOUTH YARD #4 SUB-AREAS, THE VERTICAL EXTENT OF CONTAMINATION IS CONSIDERED TO BE A MAXIMUM DEPTH OF 6 FEET BGS, CORRESPONDING TO THE DEPTH TO BEDROCK IN ADJACENT SUB-AREAS.
4. THE VERTICAL EXTENT OF SOIL CONTAMINATION IN THE EAST YARD IS CONSIDERED TO BE TO THE TOP OF THE GROUNDWATER TABLE. REFER TO FIGURE1-6 FOR UNSATURATED OVERBURDEN THICKNESS.
5. REFER TO TABLE 2-7 FOR CONTAMINATED SOIL VOLUME ESTIMATE CALCULATIONS.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by : TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for : NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY : LT

DRAWN BY : PDP

CHECKED BY : MT

SUBMITTED BY : PDP

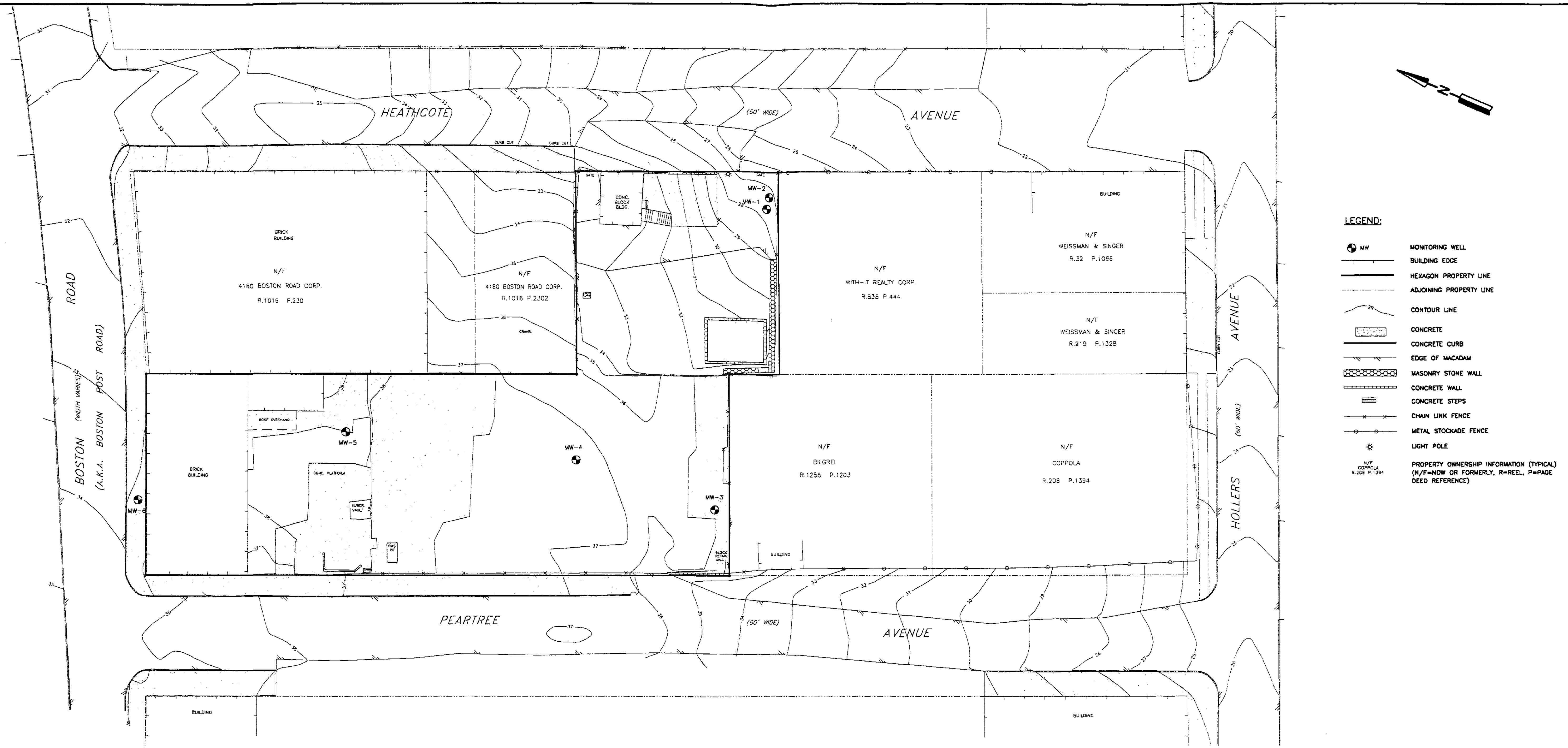
HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

CONTAMINATED SOIL VOLUME ESTIMATE

DATE : MAY 1999 | SCALE : AS SHOWN | DRAWING NO. : 2-1

U:\PROJECT.33\5851HEXL.DEC\FFS\FIGURES Filename: 2-1FFS.DWG Date: 5-21-99 User: PDP



NOTES:

1. SITE LAYOUT BASED ON SURVEY OF HEXAGON LABORATORIES PERFORMED BY YEC, INC., VALLEY COTTAGE, NEW YORK (JANUARY 1998).
2. EXISTING MONITORING WELL LOCATIONS WERE SURVEYED BY YEC, INC.
3. EXISTING MONITORING WELLS (MW-1 THROUGH MW-6) AND SIX MONITORING WELLS PROPOSED FOR INSTALLATION AS PART OF THE PHASE II REMEDIAL INVESTIGATION (NOT SHOWN) WILL BE SAMPLED ANNUALLY AS PART OF THE LONG-TERM MONITORING PROGRAM.

SYMBOL	DESCRIPTIONS	DATE	APPROVED

REVISIONS

Prepared by : TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

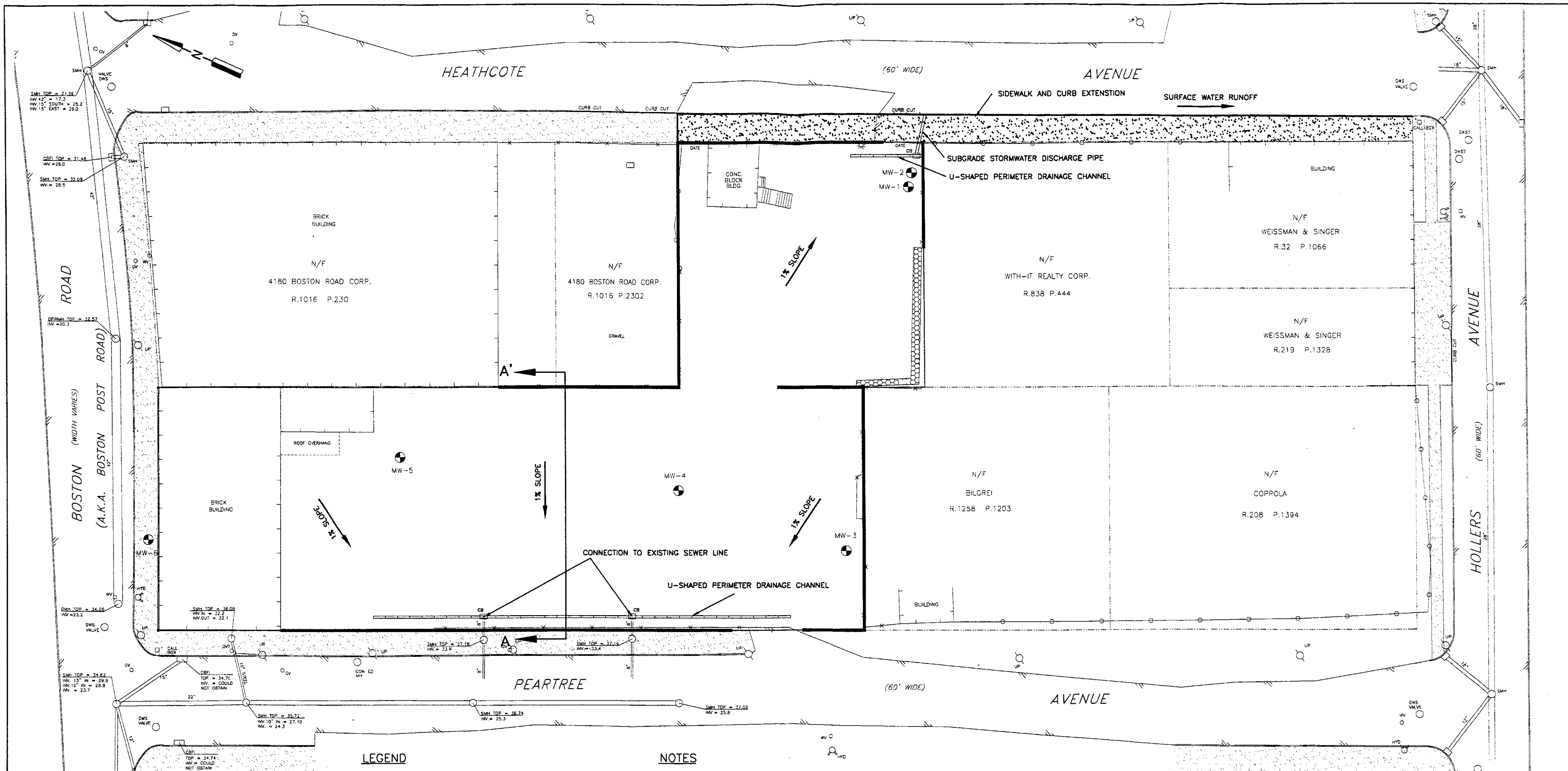
Prepared for : NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY : PDP
DRAWN BY : PDP
CHECKED BY : PK
SUBMITTED BY : PDP

HEXAGON LABORATORIES SITE
New York City
Bronx County, New York

ALTERNATIVE 1
PROPOSED SAMPLING LOCATIONS

DATE : MAY 1999
SCALE : AS SHOWN
DRAWING NO. : 4-1



LEGEND

MW	MONITORING WELL		CONCRETE
	BUILDING EDGE		CONCRETE CURB
	HEXAGON PROPERTY LINE		EDGE OF MACADAM
	ADJOINING PROPERTY LINE		MASONRY STONE WALL
HYD	HYDRANT		CONCRETE STEPS
UP	UTILITY POLE		CHAIN LINK FENCE
WV	WATER VALVE		METAL STOCKADE FENCE
GV	GAS VALVE		LIGHT POLE
	CATCH BASIN	N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	MANHOLE		CAP CURBING/RETAINING WALL
	UNDERGROUND PIPE		

NOTES

1. SITE LAYOUT BASED ON SURVEY OF HEXAGON LABORATORIES PERFORMED BY YEC, INC., VALLEY COTTAGE, NEW YORK (JANUARY 1998).
2. CURB CUTS TO BE ADDED TO SIDEWALK EXTENSION AS NECESSARY FOR ACCESS TO PROPERTIES ALONG HEATHCOTE AVENUE.
3. EXISTING MONITORING WELLS (MW-1 THROUGH MW-6) AND SIX MONITORING WELLS PROPOSED FOR INSTALLATION AS PART OF THE PHASE II REMEDIAL INVESTIGATION (NOT SHOWN) WILL BE SAMPLED ANNUALLY TO MONITOR LONG-TERM EFFECTIVENESS OF THE CAPPING SYSTEM.

SCALE

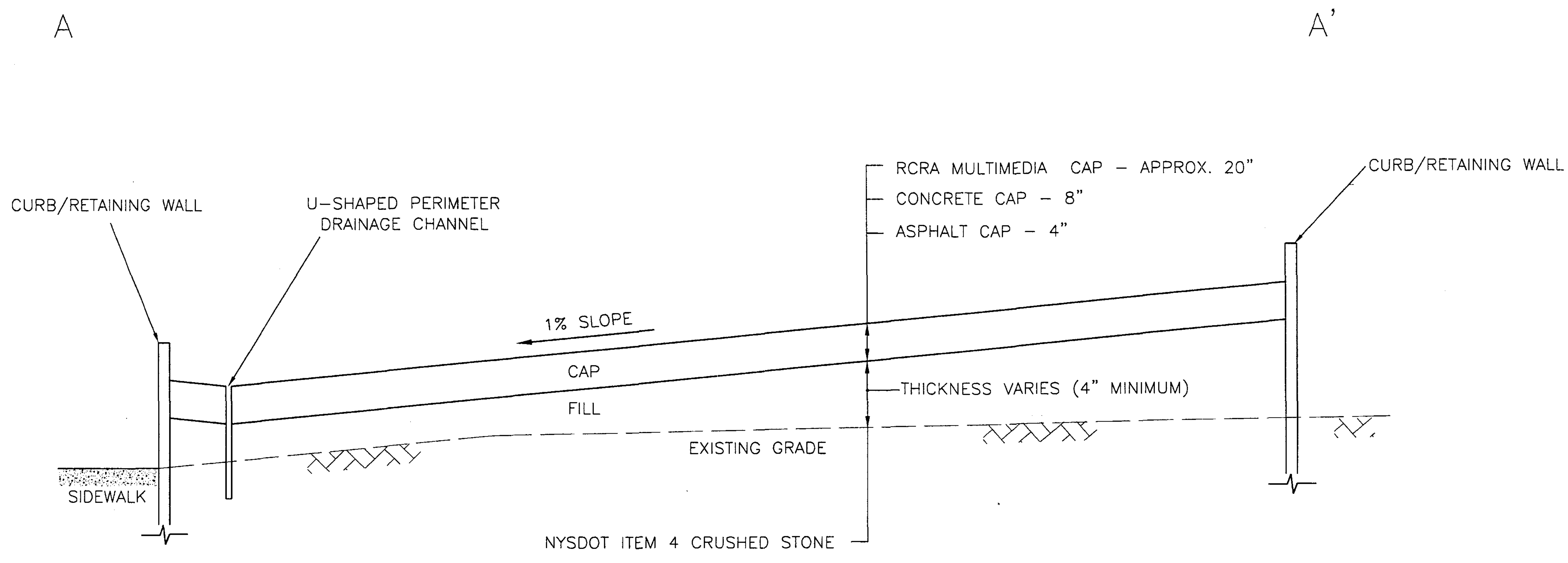
40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY: LT	**HEXAGON LABORATORIES SITE** New York City Bronx County, New York
DRAWN BY: PDP	
CHECKED BY: MT	**ALTERNATIVES 2A, 2B, AND 2C PLAN VIEW OF FINAL SITE CONDITIONS**
SUBMITTED BY: PDP	DATE: MAY 1999 · SCALE: AS SHOWN · DRAWING NO.: 4-2

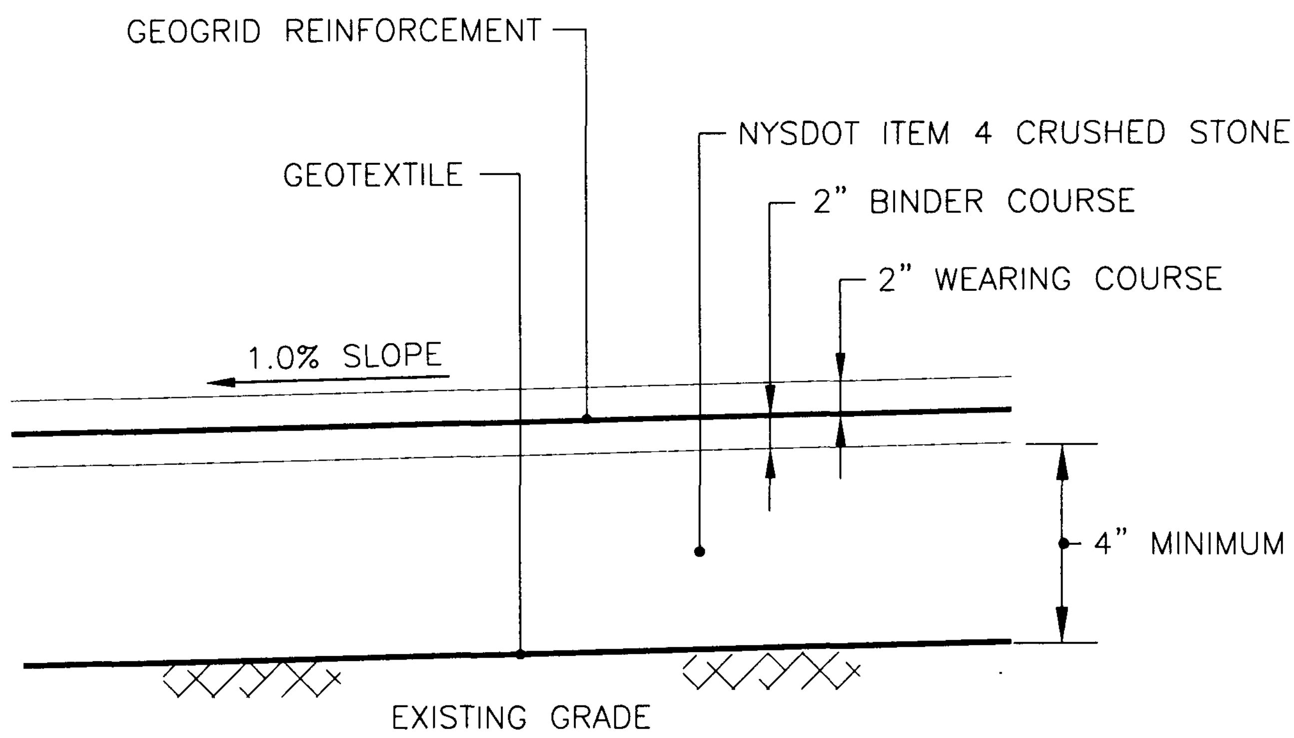


SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY: LT	**HEXAGON LABORATORIES SITE** New York City Bronx County, New York
DRAWN BY: PDP	
CHECKED BY: MT	**ALTERNATIVES 2A, 2B, AND 2C CROSS-SECTION A - A'**
SUBMITTED BY: PDP	DATE: MAY 1999 · SCALE: NOT TO SCALE · DRAWING NO.: 4-3



Prepared by:
TAMS CONSULTANTS, Inc.
300 Broadacres Drive, Bloomfield, New Jersey 07003

Prepared for:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233

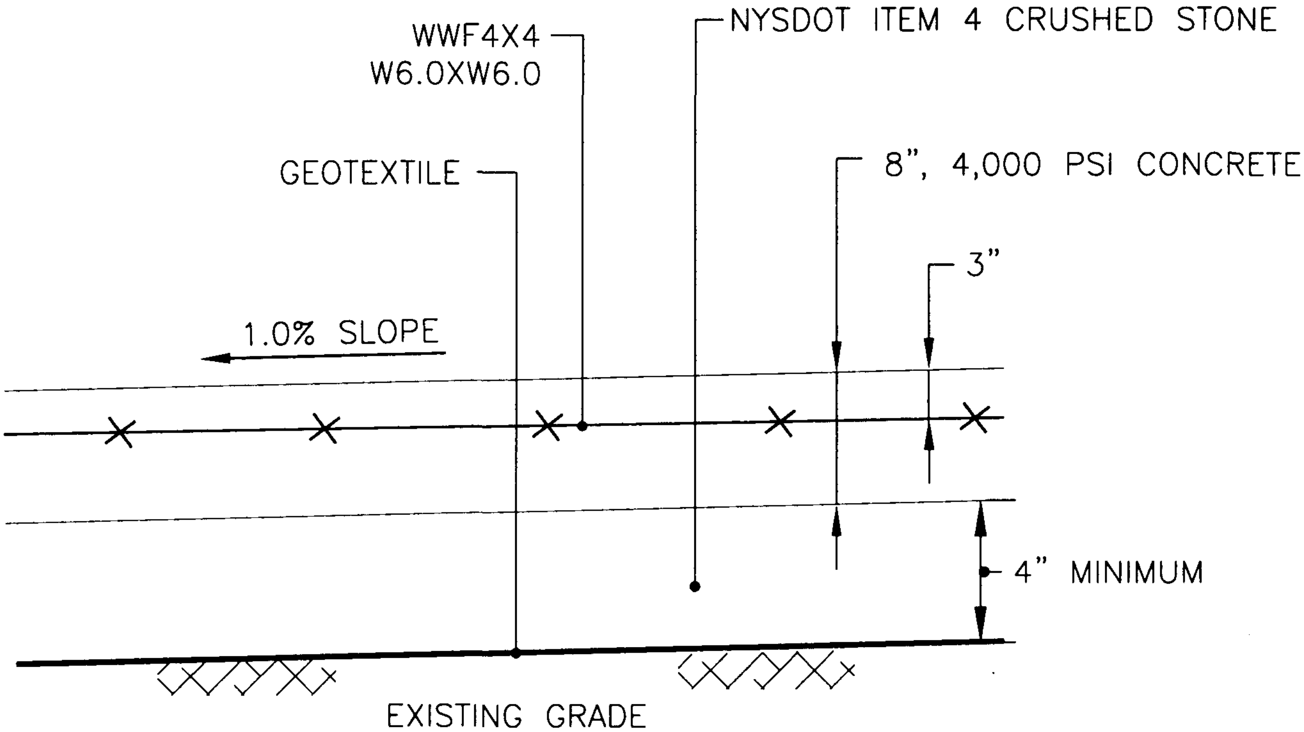
DESIGNED BY: JE
DRAWN BY: PDP
CHECKED BY: MT
SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ASPHALT CAP TYPICAL CROSS-SECTION

DATE: MAY 1999
SCALE: NOT TO SCALE
DRAWING NO.: 4-4



NOTES

1. EXPANSION JOINTS TO BE PLACED AT 30-FEET SPACING.
2. CONTRACTION JOINTS TO BE PLACED AT 10-FEET SPACING.

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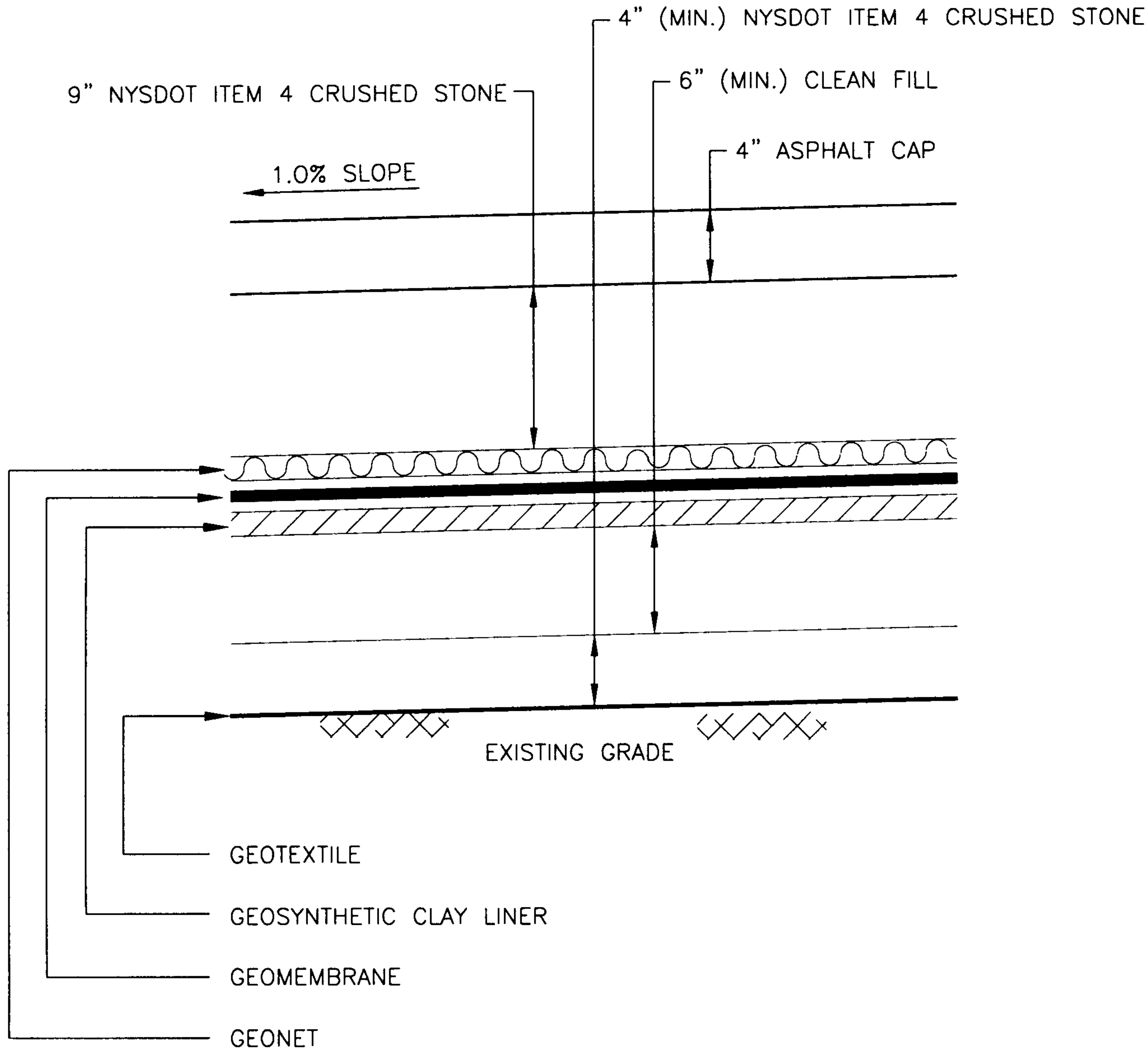
DESIGNED BY : JE	HEXAGON LABORATORIES SITE New York City Bronx County, New York CONCRETE CAP TYPICAL CROSS-SECTION		
DRAWN BY : PDP			
CHECKED BY : MT			
SUBMITTED BY : PDP	DATE : MAY 1999	SCALE : NOT TO SCALE	DRAWING NO. : 4-5



Prepared by :

TAMS CONSULTANTS, Inc.
300 Broadacres Drive, Bloomfield, New Jersey 07003

Prepared for :

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233

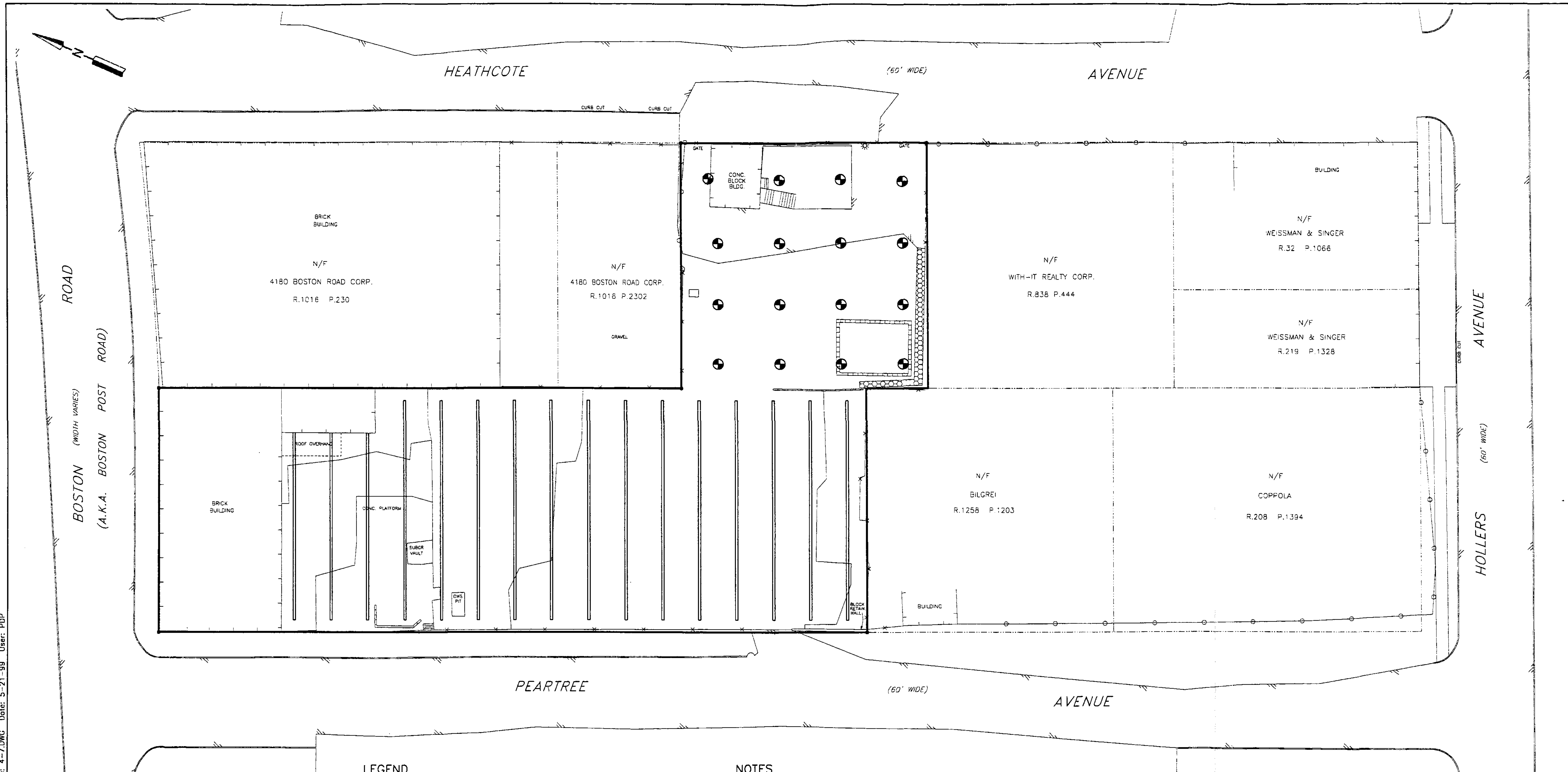
DESIGNED BY : JE
DRAWN BY : PDP
CHECKED BY : MT
SUBMITTED BY : PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

RCRA MULTIMEDIA CAP
TYPICAL CROSS-SECTION

DATE :	SCALE :	DRAWING NO. :
MAY 1999	NOT TO SCALE	4-6



LEGEND

- INJECTION TRENCH
- INJECTION WELL
- BUILDING EDGE
- HEXAGON PROPERTY LINE
- ADJOINING PROPERTY LINE
- CONCRETE CURB
- EDGE OF MACADAM
- MASONRY STONE WALL
- CONCRETE WALL
- CONCRETE STEPS
- CHAIN LINK FENCE
- METAL STOCKADE FENCE
- LIGHT POLE
- N/F COPPOLA R.208 P.1394 — PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)

NOTES

1. PROPOSED INJECTION TRENCH AND WELL LOCATIONS BASED ON INFORMATION PROVIDED BY IN-SITU OXIDATIVE TECHNOLOGIES, INC., LAWRENCEVILLE, NEW JERSEY.
2. INJECTION TRENCH PVC PIPING WILL BE PLACED AT A DEPTH OF 1 TO 2 FEET BELOW GROUND SURFACE. INJECTION WELLS WILL BE INSTALLED TO A MAXIMUM DEPTH OF 15 FEET BELOW GROUND SURFACE.
3. INJECTION WELLS WILL BE PROPERLY ABANDONED AT THE COMPLETION OF THE IN-SITU OXIDATION TREATMENT.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED

REVISIONS

Prepared by: **TAMS CONSULTANTS, Inc.** The TAMS Building, 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, 50 Wolf Road, Albany, New York 12233

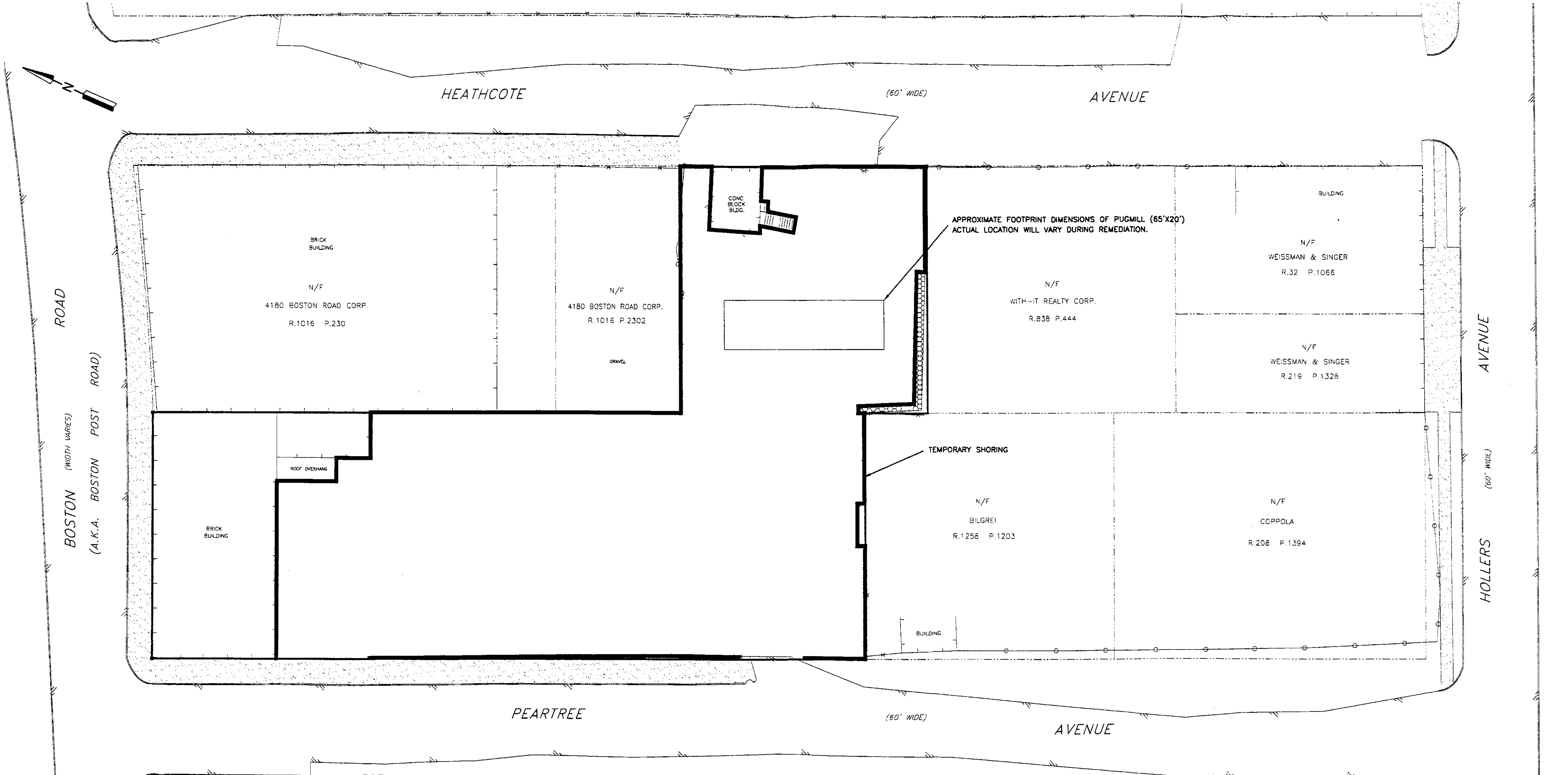
HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVE 3
PROPOSED LAYOUT OF IN-SITU OXIDATION INJECTION TRENCHES AND WELLS

DESIGNED BY : LT	DRAWN BY : PDP	CHECKED BY : MT	SUBMITTED BY : PDP
DATE : MAY 1999	SCALE : AS SHOWN	DRAWING NO. : 4-7	

U:\PROJECT.33\5851HEXL.DEC\FFS\FIGURES Filename: 4-7.DWG Date: 5-21-99 User: PDP



LEGEND

	BUILDING EDGE
	HEXAGON PROPERTY LINE
	ADJOINING PROPERTY LINE
	CONCRETE CURB
	EDGE OF MACADAM
	MASONRY STONE WALL
	CHAIN LINK FENCE
	METAL STOCKADE FENCE
	LIGHT POLE
N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	TEMPORARY SHORING

NOTES

1. SITE CONDITIONS INDICATED REPRESENT ANTICIPATED SITE CONDITIONS UPON COMPLETION OF CONCRETE REMOVAL OPERATIONS.
2. TEMPORARY SHORING WILL BE PLACED ALONG THE SIDES OF ALL EXCAVATIONS EXCEEDING FOUR FEET IN DEPTH AND ALONG THE SIDES OF ALL EXISTING BUILDINGS ADJACENT TO EXCAVATIONS, REGARDLESS OF THE DEPTH OF THE EXCAVATION.
3. APPROXIMATE DIMENSIONS OF PUGMILL PROVIDED BY STC REMEDIATION, INC. (SCOTTSDALE, ARIZONA). ACTUAL DIMENSIONS WILL BE DEPENDENT ON THE VENDOR SELECTED TO PROVIDE SOLIDIFICATION/STABILIZATION SERVICES.
4. POTENTIAL PUGMILL LOCATION IS INDICATED. PUGMILL WILL BE RELOCATED DURING REMEDIATION AS NECESSARY TO ACCESS THE CONTAMINATED SOIL.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by : TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for : NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY : LT
DRAWN BY : PDP
CHECKED BY : MT
SUBMITTED BY : PDP

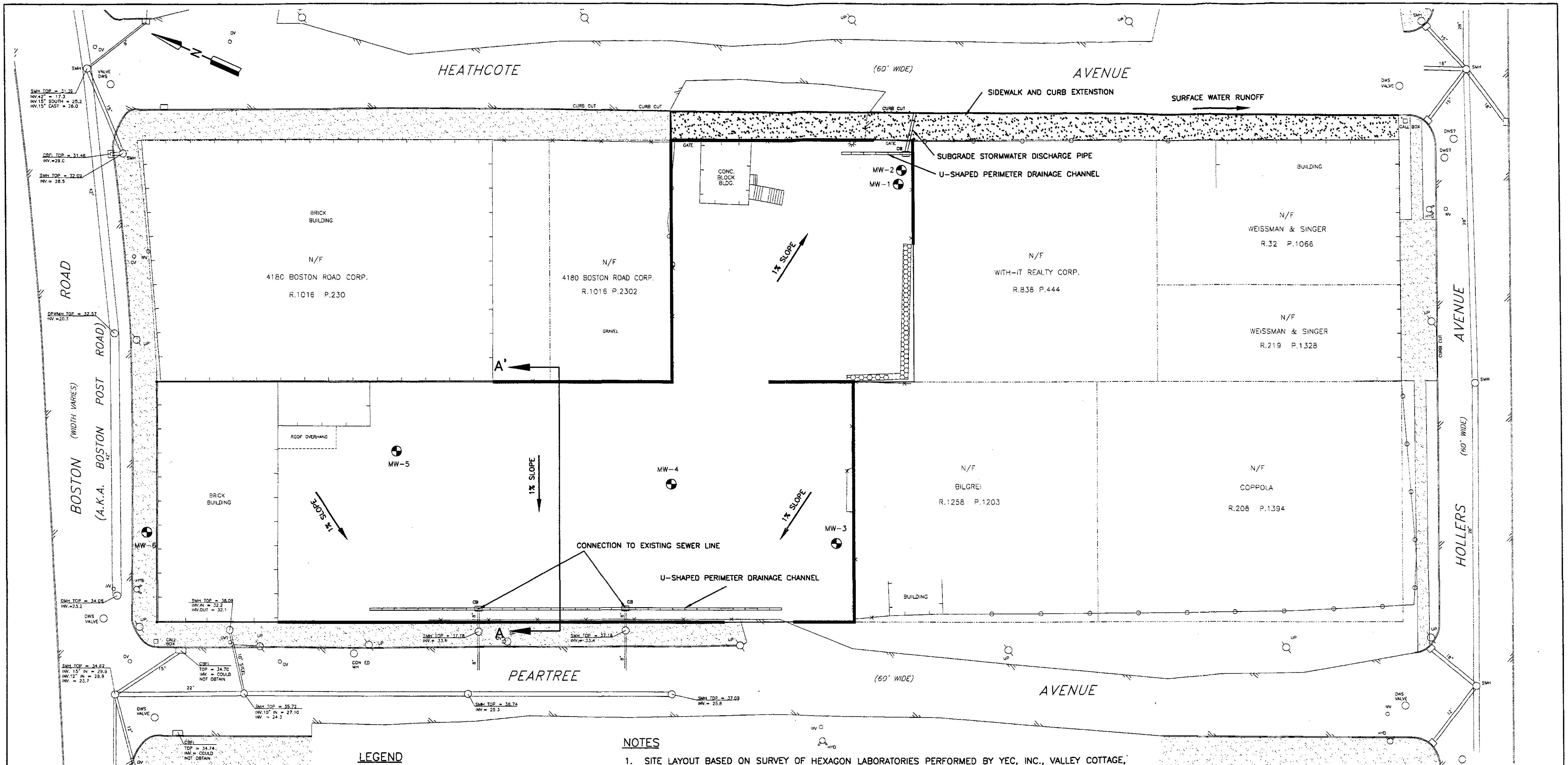
HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVE 3
POTENTIAL PUG MILL LOCATION AND PROPOSED LAYOUT OF TEMPORARY SHORING

DATE : MAY 1999
SCALE : AS SHOWN
DRAWING NO. : 4-8

U:\PROJECT.33\5851HEXL.DEC\FFS\FIGURES Filename: 4-8.DWG Date: 5-21-99 User: PDP



LEGEND

MW	MONITORING WELL		CONCRETE
	BUILDING EDGE		CONCRETE CURB
	HEXAGON PROPERTY LINE		EDGE OF MACADAM
	ADJOINING PROPERTY LINE		MASONRY STONE WALL
HYD	HYDRANT		CONCRETE STEPS
UP	UTILITY POLE		CHAIN LINK FENCE
WV	WATER VALVE		METAL STOCKADE FENCE
GV	GAS VALVE		LIGHT POLE
	CATCH BASIN	N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	MANHOLE		CAP CURBING
	UNDERGROUND PIPE		

NOTES

1. SITE LAYOUT BASED ON SURVEY OF HEXAGON LABORATORIES PERFORMED BY YEC, INC., VALLEY COTTAGE, NEW YORK (JANUARY 1998).
2. CURB CUTS TO BE ADDED TO SIDEWALK EXTENSION AS NECESSARY FOR ACCESS TO PROPERTIES ALONG HEATHCOTE AVENUE.
3. IT IS ASSUMED THAT EXISTING SHALLOW MONITORING WELLS MW-1, MW-3, MW-4, AND MW-5 WILL BE REMOVED DURING SOIL EXCAVATION AND WILL BE REPLACED UPON COMPLETION OF SITE BACKFILL.
4. EXISTING MONITORING WELLS (MW-1 THROUGH MW-6) AND SIX MONITORING WELLS PROPOSED FOR INSTALLATION AS PART OF THE PHASE II REMEDIAL INVESTIGATION (NOT SHOWN) WILL BE SAMPLED ANNUALLY TO MONITOR EFFECTIVENESS OF SOLIDIFICATION/STABILIZATION TREATMENT OF THE METAL COCS.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building, 655 Third Avenue, New York, New York

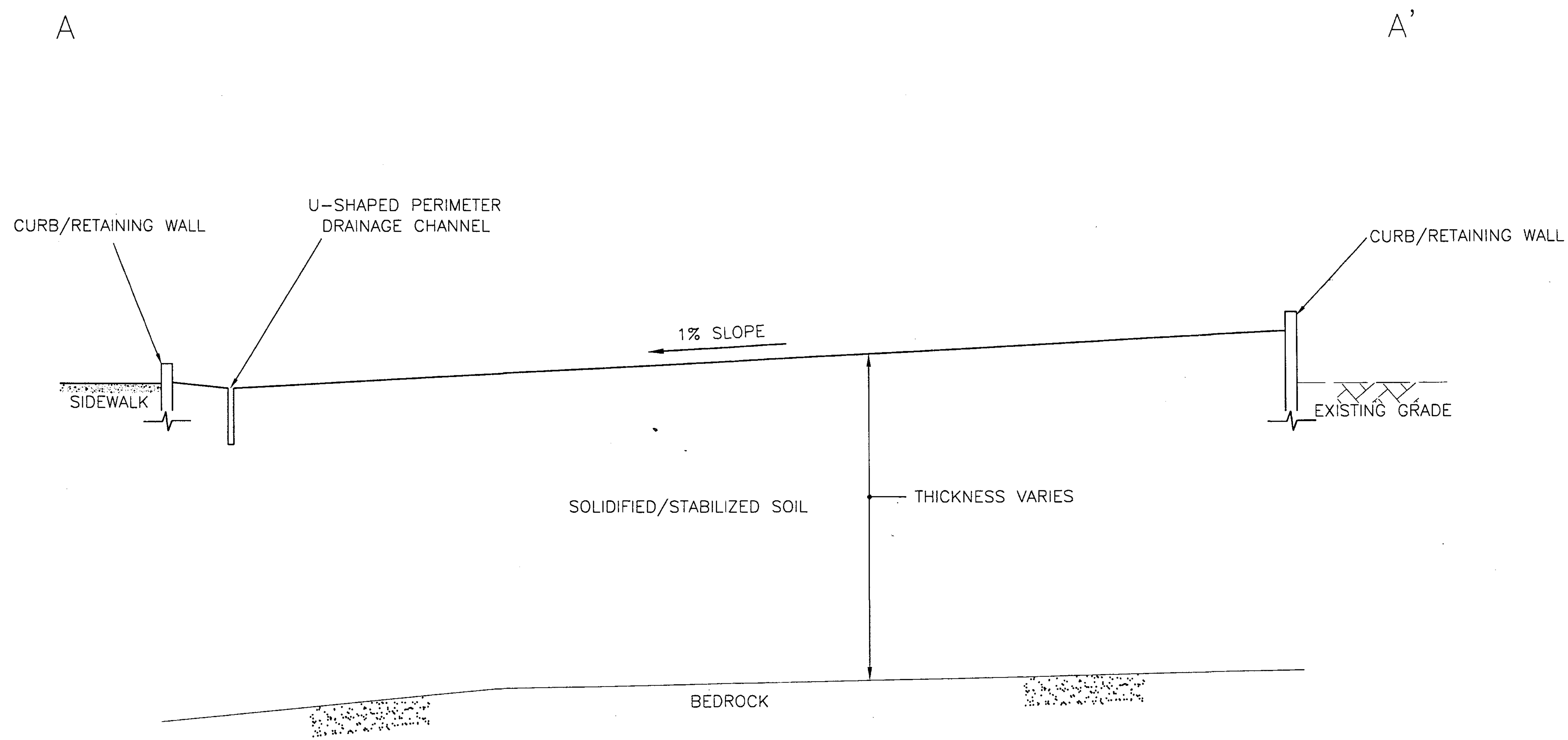
Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, 50 Wolf Road, Albany, New York 12233

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVE 3
PLAN VIEW OF FINAL SITE CONDITIONS

DESIGNED BY:	LT
DRAWN BY:	PDP
CHECKED BY:	MT
SUBMITTED BY:	PDP
DATE:	MAY 1999
SCALE:	AS SHOWN
DRAWING NO.:	4-9



SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: **TAMS CONSULTANTS, Inc.** The TAMS Building, 655 Third Avenue, New York, New York

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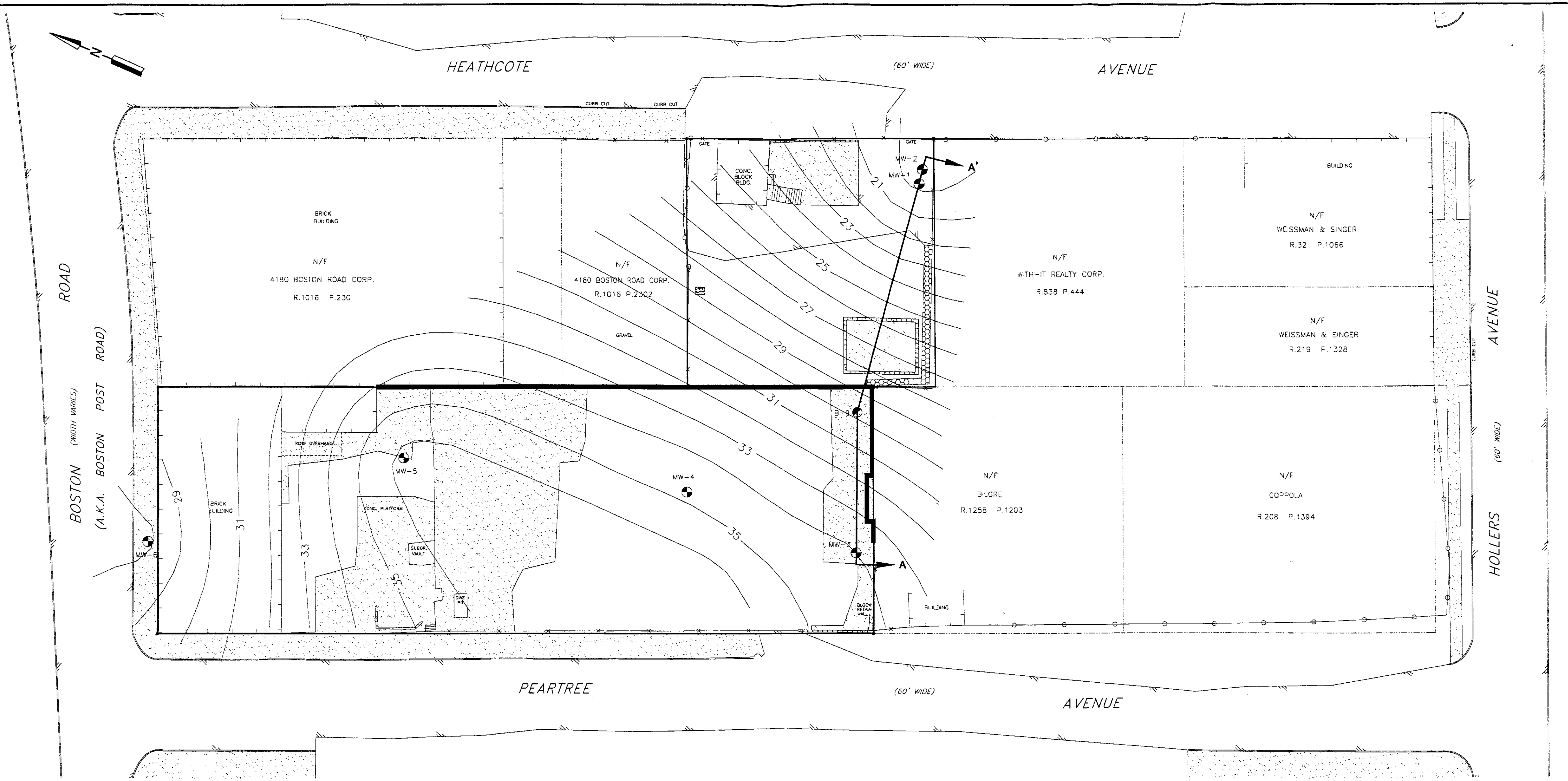
HEXAGON LABORATORIES SITE
New York City
Bronx County, New York

ALTERNATIVE 3
CROSS-SECTION A – A’

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUBMITTED BY:	DATE:	SCALE:	DRAWING NO.:
LT	PDP	MT	PDP	MAY 1999	NOT TO SCALE	4-10



LEGEND

B	SOIL BORING		CONCRETE WALL
MW	MONITORING WELL		CONCRETE STEPS
	BUILDING EDGE		CHAIN LINK FENCE
	HEXAGON PROPERTY LINE		METAL STOCKADE FENCE
	ADJOINING PROPERTY LINE		SLURRY WALL
	CONCRETE	N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	CONCRETE CURB	35	GROUNDWATER ISOPLETH IN FEET, NGVD (TYP.)
	EDGE OF MACADAM		
	MASONRY STONE WALL		

NOTES

1. SITE LAYOUT BASED ON SURVEY OF HEXAGON LABORATORIES PERFORMED BY YEC, INC., VALLEY COTTAGE, NEW YORK (JANUARY 1998)
2. CEMENT-BENTONITE SLURRY WALL WILL BE CONSTRUCTED PRIOR TO EXCAVATION OF SATURATED OVERBURDEN IN THE UPPER SITE.
3. GROUNDWATER CONTOURS BASED ON GROUNDWATER ELEVATIONS MEASURED IN ON-SITE MONITORING WELLS (MW-1 THROUGH MW-6) ON MARCH 5, 1998.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: TAMS CONSULTANTS, Inc.
300 Broadacres Drive, Bloomfield, New Jersey 07003

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233

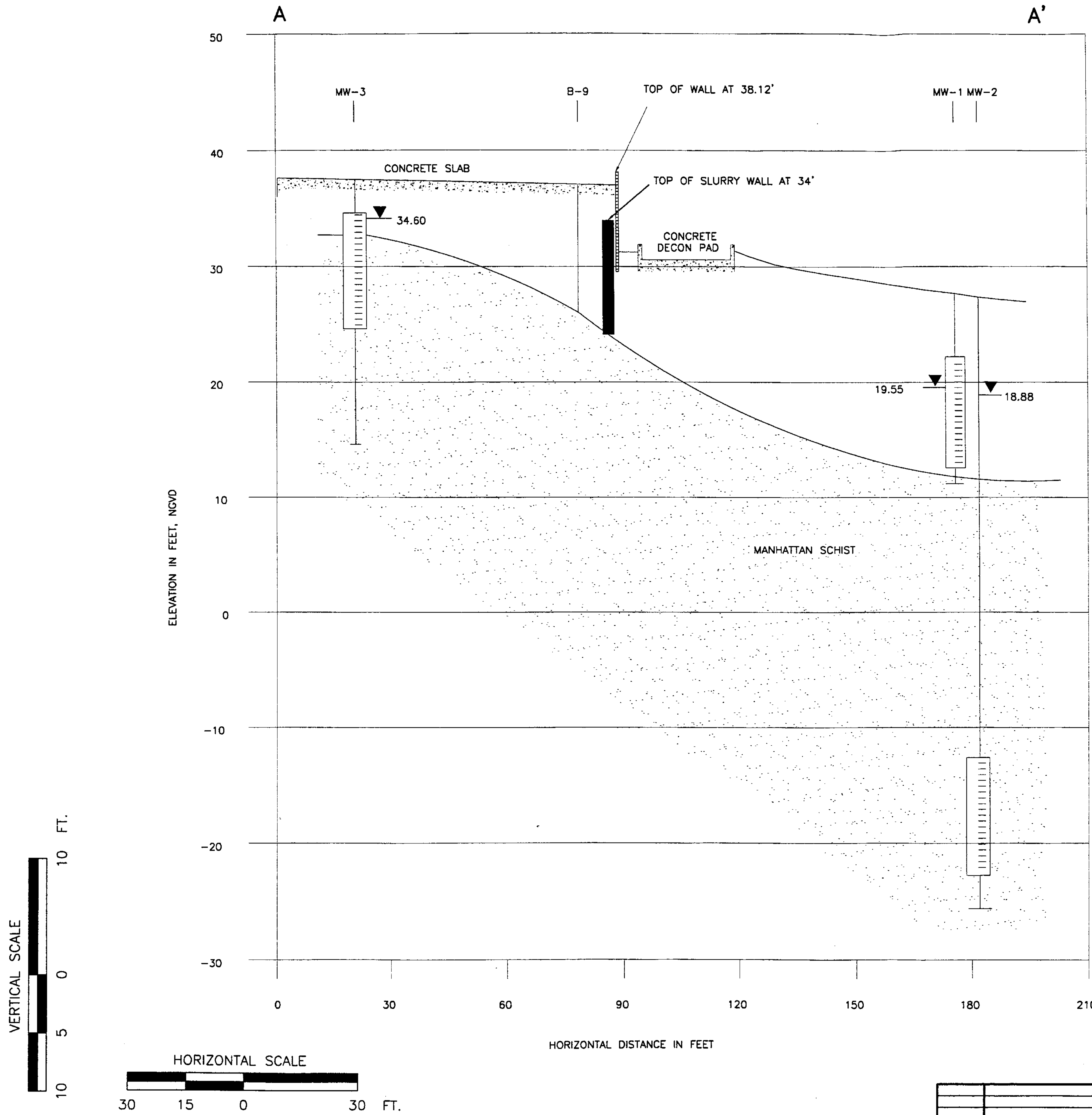
DESIGNED BY: MT
DRAWN BY: PDP
CHECKED BY: MT
SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 4A, 4B, 5A, AND 5B PROPOSED SLURRY WALL LOCATION

DATE: MAY 1999
SCALE: AS SHOWN
DRAWING NO.: 4-11



LEGEND

LEGEND

▼ 18.88 — GROUNDWATER ELEVATION IN FEET, NGVD (TYP.)

MW-1 — MONITORING WELL/BORING DESIGNATION (TYP.)

MONITORING WELL SCREENED INTERVAL

MAXIMUM DEPTH OF BORING

NOTES

1. GROUNDWATER ELEVATIONS MEASURED ON MARCH 5, 1998.
2. CEMENT-BENTONITE SLURRY WALL WILL BE CONSTRUCTED PRIOR TO EXCAVATION OF SATURATED OVERBURDEN IN THE UPPER SITE.

SYMBOL	DESCRIPTIONS	DATE	APPROVED

REVISIONS

Prepared by: TAMS CONSULTANTS, Inc. 300 Broadacres Drive, Bloomfield, New Jersey 07003

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

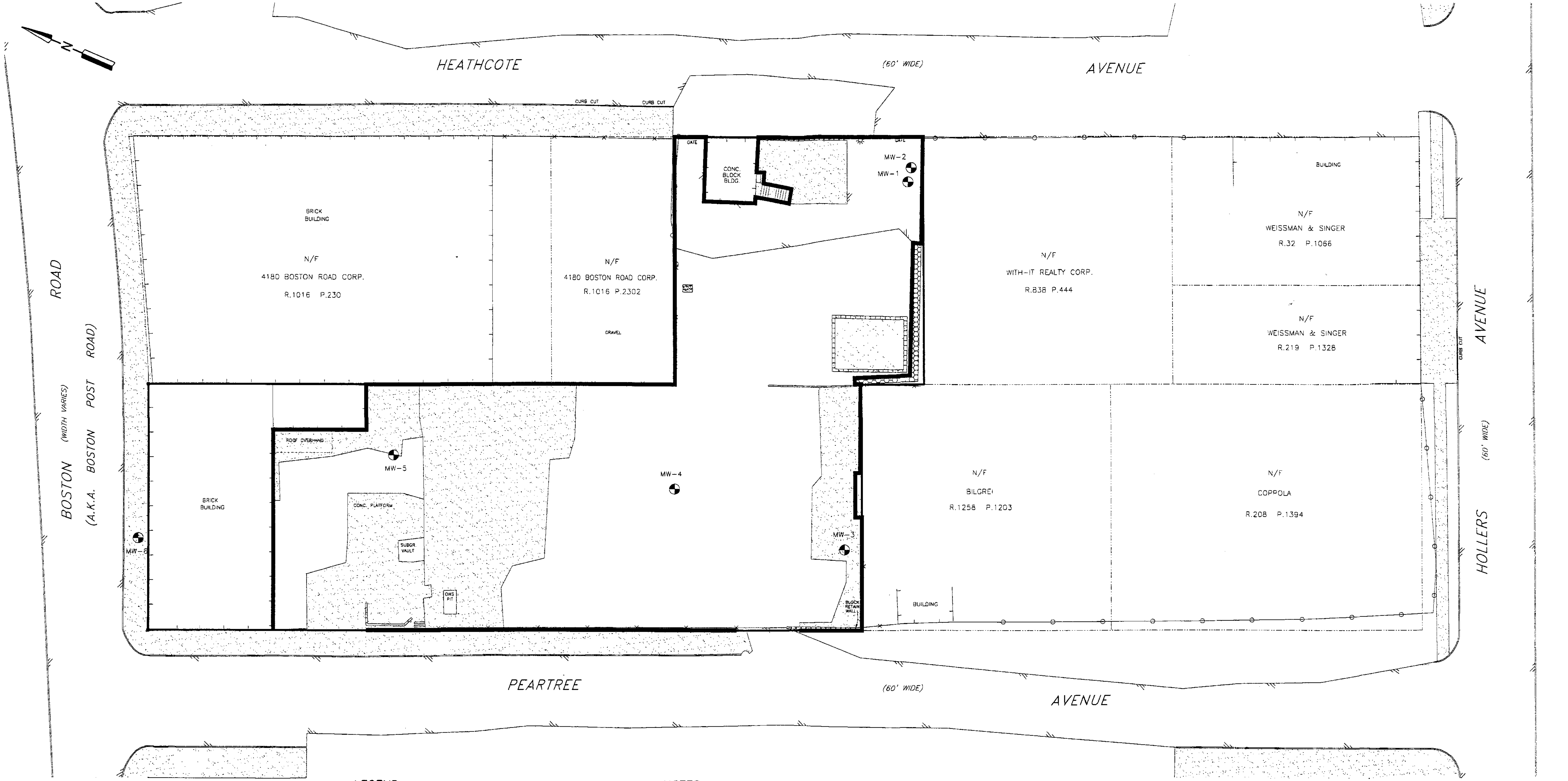
DESIGNED BY: MT
DRAWN BY: PDP
CHECKED BY: MT
SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 4A, 4B, 5A, AND 5B CROSS-SECTION A-A'

DATE: MAY 1999
SCALE: AS SHOWN
DRAWING NO.: 4-12



LEGEND

MW	MONITORING WELL		CONCRETE WALL
	BUILDING EDGE		CONCRETE STEPS
	HEXAGON PROPERTY LINE		CHAIN LINK FENCE
	ADJOINING PROPERTY LINE		METAL STOCKADE FENCE
	CONCRETE		LIGHT POLE
	CONCRETE CURB	N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	EDGE OF MACADAM		TEMPORARY SHORING
	MASONRY STONE WALL		

NOTES

1. TEMPORARY SHORING WILL BE PLACED ALONG THE SIDES OF ALL EXCAVATIONS EXCEEDING FOUR FEET IN DEPTH AND ALONG THE SIDES OF ALL EXISTING BUILDINGS ADJACENT TO EXCAVATIONS, REGARDLESS OF DEPTH.
2. CONCRETE REMOVED DURING THE EXCAVATION ACTIVITIES WILL BE DECONTAMINATED, AS NECESSARY, AND DISPOSED OF OFF SITE.
3. IT IS ASSUMED THAT EXISTING MONITORING WELLS MW-1, MW-3, MW-4, AND MW-5 WILL BE REMOVED DURING SOIL EXCAVATION. REMAINING MONITORING WELLS CAN BE USED FOR MONITORING OF REMAINING CONTAMINATED SATURATED OVERBURDEN AND GROUNDWATER.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by :
TAMS CONSULTANTS, Inc.
The TAMS Building
655 Third Avenue, New York, New York

Prepared for :
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233

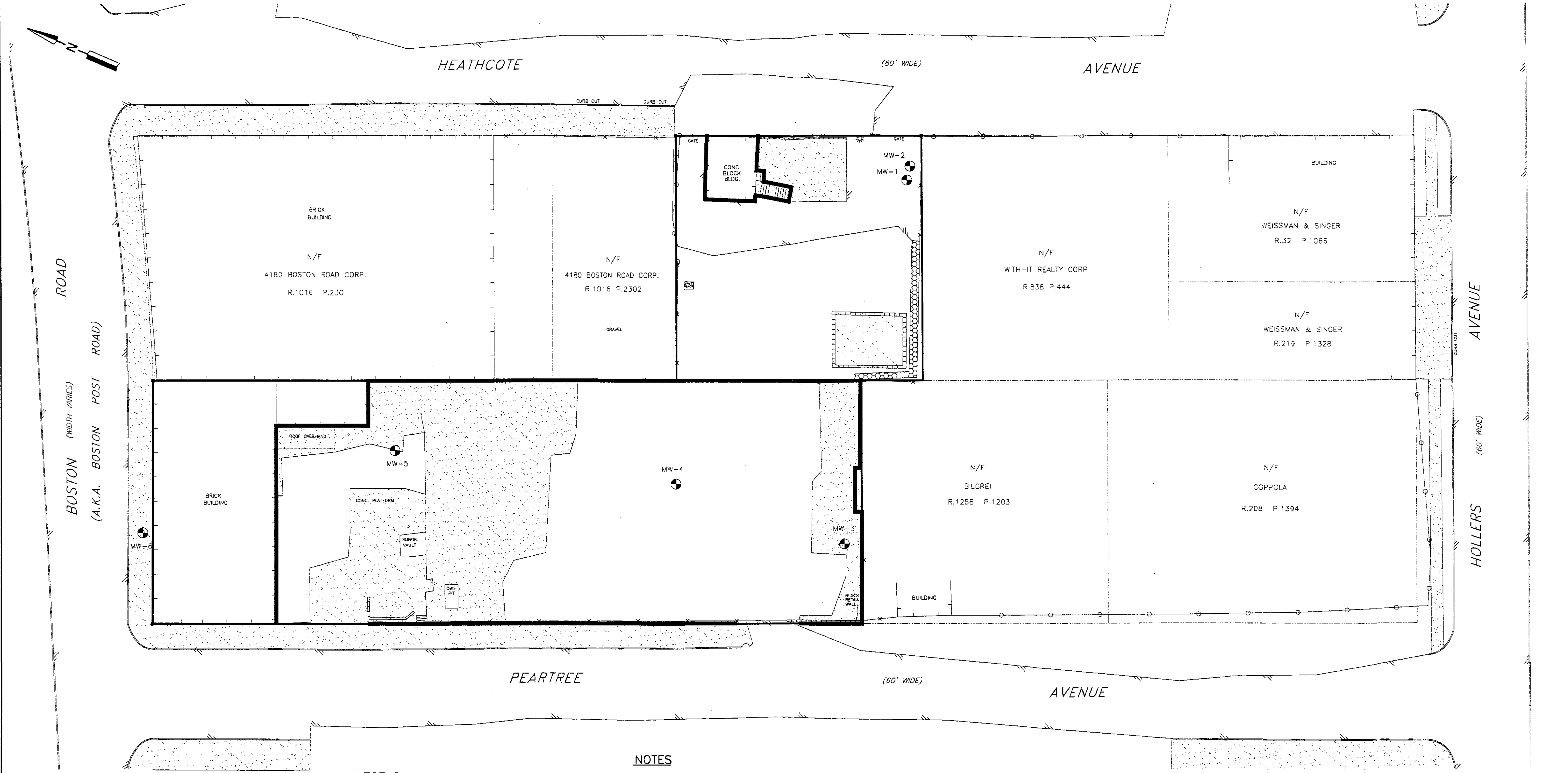
HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 4A AND 4B
PROPOSED LAYOUT OF TEMPORARY SHORING

DESIGNED BY : LT
DRAWN BY : PDP
CHECKED BY : MT
SUBMITTED BY : PDP
DATE : MAY 1999
SCALE : AS SHOWN
DRAWING NO. : 4-13

U:\PROJECT.33\5851HEXL.DEC\FFS\FIGURES Filename: 4-13.DWG Date: 5-24-99 User: PDP



LEGEND

MW	MONITORING WELL
	BUILDING EDGE
	HEXAGON PROPERTY LINE
	ADJOINING PROPERTY LINE
	CONCRETE
	CONCRETE CURB
	EDGE OF MACADAM
	MASONRY STONE WALL
	CONCRETE WALL
	CONCRETE STEPS
	CHAIN LINK FENCE
	METAL STOCKADE FENCE
	LIGHT POLE
N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	TEMPORARY SHORING

NOTES

1. TEMPORARY SHORING WILL BE PLACED ALONG THE SIDES OF ALL EXCAVATIONS EXCEEDING FOUR FEET IN DEPTH AND ALONG THE SIDES OF ALL EXISTING BUILDINGS ADJACENT TO EXCAVATIONS, REGARDLESS OF DEPTH.
2. CONCRETE REMOVED DURING THE EXCAVATION ACTIVITIES WILL BE DECONTAMINATED, AS NECESSARY, AND DISPOSED OF OFF-SITE.
3. IT IS ASSUMED THAT EXISTING MONITORING WELLS MW-3, MW-4, AND MW-5 WILL BE REMOVED DURING SOIL EXCAVATION. REMAINING MONITORING WELLS WILL BE PROTECTED AS NECESSARY TO PREVENT DAMAGE DURING EXCAVATION AND BACKFILL ACTIVITIES.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by : TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for : NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY : LT

DRAWN BY : PDP

CHECKED BY : MT

SUBMITTED BY : PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

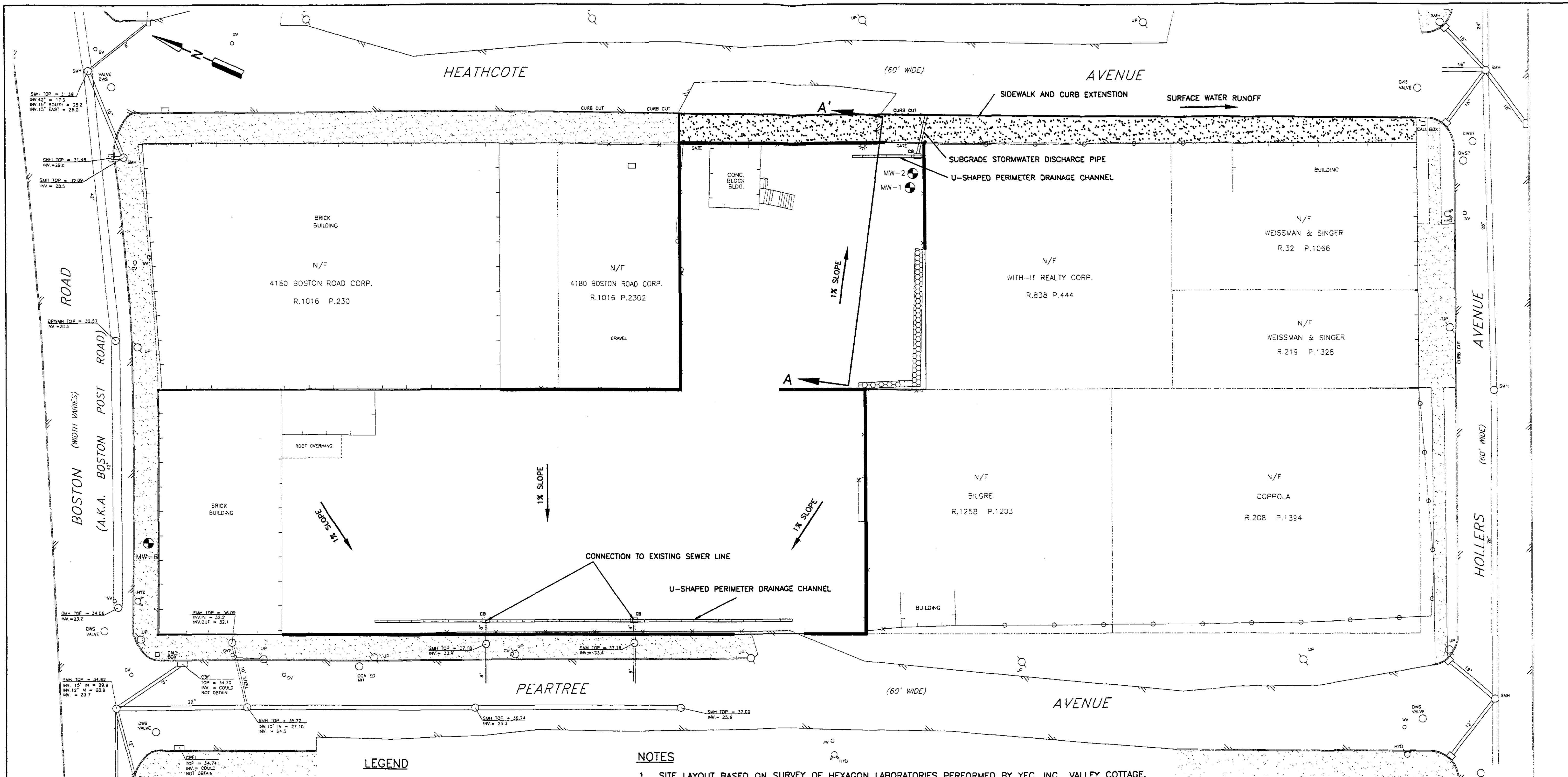
ALTERNATIVES 5A AND 5B
PROPOSED LAYOUT OF TEMPORARY SHORING

DATE : MAY 1999

SCALE : AS SHOWN

DRAWING NO. : 4-14

U:\PROJECT.33\5851HEXL.DEC\FFS\FIGURES Filename: 4-14.DWG Date: 5-24-99 User: PDP



LEGEND

MW	MONITORING WELL		CONCRETE
	BUILDING EDGE		CONCRETE CURB
	HEXAGON PROPERTY LINE		EDGE OF MACADAM
	ADJOINING PROPERTY LINE		MASONRY STONE WALL
HYD	HYDRANT		CONCRETE STEPS
UP	UTILITY POLE		CHAIN LINK FENCE
WV	WATER VALVE		METAL STOCKADE FENCE
GV	GAS VALVE		LIGHT POLE
	CATCH BASIN	N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	MANHOLE		CAP CURBING
	UNDERGROUND PIPE		

NOTES

1. SITE LAYOUT BASED ON SURVEY OF HEXAGON LABORATORIES PERFORMED BY YEC, INC., VALLEY COTTAGE, NEW YORK (JANUARY 1998).
2. CURB CUTS TO BE ADDED TO SIDEWALK EXTENSION AS NECESSARY FOR ACCESS TO PROPERTIES ALONG HEATHCOTE AVENUE.
3. REMAINING EXISTING MONITORING WELLS (MW-1, MW-2, AND MW-6) AND THREE OF SIX MONITORING WELLS PROPOSED FOR INSTALLATION AS PART OF THE PHASE II REMEDIAL INVESTIGATION (NOT SHOWN) WILL BE SAMPLED ANNUALLY TO MONITOR LONG-TERM EFFECTIVENESS OF SOIL REMOVAL AND CAP PLACEMENT IN REDUCING CONTAMINANT CONCENTRATIONS.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by :
TAMS CONSULTANTS, Inc.
The TAMS Building
655 Third Avenue, New York, New York

Prepared for :
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233

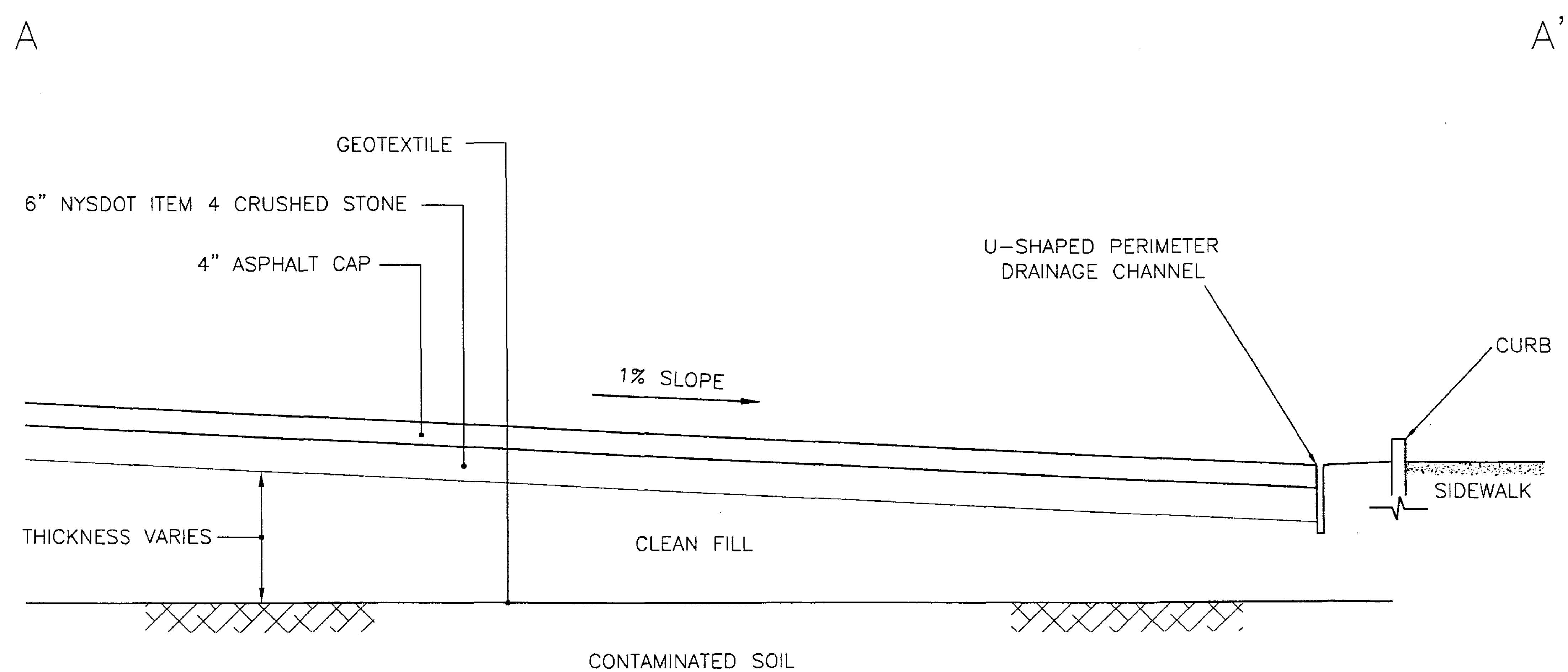
DESIGNED BY : LT
DRAWN BY : PDP
CHECKED BY : MT
SUBMITTED BY : PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 5A AND 5B PLAN VIEW OF FINAL SITE CONDITIONS

DATE : MAY 1999
SCALE : AS SHOWN
DRAWING NO. : 4-15



SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: **TAMS CONSULTANTS, Inc.** The TAMS Building, 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, 50 Wolf Road, Albany, New York 12233

HEXAGON LABORATORIES SITE
New York City
Bronx County, New York

ALTERNATIVES 5A AND 5B
CROSS-SECTION A - A'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUBMITTED BY:	DATE:	SCALE:	DRAWING NO.:
LT	PDP	MT	PDP	MAY 1999	NOT TO SCALE	4-16

Appendix

APPENDIX A

COST ESTIMATE AND BACKUP

ALTERNATIVE 1
NO ACTION

TABLE A-1
COST ESTIMATE
ALTERNATIVE 1: NO ACTION

ITEM	QUANTITY	UNIT COST	UNIT	COST
CAPITAL COSTS				
Direct Capital Costs				
None	0	$0		$0
Total Direct Costs				$0
Indirect Capital Costs				
1. Engineering and Permitting				$0
2. Contingency (15% of Total Direct Costs)				$0
Total Indirect Costs				$0
TOTAL CAPITAL COSTS				$0
ANNUAL O&M COSTS				
1. Annual Groundwater Sampling	1	$22,200	LS	$22,200
TOTAL ANNUAL O&M COSTS				$22,200
PRESENT WORTH OF COSTS				
1. Annual O&M Costs (30 year duration, 5% discount rate)				$341,258
2. Total Capital Costs				$0
TOTAL PRESENT WORTH				**$341,258**

Assume: $341,000

Alternative 1 - No Action

Prepared By: PDP
Checked By: LT

Long-Term Monitoring

Assumed that groundwater will be sampled annually from the 6 on-site and 6 off-site monitoring wells to monitor contaminant concentrations.
Assume that a brief sampling report (data tabulation only) will be generated for each sampling event; no 5-year review report will be generated.
Assume no validation of sample data.

1. Analytical Costs

Number of Environmental Samples:	12
Number of QA/QC Samples:	
Trip Blank	3 (analyzed for VOCs only)
Field Blank	1
MS/MSD	2
Duplicate	1
Total:	19

Samples will be analyzed for:	VOCs	$ 125
	SVOCs	$ 250
	PCBs	$ 150
	TAL ICP Metals	$ 135
	Total:	$ 660 per sample

Analytical Cost = 16 samples x $660 /sample + 3 trip blank x $125 /sample
= $10,935 per sampling event

Assume: $10,900 per sampling event

2. Sampling Cost

Assume sampling will be performed by two technicians @ $25/hour.
Assume sampling will be conducted over a period of three 8-hour days.
Assume labor multiplier of 3.
Assume van rental of $80 per day.
Assume per diem of $120 per person per day.
Assume H&S PPE @ $18 per person per half day.
Assume rental of H&S monitoring equipment and field measurement equipment @ $800.
Assume use of disposable bailers @ $20/bailer.
Assume consumable supplies @ $250.
Assume sample shipment of $500.

Total: $ 6,566

Assume: $ 6,600 per sampling event

Alternative 1 - No Action

Prepared By: PDP
Checked By: LT

3. Laboratory Procurement & Sampling Report Preparation

Assume one person @ $30 per hour for 3 days for Sampling Report Preparation.
Assume one person @ $35 per hour for 3 days for laboratory procurement.
Assume labor multiplier of 3.

Total: $ 4,680

Assume: $ 4,700 per sampling event

Total for Long Term Monitoring: $ 22,200 per sampling event

ALTERNATIVE 2A
ASPHALT CAP

TABLE A-2A
COST ESTIMATE
ALTERNATIVE 2A: ASPHALT CAP

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	CAPITAL COSTS				
	Direct Capital Costs				
A.	Mobilization /Temporary Facilities/ Demobilization				
	1. Mobilization/Demobilization	1	$55,200	LS	$55,200
	2. Temporary facilities	1	$46,500	LS	$46,500
	3. Site security	3.5	$10,700	Month	$37,500
B.	Health and Safety				
	1. Health & safety measures	2.5	$18,500	Month	$46,300
	2. Decon water sampling and disposal	1	$9,200	LS	$9,200
	3. Decon pad	1	$10,200	LS	$10,200
C.	Construction Management	5.5	$30,000	Month	$165,000
D.	Construction and Remediation				
	1. Removal of Concrete Structures				
	a. Demolition of concrete slabs and walls	110	$136.43	CY	$15,000
	b. Off-site concrete recycling	165	$18	CY	$3,000
	2. Asphalt Cap				
	a. Geotextile	3,633	$2.38	SY	$8,700
	b. NYSDOT Item 4 crushed stone	900	$31.88	CY	$28,700
	c. Bituminous binder course	3,633	$4.69	SY	$17,000
	d. Geogrid reinforcement	3,633	$2.38	SY	$8,700
	e. Bituminous wear course	3,633	$5.52	SY	$20,100
	3. Surface Water Runoff Control				
	a. Catchbasins	3	$1,600	EA	$4,800
	b. Perimeter drain	200	$50	LF	$10,000
	c. Curb/retaining wall	1,625	$22	SF	$35,800
	d. Sidewalk and curb extension	1	$15,800	LS	$15,800
	Total Direct Costs				$537,500
	Indirect Capital Costs				
	1. Engineering and Permitting				$150,000
	2. Contingency (15% of Total Direct Costs)				$80,625
	Total Indirect Costs				$230,625
	TOTAL CAPITAL COSTS				$768,125
	ANNUAL O&M COSTS				
	1. Cap Maintenance & Repair	1	$1,400	LS	$1,400
	2. Annual Groundwater Sampling	1	$22,200	LS	$22,200
	TOTAL ANNUAL O&M COSTS				$23,600
	PRESENT WORTH OF COSTS				
	1 Annual O&M Costs (30 year duration, 5% discount rate)				$362,779
	2 Total Capital Costs				$768,125
	TOTAL PRESENT WORTH				**$1,130,904**

Assume: $1,131,000

Alternative 2A - Asphalt Cap

Prepared By: PDP
Checked By: LT

Project Duration

Assume:	Mobilization/demobilization	4 weeks
	Site preparation (concrete demolition: trenching for retaining wall/curb; excavation for catch basin placement)	2 weeks
	Asphalt cap placement	3 weeks
	Surface water runoff control	5 weeks
	Total:	**14 weeks**
	Assume:	**3.5 months**

Time for workplan preparation and for obtaining any approvals/permits is not included.

Prepared By: PDP
Checked By: LT

Engineering & Permitting

It is assumed that NYSDEC will hire an Engineering Consultant to prepare plans and specifications for the remediation.

It is assumed that work includes the preparation of:

- Plans and specifications for competitive bidding;
- Discussion with state and local agencies regarding permit requirements;
- Submission of 30% design submittal for review;
- Submission of 90% design submittal for review;
- Preparation of a design report;
- Preparation of an engineering cost estimate; and
- Provision of pre-award services.

Based on TAMS' experience, this work can cost between $150,000 to $250,000, depending on the complexity of the remediation.

- $250,000 for high complexity
- $200,000 for medium complexity
- $150,000 for low complexity

For Alternative 2A, work is considered to be low complexity.

Assume Engineering & Permitting cost of: **$150,000**

Prepared By: PDP
Checked By: LT

Construction Management

It is assumed that NYSDEC will hire an engineering consultant to perform construction period services during the remediation.

It is assumed that work includes the preparation of:

- Attendance at pre-construction meetings;
- Review of contractor submittals;
- Full time project inspection;
- Maintenance of construction records and reports;
- Quality assurance;
- Change order preparation;
- Processing of contractor application for payment; and
- Preparation of Final Remediation Report.

It is assumed that construction management services will begin one month prior to the start of construction activities.

It is assumed that construction management services will continue for one month after the end of on-site activities.

Based on TAMS' experience, the cost of construction management is approximately $30,000 per month.

Assume a monthly Construction Management cost of: **$30,000**

Alternative 2A - Asphalt Cap

Prepared By: PDP
Checked By: LT

Mobilization & Demobilization (Includes Contractor Preparation of Project Plans)

1. Materials & Equipment

Assume 15 pieces of equipment at $500 per piece for mobilization:	$	7.500
Assume 15 pieces of equipment at $500 per piece for demobilization:	$	7.500
Assume $10.000 for mob/demob of materials:	$	10.000
Subtotal:	**$**	**25,000**

2. Contractor Preparation of Project Plans

Includes Work Plans. Health & Safety Plans. QA/QC Plans. and Erosion Control Plan

Assume labor requirement of 2 persons @ $30 per hour per person for 1 month.
Assume multiplier of 3

= 2 persons x $30 /hour x 40 hours/week x 4.2 weeks/month x 1 month x 3 multiplier

= $30.240

Assume: **$30,200**

Total Mobilization/Demobilization Cost: **$55,200**

Alternative 2A - Asphalt Cap

Prepared By: PDP
Checked By: LT

Temporary Facilities

1. **Temporary Facilities - One Time Cost**
   Assume 2 trailers @ $1,300 per trailer.
   Assume office trailer equipment @ $5,000 per trailer.

- Computer	$	2,500
- Printer	$	500
- Modem	$	200
- Fax Machine	$	500
- Copier	$	500
- Phone	$	100
- Answering Machine	$	100
- Desk & Chair (2)	$	300
- Conference Table	$	100
- Chairs (4)	$	100
- File Cabinet	$	100
	$	5,000

   Assume electrical hookup @ $2,500 per trailer.
   Assume phone hookup @ $200 per trailer.
   Assume project sign @ $500.
   Assume temporary site controls (e.g. barricades, traffic control, erosion control) @ $5,500.
   Assume decon facility mob/demob @ $1,000.
   Assume water tank(s) mob/demob @ $1000.
   Assume misc. equipment/supplies @ $3,000.

   Total Temp. Facilities One Time Cost: $ 29,000

2. **Monthly Costs**
   Assume trailer rental @ $500 per trailer.
   Assume sanitary facility & water @ $500.
   Assume janitorial service @ $500.
   Assume trailer electrical service @ $200 per trailer.
   Assume miscellaneous electrical requirements @ $200.
   Assume phone service @ $200 per trailer.
   Assume miscellaneous costs @ $2000.

   Subtotal: $ 5,000 per month

   Duration: 3.5 months

   Total Monthly Costs: $ 17,500

Total Temporary Facilities Cost: $ 46,500

Assume: $ 46,500

Alternative 2A - Asphalt Cap

Prepared By: PDP
Checked By: LT

Site Security

Assume on-site security will be provided from 5 PM to 7AM during construction activities.
Assume on-site security will be provided 24 hours per day for weekends during construction activities.
Assume 2 unarmed security guards @ $11 per hour per guard.

Monthly Security Cost:	=	2 guards x	14 hours per day x	21 weekdays per month x	$11 per hour +
		2 guards x	24 hours per day x	8 weekend days per month x	$11 per hour

= $10,692

Assume monthly security cost of: $10,700

Prepared By: PDP
Checked By: LT

Health & Safety

Assume monitoring equipment @ $3.000 per month.
Assume 2 sets of PPE per day per person @ $18 per unit (PPE costs associated with sampling included separately in sampling cost estimate).
Assume 10 workers within exclusion zone at one time.
Assume on-site Safety Coordinator @ $5.000 per month.
Assume decon facility (shower, etc.) @ $2.900 per month (Means Environmental. 1999; Item No. 33 17 0821; includes 1.23 Location Factor)

Total: $ 18.460 per month

Assume: $ 18,500 per month (during construction activities excluding mob/demob)

Prepared By: PDP
Checked By: LT

Decontamination Pad

Assume temporary decontamination pad constructed of sand (base course), geomembrane liner sloped towards sump pit, and plywood surface) @ $3,000 including sump pump.
Assume pressure washer @ $3,500 (purchase: Means Environmental, 1999; Item No. 33 17 0815; Location factor of 1.23).
Assume one 6,900 gallon poly tank @ $600 per month and one 2,450 gallon poly tank @ $450 per month (Rain for Rent, 5/99).
Assume project duration of 3.5 months.

Total = **10,175**

Assume: **$ 10,200**

Alternative 2A - Asphalt Cap

Prepared By: PDP
Checked By: LT

Estimate of Volume of Decontamination Water

1. **Personnel Decon**
   Assume 10 workers, two showers per day, and five gallons per shower.

Total Volume =	100 gallons per day x	21 days per month	
=	2,100 gallons per month x	2.5 months	
=	5,250 gallons		

2. **Equipment Decon**
   Assume 10 pieces of equipment, one wash per two weeks, 20 gallons per wash per piece of equipment.

Total Volume =	400 gallons per month x	2.5 months
=	1,000 gallons	

3. **Concrete Decon (prior to disposal)**
   Assume 10 cy (200 sf) of concrete removed for retaining wall/curb installation.
   Assume 100 cy (2,500 sf) of concrete removed as part of site preparation.
   Assume 25 sf per minute @ 6 gallons per minute.
   Assume surface area of concrete to be washed is 5,400 sf (includes both sides of concrete slabs).

Total Volume =	5400 sf /	25 sf/minutes x	6 gallons/minute
=	1,296 gallons		

Total Volume of Decon Water = 7,546 gallons

Assume: 7,500 gallons

Alternative 2A - Asphalt Cap

Prepared By: PDP
Checked By: LT

Collection & Disposal of Decontamination Water

1. Equipment and Concrete Decon Labor

Assume 2 laborers @ $25 per hour for pressure washing.
Assume total area of concrete = 5,400 sf.
Assume decon rate of 25 sf per minute.
Assume one 8-hour day total for decon of equipment over course of construction activities (10 minutes per piece of equipment: 10 pieces of equipment per two weeks: 10.5 weeks of construction activities).
Assume multiplier of 2.

Time for decon = 12 hours

Labor cost = 12 hours x $ 25 / hour x 2 laborers x 2 multiplier

= $ 1,200
Assume: $ 1,200

2. Analytical Costs for Disposal

Assume 4 water samples for disposal @ $1,050 per sample (includes 25% increase for 1 week turnaround).

Analytical:	VOCs	$	125	
	SVOCs	$	250	
	Pest/PCBs	$	150	
	TAL ICP Metals	$	135	
	TDS	$	10	
	TSS	$	10	
	TOC	$	35	
	Dissolved Metals	$	120	
		$	835	plus 25% markup for 1 week turnaround time

Analytical Cost = $ 4,200

3. Transport and Treatment/Disposal Cost

Assume hazardous water transport and disposal @ $0.78 per gallon.
Assume non-hazardous water transport and disposal @ $0.50 per gallon.
Assume decon water is non-hazardous.

Total Volume of Decon Water = 7,500 gallons

Transport and Disposal Cost = $ 3,750

Total Collection, Analysis, Transport, and Disposal = $ 9,150

Assume $ 9,200

Alternative 2A - Asphalt Cap

Prepared By: PDP
Checked By: LT

1. Volume and Area of Concrete to be Removed/Disposed (see Figure A-2.1)

Assume 10 cy (200 sf) of concrete removed for retaining wall/curb installation).
Assume 100 cy (2,500 sf) of concrete removed as part of site preparation.
Assume 50 percent expansion factor for disposal.

Total volume of concrete to be removed:	**110 cy**
Total volume of concrete to be disposed:	**165 cy (including 50% expansion factor)**

2. Concrete Demolition

Assume demolition of reinforced concrete (7 to 24 inches thick) @ $107/cy
(Means 1998: Item No. 020 554 2200).
Assume location factor of 1.275.

= 110 cy x $ 107 /cy x 1.275 location factor
= $ 15,007

Assume: **$ 15,000**

Assume productivity rate for concrete demolition is 24 cy per day. Total of 5 days required for concrete removal.

3. Transport and Disposal of Concrete

Assume transport and disposal cost of concrete with rebar @ $18 /cy (quote from Liotta & Sons, Inc.; 10/98).

= 165 cy x $ 18 /cy
= $ 2,970

Assume: **$ 3,000**

Alternative 2A - Asphalt Cap

Prepared By: PDP
Checked By: LT

Asphalt Cap

Assume total area for asphalt cap of 32,700 sf.
Cap shall consist of 4 inches (minimum) of compacted NYSDOT Item No. 4 crushed stone, 2 inches of binder course, and 2 inches of wearing course.
Assume average thickness of crushed stone layer is 9 inches as necessary for 1% slope.
Geogrid reinforcement shall be placed between the bituminous binder and wearing courses.
Geotextile shall be placed between the existing grade and the cap materials to delineate between contaminated and non-contaminated materials.
Assume crushed stone @ $25/cy (Means 1998, Item No. 022 308 1521).
Assume 2-inch binder course @ $3.68/sy (Means 1998, Item No. 025 104 0120).
Assume 2-inch wearing course @ $4.33/sy (Means 1998, Item No. 025 104 0380).
Assume geogrid @ $1.87/sy (based on Means cost for geotextile: Means 1998, Item No. 022 412 1510).
Assume location factor of 1.275.

1. Geotextile Placement

Placement Cost =		32,700	sf /	9 sf/sy x	$1.87	/sy x	1.275	location factor
=	$	8,663						
Assume:	**$**	**8,700**						

Productivity rate of 2400 sy per day. Assume 2 days for placement.

2. Crushed Stone Placement

Volume of stone =		32,700	sf x	0.75 ft		
=		24525	cf			
=		900	cy			
Placement Cost =		900	cy x	$25 /cy x	1.275	location factor
=	$	28,688				
Assume:	**$**	**28,700**				

Productivity rate of 750 cy per day. Assume 2 days for placement.

3. Binder Course Placement

Placement Cost =		32,700	sf /	9 sf/sy x	$3.68	/sy x	1.275	location factor
=	$	17,048						
Assume:	**$**	**17,000**						

Productivity rate of 6345 sy per day. Assume 1 day for placement.

4. Geogrid Placement

Placement Cost =		32,700	sf /	9 sf/sy x	$1.87	/sy x	1.275	location factor
=	$	8,663						
Assume:	**$**	**8,700**						

Productivity rate of 2400 sy per day. Assume 2 days for placement.

5. Wearing Course Placement

Placement Cost =	32,700	sf /	9 sf/sy x	$4.33	/sy x	1.275 location factor
= $	20,059					
Assume: $	**20,100**					

Productivity rate of 6345 sy per day. Assume 1 day for placement.

Total for Asphalt Cap Placement: $ 83,200

Total Time for Asphalt Cap Placement is 2 weeks.
Assume 3 weeks (to account for contingencies)

Alternative 2A - Asphalt Cap

Prepared By: PDP
Checked By: LT

Surface Water Runoff Control

1. Catchbasin Installation

Assume excavation @ $12.35/cy (Means, 1998; Item No. 022 250 2035).
Assume backfill of catchbasins by hand with compaction @ $36.10 per cy (Means, 1998; Items No. 022 204 0100 and 022 204 0300).
Assume precast catchbasin (4 ft x 4 ft x 6 ft) @ $910 each (Means, 1998; Item No. 027 152 1120).
Assume 6 cy excavated per catchbasin and 2.75 cy used to backfill around each catchbasin.
Assume frame & cover (18-inch diameter, light traffic, 100 lbs) @ $202 each set (Means, 1998; Item No. 027 152 1800).
Assume location factor of 1.275.
Assume 2 days for placement of catchbasins.

Cost per catchbasin:	$	1,639	
Assume:	**$**	**1,600**	**per catchbasin**

2. U-Shaped Perimeter Drain Installation

Assume no additional excavation necessary for drain installation.
Assume cost for backfill of drain is included in cap placement estimate.
Assume cost materials & installation of U-shaped (19 inch channel depth) perimeter drain @ $50/lf (ABT, Inc., 10/98).
Assume 1.5 weeks for placement of perimeter drain system.

Total length of perimeter drain is: 200 lf

Cost for placement: $ 10,000

3. Curb/Retaining Wall Installation

Assume length of curb/retaining wall is 650 feet.
Assume average height of 2.5 feet.
Assume placement of Versa-Lok (or equivalent) masonry retaining wall @ $22/sf - installed cost (materials, labor, equipment) including trenching approximately 6-inches bgs and placement of 6 inches of gravel base material (Versa-Lok, 12/98).
Assume soil excavated during installation of wall trench for base material will be spread on site.
Assume production rate of 250 sf/day.
Assume 8 days for installation.

Cost for curb placement:	$	35,750
Assume:	**$**	**35,800**

4. Extension of Sidewalk and Curb

Assume 12 ft by 300 ft sidewalk extension from southeastern edge of East Yard to corner of Hollers Avenue.
Assume concrete sidewalk (3,000 psi concrete, 4 inches thick) @ $2.55/sf (Means, 1998; 025 128 0310).
Assume 4-inch bank run gravel base @ $0.44/sf (Means, 1998; 025 128 0450).
Assume placement of concrete curbing @ $5.40/lf (includes steel forms; Means, 1998; Item No. 025 254 0300).
Assume location factor of 1.275.
Assume production rate of 2500 sf per day for base material and 600 sf per day for concrete.
Assume production rate of 700 lf/day for placement of curb.

Cost for curb placement:	$	15,790
Assume:	**$**	**15,800**

Assume time for installation of surface water runoff controls of 5 weeks.

Alternative 2A - Asphalt Cap

Prepared By: PDP
Checked By: LT

Long-Term Monitoring

Assumed that groundwater will be sampled annually from the 6 on-site and 6 off-site monitoring wells to monitor contaminant concentrations.
Assume that a brief sampling report (data tabulation only) will be generated for each sampling event; no 5-year review report will be generated.
Assume no validation of sample data.

1. Analytical Costs

Number of Environmental Samples:	12	
Number of QA/QC Samples:		
Trip Blank	3	(analyzed for VOCs only)
Field Blank	1	
MS/MSD	2	
Duplicate	1	
Total:	19	

Samples will be analyzed for:	VOCs	$ 125	
	SVOCs	$ 250	
	PCBs	$ 150	
	TAL ICP Metals	$ 135	
	Total:	$ 660	per sample

Analytical Cost = 16 samples x $660 /sample + 3 trip blank x $125 /sample
= $10,935 per sampling event

Assume: $10,900 per sampling event

2. Sampling Cost

Assume sampling will be performed by two technicians @ $25/hour.
Assume sampling will be conducted over a period of three 8-hour days.
Assume labor multiplier of 3.
Assume van rental of $80 per day.
Assume per diem of $120 per person per day.
Assume H&S PPE @ $18 per person per half day.
Assume rental of H&S monitoring equipment and field measurement equipment @ $800.
Assume use of disposable bailers @ $20/bailer.
Assume consumable supplies @ $250.
Assume sample shipment of $500.

Total: $ 6,566

Assume: $ 6,600 per sampling event

Prepared By: PDP
Checked By: LT

3. Laboratory Procurement & Sampling Report Preparation

Assume one person @ $30 per hour for 3 days for Sampling Report Preparation.
Assume one person @ $35 per hour for 3 days for laboratory procurement.
Assume labor multiplier of 3.

Total: $ 4,680

Assume: $ 4,700 per sampling event

Total for Long Term Monitoring: $ 22,200 per sampling event

Alternative 2A - Asphalt Cap

Prepared By: PDP
Checked By: LT

Asphalt Cap Maintenance

Assume 2 persons @ $25 per hour for 12 hours per year inspecting for and patching cracks in asphalt surface.
Assume patching materials @ $200 per year.
Assume labor multiplier of 2.

Total: $ 1,400 per year

TAMS

Job No. ______
Project: Hexagon Laboratories FS
Subject: Cost Backup
Asphalt Cap Option

Date: 10-22-98
By: GL
Ch'k. by: KK

Run-off Calculation – PRELIMINARY

Run-off calculations done as per NYCDEP document: Rules and Regulations Governing the Construction of Private Sewers and Drains

Run-off equation: $Q = CRA$

where Q = peak run-off in cfs
C = run-off coefficient = 0.85 for industrial areas (given pg. 9 - Appendix A)
R = rainfall intensity in in/hr
A = area drained in acre

From proposed contours, site broken up into 2 sections, Eastern Section (East Yard) & Western Section (North & South Yards). From scaled drawings:

Parameter	Eastern Section	Western Section
A (Area)	0.23 acre	0.56 acre
Tc (Time of Concentration)	1.0 min	1.2 min
R (Rainfall Intensity)	$R = \frac{125}{Tc+15} = \frac{125}{16}$; $R = 7.81 \frac{in}{hr}$	$R = \frac{125}{Tc+15} = \frac{125}{16.5}$; $R = 7.58 \frac{in}{hr}$
Q (Peak Run-off)	$Q = CRA = (0.85)(7.81)(0.23)$; $Q = 1.53$ cfs $= 685$ gpm	$Q = CRA = (0.85)(7.58)(0.56)$; $Q = 3.61$ cfs $= 1620$ gpm

Preliminary Drain Design

For F.S. estimate use prefabricated U-shaped perimeter drain manufactured by ABT, Inc. (Polydrain). All Polydrain Specifications Used (Polydrain: Pre-Engineered Surface Drainage - Sloped System Manual)

TAMS

Job No.

Project Hexagon Laboratories F.S.

Subject Cost Backup
Asphalt Cap Option

Sheet 5 of 6

Date 10-23-98

By G.L.

Ch'k. by KK

<u>For eastern end:</u>

Peak flow, Q = 685 gpm

From pg 6 of Polydrain manual:

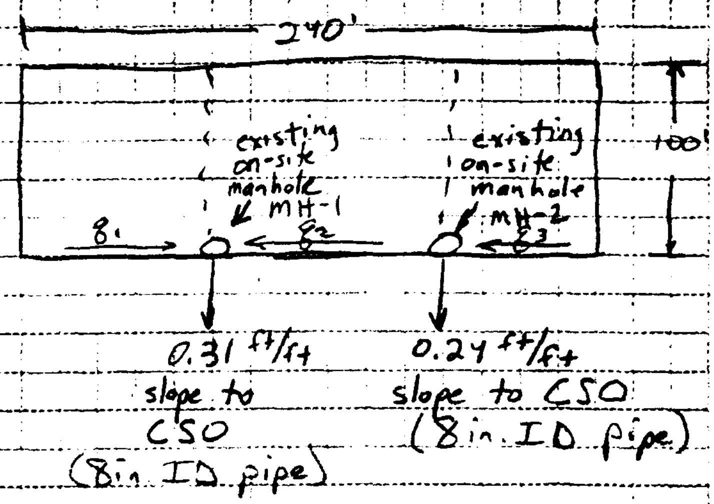
Use "Part No. 290 - Channel w/ Poly Wall I"

max flow = 852 gpm

channel depth = 19 in. U-shape

From drawing, length = 20 LF

<u>For western end:</u>



Total Runoff = 2020 gpm

Assume: $q_1 = q_2 = q_3$

$q_1 + q_2 + q_3 = 1620$ gpm

$\therefore q_1 = q_2 = q_3 = 540$ gpm

$Q_{MH-1} = q_1 + q_2 = 1080$ gpm

$Q_{MH-2} = q_3 = 540$ gpm

Use "Part No. 150 - Channel w/ Poly Wall I" (pg 6 - manual)

max flow = 674 gpm

channel depth = 16 in. U-shape

Total length = 170 LF

Check that existing manholes can handle flow

<u>Assume</u>: Pipe leaving both manholes are 8 in ID at 0.24 ft/ft slope

($S = 0.24$ ft/ft more conservative than $S = 0.31$ ft/ft)

Manning Equation $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

For pipe flowing full:

Area of flow = $A = \pi r^2 = \pi \left(\frac{1}{2}\left(\frac{8}{12}\right)\right)^2 = 0.35\ ft^2$

Wetted Perimeter = $P = \pi D = \pi \left(\frac{8}{12}\right) = 2.1$ ft

Hydraulic Radius = $R = A/P = 0.35/2.1 = 0.17$ ft

$n = 0.015$ for concrete pipe

TAMS

Job No. ______ Sheet 6 of 6
Project: Hexagon Labs FS Date: 10-23-98
Subject: Cost Backup – Asphalt Cap Option By: GL
Ch'k. by: KK

$$Q_{max} = \frac{1.49}{0.015}(0.35)(0.17)^{2/3}(0.24)^{1/2}$$

$$= \frac{1.49(0.35)(0.31)(0.49)}{0.015}$$

$$= 5.3 \text{ cfs} = 1080 \text{ gpm}$$

$Q_{max} > Q_{MH-1} = 1346$ gpm

∴ Perimeter drainage system is adequate.

~~Perimeter Retaining Wall:~~

~~Length of Perimeter Retaining Wall Required = 700 LF~~
~~Average Height of Wall Required = 2.5 feet~~
~~Area = 1,750 ft²~~

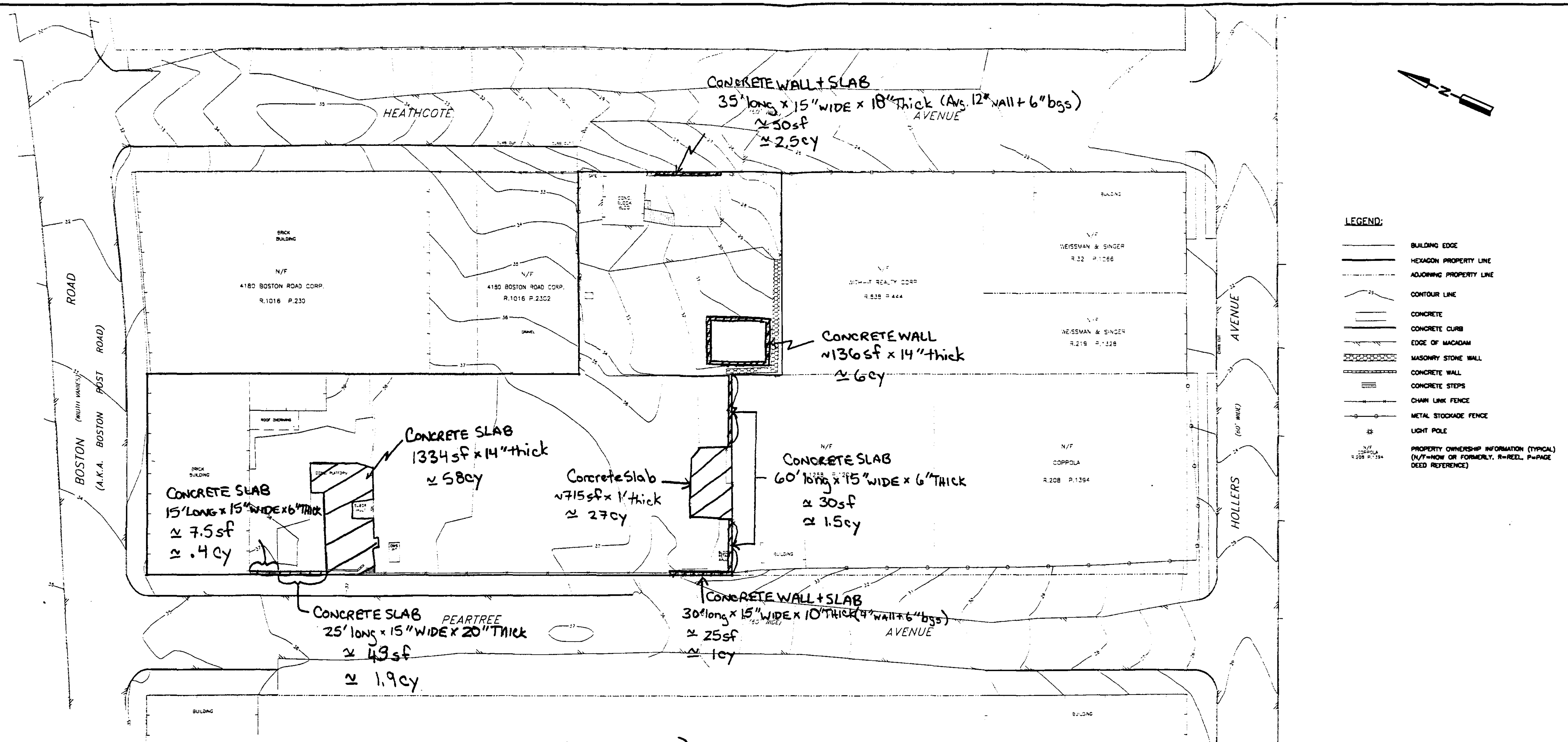
~~Retaining Wall will be a solid concrete block wall (reinforced) 12 in thick, using 8"×16" blocks From Means, Section 042-320-1650~~

~~Bare Cost = \$8.55 / SF wall~~
~~Production Rate = 375 SF/Day~~

~~Adjusted Cost = \$8.55 × 1.333 = \$11.40 / SF~~
~~Duration of Task = 1750 SF / 375 SF/Day = 4.7 days~~
~~– Say 5 days~~

Note: Price for installation of perimeter drain quoted by vendor on 10/27/98

~~Cap O+M: Assume \$1000/year for cap maintenance & repair.~~



Total For SITE PREP: 91cy (Assume 100cy)
2,185sf (Assume 2500sf)

Total For RETAINING WALL INST.: 7.3cy (Assume 10cy)
155sf (Assume 200sf)

NOTES:

1. SITE LAYOUT BASED ON SURVEY OF HEXAGON LABORATORIES PERFORMED BY YEC, INC., VALLEY COTTAGE, NEW YORK (JANUARY 1998).

SCALE

50 25 0 50 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED

REVISIONS

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HEXAGON LABORATORIES SITE
New York City
Bronx County, New York

ALTERNATIVES 2A, 2B, 2C
CONCRETE REMOVAL VOLUME ESTIMATE

DATE: MAY 1999
SCALE: AS SHOWN
DRAWING NO.: A-2.1

ALTERNATIVE 2B
CONCRETE CAP

TABLE A-2B
COST ESTIMATE
ALTERNATIVE 2B: CONCRETE CAP

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	CAPITAL COSTS				
	Direct Capital Costs				
A.	Mobilization /Temporary Facilities/ Demobilization				
	1. Mobilization/Demobilization	1	$55,200	LS	$55,200
	2. Temporary facilities	1	$49,000	LS	$49,000
	3. Site security	4	$10,700	Month	$42,800
B.	Health and Safety				
	1. Health & safety measures	3	$18,500	Month	$55,500
	2. Decon water sampling and disposal	1	$10,100	LS	$10,100
	3. Decon pad	1	$10,700	LS	$10,700
C.	Construction Management	6	$30,000	Month	$180,000
D.	Construction and Remediation				
	1. Removal of Concrete Structures				
	a. Demolition of concrete slabs and walls	110	$136.43	CY	$15,000
	b. Off-site concrete recycling	165	$18	CY	$3,000
	2. Concrete Cap				
	a. Geotextile	3,633	$2.38	SY	$8,700
	b. NYSDOT Item 4 crushed stone	900	$31.88	CY	$28,700
	c. Reinforced concrete cap	825	$239.70	CY	$197,800
	3. Surface Water Runoff Control				
	a. Catchbasins	3	$1,600	EA	$4,800
	b. Perimeter drain	200	$50	LF	$10,000
	c. Curb/retaining wall	1,625	$22	SF	$35,800
	d. Sidewalk and curb extension	1	$15,800	LS	$15,800
	Total Direct Costs				$722,900
	Indirect Capital Costs				
	1. Engineering and Permitting				$150,000
	2. Contingency (15% of Total Direct Costs)				$108,435
	Total Indirect Costs				$258,435
	TOTAL CAPITAL COSTS				$981,335
	ANNUAL O&M COSTS				
	1. Cap Maintenance & Repair	1	$1,400	LS	$1,400
	2. Annual Groundwater Sampling	1	$22,200	LS	$22,200
	TOTAL ANNUAL O&M COSTS				$23,600
	PRESENT WORTH OF COSTS				
	1. Annual O&M Costs (30 year duration, 5% discount rate)				$362,779
	2. Total Capital Costs				$981,335
	TOTAL PRESENT WORTH				**$1,344,114**

Assume: $1,344,000

Alternative 2B - Concrete Cap

Prepared By: PDP
Checked By: LT

Project Duration

Assume:	Mobilization/demobilization	4 weeks
	Site preparation (concrete demolition: trenching for retaining wall/curb: excavation for catch basin placement)	2 weeks
	Concrete cap placement	5 weeks
	Surface water runoff control	5 weeks
	Total:	**16 weeks**
	Assume:	**4 months**

Time for workplan preparation and for obtaining any approvals/permits is not included.

Prepared By: PDP
Checked By: LT

Engineering & Permitting

It is assumed that NYSDEC will hire an Engineering Consultant to prepare plans and specifications for the remediation.

It is assumed that work includes the preparation of:

- Plans and specifications for competitive bidding;
- Discussion with state and local agencies regarding permit requirements;
- Submission of 30% design submittal for review;
- Submission of 90% design submittal for review;
- Preparation of a design report;
- Preparation of an engineering cost estimate; and
- Provision of pre-award services.

Based on TAMS' experience, this work can cost between $150,000 to $250,000, depending on the complexity of the remediation.

- $250,000 for high complexity
- $200,000 for medium complexity
- $150,000 for low complexity

For Alternative 2B, work is considered to be low complexity.

Assume Engineering & Permitting cost of: $150,000

Prepared By: PDP
Checked By: LT

Construction Management

It is assumed that NYSDEC will hire an engineering consultant to perform construction period services during the remediation.
It is assumed that work includes the preparation of:
- Attendance at pre-construction meetings;
- Review of contractor submittals;
- Full time project inspection;
- Maintenance of construction records and reports;
- Quality assurance;
- Change order preparation;
- Processing of contractor application for payment; and
- Preparation of Final Remediation Report.

It is assumed that construction management services will begin one month prior to the start of construction activities.
It is assumed that construction management services will continue for one month after the end of on-site activities.
Based on TAMS' experience, the cost of construction management is approximately $30,000 per month.

Assume a monthly Construction Management cost of: **$30,000**

Prepared By: PDP
Checked By: LT

Mobilization & Demobilization (Includes Contractor Preparation of Project Plans)

1. **Materials & Equipment**

Assume 15 pieces of equipment at $500 per piece for mobilization:	$	7,500
Assume 15 pieces of equipment at $500 per piece for demobilization:	$	7,500
Assume $10,000 for mob/demob of materials:	$	10,000
Subtotal:	**$**	**25,000**

2. **Contractor Preparation of Project Plans**

   Includes Work Plans, Health & Safety Plans, QA/QC Plans, and Erosion Control Plan

   Assume labor requirement of 2 persons @ $30 per hour per person for 1 month.
   Assume multiplier of 3.

   = 2 persons x $30 /hour x 40 hours/week x 4.2 weeks/month x 1 month x 3 multiplier

   = $30,240

   Assume: **$30,200**

Total Mobilization/Demobilization Cost: **$55,200**

Alternative 2B - Concrete Cap

Prepared By: PDP
Checked By: LT

Temporary Facilities

1. **Temporary Facilities - One Time Cost**
   Assume 2 trailers @ $1.300 per trailer.
   Assume office trailer equipment @ $5.000 per trailer.

- Computer	$	2.500
- Printer	$	500
- Modem	$	200
- Fax Machine	$	500
- Copier	$	500
- Phone	$	100
- Answering Machine	$	100
- Desk & Chair (2)	$	300
- Conference Table	$	100
- Chairs (4)	$	100
- File Cabinet	$	100
	$	5,000

   Assume electrical hookup @ $2.500 per trailer.
   Assume phone hookup @ $200 per trailer.
   Assume project sign @ $500.
   Assume temporary site controls (e.g. barricades. traffic control, erosion control) @ $5.500.
   Assume decon facility mob/demob @ $1.000.
   Assume water tank(s) mob/demob @ $1000.
   Assume misc. equipment/supplies @ $3,000.

   Total Temp. Facilities One Time Cost: $ 29,000

2. **Monthly Costs**
   Assume trailer rental @ $500 per trailer.
   Assume sanitary facility & water @ $500.
   Assume janitorial service @ $500.
   Assume trailer electrical service @ $200 per trailer.
   Assume miscellaneous electrical requirements @ $200.
   Assume phone service @ $200 per trailer.
   Assume miscellaneous costs @ $2000.

   Subtotal: $ 5,000 per month

   Duration: 4 months

   Total Monthly Costs: $ 20,000

Total Temporary Facilities Cost: $ 49,000

Assume: $ 49,000

Alternative 2B - Concrete Cap

Prepared By: PDP
Checked By: LT

Site Security

Assume on-site security will be provided from 5 PM to 7AM during construction activities.
Assume on-site security will be provided 24 hours per day for weekends during construction activities.
Assume 2 unarmed security guards @ $11 per hour per guard.

Monthly Security Cost:	=	2 guards x	14 hours per day x	21 weekdays per month x	$11	per hour +
		2 guards x	24 hours per day x	8 weekend days per month x	$11	per hour

= $10.692

Assume monthly security cost of: **$10,700**

Prepared By: PDP
Checked By: LT

Health & Safety

Assume monitoring equipment @ $3,000 per month
Assume 2 sets of PPE per day per person @ $18 per unit (PPE costs associated with sampling included separately in sampling cost estimate).
Assume 10 workers within exclusion zone at one time
Assume on-site Safety Coordinator @ $5,000 per month
Assume decon facility (shower, etc.) @ $2,900 per month
(Means Environmental, 1999: Item No. 33 17 0821; includes 1.23 Location Factor).

Total: $ 18,460 per month

Assume: $ 18,500 per month (during construction activities excluding mob/demob)

Prepared By: PDP
Checked By: LT

Decontamination Pad

Assume temporary decontamination pad constructed of sand (base course), geomembrane liner
sloped towards sump pit, and plywood surface) @ $3,000 including sump pump.
Assume pressure washer @ $3,500 (purchase: Means Environmental, 1999; Item No. 33 17 0815;
Location factor of 1.23)
Assume one 6,900 gallon poly tank @ $600 per month and one 2,450 gallon poly tank @ $450 per month (Rain for Rent, 5/99)
Assume project duration of 4 months

Total = **10,700**

Assume: **$ 10,700**

Alternative 2B - Concrete Cap

Prepared By: PDP
Checked By: LT

Estimate of Volume of Decontamination Water

1. **Personnel Decon**
   Assume 10 workers, two showers per day, and five gallons per shower.

Total Volume =	100 gallons per day x	21 days per month
=	2,100 gallons per month x	3 months
=	6,300 gallons	

2. **Equipment Decon**
   Assume 10 pieces of equipment, one wash per two weeks, 20 gallons per wash per piece of equipment

Total Volume =	400 gallons per month x	3 months
=	1,200 gallons	

3. **Concrete Decon (prior to disposal)**
   Assume 10 cy (200 sf) of concrete removed for retaining wall/curb installation.
   Assume 100 cy (2,500 sf) of concrete removed as part of site preparation.
   Assume 25 sf per minute @ 6 gallons per minute.
   Assume surface area of concrete to be washed is 5,400 sf (includes both sides of concrete slabs)

Total Volume =	5400 sf /	25 sf/minutes x	6 gallons/minute
=	1,296 gallons		

Total Volume of Decon Water =	**8,796 gallons**
Assume:	**8,800 gallons**

Alternative 2B - Concrete Cap

Prepared By: PDP
Checked By: LT

Collection & Disposal of Decontamination Water

1. Equipment and Concrete Decon Labor

Assume 2 laborers @ $25 per hour for pressure washing.
Assume total area of concrete = 5,400 sf.
Assume decon rate of 25 sf per minute.
Assume 11 hours total for decon of equipment over course of construction activities (10 minutes per piece of equipment; 10 pieces of equipment per two weeks; 12.6 weeks of construction activities).
Assume multiplier of 2.

Time for decon = 15 hours

Labor cost = 15 hours x $ 25 / hour x 2 laborers x 2 multiplier

= $ 1,500
Assume: $ 1,500

2. Analytical Costs for Disposal

Assume 4 water samples for disposal @ $1,050 per sample (includes 25% increase for 1 week turnaround).

Analytical:	VOCs	$	125
	SVOCs	$	250
	Pest/PCBs	$	150
	TAL ICP Metals	$	135
	TDS	$	10
	TSS	$	10
	TOC	$	35
	Dissolved Metals	$	120
		$	835 plus 25% markup for 1 week turnaround time

Analytical Cost = $ 4,200

3. Transport and Treatment/Disposal Cost

Assume hazardous water transport and disposal @ $0.78 per gallon.
Assume non-hazardous water transport and disposal @ $0.50 per gallon.
Assume decon water is non-hazardous.

Total Volume of Decon Water = 8,800 gallons

Transport and Disposal Cost = $ 4,400

Total Collection, Analysis, Transport, and Disposal = $ 10,100

Assume $ 10,100

Prepared By: PDP
Checked By: LT

1. **Volume and Area of Concrete to be Removed/Disposed (see attached Figure A-2.1)**

Assume 10 cy (200 sf) of concrete removed for retaining wall/curb installation).
Assume 100 cy (2,500 sf) of concrete removed as part of site preparation.
Assume 50 percent expansion factor for disposal.

Total volume of concrete to be removed:	**110 cy**
Total volume of concrete to be disposed:	**165 cy (including 50% expansion factor)**

2. **Concrete Demolition**

Assume demolition of reinforced concrete (7 to 24 inches thick) @ $107/cy
(Means 1998; Item No. 020 554 2200)
Assume location factor of 1.275

= 110 cy x $ 107 /cy x 1.275 location factor
= $ 15,007

Assume: $ 15,000

Assume productivity rate for concrete demolition is 24 cy per day. Total of 5 days required for concrete removal.

3. **Transport and Disposal of Concrete**

Assume transport and disposal cost of concrete with rebar @ $18 /cy (quote from Liotta & Sons. Inc.; 10/98)

= 165 cy x $ 18 /cy
= $ 2,970

Assume: $ 3,000

Alternative 2B - Concrete Cap

Prepared By: PDP
Checked By: LT

Concrete Cap

Assume total area for concrete cap of 32,700 sf.
Cap shall consist of 4 inches (minimum) of compacted NYSDOT Item No. 4 crushed stone and 8 inches of welded wire fabric-reinforced concrete.
Assume placement of reinforced concrete @ $188/cy (includes forms, reinforcement, and finish; Means, 1998; Item No. 033 130 4050).
Assume average thickness of crushed stone layer is 9 inches as necessary for 1% slope.
Geotextile shall be placed between the existing grade and the cap materials to delineate between contaminated and non-contaminated materials.
Assume crushed stone @ $25/cy (Means 1998, Item No. 022-308-1521).
Assume location factor of 1.275.

1. Geotextile Placement

Placement Cost =		32,700	sf /	9 sf/sy x	$ 1.87	/sy x	1.275 location factor
=	$	8,663					
Assume:	**$**	**8,700**					

Productivity rate of 2400 sy per day. Assume 2 days for placement.

2. Crushed Stone Placement

Volume of stone =		32,700	sf x	0.75 ft	
=		24525	cf		
=		900	cy		
Placement Cost =		900	cy x	$25 /cy x	1.275 location factor
=	$	28,688			
Assume:	**$**	**28,700**			

Productivity rate of 750 cy per day. Assume 2 days for placement.

3. Reinforced Concrete Placement

Placement Cost =		825	cy x	188 /cy x	$ 1.275 location factor
=		197,753			
Assume:	**$**	**197,800**			

Productivity rate of 56 cy per day. Assume 15 days for placement.

Total for Concrete Cap Placement: $ 235,200

Total Time for Concrete Cap Placement is 4 weeks.
Assume 5 weeks (to account for contingencies)

Alternative 2B - Concrete Cap

Prepared By: PDP
Checked By: LT

Surface Water Runoff Control

1. Catchbasin Installation

Assume excavation @ $12.35/cy (Means, 1998; Item No. 022 250 2035).
Assume backfill of catchbasins by hand with compaction @ $36.10 per cy (Means, 1998; Items No. 022 204 0100 and 022 204 0300).
Assume precast catchbasin (4 ft x 4 ft x 6 ft) @ $910 each (Means, 1998; Item No. 027 152 1120).
Assume 6 cy excavated per catchbasin and 2.75 cy used to backfill around each catchbasin.
Assume frame & cover (18-inch diameter, light traffic, 100 lbs) @ $202 each set (Means, 1998; Item No. 027 152 1800).
Assume location factor of 1.275.
Assume 2 days for placement of catchbasins.

Cost per catchbasin: $ 1,639
Assume: $ 1,600 per catchbasin

2. U-Shaped Perimeter Drain Installation

Assume no additional excavation necessary for drain installation.
Assume cost for backfill of drain is included in estimate for placement of cap.
Assume cost materials & installation of U-shaped (19 inch channel depth) perimeter drain @ $50/lf (ABT, Inc., 10/98).
Assume 1.5 weeks for placement of perimeter drain system.

Total length of perimeter drain is: 200 lf

Cost for placement: $ 10,000

3. Curb/Retaining Wall Installation

Assume length of curb/retaining wall is 650 feet.
Assume average height of 2.5 feet.
Assume placement of Versa-Lok (or equivalent) masonry retaining wall @ $22/sf - installed cost (materials, labor, equipment) including trenching approximately 6-inches bgs and placement of 6 inches of gravel base material (Versa-Lok, 12/98).
Assume soil excavated during installation of wall trench for base material will be spread on site.
Assume production rate of 250 sf/day.
Assume 8 days for installation.

Cost for curb placement: $ 35,750
Assume: $ 35,800

4. Extension of Sidewalk and Curb

Assume 12 ft by 300 ft sidewalk extension from southeastern edge of East Yard to corner of Hollers Avenue.
Assume concrete sidewalk (3,000 psi concrete, 4 inches thick) @ $2.55/sf (Means, 1998; 025 128 0310).
Assume 4-inch bank run gravel base @ $0.44/sf (Means, 1998; 025 128 0450).
Assume placement of concrete curbing @ $5.40/lf (includes steel forms: Means, 1998; Item No. 025 254 0300).
Assume location factor of 1.275.
Assume production rate of 2500 sf per day for base material and 600 sf per day for concrete.
Assume production rate of 700 lf/day for placement of curb.

Cost for curb placement: $ 15,790
Assume: $ 15,800

Assume time for installation of surface water runoff controls of 5 weeks.

Alternative 2B - Concrete Cap

Prepared By: PDP
Checked By: LT

Long-Term Monitoring

Assumed that groundwater will be sampled annually from the 6 on-site and 6 off-site monitoring wells to monitor contaminant concentrations.
Assume that a brief sampling report (data tabulation only) will be generated for each sampling event; no 5-year review report will be generated.
Assume no validation of sample data.

1. Analytical Costs

Number of Environmental Samples:	12	
Number of QA/QC Samples:		
Trip Blank	3	(analyzed for VOCs only)
Field Blank	1	
MS/MSD	2	
Duplicate	1	
Total:	19	

Samples will be analyzed for:

VOCs	$ 125	
SVOCs	$ 250	
PCBs	$ 150	
TAL ICP Metals	$ 135	
Total:	$ 660	per sample

Analytical Cost = 16 samples x $660 /sample + 3 trip blank x $125 /sample
= $10,935 per sampling event

Assume: $10,900 per sampling event

2. Sampling Cost

Assume sampling will be performed by two technicians @ $25/hour.
Assume sampling will be conducted over a period of three 8-hour days.
Assume labor multiplier of 3.
Assume van rental of $80 per day.
Assume per diem of $120 per person per day.
Assume H&S PPE @ $18 per person per half day.
Assume rental of H&S monitoring equipment and field measurement equipment @ $800.
Assume use of disposable bailers @ $20/bailer.
Assume consumable supplies @ $250.
Assume sample shipment of $500.

Total: $ 6,566

Assume: $ 6,600 per sampling event

Prepared By: PDP
Checked By: LT

3. Laboratory Procurement & Sampling Report Preparation

Assume one person @ $30 per hour for 3 days for Sampling Report Preparation.
Assume one person @ $35 per hour for 3 days for laboratory procurement.
Assume labor multiplier of 3.

Total: $ 4.680

Assume: $ 4,700 per sampling event

Total for Long Term Monitoring: $ 22,200 per sampling event

Alternative 2B - Concrete Cap

Prepared By: PDP
Checked By: LT

Concrete Cap Maintenance

Assume 2 persons @ $25 per hour for 12 hours per year inspecting for and patching cracks in concrete surface.
Assume patching materials @ $200 per year.
Assume labor multiplier of 2.

Total: $ 1,400 per year

TAMS

Job No. 5351-500
Project Hexagon TS
Subject Concrete Slab Design

Sheet ____ of ____
Date 10-29-8
By ALT
Ch'k. by ____

6" slab

min. reinforcement ratio .0018

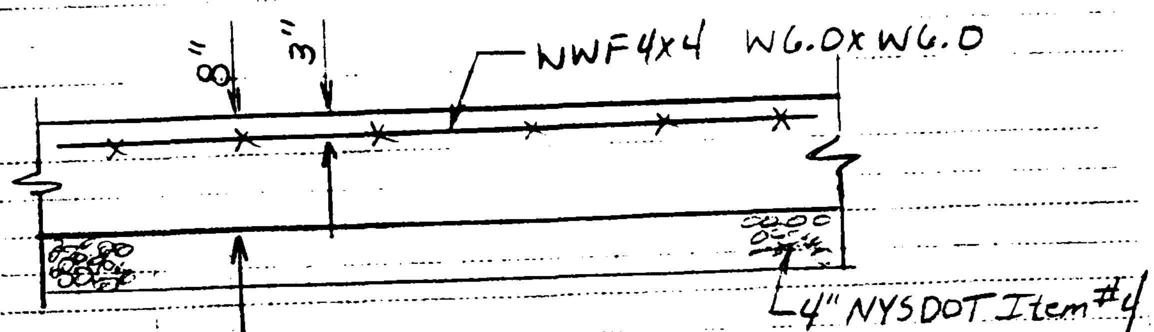
$A_s = .0018(12)6 = .13 \text{ in}^2/\text{ft}$ — WWF 4x4 W4.5xW4.5, $A_s = .135 \text{ in}^2/\text{ft}$

8" slab

min. reinforcement ratio .0015

$A_s = .0018(12)8 = .17 \text{ in}^2/\text{ft}$ — WWF 4x4 W6.0xW6.0, $A_s = .18 \text{ in}^2/\text{ft}$

Recommendation: Use 8" slab



220
x120

Use expansion joints @ 30 ft

contraction joints @ 10 ft

TAMS

Job No. ____________ Sheet 4 of 6

Project: Hexagon Laboratories FS — Date: 10-22-98

Subject: Cost Backup — Asphalt Cap Option — By: GL

Ch'k by: KK

Run-off Calculation – PRELIMINARY

Run-off calculations done as per NYCDEP document: Rules and Regulations Governing the Construction of Private Sewers and Drains

Run-off equation: $Q = CRA$

where Q = peak run-off in cfs
C = run-off coefficient = 0.85 for industrial areas (given pg. 9 - Appendix A)
R = rainfall intensity in in/hr
A = area drained in acre

From proposed contours, site broken up into 2 sections, Eastern Section (East Yard) & Western Section (North & South Yards). From scaled drawings

Parameter	Eastern Section	Western Section
A (Area)	0.23 acre	0.56 acre
Tc (Time of Concentration)	1.0 min	1.2 min
R (Rainfall Intensity)	$R = \frac{125}{T_c + 15} = \frac{125}{16}$ $R = 7.81 \frac{in}{hr}$	$R = \frac{125}{T_c + 15} = \frac{125}{16.5}$ $R = 7.58 \frac{in}{hr}$
Q (Peak Run-off)	$Q = CRA$ $= (0.85)(7.81)(0.23)$ $Q = 1.53$ cfs $= 685$ gpm	$Q = CRA$ $= (0.85)(7.58)(0.56)$ $Q = 3.61$ cfs $= 1620$ gpm

Preliminary Drain Design

For FS estimate use prefabricated U-shaped perimeter drain manufactured by ABT, Inc (Polydrain). All Polydrain Specifications Used (Polydrain Pre-Engineered Surface Drainage - Sloped System Manual)

TAMS

Job No. ______
Project: Hexagon Laboratories FS
Subject: Cost Backup — Asphalt Cap Option

Sheet 5 of 6
Date: 10-23-98
By: G.L.
Ch'k. by: KK

<u>For eastern end:</u>

Peak flow, Q = 685 gpm

From pg 6 of Polydrain manual:

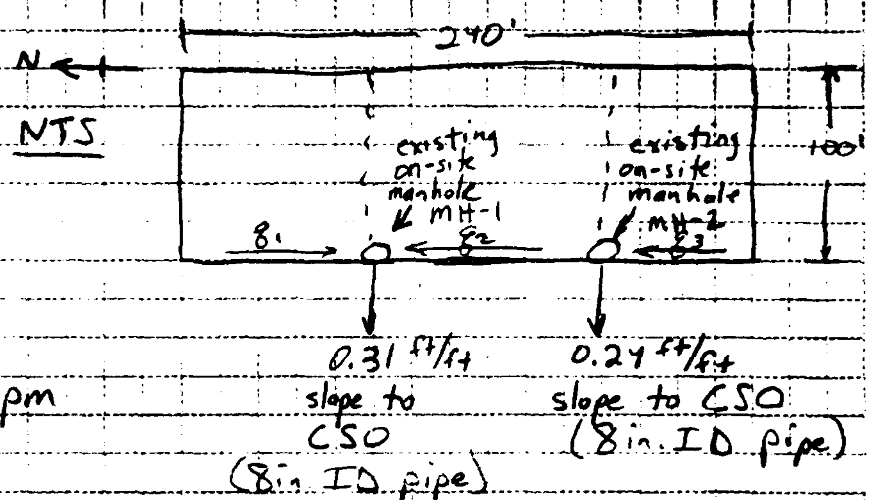
Use "Part No. 290 - Channel w/ Poly Wall I"

max flow = 852 gpm

channel depth = 19 in. U-shape

From drawing, length = 20 LF

<u>For western end:</u>



Total Runoff = 2020 gpm

Assume: $q_1 = q_2 = q_3$

$q_1 + q_2 + q_3 = 1620$ gpm

$\therefore q_1 = q_2 = q_3 = 540$ gpm

$Q_{MH-1} = q_1 + q_2 = 1080$ gpm

$Q_{MH-2} = q_3 = 540$ gpm

Use "Part No. 150 - Channel w/ Poly Wall I" (pg 6-manual)

max flow = 674 gpm

channel depth = 16 in. U-shape

Total length = 170 LF

Check that existing manholes can handle flow

<u>Assume</u>: Pipe leaving both manholes are 8 in ID at 0.24 ft/ft slope ($S = 0.24$ ft/ft more conservative than $S = 0.31$ ft/ft)

Manning Equation $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

For pipe flowing full:

Area of flow $= A = \pi r^2 = \pi \left(\frac{1}{2}\left(\frac{8}{12}\right)\right)^2 = 0.35\ ft^2$

Wetted Perimeter $= P = \pi D = \pi \left(\frac{8}{12}\right) = 2.1$ ft

Hydraulic Radius $= R = A/P = 0.35/2.1 = 0.17$ ft

$n = 0.015$ for concrete pipe

$S = 0.24$ ft/ft

TAMS

Job No. ______ Sheet 6 of 6

Project: Hexagon Labs FS Date: 10-23-98

Subject: Cost Backup By: GL

Asphalt Cap Option Ch'k. by: KK

$$Q_{max} = \frac{1.49}{0.015}(0.35)(0.17)^{2/3}(0.24)^{1/2}$$

$$= \frac{1.49(0.35)(0.31)(0.49)}{0.015}$$

$$= 5.3 \text{ cfs} = 1080 \text{ gpm}$$

$Q_{max} > Q_{MH-1} = 1346$ gpm

∴ Perimeter drainage system is adequate.

Perimeter Retaining Wall:

Length of Perimeter Retaining Wall Required = 700 LF
Average Height of Wall Required = 2.5 feet
Area = 1,750 ft^2

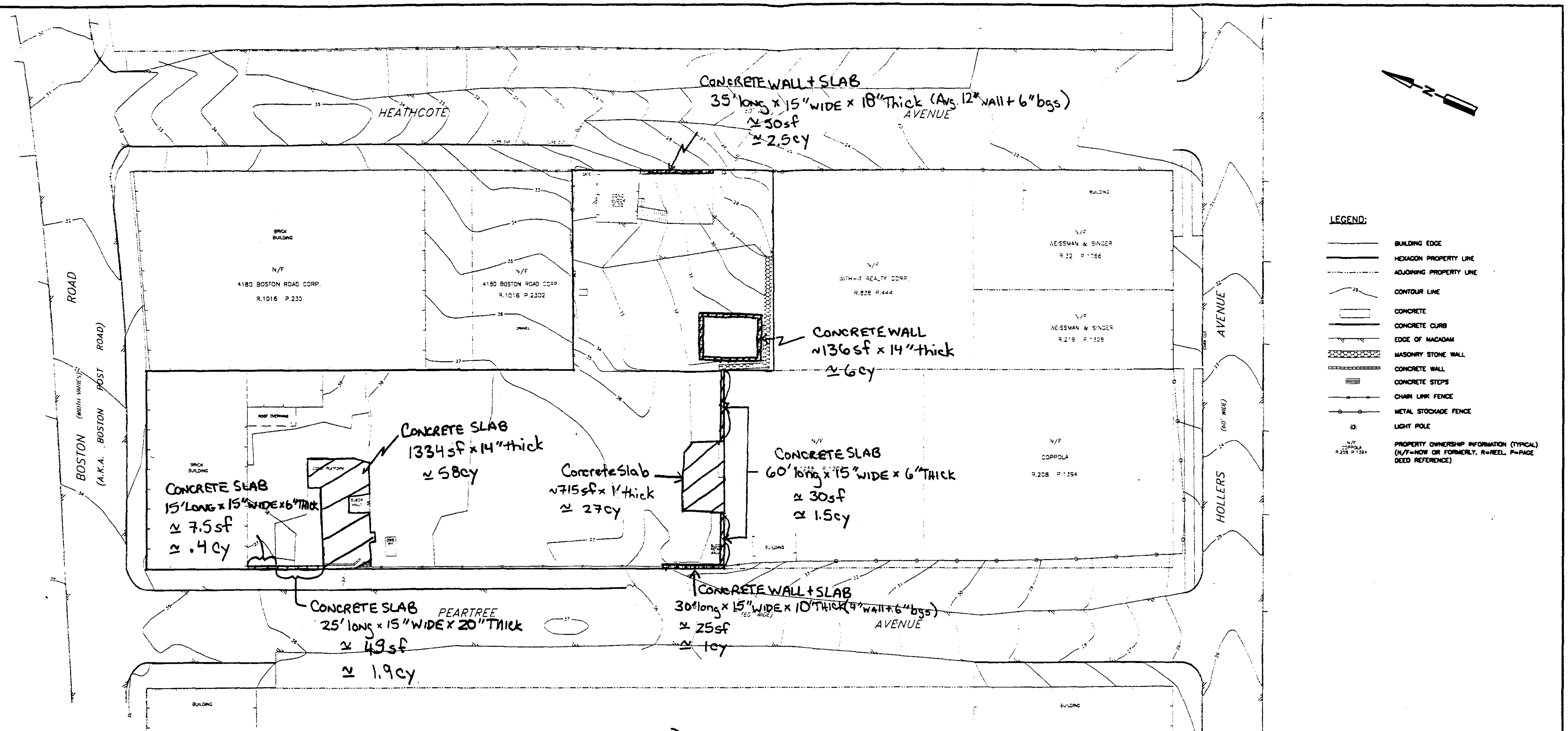
Retaining Wall will be a solid concrete block wall (reinforced) 12 in thick, using 8" × 16" blocks From Means, Section 042-320-1650

Bare Cost = \$8.55 / SF wall
Production Rate = 375 SF/Day

Adjusted Cost = \$8.55 × 1.333 = \$11.40 / SF
Duration of Task = 1750 SF / 375 SF/Day = 4.7 days
– Say 5 days

Note: Price for installation of perimeter drain quoted by vendor on 10/27/98

Cap O+M: Assume \$1000/year for cap maintenance + repair.



Total For SITE PREP: 91cy (Assume 100cy)
2,185sf (Assume 2500sf)

Total For RETAINING WALL INST.: 7.3cy (Assume 10cy)
155sf (Assume 200sf)

NOTES:

1. SITE LAYOUT BASED ON SURVEY OF HEXAGON LABORATORIES PERFORMED BY YEC, INC., VALLEY COTTAGE, NEW YORK (JANUARY 1998).

SYMBOL	DESCRIPTIONS	DATE	APPROVED

REVISIONS

Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY: PDP
DRAWN BY: PDP
CHECKED BY: PK
SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE
New York City
Bronx County, New York

ALTERNATIVES 2A, 2B, 2C
CONCRETE REMOVAL VOLUME ESTIMATE

DATE: MAY 1999 | SCALE: AS SHOWN | DRAWING NO.: A-2.1

ALTERNATIVE 2C
RCRA MULTIMEDIA CAP

TABLE A-2C
COST ESTIMATE
ALTERNATIVE 2C: RCRA MULITMEDIA CAP

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	CAPITAL COSTS				
	Direct Capital Costs				
A.	Mobilization /Temporary Facilities/ Demobilization				
	1. Mobilization/Demobilization	1	$60,200	LS	$60,200
	2. Temporary facilities	1	$50,300	LS	$50,300
	3. Site security	4.25	$10,700	Month	$45,500
B.	Health and Safety				
	1. Health & safety measures	3.25	$18,500	Month	$60,100
	2. Decon water sampling and disposal	1	$10,400	LS	$10,400
	3. Decon pad	1	$11,300	LS	$11,300
C.	Construction Management	6.25	$30,000	Month	$187,500
D.	Construction and Remediation				
	1. Removal of Concrete Structures				
	a. Demolition of concrete slabs and walls	110	$136.43	CY	$15,000
	b. Off-site concrete recycling	165	$18	CY	$3,000
	2. RCRA Multimedia Cap				
	a. Geotextile	3,633	$2.38	SY	$8,700
	b. NYSDOT Item 4 crushed stone	1,300	$31.88	CY	$41,400
	c. Common fill	1,100	$16.28	CY	$17,900
	d. Geosynthetic clay liner	32,700	$1.10	SF	$36,000
	e. Geomembrane	32,700	$0.50	SF	$16,400
	f. Geonet	32,700	$0.60	SF	$19,600
	g. Bituminous binder course	3,633	$4.69	SY	$17,000
	h. Geogrid reinforcement	3,633	$2.38	SY	$8,700
	i. Bituminous wearing course	3,633	$5.52	SY	$20,100
	3. Surface Water Runoff Control				
	a. Catchbasins	3	$1,600	EA	$4,800
	b. Perimeter drain	200	$50	LF	$10,000
	c. Curb/retaining wall	1,625	$22	SF	$35,800
	d. Sidewalk and curb extension	1	$15,800	LS	$15,800
	Total Direct Costs				$695,500
	Indirect Capital Costs				
	1. Engineering and Permitting				$200,000
	2. Contingency (15% of Total Direct Costs)				$104,325
	Total Indirect Costs				$304,325
	TOTAL CAPITAL COSTS				$999,825
	ANNUAL O&M COSTS				
	1. Cap Maintenance & Repair	1	$1,400	LS	$1,400
	2. Annual Groundwater Sampling	1	$22,200	LS	$22,200
	TOTAL ANNUAL O&M COSTS				$23,600
	PRESENT WORTH OF COSTS				
	1 Annual O&M Costs (30 year duration, 5% discount rate)				$362,779
	2 Total Capital Costs				$999,825
	TOTAL PRESENT WORTH				**$1,362,604**

Assume: $1,363,000

Prepared By: PDP
Checked By: LT

Project Duration

Assume:	Mobilization/demobilization	4 weeks
	Site preparation (concrete demolition: trenching for retaining wall/curb: excavation for catch basin placement)	2 weeks
	RCRA Multimedia cap placement	6 weeks
	Surface water runoff control	5 weeks
	Total:	**17 weeks**
	Assume:	**4.25 months**

Time for workplan preparation and for obtaining any approvals/permits is not included.

Prepared By: PDP
Checked By: LT

Engineering & Permitting

It is assumed that NYSDEC will hire an Engineering Consultant to prepare plans and specifications for the remediation.

It is assumed that work includes the preparation of:

- Plans and specifications for competitive bidding;
- Discussion with state and local agencies regarding permit requirements;
- Submission of 30% design submittal for review;
- Submission of 90% design submittal for review;
- Preparation of a design report;
- Preparation of an engineering cost estimate; and
- Provision of pre-award services.

Based on TAMS' experience, this work can cost between $150,000 to $250,000, depending on the complexity of the remediation.

- $250,000 for high complexity
- $200,000 for medium complexity
- $150,000 for low complexity

For Alternative 2C, work is considered to be medium complexity.

Assume Engineering & Permitting cost of: $200,000

Prepared By: PDP
Checked By: LT

Construction Management

It is assumed that NYSDEC will hire an engineering consultant to perform construction period services during the remediation.
It is assumed that work includes the preparation of:
- Attendance at pre-construction meetings;
- Review of contractor submittals;
- Full time project inspection;
- Maintenance of construction records and reports;
- Quality assurance;
- Change order preparation;
- Processing of contractor application for payment; and
- Preparation of Final Remediation Report.

It is assumed that construction management services will begin one month prior to the start of construction activities.
It is assumed that construction management services will continue for one month after the end of on-site activities.
Based on TAMS' experience, the cost of construction management is approximately $30,000 per month.

Assume a monthly Construction Management cost of: $30,000

Prepared By: PDP
Checked By: LT

Mobilization & Demobilization (Includes Contractor Preparation of Project Plans)

1. Materials & Equipment

Assume 20 pieces of equipment at $500 per piece for mobilization:	$	10,000
Assume 20 pieces of equipment at $500 per piece for demobilization:	$	10,000
Assume $10,000 for mob/demob of materials:	$	10,000
Subtotal:	**$**	**30,000**

2. Contractor Preparation of Project Plans

Includes Work Plans, Health & Safety Plans, QA/QC Plans, and Erosion Control Plan.

Assume labor requirement of 2 persons @ $30 per hour per person for 1 month.
Assume multiplier of 3.

= 2 persons x $30 /hour x 40 hours/week x 4.2 weeks/month x 1 month x 3 multiplier

= $30,240

Assume: **$30,200**

Total Mobilization/Demobilization Cost: **$60,200**

Alternative 2C - RCRA Multimedia Cap

Prepared By: PDP
Checked By: LT

Temporary Facilities

1. Temporary Facilities - One Time Cost

Assume 2 trailers @ $1,300 per trailer.
Assume office trailer equipment @ $5,000 per trailer.

- Computer	$ 2,500
- Printer	$ 500
- Modem	$ 200
- Fax Machine	$ 500
- Copier	$ 500
- Phone	$ 100
- Answering Machine	$ 100
- Desk & Chair (2)	$ 300
- Conference Table	$ 100
- Chairs (4)	$ 100
- File Cabinet	$ 100
	$ 5,000

Assume electrical hookup @ $2,500 per trailer.
Assume phone hookup @ $200 per trailer.
Assume project sign @ $500.
Assume temporary site controls (e.g. barricades, traffic control, erosion control) @ $5,500.
Assume decon facility mob/demob @ $1,000.
Assume water tank(s) mob/demob @ $1000.
Assume misc. equipment/supplies @ $3,000.

Total Temp. Facilities One Time Cost: $ 29,000

2. Monthly Costs

Assume trailer rental @ $500 per trailer.
Assume sanitary facility & water @ $500.
Assume janitorial service @ $500.
Assume trailer electrical service @ $200 per trailer.
Assume miscellaneous electrical requirements @ $200.
Assume phone service @ $200 per trailer.
Assume miscellaneous costs @ $2000.

Subtotal: $ 5,000 per month

Duration: 4.25 months

Total Monthly Costs: $ 21,250

Total Temporary Facilities Cost: $ 50,250

Assume: $ 50,300

Prepared By: PDP
Checked By: [illegible]

Site Security

Assume on-site security will be provided from 5 PM to 7AM during construction activities.
Assume on-site security will be provided 24 hours per day for weekends during construction activities.
Assume 2 unarmed security guards @ $11 per hour per guard.

Monthly Security Cost:	=	2 guards x	14 hours per day x	21 weekdays per month x	$11	per hour +
		2 guards x	24 hours per day x	8 weekend days per month x	$11	per hour

= $10,692

Assume monthly security cost of: $10,700

Prepared By: PDP
Checked By: LT

Health & Safety

Assume monitoring equipment @ $3,000 per month.
Assume 2 sets of PPE per day per person @ $18 per unit (PPE costs associated with sampling included separately in sampling cost estimate).
Assume 10 workers within exclusion zone at one time.
Assume on-site Safety Coordinator @ $5,000 per month.
Assume decon facility (shower, etc.) @ $2,900 per month (Means Environmental, 1999; Item No. 33 17 0821; includes 1.23 Location Factor).

Total: $ 18,460 per month

Assume: $ 18,500 per month (during construction activities excluding mob/demob)

Prepared By: PDP
Checked By: LT

Decontamination Pad

Assume temporary decontamination pad constructed of sand (base course), geomembrane liner
sloped towards sump pit, and plywood surface) @ $3,000 including sump pump.
Assume pressure washer @ $3,500 (purchase: Means Environmental, 1999; Item No. 33 17 0815;
Location factor of 1.23).
Assume one 6,900 gallon poly tank @ $600 per month and one 4,900 gallon poly tank @ $540 per month (Rain for Rent, 5/99).
Assume project duration of 4.25 months.

Total =		**11,345**
Assume:	**$**	**11,300**

Prepared By: PDP
Checked By: LT

Estimate of Volume of Decontamination Water

1. Personnel Decon
Assume 10 workers, two showers per day, and five gallons per shower.

Total Volume =	100 gallons per day x	21 days per month	
=	2,100 gallons per month x	3.25 months	
=	6,825 gallons		

2. Equipment Decon
Assume 10 pieces of equipment, one wash per two weeks, 20 gallons per wash per piece of equipment.

Total Volume =	400 gallons per month x	3.25 months
=	1,300 gallons	

3. Concrete Decon (prior to disposal)
Assume 10 cy (200 sf) of concrete removed for retaining wall/curb installation.
Assume 100 cy (2,500 sf) of concrete removed as part of site preparation.
Assume 25 sf per minute @ 6 gallons per minute.
Assume surface area of concrete to be washed is 5,400 sf (includes both sides of concrete slabs).

Total Volume =	5400 sf /	25 sf/minutes x	6 gallons/minute
=	1,296 gallons		

Total Volume of Decon Water =	**9,421 gallons**
Assume:	**9,400 gallons**

Prepared By: PDP
Checked By: LT

Collection & Disposal of Decontamination Water

1. Equipment and Concrete Decon Labor

Assume 2 laborers @ $25 per hour for pressure washing.
Assume total area of concrete = 5,400 sf.
Assume decon rate of 25 sf per minute.
Assume 11 hours total for decon of equipment over course of construction activities (10 minutes per piece of equipment; 10 pieces of equipment per two weeks; 13.6 weeks of construction activities).
Assume multiplier of 2.

Time for decon = 15 hours

Labor cost = 15 hours x $ 25 / hour x 2 laborers x 2 multiplier

= $ 1,500
Assume: $ 1,500

2. Analytical Costs for Disposal

Assume 4 water samples for disposal @ $1,050 per sample (includes 25% increase for 1 week turnaround).

Analytical:	VOCs	$ 125	
	SVOCs	$ 250	
	Pest/PCBs	$ 150	
	TAL ICP Metals	$ 135	
	TDS	$ 10	
	TSS	$ 10	
	TOC	$ 35	
	Dissolved Metals	$ 120	
		$ 835	plus 25% markup for 1 week turnaround time

Analytical Cost = $ 4,200

3. Transport and Treatment/Disposal Cost

Assume hazardous water transport and disposal @ $0.78 per gallon.
Assume non-hazardous water transport and disposal @ $0.50 per gallon.
Assume decon water is non-hazardous.

Total Volume of Decon Water = 9,400 gallons

Transport and Disposal Cost = $ 4,700

Total Collection, Analysis, Transport, and Disposal = $ 10,400

Assume $ 10,400

Prepared By: PDP
Checked By: LT

1. Volume and Area of Concrete to be Removed/Disposed (see Figure A-2.1)

Assume 10 cy (200 sf) of concrete removed for retaining wall/curb installation).
Assume 100 cy (2.500 sf) of concrete removed as part of site preparation.
Assume 50 percent expansion factor for disposal.

Total volume of concrete to be removed:	**110 cy**
Total volume of concrete to be disposed:	**165 cy (including 50% expansion factor)**

2. Concrete Demolition

Assume demolition of reinforced concrete (7 to 24 inches thick) @ $107/cy
(Means 1998; Item No. 020 554 2200).
Assume location factor of 1.275.

= 110 cy x $ 107 /cy x 1.275 location factor
= $ 15,007

Assume: **$ 15,000**

Assume productivity rate for concrete demolition is 24 cy per day. Total of 5 days required for concrete removal.

3. Transport and Disposal of Concrete

Assume transport and disposal cost of concrete with rebar @ $18 /cy (quote from Liotta & Sons. Inc.; 10/98)

= 165 cy x $ 18 /cy
= $ 2,970

Assume: **$ 3,000**

Prepared By: PDP
Checked By: LT

RCRA Multimedia Cap

Assume total area for RCRA multimedia cap of 32,700 sf.
Cap shall consist of (sequentially): 4 inches (minimum) of compacted NYSDOT Item No. 4 crushed stone; 6 inches (minimum) of clean fill; geosynthetic clay liner; geomembrane; geonet; 9 inches of compacted NYSDOT Item No. 4 crushed stone; 2 inches of bituminous binder course; geogrid reinforcement; and 2 inches of bituminous wearing course.
Assume total thickness of crushed stone layers is 13 inches (9 inches and 4 inches).
Assume average thickness of common fill layer is 11 inches as necessary for 1% slope.
Geotextile shall be placed between the existing grade and the cap materials to delineate between contaminated and non-contaminated materials.
Assume crushed stone @ $25/cy (Means 1998. Item No. 022 308 1521).
Assume placement of common fill @ $12.77/cy (Means, 1998; Item Nos. 022 216 4060, 022 226 5100, and 022 266 0500).
Assume needle-punched GCL @ $1.10/sf (Cetco, 10/98).
Assume 40 mil. BFPE geomembrane @ $0.50/sf (GSE Lining Technology, 10/98).
Assume geonet @ $0.60/sf.
Assume location factor of 1.275.

1. Geotextile Placement

Placement Cost =		32,700	sf /	9 sf/sy x	$ 1.87	/sy x	1.275 location factor
=	$	8,663					
Assume:	**$**	**8,700**					

Productivity rate of 2400 sy per day. Assume 2 days for placement.

2. Crushed Stone Placement

Volume of stone =		32,700	sf x	1.08 ft		
=		35425	cf			
=		1300	cy			
Placement Cost =		1300	cy x	$ 25	/cy x	1.275 location factor
=	$	41,438				
Assume:	**$**	**41,400**				

Productivity rate of 750 cy per day. Assume 2 days for placement.

3. Common Fill Placement

Volume of Common Fill =		32,700	sf x	0.92 ft		
=		29975	cf			
=		1100	cy			
Placement Cost =		1100	cy x	$12.77	/cy x	1.275 location factor
=	$	17,910				
Assume:	**$**	**17,900**				

Rate limiting productivity rate of 125 cy per day (hauling). Assume 9 days for placement.

Prepared By: PDP
Checked By: LT

4. GCL Placement

Placement Cost =		32,700	sf x	$ 1.10 /sf
	= $	35,970		
Assume:	**$**	**36,000**		

Assume 3 days for placement.

5. Geomembrane Placement

Placement Cost =		32,700	sf x	$ 0.50 /sf
	= $	16,350		
Assume:	**$**	**16,400**		

Assume 3 days for placement.

6. Geonet Placement

Placement Cost =		32,700	sf x	$ 0.60 /sf
	= $	19,620		
Assume:	**$**	**19,600**		

Assume 2 days for placement.

7. Binder Course Placement

Placement Cost =		32,700	sf /	9 sf/sy x	$ 3.68	/sy x	1.275 location factor
	= $	17,048					
Assume:	**$**	**17,000**					

Productivity rate of 6345 sy per day. Assume 1 day for placement.

8. Geogrid Placement

Placement Cost =		32,700	sf /	9 sf/sy x	$ 1.87	/sy x	1.275 location factor
	= $	8,663					
Assume:	**$**	**8,700**					

Productivity rate of 2400 sy per day. Assume 2 days for placement.

9. Wearing Course Placement

Placement Cost =		32,700	sf /	9 sf/sy x	$ 4.33	/sy x	1.275 location factor
	= $	20,059					
Assume:	**$**	**20,100**					

Productivity rate of 6345 sy per day. Assume 1 day for placement.

Total for RCRA Multimedia Cap Placemen $ 185,800

Total Time for RCRA Multimedia Cap Placement is 5 weeks.
Assume 6 weeks (to account for contingencies)

Prepared By: PDP
Checked By: LT

Surface Water Runoff Control

1. Catchbasin Installation

Assume excavation @ $12.35/cy (Means. 1998; Item No. 022 250 2035).
Assume backfill of catchbasins by hand with compaction @ $36.10 per cy (Means. 1998; Items No. 022 204 0100 and 022 204 0300).
Assume precast catchbasin (4 ft x 4 ft x 6 ft) @ $910 each (Means, 1998; Item No. 027 152 1120).
Assume 6 cy excavated per catchbasin and 2.75 cy used to backfill around each catchbasin.
Assume frame & cover (18-inch diameter, light traffic, 100 lbs) @ $202 each set (Means, 1998; Item No. 027 152 1800).
Assume location factor of 1.275.
Assume 2 days for placement of catchbasins.

Cost per catchbasin: $ 1,639
Assume: $ 1,600 per catchbasin

2. U-Shaped Perimeter Drain Installation

Assume no additional excavation necessary for drain installation.
Assume cost for backfill of drain is included in cap placement estimate.
Assume cost materials & installation of U-shaped (19 inch channel depth) perimeter drain @ $50/lf (ABT, Inc., 10/98).
Assume 1.5 weeks for placement of perimeter drain system.

Total length of perimeter drain is: 200 lf

Cost for placement: $ 10,000

3. Curb/Retaining Wall Installation

Assume length of curb/retaining wall is 650 feet.
Assume average height of 2.5 feet.
Assume placement of Versa-Lok (or equivalent) masonry retaining wall @ $22/sf - installed cost (materials, labor, equipment) including trenching approximately 6-inches bgs and placement of 6 inches of gravel base material (Versa-Lok, 12/98).
Assume soil excavated during installation of wall trench for base material will be spread on site.
Assume production rate of 250 sf/day.
Assume 8 days for installation.

Cost for curb placement: $ 35,750
Assume: $ 35,800

4. Extension of Sidewalk and Curb

Assume 12 ft by 300 ft sidewalk extension from southeastern edge of East Yard to corner of Hollers Avenue.
Assume concrete sidewalk (3,000 psi concrete, 4 inches thick) @ $2.55/sf (Means, 1998; 025 128 0310).
Assume 4-inch bank run gravel base @ $0.44/sf (Means, 1998; 025 128 0450).
Assume placement of concrete curbing @ $5.40/lf (includes steel forms; Means, 1998; Item No. 025 254 0300).
Assume location factor of 1.275.
Assume production rate of 2500 sf per day for base material and 600 sf per day for concrete.
Assume production rate of 700 lf/day for placement of curb.

Cost for curb placement: $ 15,790
Assume: $ 15,800

Assume time for installation of surface water runoff controls of 5 weeks.

Prepared By: PDP
Checked By: LT

Long-Term Monitoring

Assumed that groundwater will be sampled annually from the 6 on-site and 6 off-site monitoring wells to monitor contaminant concentrations.
Assume that a brief sampling report (data tabulation only) will be generated for each sampling event; no 5-year review report will be generated.
Assume no validation of sample data.

1. Analytical Costs

Number of Environmental Samples:	12	
Number of QA/QC Samples:		
Trip Blank	3	(analyzed for VOCs only)
Field Blank	1	
MS/MSD	2	
Duplicate	1	
Total:	19	

Samples will be analyzed for:

VOCs	$ 125	
SVOCs	$ 250	
PCBs	$ 150	
TAL ICP Metals	$ 135	
Total:	$ 660	per sample

Analytical Cost = 16 samples x $660 /sample + 3 trip blank x $125 /sample
= $10,935 per sampling event

Assume: $10,900 per sampling event

2. Sampling Cost

Assume sampling will be performed by two technicians @ $25/hour.
Assume sampling will be conducted over a period of three 8-hour days.
Assume labor multiplier of 3.
Assume van rental of $80 per day.
Assume per diem of $120 per person per day.
Assume H&S PPE @ $18 per person per half day.
Assume rental of H&S monitoring equipment and field measurement equipment @ $800.
Assume use of disposable bailers @ $20/bailer.
Assume consumable supplies @ $250.
Assume sample shipment of $500.

Total: $ 6.566

Assume: $ 6,600 per sampling event

Prepared By: PDP
Checked By: LT

3. Laboratory Procurement & Sampling Report Preparation

Assume one person @ $30 per hour for 3 days for Sampling Report Preparation.
Assume one person @ $35 per hour for 3 days for laboratory procurement.
Assume labor multiplier of 3.

Total: $ 4,680

Assume: $ 4,700 per sampling event

Total for Long Term Monitoring: $ 22,200 per sampling event

Alternative 2C - RCRA Multimedia Cap

Prepared By: PDP
Checked By: LT

RCRA Multimedia Cap Maintenance

Assume 2 persons @ $25 per hour for 12 hours per year inspecting for and patching cracks in asphalt surface.
Assume patching materials @ $200 per year.
Assume labor multiplier of 2.

Total: $ 1,400 per year

TAMS

Job No. ______ Sheet 4 of 6
Project Hexagon Laboratories FS Date 10-22-98
Subject Cost Backup By GL
Asphalt Cap Option Ch'k. by KK

Run-off Calculation – **PRELIMINARY**

Run-off calculations done as per NYCDEP document: Rules and Regulations Governing the Construction of Private Sewers and Drains

Run-off equation: $Q = CRA$

where Q = peak run-off in cfs
C = run-off coefficient = 0.85 for industrial areas (given pg. 9 - Appendix A)
R = rainfall intensity in in/hr
A = area drained in acre

From proposed contours, site broken up into 2 sections, Eastern Section (East Yard) & Western Section (North & South Yards). From scaled drawings:

Parameter	Eastern Section	Western Section
A (Area)	0.23 acre	0.56 acre
Tc (Time of Concentration)	1.0 min	1.2 min
R (Rainfall Intensity)	$R = \frac{125}{Tc+15} = \frac{125}{16}$; $R = 7.81$ in/hr	$R = \frac{125}{Tc+15} = \frac{125}{16.5}$; $R = 7.58$ in/hr
Q (Peak Run-off)	$Q = CRA = (0.85)(7.81)(0.23)$; $Q = 1.53$ cfs = 685 gpm	$Q = CRA = (0.85)(7.58)(0.56)$; $Q = 3.61$ cfs = 1620 gpm

Preliminary Drain Design

For FS estimate use prefabricated U-shaped perimeter drain manufactured by ABT, Inc (Polydrain). All Polydrain Specifications Used (Polydrain: Pre-Engineered Surface Drainage - Sloped System Manual)

TAMS

Job No. ______ Sheet 5 of 6

Project: Hexagon Laboratories FS Date: 10-23-98

Subject: Cost Backup — Asphalt Cap Option By: G.L.

Ch'k by: KK

For eastern end:

Peak flow, Q = 685 gpm

From pg 6 of Polydrain manual:

Use "Part No. 290 - Channel w/ Poly Wall I"

max flow = 852 gpm

channel depth = 19 in. U-shape

From drawing, length = 20 LF

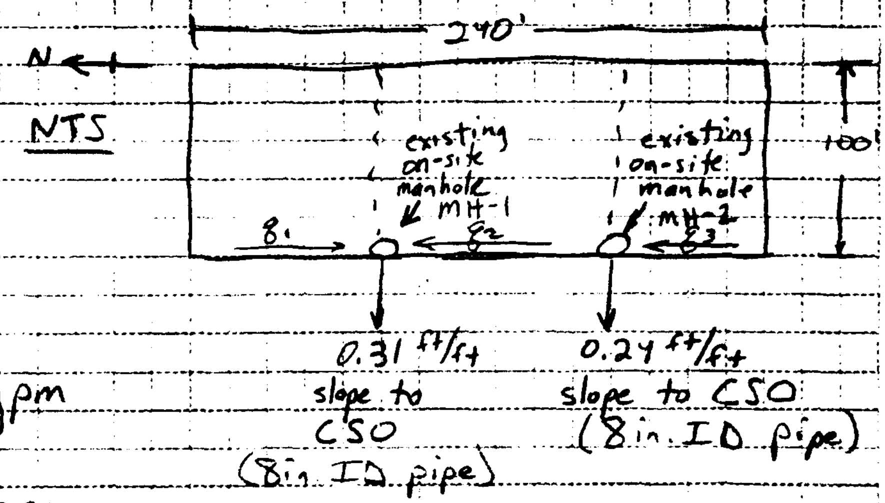
For western end:

Total Runoff = 2020 gpm

Assume: $q_1 = q_2 = q_3$

$q_1 + q_2 + q_3 = 1620$ gpm

$\therefore q_1 = q_2 = q_3 = 540$ gpm



$Q_{MH-1} = q_1 + q_2 = 1080$ gpm

$Q_{MH-2} = q_3 = 540$ gpm

Use "Part No. 150 - Channel w/ Poly Wall I" (pg 6-manual)

max flow = 674 gpm

channel depth = 16 in. U-shape

Total length = 170 LF

Check that existing manholes can handle flow

Assume: Pipe leaving both manholes are 8 in ID at 0.24 ft/ft slope (S = 0.24 ft/ft more conservative than S = 0.31 ft/ft)

Manning Equation $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

For pipe flowing full:

Area of flow = $A = \pi r^2 = \pi \left(\frac{1}{2}\left(\frac{8}{12}\right)\right)^2 = 0.35 \text{ ft}^2$

Wetted Perimeter = $P = \pi D = \pi \left(\frac{8}{12}\right) = 2.1$ ft

Hydraulic Radius = $R = A/P = 0.35/2.1 = 0.17$ ft

$n = 0.025$ for concrete pipe

S = 0.24 ft/ft

Job No. ____

Project: Hexagon Labs FS

Subject: Cost Backup Asphalt Cap Option

Date: 10-23-98

By: GL

Ch'k by: KK

$$Q_{max} = \frac{1.49}{0.015}(0.35)(0.17)^{2/3}(0.24)^{1/2}$$

$$= \frac{1.49(0.35)(0.31)(0.49)}{0.015}$$

$$= 5.3 \text{ cfs} = 1080 \text{ gpm}$$

$Q_{max} > Q_{MH-1} = 1346$ gpm

∴ Perimeter drainage system is adequate.

~~Perimeter Retaining Wall:~~

~~Length of Perimeter Retaining Wall Required = 700 LF~~
~~Average Height of Wall Required = 2.5 feet~~
~~Area = 1,750 ft^2~~

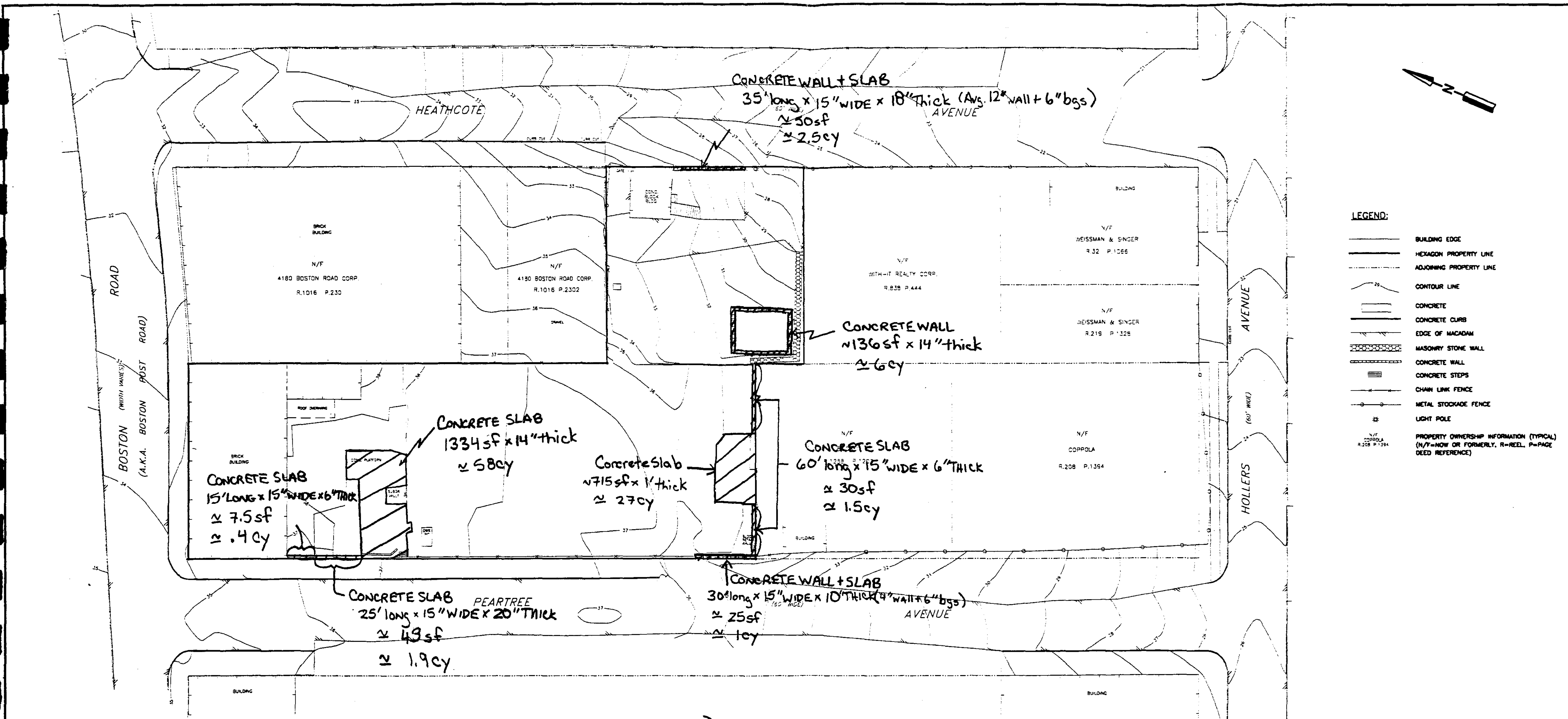
~~Retaining Wall will be a solid concrete block wall (reinforced) 12 in thick, using 8"×16" blocks From Means, Section 042-320-1650~~

~~Bare Cost = \$ 8.55 / SF wall~~
~~Production Rate = 375 SF/Day~~

~~Adjusted Cost = \$8.55 × 1.333 = \$11.40 / SF~~
~~Duration of Task = 1750 SF / 375 SF/Day = 4.7 days~~
~~– Say 5 days~~

Note: Price for installation of perimeter drain quoted by vendor on 10/27/98

~~Cap O+M: Assume \$1000/year for cap maintenance + repair.~~



Total For SITE PREP: 91cy (Assume 100cy)
2,185sf (Assume 2500sf)

Total For RETAINING WALL INST.: 7.3cy (Assume 10cy)
155sf (Assume 200sf)

NOTES:

1. SITE LAYOUT BASED ON SURVEY OF HEXAGON LABORATORIES PERFORMED BY YEC, INC., VALLEY COTTAGE, NEW YORK (JANUARY 1998).

SCALE

50 25 0 50 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY: PDP
DRAWN BY: PDP
CHECKED BY: PK
SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 2A, 2B, 2C
CONCRETE REMOVAL VOLUME ESTIMATE

DATE: MAY 1999
SCALE: AS SHOWN
DRAWING NO.: A-2.1

ALTERNATIVE 3
IN-SITU OXIDATION/EX-SITU STABILIZATION/ON-SITE DISPOSAL

TABLE A-3
COST ESTIMATE
ALTERNATIVE 3 - IN-SITU OXIDATION/EX-SITU STABILIZATION/ON-SITE DISPOSAL

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	CAPITAL COSTS				
	Direct Capital Costs				
A.	Mobilization /Temporary Facilities/ Demobilization				
	1. Mobilization/Demobilization	1	$70,200	LS	$70,200
	2. Temporary facilities	1	$94,000	LS	$94,000
	3. Site security	13	$10,700	Month	$139,100
B.	Health and Safety				
	1. Health & safety measures	10.5	$18,500	Month	$194,300
	2. Decon water sampling and disposal	1	$27,800	LS	$27,800
	3. Decon pad	1	$25,000	LS	$25,000
C.	Construction Management	13.5	$30,000	Month	$405,000
D.	Construction and Remediation				
	1. Treatability Testing				
	a. Fenton's Reagent	1	$8,000	LS	$8,000
	b. Stabilization	1	$11,000	LS	$11,000
	2. Concrete Slab/Asphalt Paving Demolition and Disposal				
	a. Demolition - concrete	1,070	$136.43	CY	$146,000
	b. Demolition - pavement	340	$7.78	SY	$2,600
	c. Transportation and disposal	1,640	$18	CY	$29,500
	3. Fenton's Reagent Treatment				
	a. Injection well installation	1	$17,800	LS	$17,800
	b. Injection trench installation	1	$20,500	LS	$20,500
	c. Treatment	1	$797,900	LS	$797,900
	d. Monitoring during treatment	3	$21,000	EA	$63,000
	e. Injection well abandonment	1	$6,100	LS	$6,100
	4. Excavation				
	a. Temporary shoring	7,600	$8.03	SF	$61,000
	b. Soil excavation	6,400	$11.09	CY	$71,000
	5. Stabilization				
	a. Treatment/Processing	1	$336,000	LS	$336,000
	b. Monitoring during treatment	1	$5,200	LS	$5,200
	6. Surface Water Runoff Control				
	a. Catchbasin installation	3	$1,400	EA	$4,200
	b. Perimeter drain	200	$50	LF	$10,000
	c. Curb	650	$6.89	LF	$4,500
	d. Sidewalk/curb extension	1	$15,800	LS	$15,800
	7. Backfill (Treated Soil)	6,720	$2.14	CY	$14,400
	8. Monitoring Well Installation	1	$12,000	LS	$12,000
	Total Direct Costs				$2,591,900

TABLE A-3
COST ESTIMATE
ALTERNATIVE 3 - IN-SITU OXIDATION/EX-SITU STABILIZATION/ON-SITE DISPOSAL

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	Indirect Capital Costs				
	1. Engineering and Permitting				$200,000
	2. Contingency (15% of Total Direct Costs)				$388,785
	Total Indirect Costs				$588,785
	TOTAL CAPITAL COSTS				$3,180,685
	ANNUAL O&M COSTS				
	1. Annual Groundwater Sampling	1	$11,500	LS	$11,500
	TOTAL ANNUAL O&M COSTS				$11,500
	PRESENT WORTH OF COSTS				
A.	Annual O&M Costs (30 year duration, 5% discount rate)				$176,778
B.	Total Capital Costs				$3,180,685
	TOTAL PRESENT WORTH				$3,357,463

Assume: **$3,357,000**

Alternative 3 - In-Situ Oxidation/Ex-Situ Stabilization/On-Site Disposal

Prepared By: PDP
Checked By: LT

Project Duration

Assume:	Mobilization/demobilization	4 weeks	
	Sampling prior to treatment: analysis: well/trench installation	4 weeks	
	First application of reagents	6 weeks	
	Reaction: sampling and analysis	4 weeks	(1 week of CM & H&S)
	Second application of reagents	6 weeks	
	Reaction: sampling and analysis	4 weeks	(1 week of CM & H&S)
	Concrete/pavement demolition	6 weeks & during excavation	
	Shoring placement	2.5 weeks & during excavation	
	Excavation for stabilization treatment	6 weeks & during stabilization treatment	
	Stabilization treatment	4 weeks	
	Surface water runoff control	4 weeks	
	Backfill & Compaction	2 weeks	
	Total:	**52.5 weeks**	
	Assume:	**13 months**	

Time for workplan preparation. laboratory bench scale testing, and for obtaining approvals/permits is not included.

Prepared By: PDP
Checked By: LT

Engineering & Permitting

It is assumed that NYSDEC will hire an Engineering Consultant to prepare plans and specifications for the remediation.

It is assumed that work includes the preparation of:

- Plans and specifications for competitive bidding;
- Discussion with state and local agencies regarding permit requirements;
- Submission of 30% design submittal for review;
- Submission of 90% design submittal for review;
- Preparation of a design report;
- Preparation of an engineering cost estimate; and
- Provision of pre-award services.

Based on TAMS' experience, this work can cost between $150,000 to $250,000, depending on the complexity of the remediation.

- $250,000 for high complexity
- $200,000 for medium complexity
- $150,000 for low complexity

For Alternative 3, work is considered to be medium complexity.

Assume Engineering & Permitting cost of: $200,000

Prepared By: PDP
Checked By: LT

Construction Management

It is assumed that NYSDEC will hire an engineering consultant to perform construction period services during the remediation.
It is assumed that work includes the preparation of:
- Attendance at pre-construction meetings;
- Review of contractor submittals;
- Full time project inspection;
- Maintenance of construction records and reports;
- Quality assurance;
- Change order preparation;
- Processing of contractor application for payment; and
- Preparation of Final Remediation Report.

It is assumed that construction management services will begin one month prior to the start of construction activities.
It is assumed that construction management services will continue for one month after the end of on-site activities.
It is assumed that during 2 months allotted for reaction time & sampling, project inspection will be required for a total of 2 weeks.
Based on TAMS' experience, the cost of construction management is approximately $30,000 per month.

Assume a monthly Construction Management cost of: $30,000

Prepared By: PDP
Checked By: LT

Mobilization & Demobilization (Includes Contractor Preparation of Project Plans)

1. Materials & Equipment

Assume 20 pieces of equipment at $500 per piece for mobilization:	$	10,000
Assume 20 pieces of equipment at $500 per piece for demobilization:	$	10,000
Assume $10,000 for mob/demob of materials:	$	10,000
Subtotal:	**$**	**30,000**

2. Contractor Preparation of Project Plans

Includes Work Plans, Health & Safety Plans, QA/QC Plans, and Erosion Control Plan.
Assume labor requirement of 2 persons @ $30 per hour per person for 1 month.
Assume labor multiplier of 3.
Assume 3 contractors for Alternative 3: 1 general contractor responsible for injection well/trench installation and concrete removal activities; 1 subcontractor for implementing Fenton's Reagent process; and 1 subcontractor for implementing solidification/stabilization treatment.
Assume additional cost of $10,000 to account for cost of subcontractor's contribution to the workplan.

= 2 persons x $30 /hour x 40 hours/week x 4.2 weeks/month x 1 month x 3 multiplier + $ 10,000

= $40,240

Assume: $40,200

Total Mobilization/Demobilization Cost: $70,200

Note: The Fenton's Reagent vendor (Isotec) provided mob/demob costs in their cost quote for treatment. The solidification/stabilization contractor (STC) also included mob/demob costs in their cost quote for treatment. Total mobilization/demobilization cost does not include equipment & materials for these vendors.

Prepared By: PDP
Checked By: LT

Temporary Facilities

1. Temporary Facilities - One Time Cost

Assume 2 trailers @ $1,300 per trailer
Assume office trailer equipment @ $5,000 per trailer

- Computer	$ 2,500
- Printer	$ 500
- Modem	$ 200
- Copier	$ 500
- Fax Machine	$ 500
- Phone	$ 100
- Answering Machine	$ 100
- Desk & Chair (2)	$ 300
- Conference Table	$ 100
- Chairs (4)	$ 100
- File Cabinet	$ 100
	$ 5,000

Assume electrical hookup @ $2,500 per trailer
Assume phone hookup @ $200 per trailer
Assume project sign @ $500
Assume temporary site controls (e.g. barricades, traffic control, erosion control) @ $5,500
Assume decon facility mob/demob @ $1,000
Assume water tank(s) mob/demob @ $1000
Assume misc. equipment/supplies @ $3,000

Total Temp. Facilities One Time Cost: **$ 29,000**

2. Monthly Costs

Assume trailer rental @ $500 per trailer
Assume sanitary facility & water @ $500
Assume janitorial service @ $500
Assume trailer electrical service @ $200 per trailer
Assume miscellaneous electrical requirements @ $200
Assume phone service @ $200 per trailer
Assume miscellaneous costs @ $2000

Subtotal: $ 5,000 per month

Duration: 13 months

Total Monthly Costs: **$ 65,000**

Total Temporary Facilities Cost: **$ 94,000**
Assume: **$ 94,000**

Prepared By: PDP
Checked By: LT

Site Security

Assume on-site security will be provided from 5 PM to 7AM during construction activities.
Assume on-site security will be provided 24 hours per day for weekends during construction activities.
Assume 2 unarmed security guards @ $11 per hour per guard.

Monthly Security Cost:	=	2 guards x	14 hours per day x	21 weekdays per month x	$11 per hour +
		2 guards x	24 hours per day x	8 weekend days per month x	$11 per hour
	=	$10,692			

Assume monthly security cost of: $10,700

Prepared By: PDP
Checked By: LT

Health & Safety

Assume monitoring equipment @ $3,000 per month
Assume 2 sets of PPE per day per person @ $18 per unit (PPE costs associated with sampling included separately in sampling cost estimate)
Assume 10 workers within exclusion zone at one time
Assume on-site Safety Coordinator @ $5,000 per month
Assume decon facility (shower, etc.) @ $2,900 per month
(Means Environmental Remediation Cost Data - 33 17 0821; includes 1.23 Location Factor)

Total: $ 18,460 per month

Assume: $ 18,500 per month (during construction activities excluding mob/demob)

Prepared By: PDP
Checked By: LT

Decontamination Pad

Assume 20 ft x 30 ft x 6 inch decon pad with 6-inch high curbs
Assume construction of 6-inch slab on grade (not including forms or reinforcement) @$2.09/sf
(from Means. 1998: Item No. 033 130 5010)
Assume reinforcement with welded wire fabric @ $66.50 per 100 sf
(from Means. 1998: Item No. 032 207 0700)
Assume use of trench forms on floor @$10.35 per sf
(from Means. 1998: Item No. 031 170 6000)
Assume location factor of 1.275
Assume decon pad walls @ $1.000
Assume sump pit and pump @ $1.500
Assume pressure washer @ $3.500 (purchase)
(from Means Environmental. 1999: Item No. 33 17 0815: Location factor of 1.23)
Assume one 21.000 gallon frac tank @ $1,200 per month
Assume project duration of 13 months

Slab =		600 sf x	$2.09	/sf +	600 sf x	$0.67	/sf +	100 sf x	$10.35	/sf
	= $	2.688	x	1.275 multiplier						
	= $	3.427								
Total =		25,027								
Assume	S	**25,000**								

Prepared By: PDP
Checked By: LT

Estimate of Volume of Decontamination Water

1. Personnel Decon
Assume 10 workers, two showers per day, and five gallons per shower

Total Volume =	100 gallons per day x	21 days per month	
=	2,100 gallons per month x	10.5 months	
=	22,050 gallons		

2. Equipment Decon
Assume 10 pieces of equipment, one wash per two weeks, 20 gallons per wash per piece of equipment

Total Volume =	400 gallons per month x	10.5 months
=	4200 gallons	

3. Concrete Slab Decon (prior to disposal)
Assume 25 sf per minute @ 6 gallons per minute
Assume surface area of concrete to be washed is 36,900 sf (includes both sides of concrete slabs)

Total Volume =	36900 sf /	25 sf/minutes x	6 gallons/minute
=	8856 gallons		

Total Volume of Decon Water = **35,106 gallons**

Assume: **35,100 gallons**

Alternative 3 - In-Situ Oxidation/Ex-Situ Stabilization/On-Site Disposal

Prepared By: PDP
Checked By: LT

Collection & Disposal of Decontamination Water

1. Equipment and Concrete Decon Labor

Assume 2 laborers @ $25 per hour for pressure washing
Assume total area of concrete = 36.900 sf
Assume decon rate of 25 sf per minute
Assume labor multiplier of 2.
Assume 35 hours total for decon of equipment over course of construction activities
(10 minutes per piece of equipment. 10 pieces of equipment per two weeks. 44 weeks of construction activities).

Time for decon = 60 hours

Labor cost = 60 hours x $ 25 / hour x 2 laborers x 2 multiplier

= $ 6,000

2. Analytical Costs for Disposal

Assume 4 water samples for disposal @ $1.050 per sample (includes 25% increase for 1 week turnaround)

Analytical:	VOCs	$ 125	
	SVOCs	$ 250	
	Pest/PCBs	$ 150	
	TAL ICP Metals	$ 135	
	TDS	$ 10	
	TSS	$ 10	
	TOC	$ 35	
	Dissolved Metals	$ 120	
		$ 835	plus 25% markup for 1 week turnaround time

Analytical Cost = $ 4,200

3. Transport and Treatment/Disposal Cost

Assume hazardous water transport and disposal @ $0.78 per gallon
Assume non-hazardous water transport and disposal @ $0.50 per gallon
Assume decon water is non-hazardous

Total Volume of Decon Water = 35.100 gallons

Transport and Disposal Cost = $ 17.550

Total Collection. Analysis. Transport. and Disposal = $ 27.750

Assume $ 27,800

Treatability Studies

1. **Fenton's Reagent**

Assume collection of 3 surface soil and 3 subsurface soil samples to be sent to vendor for treatability testing.
Assume 1 day for sample collection.
Assume technician @ $30/hour for one 8-hour day.
Assume labor multiplier of 3.
Assume van rental @ $85 per day.
Assume auger decontamination @ $30/auger.
Assume mobilization of drill rig @ $500.
Assume 1 day of drilling @ $1.200/day.
Assume rental of H&S equipment @ $500.
Assume sample shipment @ $150.
Assume consumable supplies @ $250.
Assume treatability testing @ $4.500 (Isotec. 10/98).

Total: $ 7,995

Assume: $ 8,000

2. **Solidification/Stabilization**

Assume collection of 3 surface soil and 3 subsurface soil samples to be sent to vendor for treatability testing.
Assume 1 day for sample collection.
Assume technician @ $30/hour for one 8-hour day.
Assume labor multiplier of 3.
Assume van rental @ $85 per day.
Assume auger decontamination @ $30/auger.
Assume mobilization of drill rig @ $500.
Assume 1 day of drilling @ $1.200/day.
Assume rental of H&S equipment @ $500.
Assume sample shipment @ $150.
Assume consumable supplies @ $250.
Assume treatability testing @ $7.500 (STC Remediation. Inc.. 11/98).

Total: $ 10.995

Assume: $ 11,000

Prepared By: PDP
Checked By: LT

Injection Well and Trench Installation

1. Injection Well Installation

Assume installation of 16 overburden injection wells in the East Yard.
Assume wells are 15 ft deep, 4 inch diameter PVC wells.
Assume drilling @ $22/lf.
Assume PVC riser & screen @ $40/lf.
Assume well sand pack, bentonite seal, and grout @ $12/lf.

Total per linear foot:	$	74 /lf
Total installation cost:	$	17,760
Assume:	**$**	**17,800**

2. Injection Trench Installation

Assume installation of 16 approximately 90 feet long trenches. Four-inch slotted PVC piping will be placed in trenches.
Assume each trench @ 2 feet wide by 3 feet deep by 90 feet long.
Cost associated with removal of concrete during trench installation are included separately under concrete removal and disposal. Total volume of concrete removed during trench installation is estimated as 120 cy. Of the 120 cy, approximately 19 cy is associated with elevated sections of concrete.
Assume trench excavation cost @ $5.55/cy (Means, 1998: Item No. 022 254 0050).
Assume installation of slotted PVC pipe @ $7.55/lf (Means, 1998; Item No. 026 678 2180).
Assume gravel used to backfill trench from bottom to one foot below grade @ $20/cy.
Assume native soil used to backfill trench from top of gravel to final grade.
Assume backfill and compaction of soil @ $6.11/cy (Means, 1998: Item Nos. 022 254 3020 and 022 226 7000).
Assume location factor of 1.275.

Total volume of soil excavated =		320 cy -	101 cy concrete removed (excluding elevated concrete)	
	=	219 cy		
Total for excavation:		219 cy x	$5.55 /cy x	1.275 location factor
	= $	1,550		
Total for pipe placement:		1440 lf x	$7.55 /lf x	1.275 location factor
	= $	13,862		
Total for gravel backfill:		213 cy x	$20 /cy	
	= $	4,267		
Total for soil backfill & compaction:		107 cy x	$6.11 /cy x	1.275 location factor
	= $	831		
Total for Trench Installation:	$	20,509		

Assume: **$** **20,500**

Fenton's Reagent Treatment

1. Application of Reagents

Cost quote from Isotec (D. Zervas, 10/98):
Note: One 15-feet injection point is assumed to require the same volume of reagent as a 45-feet length of trench. Therefore, based on the volume of reagent required, each of the 90-feet long trenches is considered to be equivalent to two injection wells.

Initial treatment application: $485,190 for 38 injection trenches and 16 injection wells. (Includes treatment of soil beneath Office/Warehouse & Hydrotherm No. 1.)
Cost per injection point: $ 8,985

Number of injection trenches is reduced from 38 to 32 since soil beneath the Office/Warehouse and Hydrotherm No. 1 will not be treated.

Total number of injection points proposed: 32 injection trenches (16 - 90 feet long trenches)
16 injection wells
Total: 48 injection points

Total for initial treatment application: = 48 points x $ 8,985 / point
= $431,280

Subsequent treatment applications: $412,415 for 38 injection trenches and 16 injection wells. (Includes treatment of soil beneath Office/Warehouse & Hydrotherm No. 1.)
Cost per injection point: $ 7,637

Number of injection trenches is reduced from 38 to 32 since soil beneath the Office/Warehouse and Hydrotherm No. 1 will not be treated.

Total for subsequent treatment application: = 48 points x $ 7,637 / point
= $366,591

Total Cost for Reagent Application (assuming two applications): $ 797,871
Assume: $ 797,900

2. Monitoring during Treatment

Analytical Costs
Assume three rounds of sampling (before treatment; after first application; after second application).
Assume sampling will consist of collection of 20 subsurface soil samples.
Assume sampling will be conducted over a period of three 8-hour days.
Assume no data validation will be performed.

Number of samples:	20	environmental samples
(per sampling event)	1	duplicate sample
	1	MS
	1	MSD
	2	field blanks

Samples analyzed for:	VOCs	$	130	
	SVOCs	$	275	
	Pest/PCBs	$	160	
		$	565	per sample x 25% markup for 1 week turnaround
	Total	$	706	per sample

Analytical Cost:	=	25 samples x	$	706	/sample
	=	17,656			

Assume: $ 17,700 per sampling event

Sampling Cost

Assume sampling will be performed by one on-site personnel (no additional labor charge) and one assistant @ $25/hour.
Assume sampling will be conducted over a period of three 8-hour days.
Assume labor multiplier of 3.
Assume car rental @ $65 per day.
Assume per diem for assistant @ $120 per day.
Assume H&S PPE @ $18 per person per half day.
Assume miscellaneous cost of $200.
Assume sample shipment cost of $500.

Total: $ 3,271

Assume: $ 3,300 per sampling event

Total Monitoring Cost: $ 21,000 per sampling event

Alternative 3 - In-Situ Oxidation/Ex-Situ Stabilization/On-Site Disposal

Prepared By: PDP
Checked By: LT

Injection Well Abandonment

1. Materials

Assume grout @ $13/lf.

Total length of wells to be abandoned: 240 lf

Total = 240 lf x $ 13 /lf
= $ 3,120
Assume: $ 3,100

2. Labor

Assume 1.5 hours per well.
Assume drilling standby rate of $125 per hour.

Total = 16 wells x 1.5 hrs/well x $ 125 /hr
= **$ 3,000**

Total Cost for Well Abandonment: $ 6,100

Prepared By: PDP
Checked By: LT

1. Volume and Area of Concrete to be Removed/Disposed (see Figure A-3.2)

Area	Length (ft)	Width (ft)	Thickness (ft)	Volume (cf)	Volume (cy)	Area (sf)	Area (sy)
North Yard 1	60	15	1	900	33.3	900	100
North Yard 2	55	38	2	4180	154.8	2090	232.2
Old Plant	100	47	2	9400	348.1	4700	522.2
New Plant	100	75	1.5	11250	416.7	7500	833.3
South Yard	100	15	1	1500	55.6	1500	166.7
East Yard 1	40	25	1	1000	37.0	1000	111.1
East Yard 2	30	20	1	600	22.2	600	66.7
East Yard 2 Wall	77	1.2	1.2	104.8	3.9	89.8	10.0
East Yard 2 Wall	31	1.2	1.5	54.3	2.0	36.2	4.0

Total: 1074 cy 2046 sy
Assume: 1070 cy 2050 sy

For disposal, assume 50 percent volume expansion: 1600 cy

Note: Of this total volume of concrete removed, approximately 120 cy (in place volume) will be removed during installation of injection points (see Figure A-3.1):
13 of the 16 trenches require removal of varying amounts of concrete.
Assume 906 lf with concrete thickness of 1.5 ft.
Assume 100 lf with concrete thickness of 2.5 ft.
Assume trenches are 2 feet wide.

2. Volume and Area of Asphalt to be Removed/Disposed

Assume thickness of 4 inches

Area = 4500 sf - 1500 sf (concrete block bldg & concrete slab)
= 3000 sf
= 333 sy

Assume: 340 sy

Volume = 1000 cf
= 37 cy plus 20 percent volume expansion

Assume: 40 cy

3. Concrete Demolition

Assume demolition of reinforced concrete (7 to 24 inches thick) @ $107/cy
(Means 1998: Item No. 020 554 2200)
Assume location factor of 1.275

= 1070 cy x $ 107 /cy x 1.275 location factor
= $ 145,975

Assume: $ 146,000

Assume productivity rate for concrete demolition is 24 cy per day. Total of 45 days required for demolition. Assume six weeks plus three weeks performed during excavation of other parts of the site.

Prepared By: PDP
Checked By: LT

4. Pavement Demolition

Assume demolition of pavement (4 to 6 inches thick) @ $6.10/sy
(Means 1998; Item No. 020 554 1750)
Assume location factor of 1.275

=	340	sy x	$	6.10	/sy x	1.275 location factor
= $	2,644					

Assume: **$ 2,600**

Assume productivity rate of 420 sy per day. Assume 1 day for pavement demolition.

5. Transport and Disposal of Concrete & Asphalt

Assume transport and disposal cost of concrete with rebar and asphalt @ $18 /cy (quote from Liotta & Sons, Inc.; 10/98)

=	1640	cy x	$	18	/cy
= $	29,520				

Assume: **$ 29,500**

Shoring Placement (see Figure 4-13)

Assume temporary wood shoring (solid sheeting with wales, braces, spacers) including placement, extraction, and salvage for 8 foot excavation @ $6.30/sf (Means, 1998; Item No. 021 614 3910).
Assume location factor of 1.275.
Assume productivity rate of 330 sf per day.
Assume distance around excavated areas where shoring will be installed of 950 lf.
Assume sheeting installed to 8 feet (2 feet below deepest excavated surface).

= 8 ft x 950 ft x $6.30 /sf x 1.275 location factor
= $ 61,047

Assume: $ 61,000

Assume total duration of 5 weeks. Assume that half of the installation is performed during excavation of other areas.

Excavation

Assume excavation of soil @ $8.70/cy (Means, 1998; Item No. 022 250 2060.
Assume location factor of 1.275.
Assume productivity rate of 200 cy/day.

Total = 6400 cy x $ 8.70 /cy x 1.275 location factor
= $ 70,992

Assume: $ 71,000

Approximately 6.5 weeks to excavate 6,400 cy. Assume 6 weeks plus during stabilization treatment.

Solidification/Stabilization

1. **Solidification/Stabilization Treatment**

Assume volume of soil to be treated is 6,400 cy (note: actual volume will be smaller since oversized materials [>1.5 inches] will be screened out prior to treatment).
Assume cost for treatment @ $20 to $35/ton (includes mob/demob, screening, and treatment: STC Remediation, 12/98).
Equipment will require relocation during remediation due to size of site and extent of area to be treated. According to STC Remediation, cost is minimal and can be included as part of stabilization cost quote of $20 to $35 per ton.
Assume 1.5 tons per cy.
Assume productivity rate of 500 tons per day (STC, 12/98).

Total = 9600 tons x $35 /ton
= **$336,000**

2. **Monitoring during Treatment**

Analytical Cost

Assume 1 sample for first day of treatment and 1 sample per week of treatment thereafter.
Assume samples to be leached using ASTM Method D3987 ($40/sample) and SW-846 Method 1312 ($75/sample).
Assume leached samples to be analyzed for TAL ICP metals @ $135 per sample.
Assume 25% increase in analytical cost for 1 week turnaround.
Assume contingency of 2 re-samples.
Assume 2 QA/QC samples (duplicate, field blank)
Assume no data validation.

Total Number of Samples:		9
Cost per sample:	$	481
Total Analytical Cost:	$	4,331
Assume:	**$**	**4,300**

Sampling Cost

Assume sampling will be performed by one on-site personnel (no additional labor charge).
Assume sampling performed over period of 7 days.
Assume H&S PPE @ $18 per person per day.
Assume miscellaneous cost of $100.
Assume sample shipment cost of $700.

Total: $ 926

Assume: $ 900

Total for monitoring during stabilization treatment: $ 5,200

Surface Water Runoff Control

1. Catchbasin Installation

Assume no additional excavation necessary for catch basin placement.
Assume cost for backfill of catchbasin is included in site backfill estimate.
Assume precast catchbasin (4 ft x 4 ft x 6 ft) @ $910 each (Means. 1998: Item No. 027 152 1120).
Assume frame & cover (18-inch diameter. light traffic. 100 lbs) @ $202 each set (Means, 1998: Item No. 027 152 1800).
Assume location factor of 1.275.
Assume 2 days for placement of catchbasins.

Cost per catchbasin:	$	1,418	
Assume:	**$**	**1,400**	**per catchbasin**

2. U-Shaped Perimeter Drain Installation

Assume no additional excavation necessary for drain installation.
Assume cost for backfill of drain is included in site backfill estimate.
Assume cost materials & installation of U-shaped (19 inch channel depth) perimeter drain @ $50/lf (ABT. Inc.. 10/98).
Assume 1.5 weeks for placement of perimeter drain system.

Total length of perimeter drain is: 200 lf

Cost for placement: $ 10,000

3. Curb Installation

Assume length of curb is 650 feet.
Assume placement of concrete curbing around perimeter (see Figure 4-2 for curb placement locations) @ $5.40/lf (includes steel forms; Means. 1998; Item No. 025 254 0410).
Assume location factor of 1.275.
Assume production rate of 700 lf/day.

Cost for curb placement:	$	4,475
Assume:	**$**	**4,500**

4. Extension of Sidewalk and Curb

Assume 12 ft by 300 ft sidewalk extension from southeastern edge of East Yard to corner of Hollers Avenue.
Assume concrete sidewalk (3,000 psi concrete. 4 inches thick) @ $2.55/sf (Means. 1998: 025 128 0310).
Assume 4-inch bank run gravel base @ $0.44/sf (Means. 1998: 025 128 0450).
Assume placement of concrete curbing @ $5.40/lf (includes steel forms: Means. 1998: Item No. 025 254 0300).
Assume location factor of 1.275.
Assume production rate of 2500 sf per day for base material and 600 sf per day for concrete.
Assume production rate of 700 lf/day for placement of curb.

Cost for curb placement:	$	15,790
Assume:	**$**	**15,800**

Assume time for installation of surface water runoff controls of 4 weeks.

Prepared By: PDP
Checked By: LT

Backfilling Excavated Areas

Assume backfill of treated soil @ $1.25/cy (Means, 1998; Item No. 022 208 4220).
Assume productivity rate for backfill of 1,100 cy/day.
Assume compaction of treated soil @ $0.43/cy (Means, 1998; Item No. 022 226 6260).
Assume productivity rate for compaction of 3465 cy/day.
Assume location factor of 1.275.
Assume 5 percent volume increase as a result of 8 percent dry reagent during treatment (STC estimates volume increase of 2 percent).

Volume of soil to be backfilled: 6720 cy

Cost for backfill & compaction: $ 14,394

Assume: $ 14,400

Assume total duration for backfill of Upper Site and East Yard of 2 weeks.

Prepared By: PDP
Checked By: LT

Monitoring Well Installation

Assume 4 existing on-site shallow monitoring wells are removed during soil excavation.
Assume replacement of these 4 shallow wells for long-term monitoring @ $12,000.
Assume 15 feet monitoring wells which straddle the bedrock interface (10 feet overburden and 5 feet bedrock).
Assume oversight provided by on-site personnel.

Total : $ 12,000

Alternative 3 - In-Situ Oxidation/Ex-Situ Stabilization/On-Site Disposal

Prepared By: PDP
Checked By: LT

Long-Term Monitoring

Assume annual sample of 12 wells (6 on site and 6 off site).
Assume no validation of sample data.
Assume preparation of a brief sampling report (data tabulation only) for each sampling event: no 5-year review report will be generated.

1. Analytical Cost

Samples analyzed for TAL ICP metals only @ $135/sample.

Total number of samples:	12 environmental samples
	1 duplicate
	1 field blank
	1 MS
	1 MSD
	16 samples

Total analytical cost: $ 2.160
Assume: $ 2,200 per sampling event

2. Sampling Cost

Assume 2 sampling technicians @ $25/hour.
Assume labor multiplier of 3.
Assume sampling performed over two 8-hour days.
Assume PPE @ $18 per person per half day.
Assume van rental @ $80 per day.
Assume per diem @ $120 per person per day.
Assume rental of H&S monitoring equipment and field measurement equipment @ $800.
Assume use of diposable bailers @ $20 per bailer.
Assume consumable supplies @ $100.
Assume sample shipment @ $250.

Total: $ 4.574

Assume: $ 4,600 per sampling event

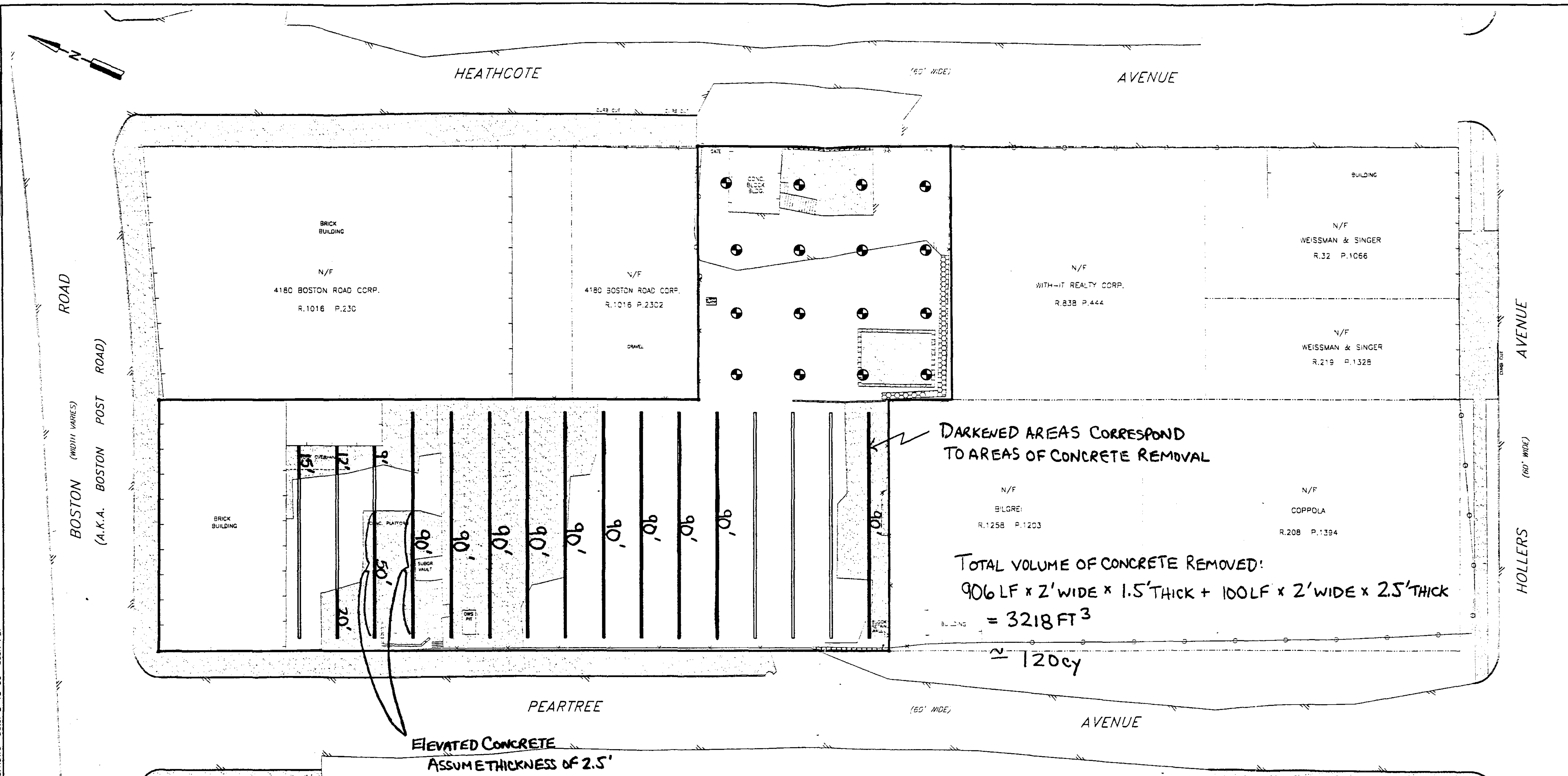
3. Laboratory Procurement & Sampling Report Preparation

Assume one person @ $30 per hour for 3 days for preparation of Sampling Report.
Assume one person @ $35 per hour for 3 days for laboratory procurement.
Assume labor multiplier of 3.

Total: $ 4.680

Assume: $ 4,700 per sampling event

Total for Long-Term Monitoring: $ 11,500 per sampling event



LEGEND

INJECTION TRENCH	CONCRETE WALL
INJECTION WELL	CONCRETE STEPS
BUILDING EDGE	CHAIN LINK FENCE
HEXAGON PROPERTY LINE	METAL STOCKADE FENCE
ADJOINING PROPERTY LINE	LIGHT POLE
CONCRETE	N/F COPPOLA R.208 P.1394 — PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
CONCRETE CURB	
EDGE OF MACADAM	
MASONRY STONE WALL	

NOTES

1. PROPOSED INJECTION TRENCH AND WELL LOCATIONS BASED ON INFORMATION PROVIDED BY IN-SITU OXIDATIVE TECHNOLOGIES, INC., LAWRENCEVILLE, NEW JERSEY.
2. INJECTION TRENCH PVC PIPING WILL BE PLACED AT A DEPTH OF 1 TO 2 FEET BELOW GROUND SURFACE. INJECTION WELLS WILL BE INSTALLED TO A MAXIMUM DEPTH OF 15 FEET BELOW GROUND SURFACE.
3. INJECTION WELLS WILL BE PROPERLY ABANDONED AT THE COMPLETION OF THE IN-SITU OXIDATION TREATMENT.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

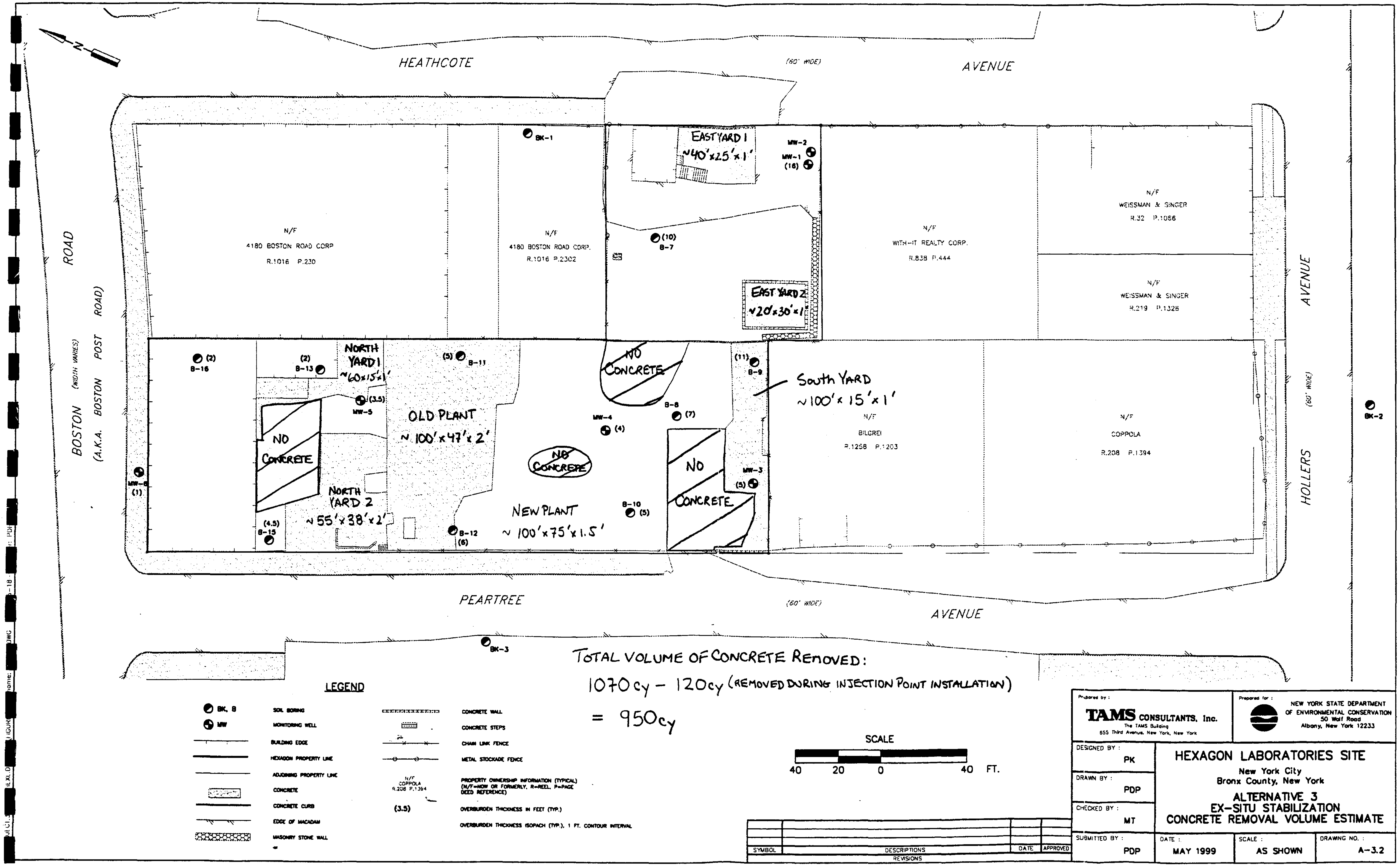
HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVE 3
IN-SITU OXIDATION INJECTION POINTS
CONCRETE REMOVAL VOLUME ESTIMATE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUBMITTED BY:	DATE:	SCALE:	DRAWING NO.:
LT	PDP	MT	PDP	MAY 1999	AS SHOWN	A-3.1

U:\PROJECT.33\5851HEXL.DEC\FFS\FIGURES Filename: A-3.1.DWG Date: 5-18-99 User: PDP


HEATHCOTE (60' WIDE) AVENUE
PEARTREE (60' WIDE) AVENUE
HOLLERS (60' WIDE) AVENUE
BOSTON (WIDTH VARIES) ROAD
(A.K.A. BOSTON POST ROAD)
N
N/F 4180 BOSTON ROAD CORP R.1016 P.230
N/F 4180 BOSTON ROAD CORP. R.1016 P.2302
N/F WITH-IT REALTY CORP. R.838 P.444
N/F WEISSMAN & SINGER R.32 P.1056
N/F WEISSMAN & SINGER R.219 P.1328
N/F BILGREI R.1258 P.1203
N/F COPPOLA R.208 P.1394
BK-1
BK-2
BK-3
MW-1 (16)
MW-2
MW-3 (5)
MW-4 (4)
MW-5 (3.5)
MW-6 (1)
B-7 (10)
B-8 (7)
B-9 (11)
B-10 (5)
B-11 (5)
B-12 (6)
B-13 (2)
B-15 (4.5)
B-16 (2)
EAST YARD 1 ~40'x25'x1'
EAST YARD 2 ~20'x30'x1'
SOUTH YARD ~100'x15'x1'
NORTH YARD 1 ~60'x15'x1'
NORTH YARD 2 ~55'x38'x2'
OLD PLANT ~100'x47'x2'
NEW PLANT ~100'x75'x1.5'
NO CONCRETE
NO CONCRETE
NO CONCRETE
NO CONCRETE
TOTAL VOLUME OF CONCRETE REMOVED:
1070cy – 120cy (REMOVED DURING INJECTION POINT INSTALLATION)
= 950cy
LEGEND
BK, B SOIL BORING
MW MONITORING WELL
BUILDING EDGE
HEXAGON PROPERTY LINE
ADJOINING PROPERTY LINE
CONCRETE
CONCRETE CURB
EDGE OF MACADAM
MASONRY STONE WALL
CONCRETE WALL
CONCRETE STEPS
CHAIN LINK FENCE
METAL STOCKADE FENCE
N/F COPPOLA R.208 P.1394 PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
(3.5) OVERBURDEN THICKNESS IN FEET (TYP.)
OVERBURDEN THICKNESS ISOPACH (TYP.), 1 FT. CONTOUR INTERVAL
SCALE
40 20 0 40 FT.
SYMBOL DESCRIPTIONS DATE APPROVED
REVISIONS
Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York
Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233
DESIGNED BY: PK
DRAWN BY: PDP
CHECKED BY: MT
SUBMITTED BY: PDP
HEXAGON LABORATORIES SITE
New York City
Bronx County, New York
ALTERNATIVE 3
EX-SITU STABILIZATION
CONCRETE REMOVAL VOLUME ESTIMATE
DATE: MAY 1999
SCALE: AS SHOWN
DRAWING NO.: A-3.2

ALTERNATIVE 4A
EXCAVATION/OFF-SITE DISPOSAL

TABLE A-4A
COST ESTIMATE
ALTERNATIVE 4A - SOIL EXCAVATION/OFF-SITE DISPOSAL

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	CAPITAL COSTS				
	Direct Capital Costs				
A.	Mobilization /Temporary Facilities/ Demobilization				
	1. Mobilization/Demobilization	1	$60,200	LS	$60,200
	2. Temporary facilities	1	$59,000	LS	$59,000
	3. Site security	6	$10,700	Month	$64,200
B.	Health and Safety				
	1. Health & safety measures	5	$18,500	Month	$92,500
	2. Decon water sampling and disposal	1	$19,200	LS	$19,200
	3. Decon pad	1	$16,600	LS	$16,600
C.	Construction Management	8	$30,000	Month	$240,000
D.	Construction and Remediation				
	1. Concrete Slab/Asphalt Paving Demolition and Disposal				
	a. Demolition - concrete	1,070	$136.43	CY	$146,000
	b. Demolition - pavement	340	$7.78	SY	$2,600
	c. Transportation and disposal	1,640	$18	CY	$29,500
	2. Excavation				
	a. Temporary shoring	7,600	$8.03	SF	$61,000
	b. Excavate trench	80	$7.08	CY	$600
	c. Slurry wall construction	3,970	$19.32	CF	$76,700
	d. Soil excavation	6,400	$11.09	CY	$71,000
	3. Sampling and Analysis (for Disposal)				
	a. Sample collection (non-haz soil)	1	$2,500	LS	$2,500
	b. Sample collection (haz soil)	1	$200	LS	$200
	c. Sample analysis (non-hazardous facility)	1	$22,900	LS	$22,900
	d. Sample analysis (hazardous facility)	1	$1,700	LS	$1,700
	4. Sampling and Analysis (for Documentation)				
	a. Sample collection	1	$3,300	LS	$3,300
	b. Sample analysis	1	$18,600	LS	$18,600
	5. Offsite Transportation				
	a. Roll-off spotting	60	$300	EA	$18,000
	b. Roll-off rental (60 containers for 11 weeks at $10/day)	1	$46,200	LS	$46,200
	c. Liner	384	$35	Load	$13,400
	d. Non-hazardous waste landfill	378	$600	Load	$226,800
	e. Hazardous waste facility	6	$2,650	Load	$15,900
	6. Offsite Disposal				
	a. Non-hazardous waste landfill	9,450	$36	Ton	$340,200
	b. Hazardous waste facility	120	$177	CY	$21,200
	7. Backfill				
	a. Gravel (Upper Site only)	1,189	$20	CY	$23,800
	b. Geotextile	31,000	$0.27	SF	$8,400
	c. Common fill	6,300	$15.00	CY	$94,500
	Total Direct Costs				$1,796,700

TABLE A-4A
COST ESTIMATE
ALTERNATIVE 4A - SOIL EXCAVATION/OFF-SITE DISPOSAL

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	Indirect Capital Costs				
	1. Engineering and Permitting				$200,000
	2. Contingency (15% of Total Direct Costs)				$269,505
	Total Indirect Costs				$469,505
	TOTAL CAPITAL COSTS				$2,266,205
	ANNUAL O&M COSTS				
	None				$0
	TOTAL ANNUAL O&M COSTS				$0
	PRESENT WORTH OF COSTS				
A.	Annual O&M Costs (30 year duration, 5% discount rate)				$0
B.	Total Capital Costs				$2,266,205
	TOTAL PRESENT WORTH				$2,266,205

Assume: $2,266,000

Alternative 4A - Soil Excavation/Off-Site Disposal

Prepared By: PDP
Checked By: LT

Project Duration

Assume:	Mobilization/demobilization	4 weeks
	Site preparation for excavation (shoring, slurry wall)	5.5 weeks
	Concrete/pavement demolition	5 weeks & during excavation
	Excavation & Backfill	8.5 weeks
	Transport and dispose (includes confirmatory sampling)	2 weeks & during excavation
	Total:	**25 weeks**
	Assume:	**6 months**

Time for workplan preparation and for obtaining any approvals/permits is not included.

Engineering & Permitting

It is assumed that NYSDEC will hire an Engineering Consultant to prepare plans and specifications for the remediation.
It is assumed that work includes the preparation of:
- Plans and specifications for competitive bidding;
- Discussion with state and local agencies regarding permit requirements;
- Submission of 30% design submittal for review;
- Submission of 90% design submittal for review;
- Preparation of a design report;
- Preparation of an engineering cost estimate; and
- Provision of pre-award services.

Based on TAMS' experience, this work can cost between $150,000 to $250,000, depending on the complexity of the remediation.
- $250,000 for high complexity
- $200,000 for medium complexity
- $150,000 for low complexity

For Alternative 4A, work is considered to be medium complexity.

Assume Engineering & Permitting cost of: $200,000

Prepared By: PDP
Checked By: LT

Construction Management

It is assumed that NYSDEC will hire an engineering consultant to perform construction period services during the remediation.
It is assumed that work includes the preparation of:
- Attendance at pre-construction meetings;
- Review of contractor submittals;
- Full time project inspection;
- Maintenance of construction records and reports;
- Quality assurance;
- Change order preparation;
- Processing of contractor application for payment; and
- Preparation of Final Remediation Report.

It is assumed that construction management services will begin one month prior to the start of construction activities.
It is assumed that construction management services will continue for one month after the end of on-site activities.
Based on TAMS' experience, the cost of construction management is approximately $30,000 per month.

Assume a monthly Construction Management cost of: $30,000

Alternative 4A - Soil Excavation/Off-Site Disposal

Prepared By: PDP
Checked By: LT

Mobilization & Demobilization (Includes Contractor Preparation of Project Plans)

1. Materials & Equipment

Assume 20 pieces of equipment at $500 per piece for mobilization:	$	10,000
Assume 20 pieces of equipment at $500 per piece for demobilization:	$	10,000
Assume $10,000 for mob/demob of materials:	$	10,000
Subtotal:	**$**	**30,000**

2. Contractor Preparation of Project Plans

Includes Work Plans, Health & Safety Plans, QA/QC Plans, and Erosion Control Plan.
Assume labor requirement of 2 persons @ $30 per hour per person for 1 month.
Assume labor multiplier of 3.

= 2 persons x $30 /hour x 40 hours/week x 4.2 weeks/month x 1 month x 3 multiplier

= $30,240

Assume: **$30,200**

Total Mobilization/Demobilization Cost: **$60,200**

Prepared By: PDP
Checked By: LT

Temporary Facilities

1. **Temporary Facilities - One Time Cost**
   Assume 2 trailers @ $1,300 per trailer
   Assume office trailer equipment @ $5,000 per trailer

- Computer	$	2,500
- Printer	$	500
- Modem	$	200
- Fax Machine	$	500
- Copier	$	500
- Phone	$	100
- Answering Machine	$	100
- Desk & Chair (2)	$	300
- Conference Table	$	100
- Chairs (4)	$	100
- File Cabinet	$	100
	$	5,000

Assume electrical hookup @ $2,500 per trailer
Assume phone hookup @ $200 per trailer
Assume project sign @ $500
Assume temporary site controls (e.g. barricades, traffic control, erosion control) @ $5,500
Assume decon facility mob/demob @ $1,000
Assume water tank(s) mob/demob @ $1000
Assume misc. equipment/supplies @ $3,000

Total Temp. Facilities One Time Cost: $ 29,000

2. **Monthly Costs**
   Assume trailer rental @ $500 per trailer
   Assume sanitary facility & water @ $500
   Assume janitorial service @ $500
   Assume trailer electrical service @ $200 per trailer
   Assume miscellaneous electrical requirements @ $200
   Assume phone service @ $200 per trailer
   Assume miscellaneous costs @ $2000

Subtotal: $ 5,000 per month

Duration: 6 months

Total Monthly Costs: $ 30,000

Total Temporary Facilities Cost: $ 59,000
Assume: $ 59,000

Prepared By: PDP
Checked By: LT

Site Security

Assume on-site security will be provided from 5 PM to 7AM during construction activities.
Assume on-site security will be provided 24 hours per day for weekends during construction activities.
Assume 2 unarmed security guards @ $11 per hour per guard.

Monthly Security Cost:	=	2 guards x	14 hours per day x	21 weekdays per month x	$11 per hour +
		2 guards x	24 hours per day x	8 weekend days per month x	$11 per hour
	= $10,692				

Assume monthly security cost of: **$10,700**

Prepared By: PDP
Checked By: LT

Health & Safety

Assume monitoring equipment @ $3,000 per month
Assume 2 sets of PPE per day per person @ $18 per unit (PPE costs associated with sampling included separately in sampling cost estimate)
Assume 10 workers within exclusion zone at one time
Assume on-site Safety Coordinator @ $5,000 per month
Assume decon facility (shower, etc.) @ $2,900 per month
(Means Environmental Remediation Cost Data - 33 17 0821; includes 1.23 Location Factor)

Total: $ 18,460 per month

Assume: $ 18,500 per month (during construction activities excluding mob/demob)

Decontamination Pad

Assume 20 ft x 30 ft x 6 inch decon pad with 6-inch high curbs
Assume construction of 6-inch slab on grade (not including forms or reinforcement) @$2.09/sf
(from Means, 1998; Item No. 033 130 5010)
Assume reinforcement with welded wire fabric @ $66.50 per 100 sf
(from Means, 1998; Item No. 032 207 0700)
Assume use of trench forms on floor @$10.35 per sf
(from Means, 1998; Item No. 031 170 6000)
Assume location factor of 1.275
Assume decon pad walls @ $1,000
Assume sump pit and pump @ $1,500
Assume pressure washer @ $3,500 (purchase)
(from Means Environmental, 1999; Item No. 33 17 0815; Location factor of 1.23)
Assume one 21,000 gallon frac tank @ $1,200 per month
Assume project duration of 6 months

Slab = 600 sf x $2.09 /sf + 600 sf x $0.67 /sf + 100 sf x $10.35 /sf

= $ 2,688 x 1.275 multiplier
= $ 3,427

Total = 16,627

Assume $ 16,600

Prepared By: POP
Checked By: LT

Estimate of Volume of Decontamination Water

1. **Personnel Decon**
   Assume 10 workers, two showers per day, and five gallons per shower

Total Volume =	100	gallons per day x	21	days per month
=	2,100	gallons per month x	5	months
=	10,500	gallons		

2. **Equipment Decon**
   Assume 10 pieces of equipment, one wash per two weeks, 20 gallons per wash per piece of equipment

Total Volume =	400	gallons per month x	5	months
=	2000	gallons		

3. **Concrete Slab Decon (prior to disposal)**
   Assume 25 sf per minute @ 6 gallons per minute
   Assume surface area of concrete to be washed is 36,900 sf (includes both sides of concrete slabs)

Total Volume =	36900	sf /	25	sf/minutes x	6	gallons/minute
=	8856	gallons				

Total Volume of Decon Water =	**21,356**	**gallons**
Assume:	**21,400**	**gallons**

Alternative 4A - Soil Excavation/Off-Site Disposal

Prepared By: PDP
Checked By: LT

Collection & Disposal of Decontamination Water

1. Equipment and Concrete Decon Labor

Assume 2 laborers @ $25 per hour for pressure washing
Assume total area of concrete = 36.900 sf
Assume decon rate of 25 sf per minute
Assume labor multiplier of 2.
Assume 18 hours total for decon of equipment over course of construction activities
(10 minutes per piece of equipment. 10 pieces of equipment per two weeks. 21 weeks of construction activities).

Time for decon = 43 hours

Labor cost = 43 hours x $ 25 / hour x 2 laborers x 2 multiplier

= $ 4,300

2. Analytical Costs for Disposal

Assume 4 water samples for disposal @ $1.050 per sample (includes 25% increase for 1 week turnaround)

Analytical:	VOCs	$	125
	SVOCs	$	250
	Pest/PCBs	$	150
	TAL ICP Metals	$	135
	TDS	$	10
	TSS	$	10
	TOC	$	35
	Dissolved Metals	$	120
		$	835 plus 25% markup for 1 week turnaround time

Analytical Cost = $ 4,200

3. Transport and Treatment/Disposal Cost

Assume hazardous water transport and disposal @ $0.78 per gallon
Assume non-hazardous water transport and disposal @ $0.50 per gallon
Assume decon water is non-hazardous

Total Volume of Decon Water = 21.400 gallons

Transport and Disposal Cost = $ 10.700

Total Collection. Analysis. Transport. and Disposal = $ 19.200

Assume $ 19,200

Prepared By: PDP
Checked By: LT

1. Volume and Area of Concrete to be Removed/Disposed (see Figure A-4.1)

Area	Length (ft)	Width (ft)	Thickness (ft)	Volume (cf)	Volume (cy)	Area (sf)	Area (sy)
North Yard 1	60	15	1	900	33.3	900	100
North Yard 2	55	38	2	4180	154.8	2090	232.2
Old Plant	100	47	2	9400	348.1	4700	522.2
New Plant	100	75	1.5	11250	416.7	7500	833.3
South Yard	100	15	1	1500	55.6	1500	166.7
East Yard 1	40	25	1	1000	37.0	1000	111.1
East Yard 2	30	20	1	600	22.2	600	66.7
East Yard 2 Wall	77	1.2	1.2	104.8	3.9	89.8	10.0
East Yard 2 Wall	31	1.2	1.5	54.3	2.0	36.2	4.0

Total: 1074 cy 2046 sy
Assume: 1070 cy 2050 sy

For disposal, assume 50 percent volume expansion: 1600 cy

2. Volume and Area of Asphalt to be Removed/Disposed

Assume thickness of 4 inches

Area = 4500 sf - 1500 sf (concrete block bldg & concrete slab)
= 3000 sf
= 333 sy

Assume: 340 sy

Volume = 1000 cf
= 37 cy plus 20 percent volume expansion

Assume: 40 cy

3. Concrete Demolition

Assume demolition of reinforced concrete (7 to 24 inches thick) @ $107/cy
(Means 1998; Item No. 020 554 2200)
Assume location factor of 1.275

= 1070 cy x $ 107 /cy x 1.275 location factor
= $ 145,975

Assume: $ 146,000

Assume productivity rate for concrete demolition is 24 cy per day. Total of 45 days required for demolition. Assume half of work is performed during excavation of other parts of the site.

4. Pavement Demolition

Assume demolition of pavement (4 to 6 inches thick) @ $6.10/sy
(Means 1998: Item No. 020 554 1750)
Assume location factor of 1.275

=		340 sy x	$	6.10	/sy x	1.275 location factor
=	$	2.644				

Assume: **$ 2,600**

Assume productivity rate of 420 sy per day. Assume 1 day for pavement demolition.

5. Transport and Disposal of Concrete & Asphalt

Assume transport and disposal cost of concrete with rebar and asphalt @ $18 /cy (quote from Liotta & Sons. Inc.: 10/98)

=		1640	cy x	$	18 /cy
=	$	29,520			

Assume: **$ 29,500**

Prepared By: PDP
Checked By: LT

Shoring Placement (see Figure 4-13)

Assume temporary wood shoring (solid sheeting with wales, braces, spacers) including placement, extraction, and salvage for 8 foot excavation @ $6.30/sf (Means, 1998; Item No. 021 614 3910).
Assume location factor of 1.275.
Assume productivity rate of 330 sf per day.
Assume distance around excavated areas where shoring will be installed of 950 lf.
Assume sheeting installed to 8 feet (2 feet below deepest excavated surface).

= 8 ft x 950 ft x $6.30 /sf x 1.275 location factor
= $ 61,047

Assume: $ 61,000

Assume total duration of 5 weeks. Assume that half of the installation is performed during excavation of other areas.

Prepared By: PDP
Checked By: LT

Slurry Wall Construction

1. Wall Volume Estimate

Assume slurry wall will be installed along the eastern and southern perimeters of the upper site as shown in Figures 4-11 and A-4.2.
Assume slurry wall will extend from the top of bedrock to an elevation of approx. 34 feet NGVD.
Assume slurry wall will be constructed of unreinforced cement-bentonite mixture.
Assume slurry wall will be 3 feet thick.

Length (ft)	Width (ft)	Height (ft)	Volume (cf)	
75	3	2	450	
70	3	4	840	
57	3	8	1368	
36	3	8	864	
37	3	4	444	
		Total:	3966	
		Assume:	**3970**	**cf**

2. Estimate of Soil Volume Above Top of Slurry Wall

Assume slurry wall will be installed along the eastern and southern perimeters of the upper site as shown in Figures 4-11 and A-4.2.
Refer to Figure 1-4 for overburden thickness.
Assume slurry wall will extend from the top of bedrock to an elevation of approx. 34 feet NGVD.
Assume slurry wall will be 3 feet thick.

Length (ft)	Width (ft)	Height (ft)	Volume (cf)	Volume (cy)	
75	3	2.5	562.5	20.8	
70	3	3	630	23.3	
57	3	2	342	12.7	
36	3	2	216	8.0	
37	3	3	333	12.3	
			Total:	77	
			Assume:	**80**	**cy**

3. Slurry Wall Construction

Assume excavated trench in wet soils, backfilled with 3,000 psi concrete, no reinforcement @ $15.15 per cf (Means, 1998; Item No. 021 684 0050).
Assume productivity rate of 333 cf/day for slurry wall placement.
Assume trench excavation (to top of slurry wall construction) @ $5.55 per cy (Means, 1998; Item No. 022 254 0050; Backfill accounted for as part of site backfill cost).
Assume productivity rate of 150 cy/day for excavation to top of slurry wall.
Assume location factor of 1.275.

=		3970	cf x	$	15.15	/cf x	1.275 location factor +
		80	cy x	$	5.55	/cy	1.275 location factor
= $	77.252						

Assume: $ **77,300**

Assume 15 days for slurry wall construction.

Prepared By: PDP
Checked By: LT

Excavation

Assume excavation of soil @ $8.70/cy (Means, 1998; Item No. 022 250 2060).
Assume location factor of 1.275.
Assume productivity rate of 200 cy/day.

Total	6400 cy x	$ 8.70 /cy	1.275 location factor
= $ 70,992			

Assu $ 71,000

Approximately 6.5 weeks to excavate 6,400 cy. Assume 8.5 weeks to account for contingencies.

Alternative 4A - Soil Excavation/Off-Site Disposal

Prepared By: PDP
Checked By: LT

Estimate of Hazardous Soil Volume

Samples which may fail TCLP (using 20-fold estimate of TCLP concentration)

Sample	Depth (ft)	Area	Analyte Category
HXB11S2	4-5	Old Plant	VOCs
HXB4S2	2-4	New Plant	VOCs
NPT2	3-3.5	New Plant	VOCs
NPT3	3-3.5	New Plant	VOCs
NPT4	3-3.5	New Plant	VOCs
HXB19	1.3-1.7	East Yard	Metals
HXSS4	0-0.5	New Plant	Metals
HXB10S1	0-2	New Plant	Metals
HXB6S1	1-2	Bos.Post Rd.	Metals
HX-OM1	Surface Scrape	Hydrotherm 1	Metals
HXB17	2-2.5	East Yard	Metals
HXB20	2.2-2.3	East Yard	Metals
HXB21	2-2.5	East Yard	Metals
HXB11S2	4-5	Old Plant	Metals
HXB15S1	2.5-4.5	North Yard	Metals
SYTC-1	2.5-4.5	South Yard	Metals
NYT-2	5.5-6	North Yard	Metals

Assume Total Volume of Hazardous Soil is 100 cy.

Alternative 4A - Soil Excavation/Off-Site Disposal

Prepared By: PDP
Checked By: LT

Sampling and Analysis for Disposal of Non-Hazardous Soil

1. Analytical Costs

Assume sampling frequency of 500 cy (James Hull, WMI - Grows Landfill; 11/98)
Assume 20 percent bulking after excavation
Total volume of excavated soil is 6,400 cy, 100 cy of which is assumed to be hazardous
Assume no validation of sample data

Number of samples = 7560 cy/ 500 cy/sample
= 15.12
Assume: 16 environmental samples

Assume contingency for re-sampling of 2 samples.

Total number of samples = 18

Samples analyzed for:	TCLP	$850
	PCBs	$90
	Reactive CN / Reactive Sulfide	$45
	Ignitability	$30
		$1,015 per sample x 25% markup for 1 week turnaround
	Total:	**$1,270 per sample**

Analytical Cost = $1,270 /sample x 18 samples

= $22,860

Assume: $22,900

2. Sampling Cost

Assume sampling will be performed by two on-site personnel (no additional labor charge)
Assume H&S PPE @ $18 per person per day
Assume miscellaneous cost of $100
Assume sample shipment of $1,800

Total: $ 2,548

Assume: $ 2,500

Total Sampling and Analytical Cost: $ 25,400

Alternative 4A - Soil Excavation/Off-Site Disposal

Prepared By: POP
Checked By: LT

Sampling and Analysis for Disposal of Hazardous Soil

1. Analytical Costs

Assume collection of one representative sample of 100 cy of hazardous soil
Assume no validation of sample data

Sample analyzed for:	VOCs	$130	
	SVOCs	$275	
	PCBs	$90	
	TCLP	$850	
		$1,345	per sample x 25% markup for 1 week turnaround
	Total:	**$1,680**	**per sample**

Analytical Cost =	$1,680	/sample x	1 sample
=	$1,680		
Assume:	**$1,700**		

2. Sampling Cost

Assume sampling will be performed by two on-site personnel (no additional labor charge)
Assume H&S PPE @ $18 per person per day
Assume miscellaneous cost of $50
Assume sample shipment of $100

Total:	$	186
Assume:	**$**	**200**

Total Sampling and Analytical Cost:	$	1,880
Assume:	**$**	**1,900**

Prepared By: PDP
Checked By: LT

Sampling and Analysis for Documentation Sampling

1. Analytical Costs

Assume documentation sampling will be conducted at the bottom surface of the excavated areas in the East Yard and the southeastern part of the South Yard. All other areas on site will be excavated to the top of bedrock and no samples will be collected.
Assume one sample will be collected per 50 ft by 50 ft grid.
Assume documentation sampling will be conducted along the perimeter of the excavation which is approximately 950 ft.
Assume one sample will be collected per 50 ft along perimeter.
Assume no validation of sample data.

Number of bottom samples =	4	samples from East Yard +	1	sample from South Yard
=	5			
Number of sidewall samples =	950	lf /	50	lf/sample
=	19			

Total number of environmental samples: 24

Assume 3 QA/QC (MS/MSD and duplicate) samples and 2 field blanks.

Total number of samples = 29

Samples analyzed for:			
	VOCs	$	130
	SVOCs	$	275
	PCBs	$	90
	TAL ICP Metals	$	145
	Total:	**$**	**640** **per sample**

Analytical Cost = $ 640 /sample x 29 samples
= $18,560

Assume: $18,600

2. Sampling Cost

Assume sampling will be performed by one on-site personnel (no additional labor charge) and one assistant @ $25/hour.
Assume sampling will be conducted over a period of three 8-hour days.
Assume labor multiplier of 3.
Assume car rental of $65 per day.
Assume per diem for assistant of $120 per day.
Assume H&S PPE @ $18 per person per half day.
Assume miscellaneous cost of $200.
Assume sample shipment of $500.

Total: $ 3,271

Assume: $ 3,300

Total Sampling and Analytical Cost: $ 21,900

Prepared By: PDP
Checked By: LT

Off-Site Transportation for Disposal

1. Roll-Off Rental

Assume 1.200 cy (1.000 cy excavated plus 20% bulking) to be containerized for off-site transportation per week.
Assume sixty 20 cy roll-offs to haul soil excavated in one week @ $10 per day.
Assume spotting charge of $300 per roll off (spotting charge for first drop off only: no spotting charge for replacement containers brought to site while picking up fill containers).
Assume one liner for each roll-off load @ $35 each.
Assume containers on site for approximately 11 weeks (8.5 weeks of excavation plus 1 week for analytical results for last batch plus 1 week for transport off site.

Spotting Fee =	60	containers x	$	300	/container			
= $	18.000							
Daily rental =	60	containers x		11	weeks x	7 days/week x	$10	/day
= $	46.200							
Liners =	384	containers x	$	35	/container			
= $	13.440							

Non haz = 7560 cy -includes bulking factor
Haz = 120 cy - includes bulking factor
378 containers for non-haz soil
6 containers for haz soil

Total Roll-Off Cost: $ 77.640

Assume: $ 77,600

2. Transportation

Assume hazardous soil is transported to the City Environmental landfill in Michigan @ $2.650 per load (Hexagon IRM cost).
Assume non-hazardous soil is transported to Grows Landfill in Pennsylvania @ $600 per load (Freehold Cartage. 10/98).

Hazardous soil =	6	loads x	$	2.650	/load
= $	15.900				
Nonhazardous soil =	378	loads x	$	600	/load
= $	226.800				

Total Transportation Cost = $ 242,700

Alternative 4A - Soil Excavation/Off-Site Disposal

Prepared By: PDP
Checked By: LT

Hazardous and Non-Hazardous Soil Disposal

Assume hazardous soil is disposed at City Environmental in Michigan (chemical oxidation prior to landfilling) @ $177/cy including $10/cy tax (Cathy Zelner, City Environmental, 10/98).
Assume non-hazardous soil is landfilled at Grows Landfill in Pennsylvania @ $36/ton (James Hull, WMI - Grows Landfill, 11/98)
Assume 1.5 tons per cy of soil.
Assume 120 cy of hazardous soil to be disposed of (includes 20% bulking factor)
Assume 6,300 cy of non-hazardous soil to be disposed of (does not include 20% bulking factor - disposal cost based on weight of soil)

Hazardous Soil:	120	cy x	$177 /cy			
	= $ 21,240					
Non-Hazardous Soil:	6300	cy x	1.5	tons/cy x	$36	/ton
	= $ 340,200					
Total Disposal Cost =	$ 361,440					
Assume:	**$ 361,400**					

Prepared By: POP
Checked By: LT

Backfilling Excavated Areas

I. Upper Site (North Yard, Old Plant, New Plant, South Yard)

Assume that excavated areas will be backfilled with clean gravel from the bottom of the excavation to the top of the water table to circumvent compaction difficulties and to facilitate future groundwater remediation at the site.
Assume that clean fill @ $15/cy will be used to backfill the excavation from the water table to final grade (cost includes bringing fill to the site, backfilling, and compaction).
Assume placement of geotextile between gravel and clean fill to prevent migration of fines @ $0.27 /sf.
Assume clean gravel fill @ $20/cy.

Gravel
Estimated volume of gravel is 32,100 cf (see attached Table A-4.1 and Figure A-4.3)

Gravel Fill Cost =	32,100 cf/	27 cf/cy x	$	20 cy
=	$ 23,778			
Assume:	**$ 23,800**			

Assume productivity rate of 1100 cy per day. Assume 2 days for placement.

Geotextile
Estimated area for geotextile is 21,500 sf (see attached Table A-4.1 and Figure A-4.3) in upper site

Geotextile Cost =	21,500 sf x	$ 0.27	/sf
=	$ 5,805		
Assume:	**$ 5,800**		

Productivity rate of 2400 sy per day. Assume 1 day for placement.

Clean Fill
Estimated volume of clean fill is calculated from the volume of material excavated from the upper site (see Table 2-7) less the volume of gravel used as backfill.

Volume of soil excavated from the upper site:		4200 cy
Volume of gravel added:	-	32100 cf
Total:		3011 cy
Total assuming 20 percent compaction factor:		3613 cy
	Assume:	3600 cy

Clean Fill Cost =	3600 cy x	$	15	/cy
=	**$ 54,000**			

Assume productivity of 975 cy per day for placement and 560 cy per day for compaction. Assume 7 days for placement and compaction (compaction & placement will be performed concurrently in different areas of the site).

2. East Yard

Assume placement of geotextile @ $0.27 /sf between bottom of excavation and clean fill to provide a separation layer between the clean fill and the remaining contaminated overburden.
Assume that clean fill @ $15/cy will be used to backfill the excavation from the geotextile to final grade.
Assume that area beneath Cinder Block building is not excavated.

Geotextile
Estimated area for geotextile is 10.000 sf (see Table 2-7) less 500 sf beneath Cinder Block building.

Geotextile Cost =	9,500 sf x	$ 0.27	/sf
= **$**	**2,565**		
Assume: $	**2,600**		

Productivity rate of 2400 sy per day. Assume one half day for placement.

Clean Fill
Estimated volume of clean fill is calculated from the volume of material excavated from the East Yard (see Table 2-7) plus a 20% compaction factor.

Volume of soil excavated from the East Yard:	2222 cy
Total assuming 20 percent compaction factor:	2666 cy
Assume:	2700 cy

Clean Fill Cost =	2700 cy x	$ 15	/cy
= **$**	**40,500**		

Assume productivity of 975 cy per day for placement and 560 cy per day for compaction. Assume 5 days for placement and compaction (compaction & placement will be performed concurrently in different areas of the site).

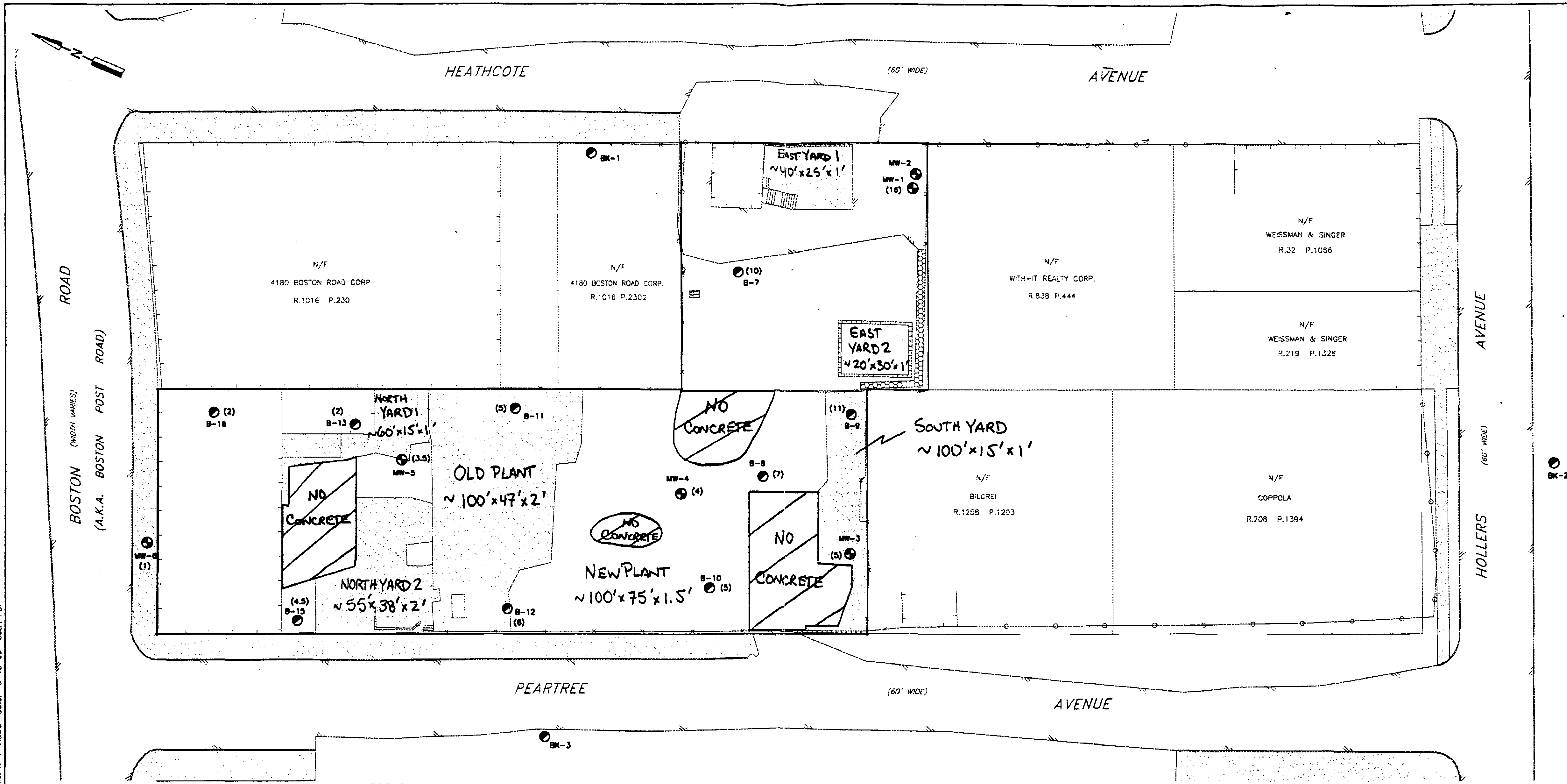
Assume total duration for backfill of Upper Site and East Yard of 3 weeks. Assume that backfilling will be performed concurrently with excavation of other parts of the site.

TABLE A-4.1
HEXAGON LABORATORIES RI/FFS
GRAVEL BASE COURSE VOLUME ESTIMATE FOR ALTERNATIVES 4A AND 4B

Area Designation[1]	Dimensions Length (Feet)	Width (Feet)	Depth [2] (Feet)	Gravel Volume (Cubic Feet)	Gravel Volume (Cubic Yards)
North Yard	39	80	1	3,120	116
Old Plant	70	100	1.5	10,500	389
New Plant #1 [3]	--	--	--	5,183	192
-- Total New Plant #1 (inc. UST Excavation)	79	54	1.25	--	--
-- New Plant UST Excavation	10	12	1.25	--	--
New Plant #2	79	46	2.5	9,085	336
South Yard #1	25	29	1.25	906	34
South Yard #2	20	25	2	1,000	37
South Yard #3 [4]	50	46	1	2,300	85
Total				**32,094**	**1,189**
			Assume:	**32,100**	**1,200**

Notes:

1. Refer to Figure A-4.3 for locations of Areas used in calculating gravel volume.
2. Gravel layer thickness corresponds to the thickness of saturated overburden. Gravel layer will be placed with a minimum thickness of 1 foot in areas where the saturated overburden thickness is less than 1 foot.
3. New Plant soil volume estimate does not include the New Plant UST excavation area since contaminated soil was removed from this area (and replaced with clean fill material) as part of the IRM. No soil removal is planned for this area as part of these alternatives.
4. Proposed maximum depth of soil removal in the upper site is 6 feet bgs in areas where depth to bedrock is greater than 6 feet bgs.
5. *The South Yard UST excavation is not included in the contaminated soil volume estimate since contaminated soil was removed from this area* (and replaced with clean fill material) as part of the IRM.
6. Area subdivisions were approximated as rectangular blocks to facilitate calculation of gravel volumes. Actual gravel volumes may vary based on subsurface conditions.



LEGEND

BK, B	SOIL BORING		CONCRETE WALL
MW	MONITORING WELL		CONCRETE STEPS
	BUILDING EDGE		CHAIN LINK FENCE
	HEXAGON PROPERTY LINE		METAL STOCKADE FENCE
	ADJOINING PROPERTY LINE	N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	CONCRETE	(3.5)	OVERBURDEN THICKNESS IN FEET (TYP.)
	CONCRETE CURB		OVERBURDEN THICKNESS ISOPACH (TYP.), 1 FT. CONTOUR INTERVAL
	EDGE OF MACADAM		
	MASONRY STONE WALL		

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

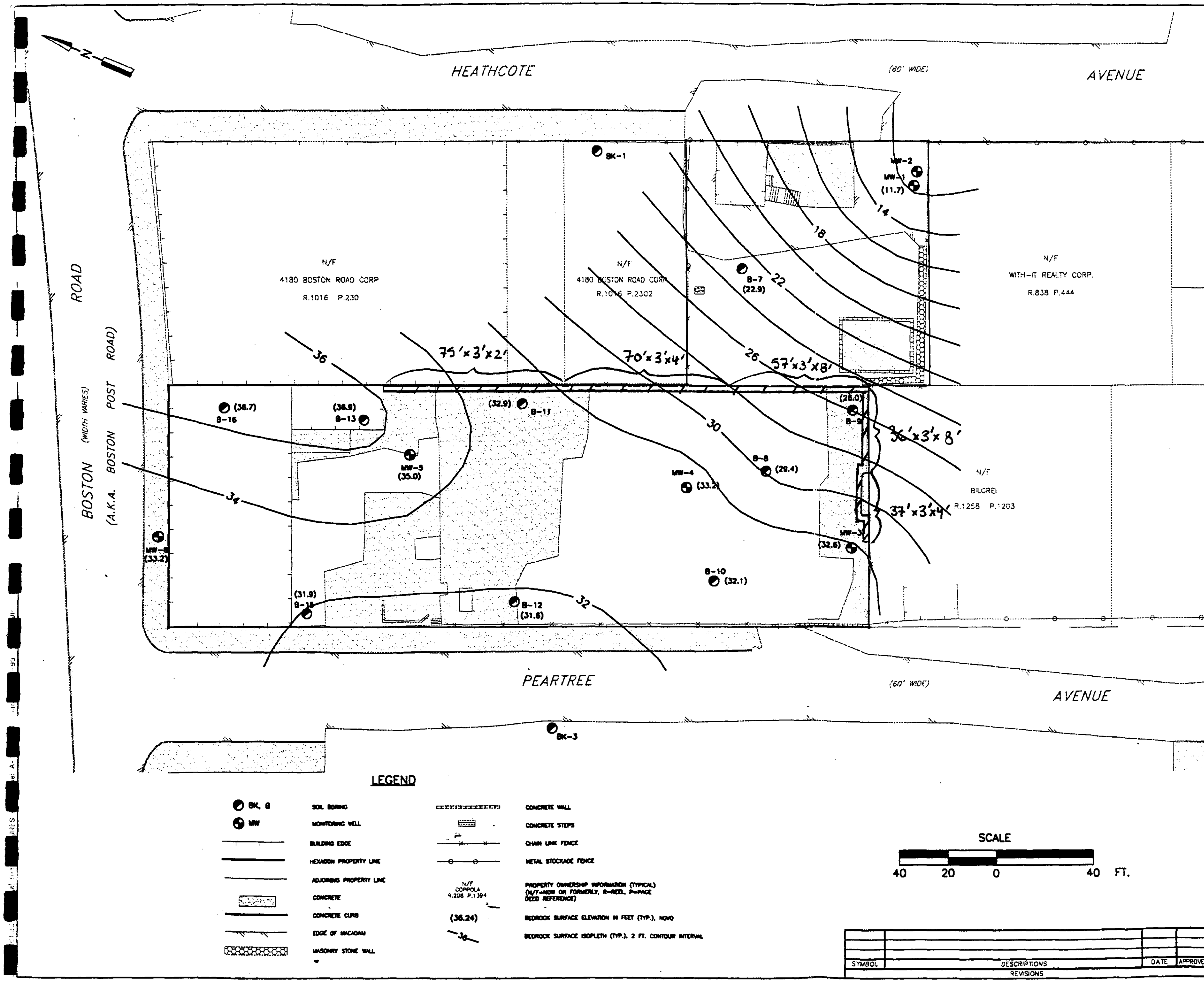
HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 4A AND 4B
CONCRETE REMOVAL VOLUME ESTIMATE

DESIGNED BY: PK
DRAWN BY: PDP
CHECKED BY: MT
SUBMITTED BY: PDP
DATE: MAY 1999
SCALE: AS SHOWN
DRAWING NO.: A-4.1

U:\PROJECT.33\5851HEXL.DEC\FFS\FIGURES Filename: A-4-1.DWG Date: 5-18-99 User: PDP



SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: **TAMS** CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY: PK

DRAWN BY: PDP

CHECKED BY: MT

SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE

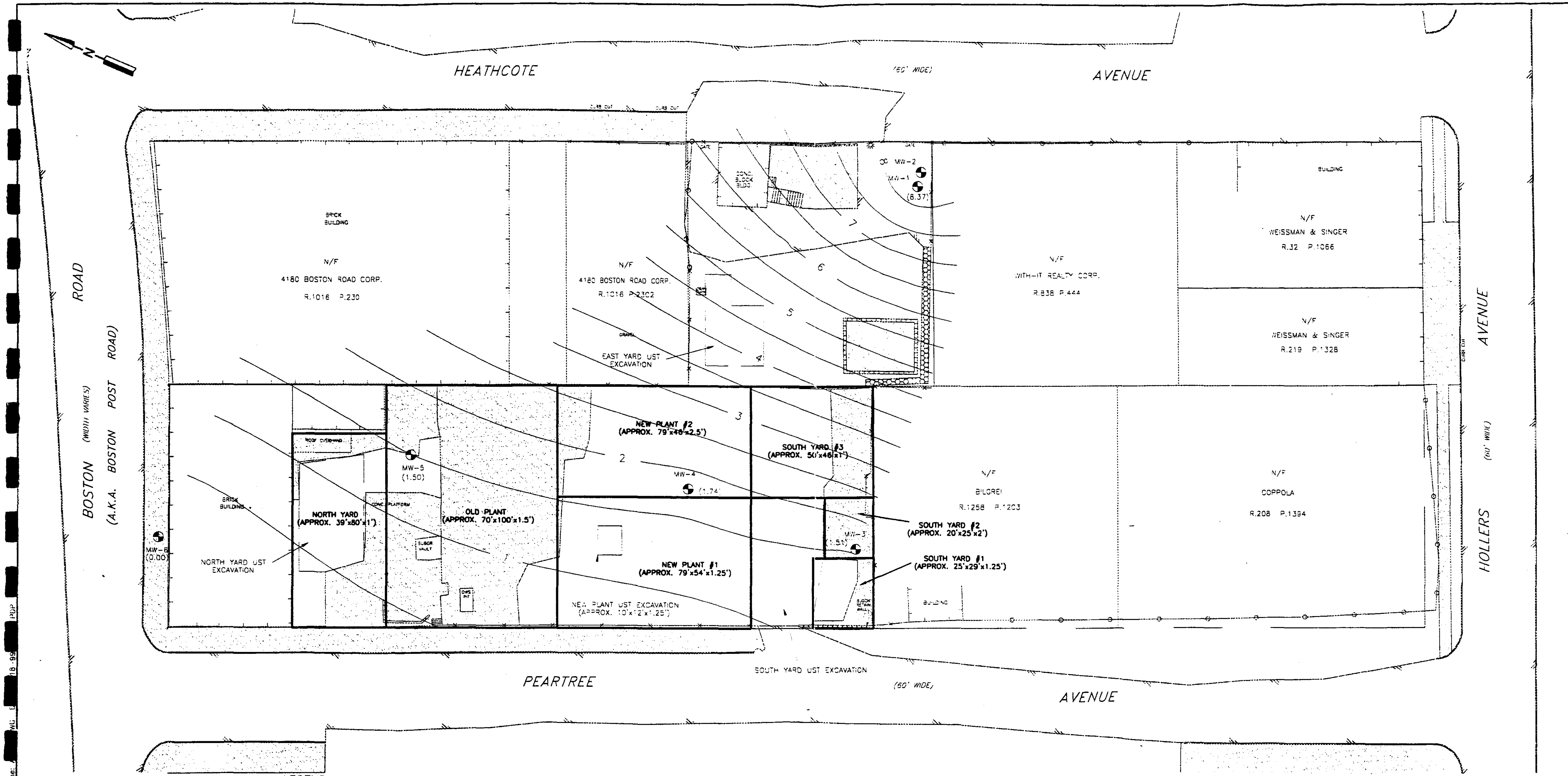
New York City
Bronx County, New York

ALTERNATIVES 4A AND 4B
SLURRY WALL VOLUME ESTIMATE

DATE: MAY 1999

SCALE: AS SHOWN

DRAWING NO.: A-4.2



LEGEND

MW	MONITORING WELL
	BUILDING EDGE
	HEXAGON PROPERTY LINE
	ADJOINING PROPERTY LINE
	CONCRETE
	CONCRETE CURB
	EDGE OF MACADAM
	MASONRY STONE WALL
	CONCRETE WALL
	CONCRETE STEPS
	CHAIN LINK FENCE
	METAL STOCKADE FENCE
N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
(36.24)	SATURATED OVERBURDEN THICKNESS IN FEET (TYP.)
36	SATURATED OVERBURDEN ISOPACH (TYP.), 0.5 FT. CONTOUR INT.

NOTES

1. GRAVEL VOLUME ESTIMATE SUBDIVISIONS ARE APPROXIMATED AS RECTANGULAR BLOCKS TO FACILITATE THE VOLUME CALCULATION. ACTUAL GRAVEL VOLUME MAY VARY BASED ON SUBSURFACE CONDITIONS.
2. REFER TO TABLE A-4.1 FOR CORRESPONDING GRAVEL VOLUME CALCULATION.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY: PK

DRAWN BY: PDP

CHECKED BY: MT

SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 4A AND 4B GRAVEL BASE COURSE VOLUME ESTIMATE

DATE: MAY 1999 | SCALE: AS SHOWN | DRAWING NO.: A-4.3

ALTERNATIVE 4B
EXCAVATION/OFF-SITE TREATMENT/OFF-SITE REUSE

TABLE A-4B
COST ESTIMATE
ALTERNATIVE 4B - SOIL EXCAVATION/OFF-SITE TREATMENT/OFF-SITE REUSE

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	CAPITAL COSTS				
	Direct Capital Costs				
A.	Mobilization /Temporary Facilities/ Demobilization				
	1. Mobilization/Demobilization	1	$60,200	LS	$60,200
	2. Temporary facilities	1	$59,000	LS	$59,000
	3. Site security	6	$10,700	Month	$64,200
B.	Health and Safety				
	1. Health & safety measures	5	$18,500	Month	$92,500
	2. Decon water sampling and disposal	1	$19,200	LS	$19,200
	3. Decon pad	1	$16,600	LS	$16,600
C.	Construction Management	8	$30,000	Month	$240,000
D.	Construction and Remediation				
	1. Concrete Slab/Asphalt Paving Demolition and Disposal				
	a. Demolition - concrete	1,070	$136.43	CY	$146,000
	b. Demolition - pavement	340	$7.78	SY	$2,600
	c. Transportation and disposal	1,640	$18	CY	$29,500
	2. Excavation				
	a. Temporary shoring	7,600	$8.03	SF	$61,000
	b. Excavate trench	80	$7.08	CY	$600
	c. Slurry wall construction	3,970	$19.32	CF	$76,700
	d. Soil excavation	6,400	$11.09	CY	$71,000
	3. Sampling and Analysis (for Disposal)				
	a. Sample collection (non-haz soil)	1	$6,700	LS	$6,700
	b. Sample collection (haz soil)	1	$200	LS	$200
	c. Sample analysis (non-hazardous facility)	1	$19,900	LS	$19,900
	d. Sample analysis (hazardous facility)	1	$1,700	LS	$1,700
	4. Sampling and Analysis (for Documentation)				
	a. Sample collection	1	$3,300	LS	$3,300
	b. Sample analysis	1	$18,600	LS	$18,600
	5. Offsite Transportation				
	a. Roll-off spotting	60	$300	EA	$18,000
	b. Roll-off rental (60 containers for 11 weeks at $10/day)	1	$46,200	LS	$46,200
	c. Liner	384	$35	Load	$13,400
	d. Non-hazardous waste landfill	378	$600	Load	$226,800
	e. Hazardous waste facility	6	$2,650	Load	$15,900
	6. Offsite Disposal				
	a. Non-hazardous waste landfill	9,450	$30	Ton	$283,500
	b. Hazardous waste facility	120	$177	CY	$21,200
	7. Backfill				
	a. Gravel (Upper Site only)	1,189	$20	CY	$23,800
	b. Geotextile	31,000	$0.27	SF	$8,400
	c. Common fill	6,300	$15.00	CY	$94,500
	Total Direct Costs				$1,741,200

TABLE A-4B
COST ESTIMATE
ALTERNATIVE 4B - SOIL EXCAVATION/OFF-SITE TREATMENT/OFF-SITE REUSE

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	Indirect Capital Costs				
	1. Engineering and Permitting				$200,000
	2. Contingency (15% of Total Direct Costs)				$261,180
	Total Indirect Costs				$461,180
	TOTAL CAPITAL COSTS				$2,202,380
	ANNUAL O&M COSTS				
	None				$0
	TOTAL ANNUAL O&M COSTS				$0
	PRESENT WORTH OF COSTS				
A.	Annual O&M Costs (30 year duration, 5% discount rate)				$0
B.	Total Capital Costs				$2,202,380
	TOTAL PRESENT WORTH				$2,202,380

Assume: **$2,202,000**

Alternative 4B - Soil Excavation/Off-Site Treatment/Off-Site Reuse

Prepared By: PDP
Checked By: LT

Project Duration

Assume:	Mobilization/demobilization	4 weeks
	Site preparation for excavation (shoring, slurry wall)	5.5 weeks
	Concrete/pavement demolition	5 weeks & during excavation
	Excavation & Backfill	8.5 weeks
	Transport and dispose (includes confirmatory sampling)	2 weeks & during excavation
	Total:	**25 weeks**
	Assume:	**6 months**

Time for workplan preparation and for obtaining any approvals/permits is not included.

Engineering & Permitting

It is assumed that NYSDEC will hire an Engineering Consultant to prepare plans and specifications for the remediation.

It is assumed that work includes the preparation of:

- Plans and specifications for competitive bidding;
- Discussion with state and local agencies regarding permit requirements;
- Submission of 30% design submittal for review;
- Submission of 90% design submittal for review;
- Preparation of a design report;
- Preparation of an engineering cost estimate; and
- Provision of pre-award services.

Based on TAMS' experience, this work can cost between $150,000 to $250,000, depending on the complexity of the remediation.

- $250,000 for high complexity
- $200,000 for medium complexity
- $150,000 for low complexity

For Alternative 4A, work is considered to be medium complexity.

Assume Engineering & Permitting cost of: $200,000

Prepared By: PDP
Checked By: LT

Construction Management

It is assumed that NYSDEC will hire an engineering consultant to perform construction period services during the remediation.

It is assumed that work includes the preparation of:
- Attendance at pre-construction meetings;
- Review of contractor submittals;
- Full time project inspection;
- Maintenance of construction records and reports;
- Quality assurance;
- Change order preparation;
- Processing of contractor application for payment; and
- Preparation of Final Remediation Report.

It is assumed that construction management services will begin one month prior to the start of construction activities.

It is assumed that construction management services will continue for one month after the end of on-site activities.

Based on TAMS' experience, the cost of construction management is approximately $30,000 per month.

Assume a monthly Construction Management cost of: $30,000

Prepared By: PDP
Checked By: LT

Mobilization & Demobilization (Includes Contractor Preparation of Project Plans)

1. **Materials & Equipment**

Assume 20 pieces of equipment at $500 per piece for mobilization:	$	10,000
Assume 20 pieces of equipment at $500 per piece for demobilization:	$	10,000
Assume $10,000 for mob/demob of materials:	$	10,000
Subtotal:	**$**	**30,000**

2. **Contractor Preparation of Project Plans**

Includes Work Plans, Health & Safety Plans, QA/QC Plans, and Erosion Control Plan.
Assume labor requirement of 2 persons @ $30 per hour per person for 1 month.
Assume labor multiplier of 3.

= 2 persons x $30 /hour x 40 hours/week x 4.2 weeks/month x 1 month x 3 multiplier

= $30,240

Assume: **$30,200**

Total Mobilization/Demobilization Cost: **$60,200**

Prepared By: PDP
Checked By: LT

Temporary Facilities

1. **Temporary Facilities - One Time Cost**
   Assume 2 trailers @ $1,300 per trailer
   Assume office trailer equipment @ $5,000 per trailer

- Computer	$	2,500
- Printer	$	500
- Modem	$	200
- Fax Machine	$	500
- Copier	$	500
- Phone	$	100
- Answering Machine	$	100
- Desk & Chair (2)	$	300
- Conference Table	$	100
- Chairs (4)	$	100
- File Cabinet	$	100
	$	5,000

Assume electrical hookup @ $2,500 per trailer
Assume phone hookup @ $200 per trailer
Assume project sign @ $500
Assume temporary site controls (e.g. barricades, traffic control, erosion control) @ $5,500
Assume decon facility mob/demob @ $1,000
Assume water tank(s) mob/demob @ $1000
Assume misc. equipment/supplies @ $3,000

Total Temp. Facilities One Time Cost: **$ 29,000**

2. **Monthly Costs**
   Assume trailer rental @ $500 per trailer
   Assume sanitary facility & water @ $500
   Assume janitorial service @ $500
   Assume trailer electrical service @ $200 per trailer
   Assume miscellaneous electrical requirements @ $200
   Assume phone service @ $200 per trailer
   Assume miscellaneous costs @ $2000

Subtotal: $ 5,000 per month

Duration: 6 months

Total Monthly Costs: $ 30,000

Total Temporary Facilities Cost: $ 59,000
Assume: $ 59,000

Alternative 4B - Soil Excavation/Off-Site Treatment/Off-Site Reuse

Prepared By: PDP
Checked By: LT

Site Security

Assume on-site security will be provided from 5 PM to 7AM during construction activities.
Assume on-site security will be provided 24 hours per day for weekends during construction activities.
Assume 2 unarmed security guards @ $11 per hour per guard.

Monthly Security Cost:	=	2 guards x	14 hours per day x	21 weekdays per month x	$11	per hour +
		2 guards x	24 hours per day x	8 weekend days per month x	$11	per hour
	= $10,692					

Assume monthly security cost of: $10,700

Health & Safety

Assume monitoring equipment @ $3.000 per month
Assume 2 sets of PPE per day per person @ $18 per unit (PPE costs associated with sampling included separately in sampling cost estimate)
Assume 10 workers within exclusion zone at one time
Assume on-site Safety Coordinator @ $5.000 per month
Assume decon facility (shower. etc.) @ $2.900 per month
(Means Environmental Remediation Cost Data - 33 17 0821; includes 1.23 Location Factor)

Total: $ 18.460 per month

Assume: $ 18,500 per month (during construction activities excluding mob/demob)

Prepared By: PDP
Checked By: LT

Decontamination Pad

Assume 20 ft x 30 ft x 6 inch decon pad with 6-inch high curbs
Assume construction of 6-inch slab on grade (not including forms or reinforcement) @$2.09/sf
(from Means. 1998: Item No. 033 130 5010)
Assume reinforcement with welded wire fabric @ $66.50 per 100 sf
(from Means. 1998: Item No. 032 207 0700)
Assume use of trench forms on floor @$10.35 per sf
(from Means. 1998: Item No. 031 170 6000)
Assume location factor of 1.275
Assume decon pad walls @ $1.000
Assume sump pit and pump @ $1.500
Assume pressure washer @ $3.500 (purchase)
(from Means Environmental. 1999: Item No. 33 17 0815: Location factor of 1.23)
Assume one 21.000 gallon frac tank @ $1,200 per month
Assume project duration of 6 months

Slab = 600 sf x $2.09 /sf + 600 sf x $0.67 /sf + 100 sf x $10.35 /sf

= $ 2,688 x 1.275 multiplier
= $ 3,427

Total = 16,627

Assume $ 16,600

Prepared By: POP
Checked By: LT

Estimate of Volume of Decontamination Water

1. **Personnel Decon**
   Assume 10 workers, two showers per day, and five gallons per shower

Total Volume =	100	gallons per day x	21 days per month
=	2,100	gallons per month x	5 months
=	10,500	gallons	

2. **Equipment Decon**
   Assume 10 pieces of equipment, one wash per two weeks, 20 gallons per wash per piece of equipment

Total Volume =	400	gallons per month x	5 months
=	2000	gallons	

3. **Concrete Slab Decon (prior to disposal)**
   Assume 25 sf per minute @ 6 gallons per minute
   Assume surface area of concrete to be washed is 36,900 sf (includes both sides of concrete slabs)

Total Volume =	36900 sf /	25 sf/minutes x	6 gallons/minute
=	8856 gallons		

Total Volume of Decon Water =	**21,356**	**gallons**
Assume:	**21,400**	**gallons**

Alternative 4B - Soil Excavation/Off-Site Treatment/Off-Site Reuse

Prepared By: POP
Checked By: LT

Collection & Disposal of Decontamination Water

1. Equipment and Concrete Decon Labor

Assume 2 laborers @ $25 per hour for pressure washing
Assume total area of concrete = 36,900 sf
Assume decon rate of 25 sf per minute
Assume labor multiplier of 2.
Assume 18 hours total for decon of equipment over course of construction activities
(10 minutes per piece of equipment, 10 pieces of equipment per two weeks, 21 weeks of construction activities).

Time for decon = 43 hours

Labor cost = 43 hours x $ 25 / hour x 2 laborers x 2 multiplier

= $ 4,300

2. Analytical Costs for Disposal

Assume 4 water samples for disposal @ $1,050 per sample (includes 25% increase for 1 week turnaround)

Analytical:	VOCs	$	125	
	SVOCs	$	250	
	Pest/PCBs	$	150	
	TAL ICP Metals	$	135	
	TDS	$	10	
	TSS	$	10	
	TOC	$	35	
	Dissolved Metals	$	120	
		$	835	plus 25% markup for 1 week turnaround time

Analytical Cost = $ 4,200

3. Transport and Treatment/Disposal Cost

Assume hazardous water transport and disposal @ $0.78 per gallon
Assume non-hazardous water transport and disposal @ $0.50 per gallon
Assume decon water is non-hazardous

Total Volume of Decon Water = 21,400 gallons

Transport and Disposal Cost = $ 10,700

Total Collection, Analysis, Transport, and Disposal = $ 19,200

Assume $ 19,200

Prepared By: PDP
Checked By: LT

1. Volume and Area of Concrete to be Removed/Disposed (see attached drawing)

Area	Length (ft)	Width (ft)	Thickness (ft)	Volume (cf)	Volume (cy)	Area (sf)	Area (sy)
North Yard 1	60	15	1	900	33.3	900	100
North Yard 2	55	38	2	4180	154.8	2090	232.2
Old Plant	100	47	2	9400	348.1	4700	522.2
New Plant	100	75	1.5	11250	416.7	7500	833.3
South Yard	100	15	1	1500	55.6	1500	166.7
East Yard 1	40	25	1	1000	37.0	1000	111.1
East Yard 2	30	20	1	600	22.2	600	66.7
East Yard 2 Wall	77	1.2	1.2	104.8	3.9	89.8	10.0
East Yard 2 Wall	31	1.2	1.5	54.3	2.0	36.2	4.0

Total: 1074 cy 2046 sy
Assume: 1070 cy 2050 sy

For disposal, assume 50 percent volume expansion: 1600 cy

2. Volume and Area of Asphalt to be Removed/Disposed

Assume thickness of 4 inches

Area = 4500 sf - 1500 sf (concrete block bldg & concrete slab)
= 3000 sf
= 333 sy

Assume: 340 sy

Volume = 1000 cf
= 37 cy plus 20 percent volume expansion

Assume: 40 cy

3. Concrete Demolition

Assume demolition of reinforced concrete (7 to 24 inches thick) @ $107/cy
(Means 1998: Item No. 020 554 2200)
Assume location factor of 1.275

= 1070 cy x $ 107 /cy x 1.275 location factor
= $ 145,975

Assume: $ 146,000

Assume productivity rate for concrete demolition is 24 cy per day. Total of 45 days required for demolition. Assume half of work is performed during excavation of other parts of the site.

Prepared By: PDP
Checked By: LT

4. Pavement Demolition

Assume demolition of pavement (4 to 6 inches thick) @ $6.10/sy
(Means 1998: Item No. 020 554 1750)
Assume location factor of 1.275

=	340 sy x	$	6.10	/sy x	1.275 location factor
= $	2,644				

Assume: **$ 2,600**

Assume productivity rate of 420 sy per day. Assume 1 day for pavement demolition.

5. Transport and Disposal of Concrete & Asphalt

Assume transport and disposal cost of concrete with rebar and asphalt @ $18 /cy (quote from Liotta & Sons. Inc.: 10/98)

=	1640 cy x	$	18 /cy
= $	29,520		

Assume: **$ 29,500**

Prepared By: POP
Checked By: LT

Shoring Placement (see Figure 4-13)

Assume temporary wood shoring (solid sheeting with wales, braces, spacers) including placement, extraction, and salvage for 8 foot excavation @ $6.30/sf (Means, 1998; Item No. 021 614 3910).
Assume location factor of 1.275.
Assume productivity rate of 330 sf per day.
Assume distance around excavated areas where shoring will be installed of 950 lf.
Assume sheeting installed to 8 feet (2 feet below deepest excavated surface).

= 8 ft x 950 ft x $6.30 /sf x 1.275 location factor
= $ 61,047

Assume: $ 61,000

Assume total duration of 5 weeks. Assume that half of the installation is performed during excavation of other areas.

Slurry Wall Construction

1. Wall Volume Estimate

Assume slurry wall will be installed along the eastern and southern perimeters of the upper site as shown in Figures 4-11 and A-4.2.
Assume slurry wall will extend from the top of bedrock to an elevation of approx. 34 feet NGVD.
Assume slurry wall will be constructed of unreinforced cement-bentonite mixture.
Assume slurry wall will be 3 feet thick.

Length (ft)	Width (ft)	Height (ft)	Volume (cf)	
75	3	2	450	
70	3	4	840	
57	3	8	1368	
36	3	8	864	
37	3	4	444	
		Total:	3966	
		Assume:	**3970**	**cf**

2. Estimate of Soil Volume Above Top of Slurry Wall

Assume slurry wall will be installed along the eastern and southern perimeters of the upper site as shown in Figures 4-11 and A-4.2.
Refer to Figure 1-4 for overburden thickness.
Assume slurry wall will extend from the top of bedrock to an elevation of approx. 34 feet NGVD.
Assume slurry wall will be 3 feet thick.

Length (ft)	Width (ft)	Height (ft)	Volume (cf)	Volume (cy)	
75	3	2.5	562.5	20.8	
70	3	3	630	23.3	
57	3	2	342	12.7	
36	3	2	216	8.0	
37	3	3	333	12.3	
			Total:	77	
			Assume:	**80**	cy

3. Slurry Wall Construction

Assume excavated trench in wet soils, backfilled with 3,000 psi concrete, no reinforcement @ $15.15 per cf (Means, 1998; Item No. 021 684 0050).
Assume productivity rate of 333 cf/day for slurry wall placement.
Assume trench excavation (to top of slurry wall construction) @ $5.55 per cy (Means, 1998; Item No. 022 254 0050; Backfill accounted for as part of site backfill cost).
Assume productivity rate of 150 cy/day for excavation to top of slurry wall.
Assume location factor of 1.275.

=	3970	cf x	$	15.15	/cf x	1.275 location factor +
	80	cy x	$	5.55	/cy	1.275 location factor
= $	77,252					

Assume: $ **77,300**

Assume 15 days for slurry wall construction.

Alternative 4B - Soil Excavation/Off-Site Treatment/Off-Site Reuse

Prepared By: PDP
Checked By: LT

Assume excavation of soil @ $8.70/cy (Means, 1998; Item No. 022 250 2060.
Assume location factor of 1.275.
Assume productivity rate of 200 cy/day.

Total	6400 cy x	$ 8.70 /cy	1.275 location factor
= $ 70,992			

Assu $ 71,000

Approximately 6.5 weeks to excavate 6,400 cy. Assume 8.5 weeks to account for contingencies.

Prepared By: PDP
Checked By: LT

Estimate of Hazardous Soil Volume

Samples which may fail TCLP (using 20-fold estimate of TCLP concentration)

Sample	Depth (ft)	Area	Analyte Category
HXB11S2	4-5	Old Plant	VOCs
HXB4S2	2-4	New Plant	VOCs
NPT2	3-3.5	New Plant	VOCs
NPT3	3-3.5	New Plant	VOCs
NPT4	3-3.5	New Plant	VOCs
HXB19	1.3-1.7	East Yard	Metals
HXSS4	0-0.5	New Plant	Metals
HXB10S1	0-2	New Plant	Metals
HXB6S1	1-2	Bos.Post Rd.	Metals
HX-OM1	Surface Scrape	Hydrotherm 1	Metals
HXB17	2-2.5	East Yard	Metals
HXB20	2.2-2.3	East Yard	Metals
HXB21	2-2.5	East Yard	Metals
HXB11S2	4-5	Old Plant	Metals
HXB15S1	2.5-4.5	North Yard	Metals
SYTC-1	2.5-4.5	South Yard	Metals
NYT-2	5.5-6	North Yard	Metals

Assume Total Volume of Hazardous Soil is 100 cy.

Prepared By: PDP
Checked By: LT

Sampling and Analysis for Treatment/Reuse of Non-Hazardous Soil

1. Analytical Costs

Assume sampling frequency of one per 700 tons for metals, ignitability, corrosivity, reactivity, and PCBs (Group 1 Analysis; R3 Technologies; 11/98).
Assume sampling frequency of one per 135 tons for TPH and total organic halides (Group 2 Analysis; R3 Technologies, 11/98).
Assume 20 percent bulking after excavation.
Total volume of excavated soil is 6,400 cy, 100 cy of which is assumed to be hazardous.
Assume 1.5 tons per cy.
Assume no validation of sample data.

Sampling for Group 1 Analysis (Metals, Ignitability, Corrosivity, Reactivity, and PCBs):

Number of samples =	6300 cy/ x	1.5 tons/cy/	700 tons/sample
=	13.5		
Assume:	14 samples		

Assume contingency for re-sampling of 2 samples.

Total Number of samples = 16

Samples analyzed for:	Metals	$145	
	Ignitability	$30	
	Corrosivity	$10	
	Reactivity	$45	
	PCBs	$90	
		$320	per sample x 25% markup for 1 week turnaround
	Total:	$400	per sample

Analytical Cost = $400 /sample x 16 samples

= **$6,400 for Group 1 samples**

Sampling for Group 2 Analysis (TPH and Total Organic Halides):

Number of samples =	6300 cy/ x	1.5 tons/cy/	135 tons/sample
=	70		
Assume:	70 samples		

Assume contingency for re-sampling 7 samples.

Total Number of Samples = 77

Samples analyzed for:	TPH	$90	
	TOH	$50	
		$140	per sample x 25% markup for 1 week turnaround
	Total:	$175	per sample

Analytical Cost = $175 /sample x 77 samples

= **$13,475 for Group 2 samples**

Total Analytical Cost: $19,875

Assume: $19,900

Prepared By: POP
Checked By: LT

2. Sampling Cost

Assume sampling will be performed by two on-site personnel (no additional labor charge).
Assume H&S PPE @ $18 per person per day.
Assume sampling takes place on 40 separate days.
Assume miscellaneous cost of $300.
Assume sample shipment of $5,000.

Total: $ 6,740

Assume: $ 6,700

Alternative 4B - Soil Excavation/Off-Site Treatment/Off-Site Reuse

Prepared By: DDP
Checked By: LT

Sampling and Analysis for Disposal of Hazardous Soil

1. Analytical Costs

Assume collection of one representative sample of 100 cy of hazardous soil
Assume no validation of sample data

Samples analyzed for:	VOCs	$130	
	SVOCs	$275	
	PCBs	$90	
	TCLP	$850	
		$1,345	per sample x 25% markup for 1 week turnaround
	Total:	**$1,680**	**per sample**

Analytical Cost =	$1,680	/sample x	1 sample
=	$1,680		
Assume:	**$1,700**		

2. Sampling Cost

Assume sampling will be performed by two on-site personnel (no additional labor charge)
Assume H&S PPE @ $18 per person per day
Assume miscellaneous cost of $50
Assume sample shipment of $100

Total: $ 186

Assume: $ 200

Total Sampling and Analytical Cost: $ 1,880

Assume: $ 1,900

Prepared By: PDP
Checked By: LT

Sampling and Analysis for Documentation Sampling

1. Analytical Costs

Assume documentation sampling will be conducted at the bottom surface of the excavated areas in the East Yard and the southeastern part of the South Yard. All other areas on site will be excavated to the top of bedrock and no samples will be collected.
Assume one sample will be collected per 50 ft by 50 ft grid.
Assume documentation sampling will be conducted along the perimeter of the excavation which is approximately 950 ft.
Assume one sample will be collected per 50 ft along perimeter.
Assume no validation of sample data.

Number of bottom samples = 4 samples from East Yard + 1 sample from South Yard
= 5

Number of sidewall samples = 950 lf / 50 lf/sample
= 19

Total number of environmental samples: 24

Assume 3 QA/QC (MS/MSD and duplicate) samples and 2 field blanks.

Total number of samples = 29

Samples analyzed for:	VOCs	$	130	
	SVOCs	$	275	
	PCBs	$	90	
	TAL ICP Metals	$	145	
	Total:	**$**	**640**	**per sample**

Analytical Cost = $ 640 /sample x 29 samples
= $18,560

Assume: $18,600

2. Sampling Cost

Assume sampling will be performed by one on-site personnel (no additional labor charge) and one assistant @ $25/hour.
Assume sampling will be conducted over a period of three 8-hour days.
Assume labor multiplier of 3.
Assume car rental of $65 per day.
Assume per diem for assistant of $120 per day.
Assume H&S PPE @ $18 per person per half day.
Assume miscellaneous cost of $200.
Assume sample shipment of $500.

Total: $ 3,271

Assume: $ 3,300

Total Sampling and Analytical Cost: $ 21,900

Alternative 4B - Soil Excavation/Off-Site Treatment/Off-Site Reuse

Prepared By: PDP
Checked By: LT

Off-Site Transportation for Disposal

1. Roll-Off Rental

Assume 1.200 cy (1.000 cy excavated plus 20% bulking) to be containerized for off-site transportation per week.
Assume sixty 20 cy roll-offs to haul soil excavated in one week @ $10 per day.
Assume spotting charge of $300 per roll off (spotting charge for first drop off only: no spotting charge for replacement containers brought to site while picking up fill containers).
Assume one liner for each roll-off load @ $35 each.
Assume containers on site for approximately 11 weeks (8.5 weeks of excavation plus 1 week for analytical results for last batch plus 1 week for transport off site.

Spotting Fee =	60	containers x	$	300	/container		
= $	18.000						
Daily rental =	60	containers x	11	weeks x	7 days/week x	$10	/day
= $	46.200						
Liners =	384	containers x	$	35	/container		
= $	13.440						

Non haz = 7560 cy -includes bulking factor
Haz = 120 cy - includes bulking factor
378 containers for non-haz soil
6 containers for haz soil

Total Roll-Off Cost: $ 77,640

Assume: $ 77,600

2. Transportation

Assume hazardous soil is transported to the City Environmental landfill in Michigan @ $2,650 per load (Hexagon IRM cost).
Assume non-hazardous soil is transported to R3 Technologies in Pennsylvania @ $600 per load (Freehold Cartage. 10/98).

Hazardous soil =	6	loads x	$	2,650	/load
= $	15.900				
Nonhazardous soil =	378	loads x	$	600	/load
= $	226.800				

Total Transportation Cost = $ 242,700

Prepared By: PDP
Checked By: LT

Hazardous and Non-Hazardous Soil Disposal

Assume hazardous soil is disposed at City Environmental in Michigan (chemical oxidation prior to landfilling) @ $177/cy including $10/cy tax (Cathy Zelner, City Environmental, 10/98).
Assume non-hazardous treated for subsequent reuse at R3 Technologies facility in Pennsylvania @ $30/ton (R3 Technologies, 10/98).
Assume 1.5 tons per cy of soil.
Assume 120 cy of hazardous soil to be disposed of (includes 20% bulking factor)
Assume 6,300 cy of non-hazardous soil to be disposed of (does not include 20% bulking factor - disposal cost based on weight of soil)

Hazardous Soil:		120	cy x	$177	/cy			
	= $	21,240						
Non-Hazardous Soil:		6300	cy x	1.5	tons/cy x	$30	/ton	
	= $	283,500						
Total Disposal Cost =	$	304,740						
Assume:	**$**	**304,700**						

Prepared By: PDP
Checked By: LT

Backfilling Excavated Areas

1. Upper Site (North Yard, Old Plant, New Plant, South Yard)

Assume that excavated areas will be backfilled with clean gravel from the bottom of the excavation to the top of the water table to circumvent compaction difficulties and to facilitate future groundwater remediation at the site.
Assume that clean fill @ $15/cy will be used to backfill the excavation from the water table to final grade (cost includes bringing fill to the site, backfilling, and compaction).
Assume placement of geotextile between gravel and clean fill to prevent migration of fines @ $0.27 /sf.
Assume clean gravel fill @ $20/cy.

Gravel
Estimated volume of gravel is 32,100 cf (see attached Table A-4.1 and Figure A-4.3)

Gravel Fill Cost =	32,100 cf/	27 cf/cy x	$ 20 cy
=	$ 23,778		
Assume:	**$ 23,800**		

Assume productivity rate of 1100 cy per day. Assume 2 days for placement.

Geotextile
Estimated area for geotextile is 21,500 sf (see attached Table A-4.1 and Figure A-4.3) in upper site

Geotextile Cost =	21,500 sf x	$ 0.27 /sf
=	$ 5,805	
Assume:	**$ 5,800**	

Productivity rate of 2400 sy per day. Assume 1 day for placement.

Clean Fill
Estimated volume of clean fill is calculated from the volume of material excavated from the upper site see Table 2-7) less the volume of gravel used as backfill.

Volume of soil excavated from the upper site:	4200 cy
Volume of gravel added:	- 32100 cf
Total:	3011 cy
Total assuming 20 percent compaction factor:	3613 cy
Assume:	3600 cy

Clean Fill Cost =	3600 cy x	$ 15 /cy
=	**$ 54,000**	

Assume productivity of 975 cy per day for placement and 560 cy per day for compaction. Assume 7 days for placement and compaction (compaction & placement will be performed concurrently in different areas of the site).

2. East Yard

Assume placement of geotextile @ $0.27 /sf between bottom of excavation and clean fill to provide a separation layer between the clean fill and the remaining contaminated overburden.
Assume that clean fill @ $15/cy will be used to backfill the excavation from the geotextile to final grade.
Assume that area beneath Cinder Block building is not excavated.

Geotextile

Estimated area for geotextile is 10,000 sf (see Table 2-7) less 500 sf beneath Cinder Block building.

Geotextile Cost =	9,500 sf x	$ 0.27 /sf
= $	**2,565**	
Assume: $	**2,600**	

Productivity rate of 2400 sy per day. Assume one half day for placement.

Clean Fill

Estimated volume of clean fill is calculated from the volume of material excavated from the East Yard plus a 20% compaction factor.

Volume of soil excavated from the East Yard:	2222 cy
Total assuming 20 percent compaction factor:	2666 cy
Assume:	2700 cy

Clean Fill Cost =	2700 cy x	$ 15 /cy
= $	**40,500**	

Assume productivity of 975 cy per day for placement and 560 cy per day for compaction. Assume 5 days for placement and compaction (compaction & placement will be performed concurrently in different areas of the site).

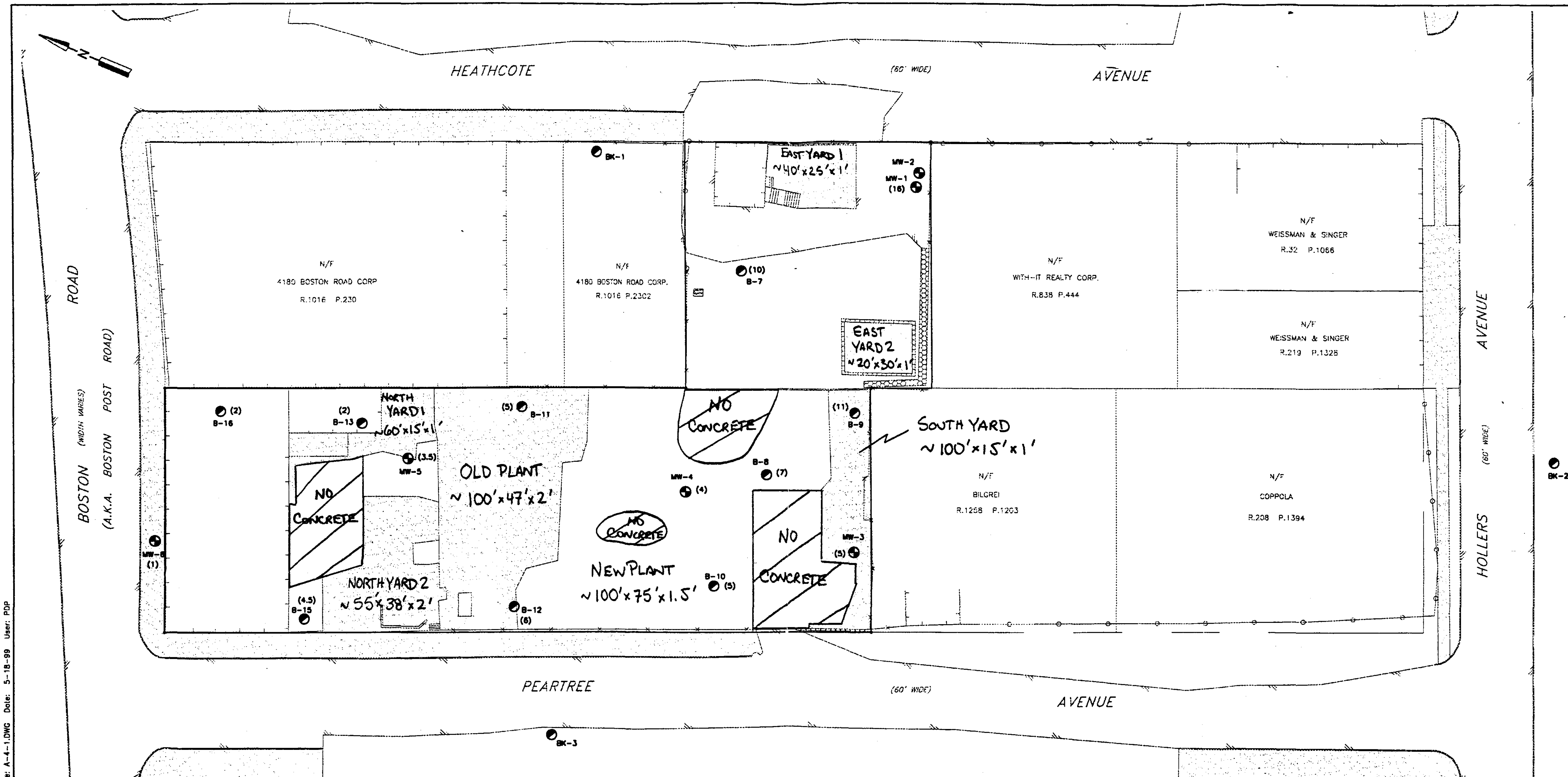
Assume total duration for backfill of Upper Site and East Yard of 3 weeks. Assume that backfilling will be performed concurrently with excavation of other parts of the site.

TABLE A-4.1
HEXAGON LABORATORIES RI/FFS
GRAVEL BASE COURSE VOLUME ESTIMATE FOR ALTERNATIVES 4A AND 4B

Area Designation[1]	Dimensions			Gravel Volume (Cubic Feet)	Gravel Volume (Cubic Yards)
	Length (Feet)	Width (Feet)	Depth [2] (Feet)		
North Yard	39	80	1	3,120	116
Old Plant	70	100	1.5	10,500	389
New Plant #1 [3]	--	--	--	5,183	192
-- Total New Plant #1 (inc. UST Excavation)	79	54	1.25	--	--
-- New Plant UST Excavation	10	12	1.25	--	--
New Plant #2	79	46	2.5	9,085	336
South Yard #1	25	29	1.25	906	34
South Yard #2	20	25	2	1,000	37
South Yard #3 [4]	50	46	1	2,300	85
Total				**32,094**	**1,189**
			Assume:	**32,100**	**1,200**

Notes:

1. Refer to Figure A-4.3 for locations of Areas used in calculating gravel volume.
2. Gravel layer thickness corresponds to the thickness of saturated overburden. Gravel layer will be placed with a minimum thickness of 1 foot in areas where the saturated overburden thickness is less than 1 foot.
3. New Plant soil volume estimate does not include the New Plant UST excavation area since contaminated soil was removed from this area (and replaced with clean fill material) as part of the IRM. No soil removal is planned for this area as part of these alternatives.
4. Proposed maximum depth of soil removal in the upper site is 6 feet bgs in areas where depth to bedrock is greater than 6 feet bgs.
5. The South Yard UST excavation is not included in the contaminated soil volume estimate since contaminated soil was removed from this area (and replaced with clean fill material) as part of the IRM.
6. Area subdivisions were approximated as rectangular blocks to facilitate calculation of gravel volumes. Actual gravel volumes may vary based on subsurface conditions.



LEGEND

BK, B	SOIL BORING
MW	MONITORING WELL
	BUILDING EDGE
	HEXAGON PROPERTY LINE
	ADJOINING PROPERTY LINE
	CONCRETE
	CONCRETE CURB
	EDGE OF MACADAM
	MASONRY STONE WALL
	CONCRETE WALL
	CONCRETE STEPS
	CHAIN LINK FENCE
	METAL STOCKADE FENCE
N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
(3.5)	OVERBURDEN THICKNESS IN FEET (TYP.)
	OVERBURDEN THICKNESS ISOPACH (TYP.), 1 FT. CONTOUR INTERVAL

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

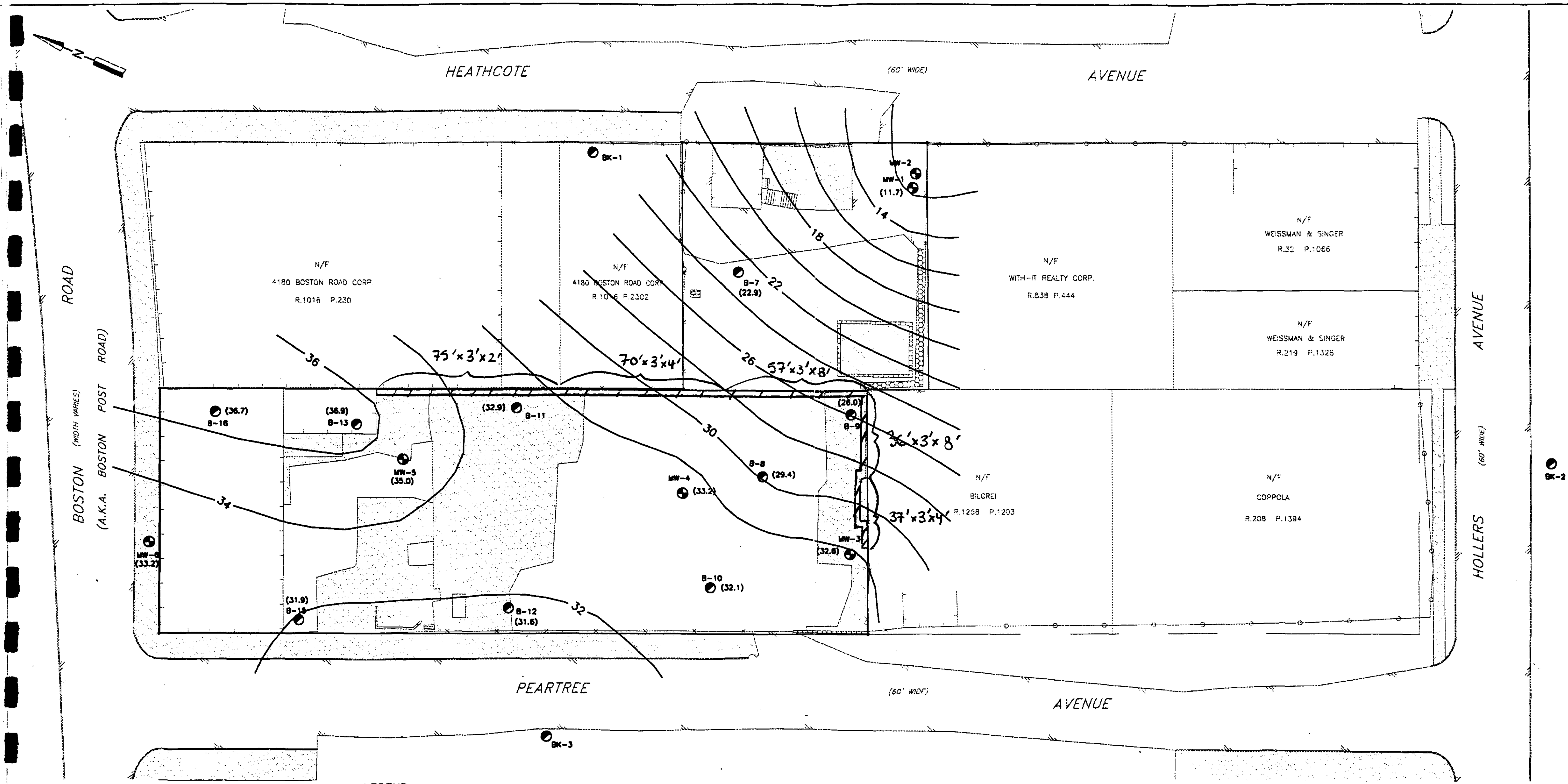
HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 4A AND 4B CONCRETE REMOVAL VOLUME ESTIMATE

DESIGNED BY:	PK
DRAWN BY:	PDP
CHECKED BY:	MT
SUBMITTED BY:	PDP
DATE:	MAY 1999
SCALE:	AS SHOWN
DRAWING NO.:	A-4.1

U:\PROJECT.33\5851HEXL.DEC\FFS\FIGURES Filename: A-4-1.DWG Date: 5-18-99 User: PDP



LEGEND

BK, B	SOIL BORING		CONCRETE WALL
MW	MONITORING WELL		CONCRETE STEPS
	BUILDING EDGE		CHAIN LINK FENCE
	HEXAGON PROPERTY LINE		METAL STOCKADE FENCE
	ADJOINING PROPERTY LINE	N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	CONCRETE	(36.24)	BEDROCK SURFACE ELEVATION IN FEET (TYP.), NGVD
	CONCRETE CURB	36	BEDROCK SURFACE ISOPLETH (TYP.), 2 FT. CONTOUR INTERVAL
	EDGE OF MACADAM		
	MASONRY STONE WALL		

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: **TAMS** CONSULTANTS, Inc.
The TAMS Building
655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233

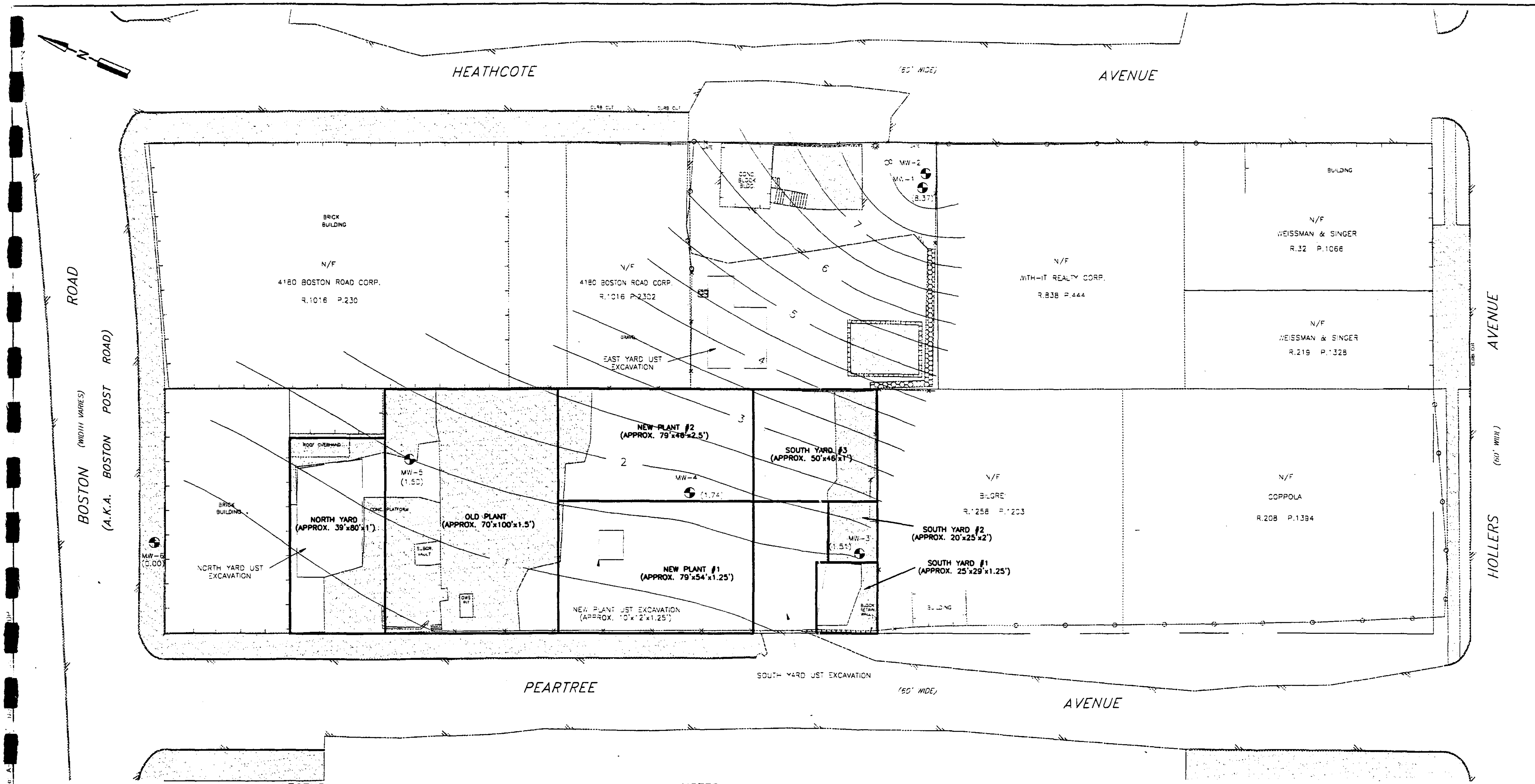
DESIGNED BY: PK
DRAWN BY: PDP
CHECKED BY: MT
SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 4A AND 4B SLURRY WALL VOLUME ESTIMATE

DATE: MAY 1999
SCALE: AS SHOWN
DRAWING NO.: A-4.2



LEGEND

MW	MONITORING WELL		CONCRETE STEPS
	BUILDING EDGE		CHAIN LINK FENCE
	HEXAGON PROPERTY LINE		METAL STOCKADE FENCE
	ADJOINING PROPERTY LINE	N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	CONCRETE	(36.24)	SATURATED OVERBURDEN THICKNESS IN FEET (TYP.)
	CONCRETE CURB	35	SATURATED OVERBURDEN ISOPACH (TYP.), 0.5 FT. CONTOUR INT.
	EDGE OF MACADAM		
	MASONRY STONE WALL		
	CONCRETE WALL		

NOTES

1. GRAVEL VOLUME ESTIMATE SUBDIVISIONS ARE APPROXIMATED AS RECTANGULAR BLOCKS TO FACILITATE THE VOLUME CALCULATION. ACTUAL GRAVEL VOLUME MAY VARY BASED ON SUBSURFACE CONDITIONS.
2. REFER TO TABLE A-4.1 FOR CORRESPONDING GRAVEL VOLUME CALCULATION.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: **TAMS CONSULTANTS, Inc.** The TAMS Building 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY: PK
DRAWN BY: PDP
CHECKED BY: MT
SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 4A AND 4B GRAVEL BASE COURSE VOLUME ESTIMATE

DATE: MAY 1999 | SCALE: AS SHOWN | DRAWING NO.: A-4.3

ALTERNATIVE 5A
LIMITED EXCAVATION/OFF-SITE DISPOSAL/ASPHALT CAP

TABLE A-5A
COST ESTIMATE
ALTERNATIVE 5A - LIMITED SOIL EXCAVATION/OFF-SITE DISPOSAL

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	CAPITAL COSTS				
	Direct Capital Costs				
A.	*Mobilization /Temporary Facilities/ Demobilization*				
	1. Mobilization/Demobilization	1	$60,200	LS	$60,200
	2. Temporary facilities	1	$61,500	LS	$61,500
	3. Site security	6.5	$10,700	Month	$69,600
B.	Health and Safety				
	1. Health & safety measures	5.5	$18,500	Month	$101,800
	2. Decon water sampling and disposal	1	$19,900	LS	$19,900
	3. Decon pad	1	$17,200	LS	$17,200
C.	Construction Management	8.5	$30,000	Month	$255,000
D.	Construction and Remediation				
	1. Concrete Slab/Asphalt Paving Demolition and Disposal				
	a. Demolition - concrete	1,070	$136.43	CY	$146,000
	b. Demolition - pavement	340	$7.78	SY	$2,600
	c. Transportation and disposal	1,640	$18	CY	$29,500
	2. Excavation				
	a. Temporary shoring	4,800	$8.03	SF	$38,600
	b. Excavate trench	80	$7.08	CY	$600
	c. Slurry wall construction	3,970	$19.32	CF	$76,700
	d. Soil excavation	5,000	$11.09	CY	$55,500
	3. Sampling and Analysis (for Disposal)				
	a. Sample collection (non-haz soil)	1	$2,000	LS	$2,000
	b. Sample collection (haz soil)	1	$200	LS	$200
	c. Sample analysis (non-hazardous facility)	1	$17,800	LS	$17,800
	d. Sample analysis (hazardous facility)	1	$1,700	LS	$1,700
	4. Sampling and Analysis (for Documentation)				
	a. Sample collection	1	$3,300	LS	$3,300
	b. Sample analysis	1	$18,600	LS	$18,600
	5. Offsite Transportation				
	a. Roll-off spotting	60	$300	EA	$18,000
	b. Roll-off rental (60 containers for 10 weeks at $10/day)	1	$33,600	LS	$33,600
	c. Liner	300	$35	Load	$10,500
	d. Non-hazardous waste landfill	294	$600	Load	$176,400
	e. Hazardous waste facility	6	$2,650	Load	$15,900
	6. Offsite Disposal				
	a. Non-hazardous waste landfill	7,350	$36	Ton	$264,600
	b. Hazardous waste facility	120	$177	CY	$21,200
	7. Backfill				
	a. Gravel (Upper Site only)	1,189	$20	CY	$23,800
	b. Geotextile	31,000	$0.27	SF	$8,400
	c. Common fill	4,000	$15	CY	$60,000
	8. Asphalt Cap				
	a. Crushed stone	600	$31.88	CY	$19,100
	b. Binder course	3,633	$4.69	SY	$17,000
	c. Geogrid	3,633	$2.38	SY	$8,700
	d. Wearing course	3,633	$5.52	SY	$20,100

TABLE A-5A
COST ESTIMATE
ALTERNATIVE 5A - LIMITED SOIL EXCAVATION/OFF-SITE DISPOSAL

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	9. Surface Water Runoff Control				
	a. Catchbasins	3	$1,400	EA	$4,200
	b. Perimeter drain	200	$50	LF	$10,000
	c. Curb	650	$7	LF	$4,500
	d. Sidewalk/curb extension	1	$15,800	LS	$15,800
	Total Direct Costs				$1,710,100
	Indirect Capital Costs				
	1. Engineering and Permitting				$200,000
	2. Contingency (15% of Total Direct Costs)				$256,515
	Total Indirect Costs				$456,515
	TOTAL CAPITAL COSTS				$2,166,615
	ANNUAL O&M COSTS				
	1. Cap Maintenance & Repair	1	$700	LS	$700
	2. Long-Term Monitoring	1	$14,500	LS	$14,500
	TOTAL ANNUAL O&M COSTS				$15,200
	PRESENT WORTH OF COSTS				
A.	Annual O&M Costs (30 year duration, 5% discount rate)				$233,654
B.	Total Capital Costs				$2,166,615
	TOTAL PRESENT WORTH				$2,400,269

Assume: $2,400,000

Alternative 5A - Limited Soil Excavation/Off-Site Disposal/Asphalt Cap

Prepared By: PDP
Checked By: LT

Project Duration

Assume:	Mobilization/demobilization	4 weeks
	Site preparation for excavation (shoring, slurry wall)	4.5 weeks
	Concrete/pavement demolition	5 weeks & during excavation
	Excavation & Backfill	6 weeks
	Transport and dispose (includes confirmatory sampling)	2 weeks & during excavation
	Asphalt cap placement	1 week
	Surface water runoff control	4 weeks
	Total:	**26.5 weeks**
	Assume:	**6.5 months**

Time for workplan preparation and for obtaining any approvals/permits is not included.

Prepared By: PDP
Checked By: LI

Engineering & Permitting

It is assumed that NYSDEC will hire an Engineering Consultant to prepare plans and specifications for the remediation.
It is assumed that work includes the preparation of:
- Plans and specifications for competitive bidding;
- Discussion with state and local agencies regarding permit requirements;
- Submission of 30% design submittal for review;
- Submission of 90% design submittal for review;
- Preparation of a design report;
- Preparation of an engineering cost estimate; and
- Provision of pre-award services.

Based on TAMS' experience, this work can cost between $150,000 to $250,000, depending on the complexity of the remediation.
- $250,000 for high complexity
- $200,000 for medium complexity
- $150,000 for low complexity

For Alternative 5A, work is considered to be medium complexity.

Assume Engineering & Permitting cost of: $200,000

Prepared By: PDP
Checked By: LT

Construction Management

It is assumed that NYSDEC will hire an engineering consultant to perform construction period services during the remediation.

It is assumed that work includes the preparation of:

- Attendance at pre-construction meetings;
- Review of contractor submittals;
- Full time project inspection;
- Maintenance of construction records and reports;
- Quality assurance;
- Change order preparation;
- Processing of contractor application for payment; and
- Preparation of Final Remediation Report.

It is assumed that construction management services will begin one month prior to the start of construction activities.

It is assumed that construction management services will continue for one month after the end of on-site activities.

Based on TAMS' experience, the cost of construction management is approximately $30,000 per month.

Assume a monthly Construction Management cost of: $30,000

Prepared By: PDP
Checked By: LT

Mobilization & Demobilization (Includes Contractor Preparation of Project Plans)

1. Materials & Equipment

Assume 20 pieces of equipment at $500 per piece for mobilization:	$	10,000
Assume 20 pieces of equipment at $500 per piece for demobilization:	$	10,000
Assume $10,000 for mob/demob of materials:	$	10,000
Subtotal:	**$**	**30,000**

2. Contractor Preparation of Project Plans

Includes Work Plans, Health & Safety Plans, QA/QC Plans, and Erosion Control Plan.
Assume labor requirement of 2 persons @ $30 per hour per person for 1 month.
Assume labor multiplier of 3.

= 2 persons x $30 /hour x 40 hours/week x 4.2 weeks/month x 1 month x 3 multiplier

= $30,240

Assume: **$30,200**

Total Mobilization/Demobilization Cost: **$60,200**

Prepared By: PDP
Checked By: LT

Temporary Facilities

1. **Temporary Facilities - One Time Cost**
   Assume 2 trailers @ $1,300 per trailer
   Assume office trailer equipment @ $5,000 per trailer

- Computer	$ 2,500
- Printer	$ 500
- Modem	$ 200
- Fax Machine	$ 500
- Copier	$ 500
- Phone	$ 100
- Answering Machine	$ 100
- Desk & Chair (2)	$ 300
- Conference Table	$ 100
- Chairs (4)	$ 100
- File Cabinet	$ 100
	$ 5,000

   Assume electrical hookup @ $2,500 per trailer
   Assume phone hookup @ $200 per trailer
   Assume project sign @ $500
   Assume temporary site controls (e.g. barricades, traffic control, erosion control) @ $5,500
   Assume decon facility mob/demob @ $1,000
   Assume water tank(s) mob/demob @ $1000
   Assume misc. equipment/supplies @ $3,000

   Total Temp. Facilities One Time Cost: $ 29,000

2. **Monthly Costs**
   Assume trailer rental @ $500 per trailer
   Assume sanitary facility & water @ $500
   Assume janitorial service @ $500
   Assume trailer electrical service @ $200 per trailer
   Assume miscellaneous electrical requirements @ $200
   Assume phone service @ $200 per trailer
   Assume miscellaneous costs @ $2000

   Subtotal: $ 5,000 per month

   Duration: 6.5 months

   Total Monthly Costs: $ 32,500

Total Temporary Facilities Cost: $ 61,500
Assume: $ 61,500

Prepared By: PDP
Checked By: [illegible]

Site Security

Assume on-site security will be provided from 5 PM to 7AM during construction activities.
Assume on-site security will be provided 24 hours per day for weekends during construction activities.
Assume 2 unarmed security guards @ $11 per hour per guard.

Monthly Security Cost:	=	2 guards x	14 hours per day x	21 weekdays per month x	$11	per hour +
		2 guards x	24 hours per day x	8 weekend days per month x	$11	per hour

= $10,692

Assume monthly security cost of: **$10,700**

Prepared By: PDP
Checked By: LT

Health & Safety

Assume monitoring equipment @ $3,000 per month
Assume 2 sets of PPE per day per person @ $18 per unit (PPE costs associated with sampling included separately in sampling cost estimate)
Assume 10 workers within exclusion zone at one time
Assume on-site Safety Coordinator @ $5,000 per month
Assume decon facility (shower, etc.) @ $2,900 per month
(Means Environmental Remediation Cost Data - 33 17 0821; includes 1.23 Location Factor)

Total: $ 18,460 per month

Assume: $ 18,500 per month (during construction activities excluding mob/demob)

Prepared By: PDP
Checked By: LK

Decontamination Pad

Assume 20 ft x 30 ft x 6 inch decon pad with 6-inch high curbs
Assume construction of 6-inch slab on grade (not including forms or reinforcement) @$2.09/sf
(from Means, 1998; Item No. 033 130 5010)
Assume reinforcement with welded wire fabric @ $66.50 per 100 sf
(from Means, 1998; Item No. 032 207 0700)
Assume use of trench forms on floor @$10.35 per sf
(from Means, 1998; Item No. 031 170 6000)
Assume location factor of 1.275
Assume decon pad walls @ $1,000
Assume sump pit and pump @ $1,500
Assume pressure washer @ $3,500 (purchase)
(from Means Environmental, 1999: Item No. 33 17 0815; Location factor of 1.23)
Assume one 21,000 gallon frac tank @ $1,200 per month
Assume project duration of 6.5 months

Slab =		600 sf x	$2.09	/sf +	600 sf x	$0.67	/sf +	100 sf x	$10.35	/sf			
	= $	2,688	x	1.275 multiplier									
	= $	3,427											
Total =		17,227											
Assume	**$**	**17,200**											

Alternative 5A - Limited Soil Excavation/Off-Site Disposal/Asphalt Cap

Prepared By: PDP
Checked By: LT

Estimate of Volume of Decontamination Water

1. **Personnel Decon**
   Assume 10 workers, two showers per day, and five gallons per shower

Total Volume =	100 gallons per day x	21 days per month
=	2,100 gallons per month x	5.5 months
=	11,550 gallons	

2. **Equipment Decon**
   Assume 10 pieces of equipment, one wash per two weeks, 20 gallons per wash per piece of equipment

Total Volume =	400 gallons per month x	5.5 months
=	2200 gallons	

3. **Concrete Slab Decon (prior to disposal)**
   Assume 25 sf per minute @ 6 gallons per minute
   Assume surface area of concrete to be washed is 36,900 sf (includes both sides of concrete slabs)

Total Volume =	36900 sf /	25 sf/minutes x	6 gallons/minute
=	8856 gallons		

Total Volume of Decon Water = **22,606 gallons**

Assume: **22,600 gallons**

Prepared By: PDP
Checked By: LT

Collection & Disposal of Decontamination Water

1. **Equipment and Concrete Decon Labor**

Assume 2 laborers @ $25 per hour for pressure washing
Assume total area of concrete = 36,900 sf
Assume decon rate of 25 sf per minute
Assume labor multiplier of 2.
Assume 19 hours total for decon of equipment over course of construction activities (10 minutes per piece of equipment, 10 pieces of equipment per two weeks, 23 weeks of construction activities).

Time for decon = 44 hours

Labor cost = 44 hours x $ 25 / hour x 2 laborers x 2 multiplier

= $ 4,400
Assume: $ 4,400

2. **Analytical Costs for Disposal**

Assume 4 water samples for disposal @ $1,050 per sample (includes 25% increase for 1 week turnaround)

Analytical:	VOCs	$ 125	
	SVOCs	$ 250	
	Pest/PCBs	$ 150	
	TAL ICP Metals	$ 135	
	TDS	$ 10	
	TSS	$ 10	
	TOC	$ 35	
	Dissolved Metals	$ 120	
		$ 835	plus 25% markup for 1 week turnaround time

Analytical Cost = $ 4,200

3. **Transport and Treatment/Disposal Cost**

Assume hazardous water transport and disposal @ $0.78 per gallon
Assume non-hazardous water transport and disposal @ $0.50 per gallon
Assume decon water is non-hazardous

Total Volume of Decon Water = 22,600 gallons

Transport and Disposal Cost = $ 11,300

Total Collection, Analysis, Transport, and Disposal = $ 19,900

Assume $ 19,900

Prepared By: PDP
Checked By: LT

1. Volume and Area of Concrete to be Removed/Disposed (see Figure A-5.1)

Area	Length (ft)	Width (ft)	Thickness (ft)	Volume (cf)	Volume (cy)	Area (sf)	Area (sy)
North Yard 1	60	15	1	900	33.3	900	100
North Yard 2	55	38	2	4180	154.8	2090	232.2
Old Plant	100	47	2	9400	348.1	4700	522.2
New Plant	100	75	1.5	11250	416.7	7500	833.3
South Yard	100	15	1	1500	55.6	1500	166.7
East Yard 1	40	25	1	1000	37.0	1000	111.1
East Yard 2	30	20	1	600	22.2	600	66.7
East Yard 2 Wall	77	1.2	1.2	104.8	3.9	89.8	10.0
East Yard 2 Wall	31	1.2	1.5	54.3	2.0	36.2	4.0

Total: 1074 cy 2046 sy
Assume: 1070 cy 2050 sy

For disposal, assume 50 percent volume expansion: 1600 cy

2. Volume and Area of Asphalt to be Removed/Disposed

Assume thickness of 4 inches

Area = 4500 sf - 1500 sf (concrete block bldg & concrete slab)
= 3000 sf
= 333 sy

Assume: 340 sy

Volume = 1000 cf
= 37 cy plus 20 percent volume expansion

Assume: 40 cy

3. Concrete Demolition

Assume demolition of reinforced concrete (7 to 24 inches thick) @ $107/cy
(Means 1998; Item No. 020 554 2200)
Assume location factor of 1.275

= 1070 cy x $ 107 /cy x 1.275 location factor
= $ 145,975

Assume: $ 146,000

Assume productivity rate for concrete demolition is 24 cy per day. Total of 45 days required for demolition.
Assume half of work is performed during excavation of other parts of the site.

Prepared By: PDP
Checked By: [illegible]

4. Pavement Demolition

Assume demolition of pavement (4 to 6 inches thick) @ $6.10/sy
(Means 1998; Item No. 020 554 1750)
Assume location factor of 1.275

= 340 sy x $ 6.10 /sy x 1.275 location factor
= $ 2,644

Assume: **$ 2,600**

Assume productivity rate of 420 sy per day. Assume 1 day for pavement demolition.

5. Transport and Disposal of Concrete & Asphalt

Assume transport and disposal cost of concrete with rebar and asphalt @ $18 /cy (quote from Liotta & Sons. Inc.; 10/98)

= 1640 cy x $ 18 /cy
= $ 29,520

Assume: **$ 29,500**

Prepared By: PDP
Checked By: LL

Shoring Placement (see Figure 4-14)

Assume temporary wood shoring (solid sheeting with wales, braces, spacers) including placement, extraction, and salvage for 8 foot excavation @ $6.30/sf (Means, 1998; Item No. 021 614 3910).
Assume location factor of 1.275.
Assume productivity rate of 330 sf per day.
Assume distance around excavated areas where shoring will be installed of 600 lf (does not include East Yard).
Assume no shoring required for 2 feet excavation in East Yard.
Assume sheeting installed to 8 feet (2 feet below deepest excavated surface).

= 8 ft x 600 ft x $6.30 /sf x 1.275 location factor
= $ 38,556

Assume: $ 38,600

Assume total duration of 3 weeks. Assume that half of the installation is performed during excavation of other areas.

Prepared By: PDP
Checked By: LT

Slurry Wall Construction

1. Wall Volume Estimate

Assume slurry wall will be installed along the eastern and southern perimeters of the upper site as shown in Figures 4-11 and A-5.2.
Assume slurry wall will extend from the top of bedrock to an elevation of approx. 34 feet NGVD.
Assume slurry wall will be constructed of unreinforced cement-bentonite mixture.
Assume slurry wall will be 3 feet thick.

Length (ft)	Width (ft)	Height (ft)	Volume (cf)	
75	3	2	450	
70	3	4	840	
57	3	8	1368	
36	3	8	864	
37	3	4	444	
		Total:	3966	
		Assume:	**3970**	**cf**

2. Estimate of Soil Volume Above Top of Slurry Wall

Assume slurry wall will be installed along the eastern and southern perimeters of the upper site as shown in Figures 4-11 and A-5.2.
Assume slurry wall will extend from the top of bedrock to an elevation of approx. 34 feet NGVD.
Assume slurry wall will be 3 feet thick.

Length (ft)	Width (ft)	Height (ft)	Volume (cf)	Volume (cy)	
75	3	2.5	562.5	20.8	
70	3	3	630	23.3	
57	3	2	342	12.7	
36	3	2	216	8.0	
37	3	3	333	12.3	
			Total:	77	
			Assume:	**80**	cy

3. Slurry Wall Construction

Assume excavated trench in wet soils, backfilled with 3,000 psi concrete, no reinforcement @ $15.15 per cf (Means, 1998; Item No. 021 684 0050).
Assume productivity rate of 333 cf/day for slurry wall placement.
Assume trench excavation (to top of slurry wall construction) @ $5.55 per cy (Means, 1998; Item No. 022 254 0050; Backfill accounted for as part of site backfill cost; refer to Figure 1-4 for overburden thickness).
Assume productivity rate of 150 cy/day for excavation to top of slurry wall.
Assume location factor of 1.275.

=	3970	cf x	$	15.15	/cf x	1.275 location factor +
	80	cy x	$	5.55	/cy	1.275 location factor
= $	77,252					

Assume: $ **77,300**

Assume 15 days for slurry wall construction.

Prepared By: PDP
Checked By: LT

Excavation

Assume excavation of soil @ $8.70/cy (Means, 1998; Item No. 022 250 2060.
Assume location factor of 1.275.
Assume productivity rate of 200 cy/day.

Total =	5000 cy x	$ 8.70 /cy x	1.275 location factor
= $ 55,463			

Assume: $ 55,500

Five weeks to excavate 5,000 cy. Assume 6 weeks to account for contingencies.

Note: It is assumed that the shallow monitoring wells in the Upper Site will be removed during excavation. The shallow monitoring well in the East Yard shall be protected from damage during construction activities.

Prepared By: PDP
Checked By: LT

Estimate of Hazardous Soil Volume

Samples which may fail TCLP (using 20-fold estimate of TCLP concentration)

Sample	Depth (ft)	Area	Analyte Category
HXB11S2	4-5	Old Plant	VOCs
HXB4S2	2-4	New Plant	VOCs
NPT2	3-3.5	New Plant	VOCs
NPT3	3-3.5	New Plant	VOCs
NPT4	3-3.5	New Plant	VOCs
HXB19	1.3-1.7	East Yard	Metals
HXSS4	0-0.5	New Plant	Metals
HXB10S1	0-2	New Plant	Metals
HXB6S1	1-2	Bos.Post Rd.	Metals
HX-OM1	Surface Scrape	Hydrotherm 1	Metals
HXB17	2-2.5	East Yard	Metals
HXB20	2.2-2.3	East Yard	Metals
HXB21	2-2.5	East Yard	Metals
HXB11S2	4-5	Old Plant	Metals
HXB15S1	2.5-4.5	North Yard	Metals
SYTC-1	2.5-4.5	South Yard	Metals
NYT-2	5.5-6	North Yard	Metals

Assume Total Volume of Hazardous Soil is 100 cy.

Alternative 5A - Limited Soil Excavation/Off-Site Disposal/Asphalt Cap

Sampling and Analysis for Disposal of Non-Hazardous Soil

Prepared By: PDP
Checked By: LT

1. Analytical Costs

Assume sampling frequency of 500 cy (James Hull, WMI - Grows Landfill; 11/98).
Total volume of excavated soil is 5,000 cy, 100 cy of which is assumed to be hazardous.
Assume 20 percent bulking after excavation.
Assume no validation of sample data.

Number of samples =	5880 cy/	500 cy/sample
=	11.76	
Assume:	12 environmental samples	

Assume contingency for re-sampling of 2 samples.

Total number of samples = 14

Samples analyzed for:	TCLP	$850
	PCBs	$90
	Reactive CN / Reactive Sulfide	$45
	Ignitability	$30
		$1,015 per sample x 25% markup for 1 week turnaround
	Total:	**$1,270 per sample**

Analytical Cost =	$1,270	/sample x	14 samples
=	**$17,780**		
Assume:	**$17,800**		

2. Sampling Cost

Assume sampling will be performed by two on-site personnel (no additional labor charge)
Assume H&S PPE @ $18 per person per day
Assume miscellaneous cost of $100
Assume sample shipment of $1,400

Total: $ 2,004

Assume: $ 2,000

Total Sampling and Analytical Cost: $ 19,800

Prepared By: PDP
Checked By: LT

Sampling and Analysis for Disposal of Hazardous Soil

1. Analytical Costs

Assume collection of one representative sample of 100 cy of hazardous soil
Assume no validation of sample data

Samples analyzed for:	VOCs	$130	
	SVOCs	$275	
	PCBs	$90	
	TCLP	$850	
		$1,345	per sample x 25% markup for 1 week turnaround
	Total:	**$1,680**	**per sample**

Analytical Cost =	$1,680	/sample x	1 sample
=	$1,680		
Assume:	**$1,700**		

2. Sampling Cost

Assume sampling will be performed by two on-site personnel (no additional labor charge)
Assume H&S PPE @ $18 per person per day
Assume miscellaneous cost of $50
Assume sample shipment of $100

Total:	$	186
Assume:	**$**	**200**

Total Sampling and Analytical Cost:	$	1,880
Assume:	**$**	**1,900**

Prepared By: PDP
Checked By: LT

Sampling and Analysis for Documentation Sampling

1. Analytical Costs

Assume documentation sampling will be conducted at the bottom surface of the excavated areas in the East Yard and the southeastern part of the South Yard. All other areas on site will be excavated to the top of bedrock and no samples will be collected.
Assume one sample will be collected per 50 ft by 50 ft grid.
Assume documentation sampling will be conducted along the perimeter of the excavation which is approximately 950 ft.
Assume one sample will be collected per 50 ft along perimeter.
Assume no validation of sample data.

Number of bottom samples =	4	samples from East Yard +		1	sample from South Yard
=	5				
Number of sidewall samples =	950	lf /	50	lf/sample	
=	19				

Total number of environmental samples: 24

Assume 3 QA/QC samples (MS/MSD and duplicate) and 2 field blanks.

Total number of samples = **29**

Samples analyzed for:			
	VOCs	$	130
	SVOCs	$	275
	PCBs	$	90
	TAL ICP Metals	$	145
	Total:	**$**	**640** **per sample**

Analytical Cost = $ 640 /sample x 29 samples
= $18,560

Assume: **$18,600**

2. Sampling Cost

Assume sampling will be performed by one on-site personnel (no additional labor charge) and one assistant @ $25/hour.
Assume sampling will be conducted over a period of three 8-hour days.
Assume labor multiplier of 3.
Assume car rental of $65 per day.
Assume per diem for assistant of $120 per day.
Assume H&S PPE @ $18 per person per half day.
Assume miscellaneous cost of $200.
Assume sample shipment of $500.

Total: $ 3,271

Assume: **$ 3,300**

Total Sampling and Analytical Cost: **$ 21,900**

Prepared By: PDP
Checked By: LT

Off-Site Transportation for Disposal

1. Roll-Off Rental

Assume 1.200 cy (1.000 cy excavated plus 20% bulking) to be containerized for off-site transportation per week.
Assume sixty 20 cy roll-offs to haul soil excavated in one week @ $10 per day.
Assume spotting charge of $300 per roll off (spotting charge for first drop off only; no spotting charge for replacement containers brought to site while picking up fill containers).
Assume one liner for each roll-off load @ $35 each.
Assume containers on site for 8 weeks (6 weeks of excavation plus 1 week for analytical results for last batch plus 1 week for transport off site.

Spotting Fee =	60	containers x	$	300	/container		
= $	18,000						
Daily rental =	60	containers x		8	weeks x	7 days/week x	$10 /day
= $	33.600						
Liners =	300	containers x	$	35	/container		
= $	10.500						

Non haz = 5.880 cy -includes bulking factor
Haz = 120 cy - includes bulking factor
294 containers for non-haz soil
6 containers for haz soil

Total Roll-Off Cost: **$ 62,100**

2. Transportation

Assume hazardous soil is transported to the City Environmental landfill in Michigan @ $2,650 per load (Hexagon IRM cost).
Assume non-hazardous soil is transported to Grows Landfill in Pennsylvania @ $600 per load (Freehold Cartage, 10/98).

Hazardous soil =	6	loads x	$	2,650	/load
= $	15,900				
Nonhazardous soil =	294	loads x	$	600	/load
= $	176.400				

Total Transportation Cost = **$ 192,300**

Alternative 5A - Limited Soil Excavation/Off-Site Disposal/Asphalt Cap

Prepared By: PDP
Checked By: LT

Hazardous and Non-Hazardous Soil Disposal

Assume hazardous soil is disposed at City Environmental in Michigan (chemical oxidation prior to landfilling) @ $177/cy including $10/cy tax (Cathy Zelner, City Environmental, 10/98).
Assume non-hazardous soil is landfilled at Grows Landfill in Pennsylvania @ $36/ton (James Hull, WMI - Grows Landfill, 11/98)
Assume 1.5 tons per cy of soil.
Assume 120 cy of hazardous soil to be disposed of (includes 20% bulking factor)
Assume 4900 cy of non-hazardous soil to be disposed of (does not include 20% bulking factor - disposal cost based on weight of soil)

Hazardous Soil:	120	cy x	$177	/cy			
	= $ 21,240						
Non-Hazardous Soil:	4900	cy x	1.5	tons/cy x	$36	/ton	
	= $ 264,600						
Total Disposal Cost =	$ 285,840						
Assume:	**$ 285,800**						

Prepared By: PDP
Checked By: LT

Backfilling Excavated Areas

1. Upper Site (North Yard, Old Plant, New Plant, South Yard)

Assume that excavated areas will be backfilled with clean gravel from the bottom of the excavation to the top of the water table to circumvent compaction difficulties and to facilitate future groundwater remediation at the site.
Assume that clean fill @ $15/cy will be used to backfill the excavation from the water table to 10 inches below final grade (cost includes bringing fill to the site, backfilling, and compaction).
Assume placement of geotextile between gravel and clean fill to prevent migration of fines @ $0.27 /sf.
Assume top 10 inches will be used for placement of asphalt surface (6 inches of base, 2 inches of binder course, 2 inches of wearing course).
Assume clean gravel fill @ $20/cy.

Gravel
Estimated volume of gravel is 32,100 cf (see attached Table A-5.1 and Figure A-5.3).

Gravel Fill Cost = 32,100 cf/ 27 cf/cy x $ 20 cy
= $ 23,778
Assume: $ 23,800

Assume productivity rate of 1100 cy per day. Assume 2 days for placement.

Geotextile
Estimated area for geotextile is 21,500 sf (see attached Table A-4.1 and Figure A-4.3) in upper site
Geotextile Cost = 21,500 sf x $ 0.27 /sf
= $ 5,805
Assume: $ 5,800

Productivity rate of 2400 sy per day. Assume 1 day for placement.

Clean Fill
Estimated volume of clean fill is calculated from the volume of material excavated from the upper site see Table 2-7) less the volume of gravel used as backfill less the volume for asphalt paving placement (top 10 inches) less the volume of clean soil removed from South Yard UST area for asphalt paving placement (top 10 inches from approx. 25 ft by 54 ft area).
Assume placement of an additional 6 inches across entire area to account for additional fill necessary to create 1% slope for surface water runoff.

Volume of soil excavated from the upper site:		4200 cy
Added volume for 1% slope	+	10750 cf
Volume of gravel added:	-	32100 cf
Volume for pavement placement:	-	17900 cf
Volume of soil from South Yard UST area:	-	1100 cf
Total:		2706 cy
Total assuming 20 percent compaction factor:		3247 cy
	Assume:	3200 cy

Clean Fill Cost = 3200 cy x $ 15 /cy
= **$ 48,000**

Assume productivity of 975 cy per day for placement and 560 cy per day for compaction. Assume 6 days for placement and compaction (compaction & placement will be performed concurrently in different areas of the site).

2. East Yard

Assume placement of geotextile @ $0.27 /sf between bottom of excavation and clean fill to provide a separation layer between the clean fill and the remaining contaminated overburden.
Assume that clean fill @ $15/cy will be used to backfill the excavation from the geotextile to 10 inches below final grade (i.e., 14 inches of fill will be placed: cost includes bringing fill to the site, backfilling, and compaction).
Assume top 10 inches will be used for placement of asphalt surface (6 inches of base, 2 inches of binder course, 2 inches of wearing course).
Assume that area beneath Cinder Block building is not excavated.
Assume placement of an additional 8 inches across entire area to account for additional fill necessary to create 1% slope for surface water runoff.

Geotextile

Estimated area for geotextile is 10,000 sf (see Table 2-7) less 500 sf beneath Cinder Block building.

Geotextile Cost = 9,500 sf x $ 0.27 /sf
= **$ 2,565**
Assume: $ 2,600

Productivity rate of 2400 sy per day. Assume one half day for placement.

Clean Fill

Estimated volume of clean fill is calculated from the volume of material excavated from the East Yard less the volume for placement of asphalt pavement (top 10 inches).

Volume of soil excavated from the East Yard:		19000 cf
Added volume for 1% slope	+	6333 cf
Volume for pavement placement:	-	7917 cf
Total:		17417 cf
Total assuming 20 percent compaction factor:		20900 cf
	Assume:	800 cy

Clean Fill Cost = 800 cy x $ 15 /cy
= **$ 12,000**

Assume productivity of 975 cy per day for placement and 560 cy per day for compaction. Assume 2 days for placement and compaction (compaction & placement will be performed concurrently in different areas of the site).

Assume total duration for backfill of Upper Site and East Yard of approximately 12 days. Assume that backfilling will be performed concurrently with excavation of other parts of the site.

Alternative 5A - Limited Soil Excavation/Off-Site Disposal/Asphalt Cap

Prepared By: PDP
Checked By: LT

Asphalt Cap

Assume total area for asphalt cap of 32,700 sf.
Cap shall consist of 6 inches of compacted NYSDOT Item No. 4 crushed stone, 2 inches of binder course, and 2 inches of wearing course.
Geogrid reinforcement shall be placed between the bituminous binder and wearing courses.
Assume crushed stone @ $25/cy (Means 1998, Item No. 022-308-1521).
Assume 2-inch binder course @ $3.68/sy (Means 1998, Item No. 025-104-0120).
Assume 2-inch wearing course @ $4.33/sy (Means 1998, Item No. 025-104-0380).
Assume geogrid @ $1.87/sy (based on Means cost for geotextile; Means 1998, Item No. 022-412-1510)
Assume location factor of 1.275.

1. Crushed Stone Placement

Volume of stone =	32,700	sf x	0.5 ft		
=	16350	cf			
=	600	cy			
Placement Cost =	600	cy x	$25 /cy x	1.275 location factor	
=	$ 19,125				
Assume:	**$ 19,100**				

Productivity rate of 750 cy per day. Assume 1 day for placement.

2. Binder Course Placement

Placement Cost =	32,700	sf /	9 sf/sy x	$3.68	/sy x	1.275 location factor
=	$ 17,048					
Assume:	**$ 17,000**					

Productivity rate of 6345 sy per day. Assume 1 day for placement.

3. Geogrid Placement

Placement Cost =	32,700	sf /	9 sf/sy x	$1.87	/sy x	1.275 location factor
=	$ 8,663					
Assume:	**$ 8,700**					

Productivity rate of 2400 sy per day. Assume 2 days for placement.

4. Wearing Course Placement

Placement Cost =	32,700	sf /	9 sf/sy x	$4.33	/sy x	1.275 location factor
=	$ 20,059					
Assume:	**$ 20,100**					

Productivity rate of 6345 sy per day. Assume 1 day for placement.

Total for Asphalt Cap Placement: $ 64,900

Assume Time for Asphalt Cap Placement of one week.

Prepared By: PDP
Checked By: LT

Surface Water Runoff Control

1. **Catchbasin Installation**

Assume no additional excavation necessary for catch basin placement.
Assume cost for backfill of catchbasin is included in site backfill estimate.
Assume precast catchbasin (4 ft x 4 ft x 6 ft) @ $910 each (Means, 1998; Item No. 027 152 1120).
Assume frame & cover (18-inch diameter, light traffic, 100 lbs) @ $202 each set (Means, 1998; Item No. 027 152 1800).
Assume location factor of 1.275.
Assume 2 days for placement of catchbasins.

Cost per catchbasin: $ 1,418
Assume: $ 1,400 per catchbasin

2. **U-Shaped Perimeter Drain Installation**

Assume no additional excavation necessary for drain installation.
Assume cost for backfill of drain is included in site backfill estimate.
Assume cost materials & installation of U-shaped (19 inch channel depth) perimeter drain @ $50/lf (ABT, Inc., 10/98).
Assume 1.5 weeks for placement of perimeter drain system.

Total length of perimeter drain is: 200 lf

Cost for placement: $ 10,000

3. **Curb Installation**

Assume length of curb is 650 feet.
Assume placement of concrete curbing around perimeter (see Figure 4-2 for curb placement locations) @ $5.40/lf (includes steel forms; Means, 1998; Item No. 025 254 0410).
Assume location factor of 1.275.
Assume production rate of 700 lf/day.

Cost for curb placement: $ 4,475
Assume: $ 4,500

4. **Extension of Sidewalk and Curb**

Assume 12 ft by 300 ft sidewalk extension from southeastern edge of East Yard to corner of Hollers Avenue.
Assume concrete sidewalk (3,000 psi concrete, 4 inches thick) @ $2.55/sf (Means, 1998; 025 128 0310).
Assume 4-inch bank run gravel base @ $0.44/sf (Means, 1998; 025 128 0450).
Assume placement of concrete curbing @ $5.40/lf (includes steel forms; Means, 1998; Item No. 025 254 0300).
Assume location factor of 1.275.
Assume production rate of 2500 sf per day for base material and 600 sf per day for concrete.
Assume production rate of 700 lf/day for placement of curb.

Cost for curb placement: $ 15,790
Assume: $ 15,800

Assume time for installation of surface water runoff controls of 4 weeks.

Alternative 5A - Limited Soil Excavation/Off-Site Disposal/Asphalt Cap

Prepared By: PDP
Checked By: LT

Long-Term Monitoring

Assume annual sampling of 6 existing monitoring wells.
Assume no validation of sample data.
Assume preparation of a brief sampling report (data tabulation only) for each sampling event: no 5-year review report will be generated.

1. Analytical Cost

Total number of samples:

6	environmental samples
1	duplicate
1	trip blank (VOCs only)
1	field blank
1	MS
1	MSD
11	samples

Samples will be analyzed for:

VOCs	$	125	
SVOCs	$	250	
PCBs	$	150	
TAL ICP Metals	$	135	
Total:	$	660	per sample

Analytical Cost = 10 samples x $ 660 /sample + 1 trip blank x $ 125 /sample
= $6,725 per sampling event

Assume: $6,700 per sampling event

2. Sampling Cost

Assume 2 sampling technicians @ $25/hour.
Assume labor multiplier of 3.
Assume sampling performed over one 10-hour day.
Assume PPE @ $18 per person per half day.
Assume van rental @ $80 per day.
Assume per diem @ $120 per person per day.
Assume rental of H&S monitoring equipment and field measurement equipment @ $800.
Assume use of diposable bailers @ $20 per bailer.
Assume consumable supplies @ $100.
Assume sample shipment @ $150.

Total: $ 3,062
Assume: $ 3,100 per sampling event

3. Laboratory Procurement & Sampling Report Preparation

Assume one person @ $30 per hour for 3 days for preparation of Sampling Report.
Assume one person @ $35 per hour for 3 days for laboratory procurement.
Assume labor multiplier of 3.

Total: $ 4,680
Assume: $ 4,700 per sampling event

Total for Long-Term Monitoring: $ 14,500 per sampling event

Prepared By: ADP
Checked By: LT

Asphalt Cap Maintenance

Assume 2 persons @ $25 per hour for 6 hours per year inspecting for and patching cracks in asphalt surface.
Assume patching materials @ $100 per year.
Assume labor multiplier of 2.

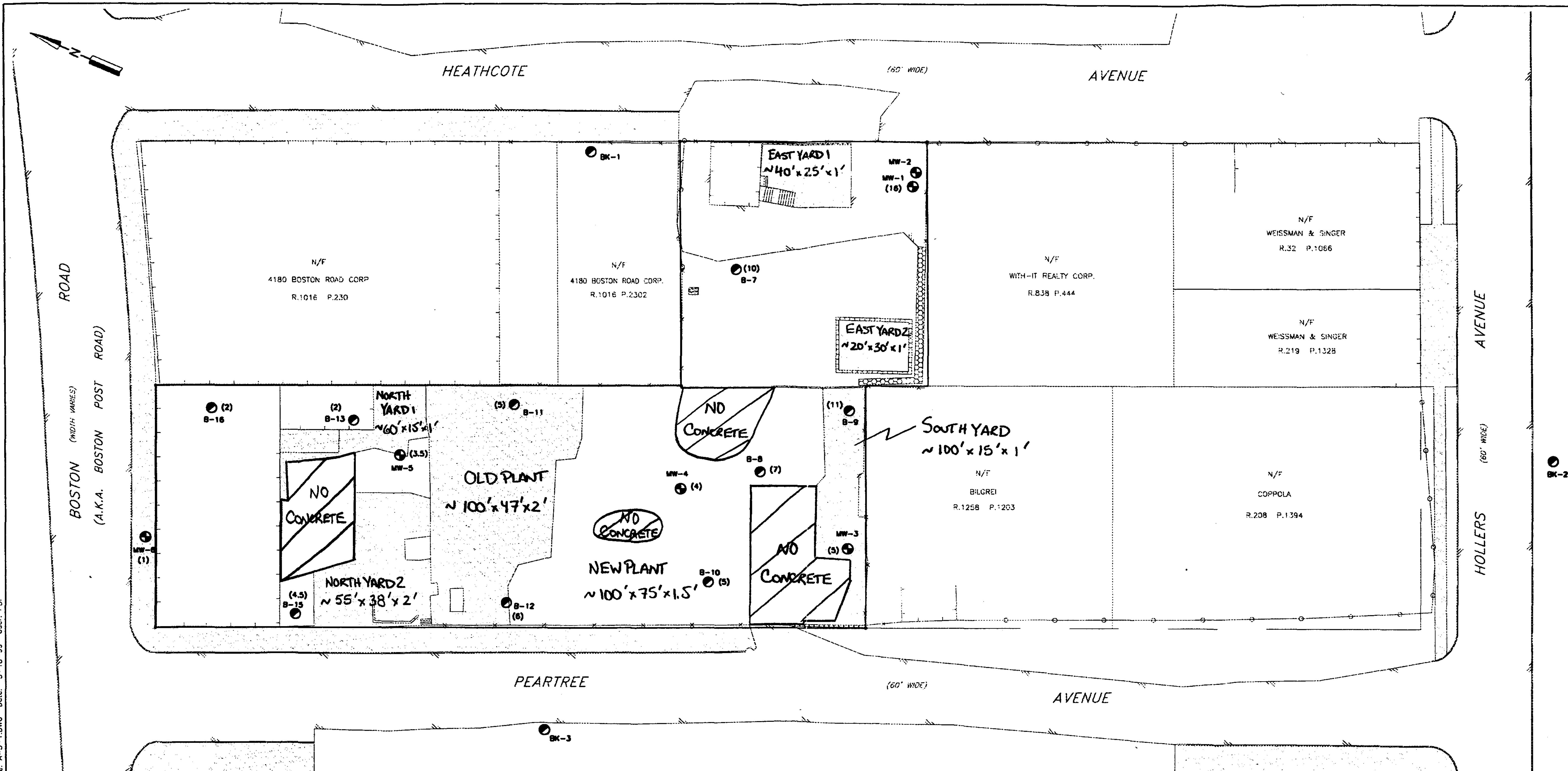
Total: $ 700 per year

TABLE A-5.1
HEXAGON LABORATORIES RI/FFS
GRAVEL BASE COURSE VOLUME ESTIMATE FOR ALTERNATIVES 5A AND 5B

Area Designation[1]	Dimensions Length (Feet)	Width (Feet)	Depth[2] (Feet)	Gravel Volume (Cubic Feet)	Gravel Volume (Cubic Yards)
North Yard	39	80	1	3,120	116
Old Plant	70	100	1.5	10,500	389
New Plant #1 [3]	--	--	--	5,183	192
-- Total New Plant #1 (inc. UST Excavation)	79	54	1.25	--	--
-- *New Plant UST Excavation*	10	12	1.25	--	--
New Plant #2	79	46	2.5	9,085	336
South Yard #1	25	29	1.25	906	34
South Yard #2	20	25	2	1,000	37
South Yard #3 [4]	50	46	1	2,300	85
Total				**32,094**	**1,189**
			Assume:	**32,100**	**1,200**

Notes:

1. Refer to Figure A-4.3 for locations of Areas used in calculating gravel volume.
2. Gravel layer thickness corresponds to the thickness of saturated overburden. Gravel layer will be placed with a minimum thickness of 1 foot in areas where the saturated overburden thickness is less than 1 foot.
3. New Plant *soil volume estimate does not include the* New Plant UST *excavation area since contaminated soil was removed from this* area (and replaced with clean fill material) as part of the IRM. No soil removal is planned for this area as part of these alternatives.
4. Proposed maximum depth of soil removal in the upper site is 6 feet bgs in areas where depth to bedrock is greater than 6 feet bgs.
5. The South Yard UST excavation is not included in the contaminated soil volume estimate since contaminated soil was removed from this area (and replaced with clean fill material) as part of the IRM.
6. Area subdivisions were approximated as rectangular blocks to facilitate calculation of gravel volumes. Actual gravel volumes may vary based on subsurface conditions.



LEGEND

BK, B	SOIL BORING		CONCRETE WALL
MW	MONITORING WELL		CONCRETE STEPS
	BUILDING EDGE		CHAIN LINK FENCE
	HEXAGON PROPERTY LINE		METAL STOCKADE FENCE
	ADJOINING PROPERTY LINE	N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F-NOW OR FORMERLY, R-REEL, P-PAGE DEED REFERENCE)
	CONCRETE	(3.5)	OVERBURDEN THICKNESS IN FEET (TYP.)
	CONCRETE CURB		OVERBURDEN THICKNESS ISOPACH (TYP.), 1 FT. CONTOUR INTERVAL
	EDGE OF MACADAM		
	MASONRY STONE WALL		

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: **TAMS** CONSULTANTS, Inc.
The TAMS Building
655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 5A AND 5B CONCRETE REMOVAL VOLUME ESTIMATE

DESIGNED BY:	PK
DRAWN BY:	PDP
CHECKED BY:	MT

SUBMITTED BY:	DATE:	SCALE:	DRAWING NO.:
PDP	MAY 1999	AS SHOWN	A-5.1

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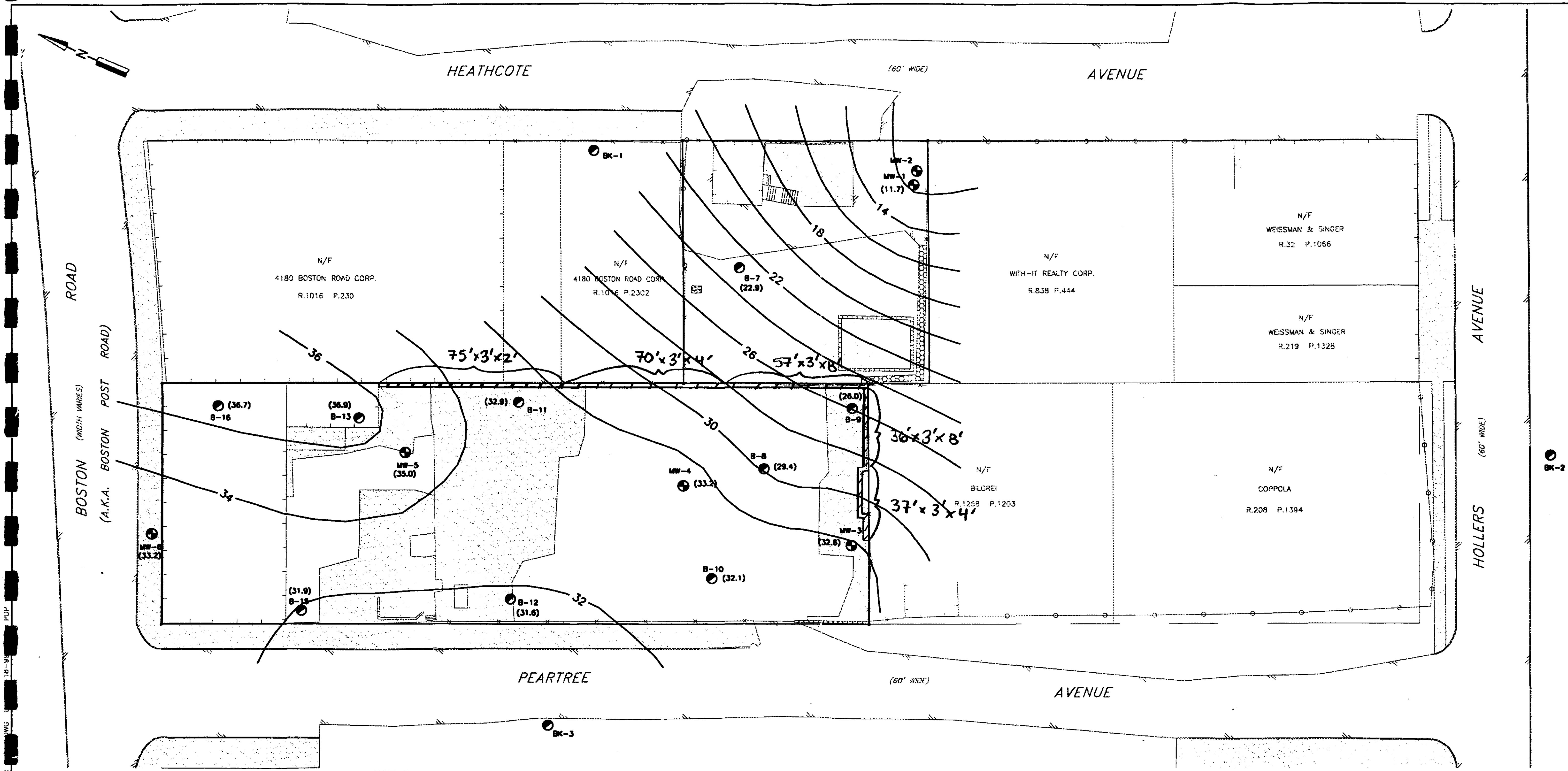


LEGEND

BK, B	SOIL BORING		CONCRETE WALL
MW	MONITORING WELL		CONCRETE STEPS
	BUILDING EDGE		CHAIN LINK FENCE
	HEXAGON PROPERTY LINE		METAL STOCKADE FENCE
	ADJOINING PROPERTY LINE	N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
	CONCRETE	(36.24)	BEDROCK SURFACE ELEVATION IN FEET (TYP.), NGVD
	CONCRETE CURB	36	BEDROCK SURFACE ISOPLETH (TYP.), 2 FT. CONTOUR INTERVAL
	EDGE OF MACADAM		
	MASONRY STONE WALL		

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED

REVISIONS

Prepared by: TAMS CONSULTANTS, Inc.
The TAMS Building
655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233

DESIGNED BY: PK

DRAWN BY: PDP

CHECKED BY: MT

SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE

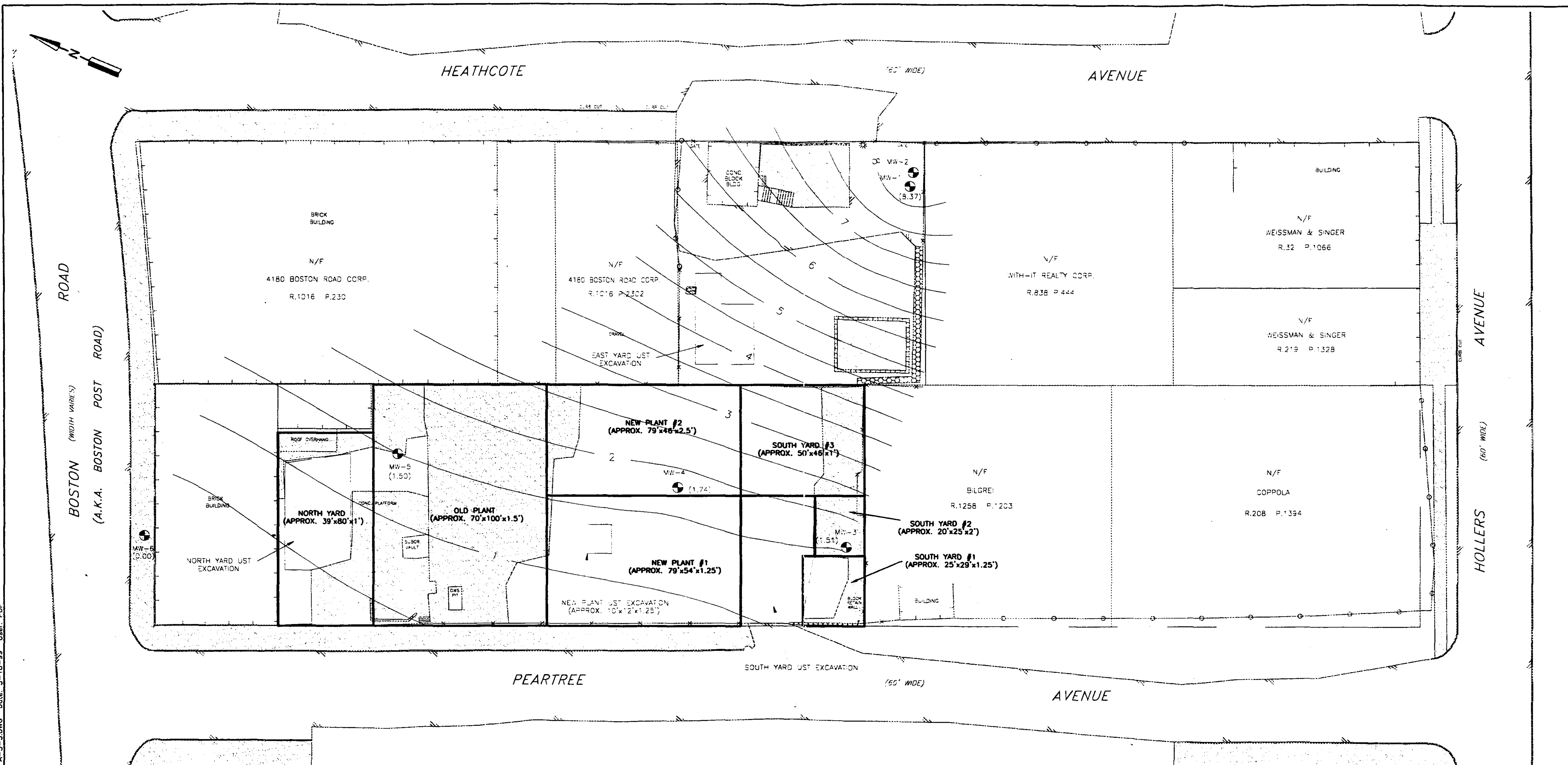
New York City
Bronx County, New York

ALTERNATIVES 5A AND 5B SLURRY WALL VOLUME ESTIMATE

DATE: MAY 1999

SCALE: AS SHOWN

DRAWING NO.: A-5.2



LEGEND

MW	MONITORING WELL
	BUILDING EDGE
	HEXAGON PROPERTY LINE
	ADJOINING PROPERTY LINE
	CONCRETE
	CONCRETE CURB
	EDGE OF MACADAM
	MASONRY STONE WALL
	CONCRETE WALL
	CONCRETE STEPS
	CHAIN LINK FENCE
	METAL STOCKADE FENCE
N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
(36.24)	SATURATED OVERBURDEN THICKNESS IN FEET (TYP.)
36	SATURATED OVERBURDEN ISOPACH (TYP.), 0.5 FT. CONTOUR INT.

NOTES

1. GRAVEL VOLUME ESTIMATE SUBDIVISIONS ARE APPROXIMATED AS RECTANGULAR BLOCKS TO FACILITATE THE VOLUME CALCULATION. ACTUAL GRAVEL VOLUME MAY VARY BASED ON SUBSURFACE CONDITIONS.
2. REFER TO TABLE A-5.1 FOR CORRESPONDING GRAVEL VOLUME CALCULATION.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: TAMS CONSULTANTS, Inc. The TAMS Building 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 50 Wolf Road Albany, New York 12233

DESIGNED BY: PK
DRAWN BY: PDP
CHECKED BY: MT
SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 5A AND 5B GRAVEL BASE COURSE VOLUME ESTIMATE

DATE: MAY 1999
SCALE: AS SHOWN
DRAWING NO.: A-5.3

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ALTERNATIVE 5B

LIMITED EXCAVATION/OFF-SITE TREATMENT/OFF-SITE REUSE/ASPHALT CAP

TABLE A-5B
COST ESTIMATE
ALTERNATIVE 5B - LIMITED SOIL EXCAVATION/OFF-SITE TREATMENT/OFF-SITE REUSE

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	CAPITAL COSTS				
	Direct Capital Costs				
A.	Mobilization /Temporary Facilities/ Demobilization				
	1. Mobilization/Demobilization	1	$60,200	LS	$60,200
	2. Temporary facilities	1	$61,500	LS	$61,500
	3. Site security	6.5	$10,700	Month	$69,600
B.	Health and Safety				
	1. Health & safety measures	5.5	$18,500	Month	$101,800
	2. Decon water sampling and disposal	1	$19,900	LS	$19,900
	3. Decon pad	1	$17,200	LS	$17,200
C.	Construction Management	8.5	$30,000	Month	$255,000
D.	Construction and Remediation				
	1. Concrete Slab/Asphalt Paving Demolition and Disposal				
	a. Demolition - concrete	1,070	$136.43	CY	$146,000
	b. Demolition - pavement	340	$7.78	SY	$2,600
	c. Transportation and disposal	1,640	$18	CY	$29,500
	2. Excavation				
	a. Temporary shoring	4,800	$8.03	SF	$38,600
	b. Excavate trench	80	$7.08	CY	$600
	c. Slurry wall construction	3,970	$19.32	CF	$76,700
	d. Soil excavation	5,000	$11.09	CY	$55,500
	3. Sampling and Analysis (for Disposal)				
	a. Sample collection (non-haz soil)	1	$5,400	LS	$5,400
	b. Sample collection (haz soil)	1	$200	LS	$200
	c. Sample analysis (non-hazardous facility)	1	$16,000	LS	$16,000
	d. Sample analysis (hazardous facility)	1	$1,700	LS	$1,700
	4. Sampling and Analysis (for Documentation)				
	a. Sample collection	1	$3,300	LS	$3,300
	b. Sample analysis	1	$18,600	LS	$18,600
	5. Offsite Transportation				
	a. Roll-off spotting	60	$300	EA	$18,000
	b. Roll-off rental (60 containers for 10 weeks at $10/day)	1	$33,600	LS	$33,600
	c. Liner	300	$35	Load	$10,500
	d. Non-hazardous waste landfill	294	$600	Load	$176,400
	e. Hazardous waste facility	6	$2,650	Load	$15,900
	6. Offsite Disposal				
	a. Non-hazardous waste treatment/reuse facility	7,350	$30	Ton	$220,500
	b. Hazardous waste facility	120	$177	CY	$21,200
	7. Backfill				
	a. Gravel (Upper Site only)	1,189	$20	CY	$23,800
	b. Geotextile	31,000	$0.27	SF	$8,400
	c. Common fill	4,000	$15	CY	$60,000
	8. Asphalt Cap				
	a. Crushed stone	600	$31.88	CY	$19,100
	b. Binder course	3,633	$4.69	SY	$17,000
	c. Geogrid	3,633	$2.38	SY	$8,700
	d. Wearing course	3,633	$5.52	SY	$20,100

TABLE A-5B
COST ESTIMATE
ALTERNATIVE 5B - LIMITED SOIL EXCAVATION/OFF-SITE TREATMENT/OFF-SITE REUSE

	ITEM	QUANTITY	UNIT COST	UNIT	COST
	9. Surface Water Runoff Control				
	a. Catchbasins	3	$1,400	EA	$4,200
	b. Perimeter drain	200	$50	LF	$10,000
	c. Curb	650	$7	LF	$4,500
	d. Sidewalk/curb extension	1	$15,800	LS	$15,800
	Total Direct Costs				$1.667.600
	Indirect Capital Costs				
	1. Engineering and Permitting				$200,000
	2. Contingency (15% of Total Direct Costs)				$250,140
	Total Indirect Costs				$450,140
	TOTAL CAPITAL COSTS				$2,117,740
	ANNUAL O&M COSTS				
	1. Cap Maintenance & Repair	1	$700	LS	$700
	2. Long-Term Monitoring	1	$14,500	LS	$14,500
	TOTAL ANNUAL O&M COSTS				$15,200
	PRESENT WORTH OF COSTS				
A.	Annual O&M Costs (30 year duration, 5% discount rate)				$233,654
B.	Total Capital Costs				$2,117,740
	TOTAL PRESENT WORTH				$2,351,394

Assume: $2,351,000

Alternative 5B - Limited Excavation/Off-Site Treatment/Off-Site Reuse/Asphalt Cap

Prepared By: PDP
Checked By: LT

Project Duration

Assume:	Mobilization/demobilization	4 weeks
	Site preparation for excavation (shoring, slurry wall)	4.5 weeks
	Concrete/pavement demolition	5 weeks & during excavation
	Excavation & Backfill	6 weeks
	Transport and dispose (includes confirmatory sampling)	2 weeks & during excavation
	Asphalt cap placement	1 week
	Surface water runoff control	4 weeks
	Total:	**26.5 weeks**
	Assume:	**6.5 months**

Time for workplan preparation and for obtaining any approvals/permits is not included.

Prepared By: PDP
Checked By: LT

Engineering & Permitting

It is assumed that NYSDEC will hire an Engineering Consultant to prepare plans and specifications for the remediation.

It is assumed that work includes the preparation of:

- Plans and specifications for competitive bidding;
- Discussion with state and local agencies regarding permit requirements;
- Submission of 30% design submittal for review;
- Submission of 90% design submittal for review;
- Preparation of a design report;
- Preparation of an engineering cost estimate; and
- Provision of pre-award services.

Based on TAMS' experience, this work can cost between $150,000 to $250,000, depending on the complexity of the remediation.

- $250,000 for high complexity
- $200,000 for medium complexity
- $150,000 for low complexity

For Alternative 5B, work is considered to be medium complexity.

Assume Engineering & Permitting cost of: **$200,000**

Prepared By: PDP
Checked By: LT

Construction Management

It is assumed that NYSDEC will hire an engineering consultant to perform construction period services during the remediation.
It is assumed that work includes the preparation of:
- Attendance at pre-construction meetings:
- Review of contractor submittals:
- Full time project inspection:
- Maintenance of construction records and reports;
- Quality assurance:
- Change order preparation:
- Processing of contractor application for payment; and
- Preparation of Final Remediation Report.

It is assumed that construction management services will begin one month prior to the start of construction activities.
It is assumed that construction management services will continue for one month after the end of on-site activities.
Based on TAMS' experience, the cost of construction management is approximately $30,000 per month.

Assume a monthly Construction Management cost of: $30,000

Alternative 5B - Limited Excavation/Off-Site Treatment/Off-Site Reuse/Asphalt Cap

Prepared By: PDP
Checked By: LT

Mobilization & Demobilization (Includes Contractor Preparation of Project Plans)

1. **Materials & Equipment**

Assume 20 pieces of equipment at $500 per piece for mobilization:	$	10,000
Assume 20 pieces of equipment at $500 per piece for demobilization:	$	10,000
Assume $10.000 for mob/demob of materials:	$	10,000
Subtotal:	**$**	**30,000**

2. **Contractor Preparation of Project Plans**
   Includes Work Plans. Health & Safety Plans. QA/QC Plans, and Erosion Control Plan

   Assume labor requirement of 2 persons @ $30 per hour per person for 1 month.
   Assume multiplier of 3

   = 2 persons x $30 /hour x 40 hours/week x 4.2 weeks/month x 1 month x 3 multiplier

   = $30,240

   Assume: **$30,200**

Total Mobilization/Demobilization Cost: **$60,200**

Prepared By: PDP
Checked By: LT

Temporary Facilities

1. **Temporary Facilities - One Time Cost**
   Assume 2 trailers @ $1,300 per trailer
   Assume office trailer equipment @ $5.000 per trailer

- Computer	$	2.500
- Printer	$	500
- Modem	$	200
- Fax Machine	$	500
- Copier	$	500
- Phone	$	100
- Answering Machine	$	100
- Desk & Chair (2)	$	300
- Conference Table	$	100
- Chairs (4)	$	100
- File Cabinet	$	100
	$	5,000

Assume electrical hookup @ $2,500 per trailer
Assume phone hookup @ $200 per trailer
Assume project sign @ $500
Assume temporary site controls (e.g. barricades, traffic control, erosion control) @ $5,500
Assume decon facility mob/demob @ $1,000
Assume water tank(s) mob/demob @ $1000
Assume misc. equipment/supplies @ $3,000

Total Temp. Facilities One Time Cost: $ 29,000

2. **Monthly Costs**
   Assume trailer rental @ $500 per trailer
   Assume sanitary facility & water @ $500
   Assume janitorial service @ $500
   Assume trailer electrical service @ $200 per trailer
   Assume miscellaneous electrical requirements @ $200
   Assume phone service @ $200 per trailer
   Assume miscellaneous costs @ $2000

Subtotal: $ 5,000 per month

Duration: 6.5 months

Total Monthly Costs: $ 32,500

Total Temporary Facilities Cost: $ 61,500
Assume: $ 61,500

Prepared By: PDP
Checked By: LT

Site Security

Assume on-site security will be provided from 5 PM to 7AM during construction activities.
Assume on-site security will be provided 24 hours per day for weekends during construction activities.
Assume 2 unarmed security guards @ $11 per hour per guard.

Monthly Security Cost:	=	2 guards x	14 hours per day x	21 weekdays per month x	$11 per hour +
		2 guards x	24 hours per day x	8 weekend days per month x	$11 per hour
	= $10,692				

Assume monthly security cost of: $10,700

Health & Safety

Assume monitoring equipment @ $3,000 per month.
Assume 2 sets of PPE per day per person @ $18 per unit (PPE costs associated with sampling included separately in sampling cost estimate).
Assume 10 workers within exclusion zone at one time.
Assume on-site Safety Coordinator @ $5,000 per month.
Assume decon facility (shower, etc.) @ $2,900 per month
(Means Environmental Remediation Cost Data - 33 17 0821; includes 1.23 Location Factor).

Total: $ 18,460 per month

Assume: $ 18,500 per month (during construction activities excluding mob/demob)

Prepared By: PDP
Checked By: LT

Decontamination Pad

Assume 20 ft x 30 ft x 6 inch decon pad with 6-inch high curbs.
Assume construction of 6-inch slab on grade (not including forms or reinforcement) @$2.09/sf (from Means, 1998; Item No. 033 130 5010).
Assume reinforcement with welded wire fabric @ $66.50 per 100 sf (from Means, 1998; Item No. 032 207 0700).
Assume use of trench forms on floor @$10.35 per sf (from Means, 1998; Item No. 031 170 6000).
Assume location factor of 1.275.
Assume decon pad walls @ $1,000.
Assume sump pit and pump @ $1,500.
Assume pressure washer @ $3,500 (purchase) (from Means Environmental, 1999; Item No. 33 17 0815; Location factor of 1.23).
Assume one 21,000 gallon frac tank @ $1,200 per month.
Assume project duration of 6.5 months.

Slab =		600 sf x $2.09 /sf + 600 sf x $0.67 /sf + 100 sf x $10.35 /sf	
	= $	2,688 x	1.275 multiplier
	= $	3,427	
Total =		17,227	
Assume	**$**	**17,200**	

Prepared By: PDP
Checked By: LT

Estimate of Volume of Decontamination Water

1. Personnel Decon
Assume 10 workers, two showers per day, and five gallons per shower

Total Volume =	100 gallons per day x	21 days per month	
	= 2,100 gallons per month x	5.5 months	
	= 11,550 gallons		

2. Equipment Decon
Assume 10 pieces of equipment, one wash per two weeks, 20 gallons per wash per piece of equipment

Total Volume =	400 gallons per month x	5.5 months
	= 2200 gallons	

3. Concrete Slab Decon (prior to disposal)
Assume 25 sf per minute @ 6 gallons per minute
Assume surface area of concrete to be washed is 36,900 sf (includes both sides of concrete slabs)

Total Volume =	36900 sf /	25 sf/minutes x	6 gallons/minute
	= 8856 gallons		

Total Volume of Decon Water =	22,606 gallons
Assume:	**22,600 gallons**

Alternative 5B - Limited Excavation/Off-Site Treatment/Off-Site Reuse/Asphalt Cap

Prepared By: PDP
Checked By: LT

Collection & Disposal of Decontamination Water

1. Equipment and Concrete Decon Labor

Assume 2 laborers @ $25 per hour for pressure washing.
Assume total area of concrete = 36,900 sf.
Assume decon rate of 25 sf per minute.
Assume 19 hours total for decon of equipment over course of construction activities (10 minutes per piece of equipment. 10 pieces of equipment per two weeks, 23 weeks of construction activities).
Assume labor multiplier of 2.

Time for decon = 44 hours

Labor cost = 44 hours x $ 25 / hour x 2 laborers x 2 multiplier

= $ 4,400
Assume: $ 4,400

2. Analytical Costs for Disposal

Assume 4 water samples for disposal @ $1,050 per sample (includes 25% increase for 1 week turnaround).

Analytical:	VOCs	$	125	
	SVOCs	$	250	
	Pest/PCBs	$	150	
	TAL ICP Metals	$	135	
	TDS	$	10	
	TSS	$	10	
	TOC	$	35	
	Dissolved Metals	$	120	
		$	835	plus 25% markup for 1 week turnaround time

Analytical Cost = $ 4,200

3. Transport and Treatment/Disposal Cost

Assume hazardous water transport and disposal @ $0.78 per gallon.
Assume non-hazardous water transport and disposal @ $0.50 per gallon.
Assume decon water is non-hazardous.

Total Volume of Decon Water = 22,600 gallons

Transport and Disposal Cost = $ 11,300

Total Collection, Analysis, Transport, and Disposal = $ 19,900

Assume $ 19,900

Alternative 5B - Limited Excavation/Off-Site Treatment/Off-Site Reuse/Asphalt Cap

Prepared By: PDP
Checked By: LT

1. Volume and Area of Concrete to be Removed/Disposed (see attached Figure A-5.1)

Area	Length (ft)	Width (ft)	Thickness (ft)	Volume (cf)	Volume (cy)	Area (sf)	Area (sy)
North Yard 1	60	15	1	900	33.3	900	100
North Yard 2	55	38	2	4180	154.8	2090	232.2
Old Plant	100	47	2	9400	348.1	4700	522.2
New Plant	100	75	1.5	11250	416.7	7500	833.3
South Yard	100	15	1	1500	55.6	1500	166.7
East Yard 1	40	25	1	1000	37.0	1000	111.1
East Yard 2	30	20	1	600	22.2	600	66.7
East Yard 2 Wall	77	1.2	1.2	104.8	3.9	89.8	10.0
East Yard 2 Wall	31	1.2	1.5	54.3	2.0	36.2	4.0

Total: 1074 cy 2046 sy
Assume: 1070 cy 2050 sy

For disposal, assume 50 percent volume expansion: 1600 cy

2. Volume and Area of Asphalt to be Removed/Disposed

Assume thickness of 4 inches

Area = 4500 sf - 1500 sf (concrete block bldg & concrete slab)
= 3000 sf
= 333 sy

Assume: 340 sy

Volume = 1000 cf
= 37 cy plus 20 percent volume expansion

Assume: 40 cy

3. Concrete Demolition

Assume demolition of reinforced concrete (7 to 24 inches thick) @ $107/cy
(Means 1998; Item No. 020 554 2200)
Assume location factor of 1.275

= 1070 cy x $ 107 /cy x 1.275 location factor
= $ 145,975

Assume: $ 146,000

Assume productivity rate for concrete demolition is 24 cy per day. Total of 45 days required for demolition.
Assume half of work is performed during excavation of other parts of the site.

Prepared By: PDP
Checked By: LC

4. Pavement Demolition

Assume demolition of pavement (4 to 6 inches thick) @ $6.10/sy
(Means 1998: Item No. 020 554 1750)
Assume location factor of 1.275

= 340 sy x $ 6.10 /sy x 1.275 location factor
= $ 2,644

Assume: $ 2,600

Assume productivity rate of 420 sy per day. Assume 1 day for pavement demolition.

5. Transport and Disposal of Concrete & Asphalt

Assume transport and disposal cost of concrete with rebar and asphalt @ $18 /cy (quote from Liotta & Sons, Inc.; 10/98)

= 1640 cy x $ 18 /cy
= $ 29,520

Assume: $ 29,500

Shoring Placement (see Figure 4-14)

Assume temporary wood shoring (solid sheeting with wales, braces, spacers) including placement, extraction, and salvage for 8 foot excavation @ $6.30/sf (Means, 1998; Item No. 021 614 3910)
Assume location factor of 1.275
Assume productivity rate of 330 sf per day.
Assume distance around excavated areas where shoring will be installed of 600 lf (does not include East Yard)
Assume no shoring required for 2 feet excavation in East Yard
Assume sheeting installed to 8 feet (2 feet below deepest excavated surface)

= 8 ft x 600 ft x $6.30 /sf x 1.275 location factor
= $ 38,556

Assume: $ 38,600

Assume total duration of 3 weeks. Assume that half of the installation is performed during excavation of other areas.

Prepared By: PDP
Checked By: LT

Slurry Wall Construction

1. Wall Volume Estimate

Assume slurry wall will be installed along the eastern and southern perimeters of the upper site as shown in Figures 4-11 and A-5.2.
Assume slurry wall will extend from the top of bedrock to an elevation of approx. 34 feet NGVD.
Assume slurry wall will be constructed of unreinforced cement-bentonite mixture.
Assume slurry wall will be 3 feet thick.

Length (ft)	Width (ft)	Height (ft)	Volume (cf)	
75	3	2	450	
70	3	4	840	
57	3	8	1368	
36	3	8	864	
37	3	4	444	
		Total:	3966	
		Assume:	**3970**	**cf**

2. Estimate of Soil Volume Above Top of Slurry Wall

Assume slurry wall will be installed along the eastern and southern perimeters of the upper site as shown in Figures 4-11 and A-5.2.
Assume slurry wall will extend from the top of bedrock to an elevation of approx. 34 feet NGVD.
Assume slurry wall will be 3 feet thick.

Length (ft)	Width (ft)	Height (ft)	Volume (cf)	Volume (cy)	
75	3	2.5	562.5	20.8	
70	3	3	630	23.3	
57	3	2	342	12.7	
36	3	2	216	8.0	
37	3	3	333	12.3	
			Total:	77	
			Assume:	**80**	cy

3. Slurry Wall Construction

Assume excavated trench in wet soils, backfilled with 3,000 psi concrete, no reinforcement @ $15.15 per cf (Means, 1998; Item No. 021 684 0050)
Assume productivity rate of 333 cf/day for slurry wall placement.
Assume trench excavation (to top of slurry wall construction) @ $5.55 per cy (Means, 1998; Item No. 022 254 0050; Backfill accounted for as part of site backfill cost; refer to Figure 1-4 for overburden thickness)
Assume productivity rate of 150 cy/day for excavation to top of slurry wall.
Assume location factor of 1.275

=	3970	cf x	$	15.15	/cf x	1.275 location factor +
	80	cy x	$	5.55	/cy	1.275 location factor
= $	77,252					

Assume: $ 77,300

Assume 15 days for slurry wall construction.

Excavation

Assume excavation of soil @ $8.70/cy (Means, 1998; Item No. 022 250 2060.
Assume location factor of 1.275.
Assume productivity rate of 200 cy/day.

Total = 5000 cy x $ 8.70 /cy x 1.275 location factor
= $ 55,463

Assume: $ 55,500

Five weeks to excavate 5,000 cy. Assume 6 weeks to account for contingencies.

Note: It is assumed that the shallow monitoring wells in the Upper Site will be removed during excavation. The shallow monitoring well in the East Yard shall be protected from damage during construction activities.

Prepared By: PDP
Checked By: LT

Estimate of Hazardous Soil Volume

Samples which may fail TCLP (using 20-fold estimate of TCLP concentration)

Sample	Depth (ft)	Area	Analyte Category
HXB11S2	4-5	Old Plant	VOCs
HXB4S2	2-4	New Plant	VOCs
NPT2	3-3.5	New Plant	VOCs
NPT3	3-3.5	New Plant	VOCs
NPT4	3-3.5	New Plant	VOCs
HXB19	1.3-1.7	East Yard	Metals
HXSS4	0-0.5	New Plant	Metals
HXB10S1	0-2	New Plant	Metals
HXB6S1	1-2	Bos.Post Rd.	Metals
HX-OM1	Surface Scrape	Hydrotherm 1	Metals
HXB17	2-2.5	East Yard	Metals
HXB20	2.2-2.3	East Yard	Metals
HXB21	2-2.5	East Yard	Metals
HXB11S2	4-5	Old Plant	Metals
HXB15S1	2.5-4.5	North Yard	Metals
SYTC-1	2.5-4.5	South Yard	Metals
NYT-2	5.5-6	North Yard	Metals

Assume Total Volume of Hazardous Soil is 100 cy.

Prepared By: PDP
Checked By: LT

Sampling and Analysis for Treatment/Reuse of Non-Hazardous Soil

1. Analytical Costs

Assume sampling frequency of one per 700 tons for metals. ignitability, corrosivity, reactivity, and PCBs (R3 Technologies: 11/98).
Assume sampling frequency of one per 135 tons for TPH and total organic halides (R3 Technologies, 11/98).
Assume 20 percent bulking after excavation.
Total volume of excavated soil is 5,000 cy, 100 cy of which is assumed to be hazardous.
Assume 1.5 tons per cy.
Assume no validation of sample data.

Sampling for Group 1 Analysis (Metals, Ignitability, Corrosivity, Reactivity, and PCBs):

Number of samples =	4900 cy/ x	1.5 tons/cy/	700 tons/sample
=	10.5		
Assume:	11 samples		

Assume contingency for re-sampling 2 samples.

Total Number of samples = 13

Samples analyzed for:	Metals	$145	
	Ignitability	$30	
	Corrosivity	$10	
	Reactivity	$45	
	PCBs	$90	
		$320	per sample x 25% markup for 1 week turnaround
	Total:	$400	per sample

Analytical Cost = $400 /sample x 13 samples

= **$5,200 for Group 1 samples**

Sampling for Group 2 Analysis (TPH and Total Organic Halides):

Number of samples =	4900 cy/ x	1.5 tons/cy/	135 tons/sample
=	54.4		
Assume:	54 samples		

Assume contingency for re-sampling 6 samples.

Total Number of Samples = 60

Samples analyzed for:	TPH	$90	
	TOH	$50	
		$140	per sample x 25% markup for 1 week turnaround
	Total:	$180	per sample

Analytical Cost = $180 /sample x 60 samples

= **$10,800 for Group 2 samples**

Total Analytical Cost: $16,000

Prepared By: PDP
Checked By: JJ

2. Sampling Cost

Assume sampling will be performed by two on-site personnel (no additional labor charge).
Assume H&S PPE @ $18 per person per day.
Assume sampling takes place on 30 separate days.
Assume miscellaneous cost of $300.
Assume sample shipment of $4,000.

Total: $ 5,380

Assume: $ 5,400

Alternative 5B - Limited Excavation/Off-Site Treatment/Off-Site Reuse/Asphalt Cap

Prepared By: PDP
Checked By: LT

Sampling and Analysis for Disposal of Hazardous Soil

1. Analytical Costs

Assume collection of one representative sample of 100 cy of hazardous soil.
Assume no validation of sample data.

Samples analyzed for:	VOCs	$130
	SVOCs	$275
	PCBs	$90
	TCLP	$850
		$1,345 per sample x 25% markup for 1 week turnaround
	Total:	**$1,680 per sample**

Analytical Cost = $1,680 /sample x 1 sample
= $1,680

Assume: $1,700

2. Sampling Cost

Assume sampling will be performed by two on-site personnel (no additional labor charge)
Assume H&S PPE @ $18 per person per day
Assume miscellaneous cost of $50
Assume sample shipment of $100

Total: $ 186

Assume: $ 200

Total Sampling and Analytical Cost: $ 1,880

Assume: $ 1,900

Prepared By: PDP
Checked By: LT

Sampling and Analysis for Documentation Sampling

1. Analytical Costs

Assume documentation sampling will be conducted at the bottom surface of the excavated areas in the East Yard and the southeastern part of the South Yard. All other areas on site will be excavated to the top of bedrock and no samples will be collected.
Assume one sample will be collected per 50 ft by 50 ft grid.
Assume documentation sampling will be conducted along the perimeter of the excavation which is approximately 950 ft.
Assume one sample will be collected per 50 ft along perimeter.
Assume no validation of sample data.

Number of bottom samples = 4 samples from East Yard + 1 sample from South Yard
= 5

Number of sidewall samples = 950 lf / 50 lf/sample
= 19

Total number of environmental samples: 24

Assume 3 QA/QC samples (MS/MSD and duplicate) and 2 field blanks.

Total number of samples = 29

Samples analyzed for:			
	VOCs	$	130
	SVOCs	$	275
	PCBs	$	90
	TAL ICP Metals	$	145
	Total:	**$**	**640 per sample**

Analytical Cost = $ 640 /sample x 29 samples
= $18,560

Assume: $18,600

2. Sampling Cost

Assume sampling will be performed by one on-site personnel (no additional labor charge) and one assistant @ $25/hour.
Assume sampling will be conducted over a period of three 8-hour days.
Assume labor multiplier of 3.
Assume car rental of $65 per day.
Assume per diem for assistant of $120 per day.
Assume H&S PPE @ $18 per person per half day.
Assume miscellaneous cost of $200.
Assume sample shipment of $500.

Total: $ 3,271

Assume: $ 3,300

Total Sampling and Analytical Cost: $ 21,860

Assume: $ 21,900

Prepared By: PDP
Checked By: LT

Off-Site Transportation for Treatment/Disposal

1. Roll-Off Rental

Assume 1,200 cy (1,000 cy excavated plus 20% bulking) to be containerized for off-site transportation per week.
Assume sixty 20 cy roll-offs to haul soil excavated in one week @ $10 per day.
Assume spotting charge of $300 per roll off (spotting charge for first drop off only; no spotting charge for replacement containers brought to site while picking up fill containers).
Assume one liner for each roll-off load @ $35 each.
Assume containers on site for 8 weeks (6 weeks of excavation plus 1 week for analytical results for last batch plus 1 week for transport off site.

Spotting Fee =	60	containers x	$	300 /container			
= $	18,000						
Daily rental =	60	containers x		8	weeks x	7 days/week x	$10 /day
= $	33,600						
Liners =	300	containers x	$	35 /container			
= $	10,500						

Non haz = 5,880 cy -includes bulking factor
Haz = 120 cy - includes bulking factor
294 containers for non-haz soil
6 containers for haz soil

Total Roll-Off Cost: **$ 62,100**

2. Transportation

Assume hazardous soil is transported to the City Environmental landfill in Michigan @ $2,650 per load (Hexagon IRM cost)
Assume non-hazardous soil is transported to R3 Technologies in Pennsylvania @ $600 per load (Freehold Cartage, 10/98).

Hazardous soil =	6	loads x	$	2,650	/load
= $	15,900				
Nonhazardous soil =	294	loads x	$	600	/load
= $	176,400				

Total Transportation Cost = **$ 192,300**

Prepared By: PDP
Checked By: LT

Hazardous and Non-Hazardous Soil Treatment and Reuse/Disposal

Assume hazardous soil is disposed at City Environmental in Michigan (chemical oxidation prior to landfilling) @ $177/cy including $10/cy tax (Cathy Zelner. City Environmental, 10/98).
Assume non-hazardous treated for subsequent reuse at R3 Technologies facility in Pennsylvania @ $30/ton (R3 Technologies, 10/98).
Assume 1.5 tons per cy of soil.
Assume 120 cy of hazardous soil to be disposed of (includes 20% bulking factor)
Assume 4900 cy of non-hazardous soil to be disposed of (does not include 20% bulking factor - disposal cost based on weight of soil)

Hazardous Soil:	120	cy x	$177 /cy			
	= $ 21,240					
Non-Hazardous Soil:	4900	cy x	1.5	tons/cy x	$30 /ton	
	= $ 220,500					
Total Disposal Cost =	$ 241,740					
Assume:	**$ 241,700**					

Backfilling Excavated Areas

1. Upper Site (North Yard, Old Plant, New Plant, South Yard)

Assume that excavated areas will be backfilled with clean gravel from the bottom of the excavation to the top of the water table to circumvent compaction difficulties and to facilitate future groundwater remediation at the site.
Assume that clean fill @ $15/cy will be used to backfill the excavation from the water table to 10 inches below final grade (cost includes bringing fill to the site, backfilling, and compaction).
Assume placement of geotextile between gravel and clean fill to prevent migration of fines @ $0.27 /sf.
Assume top 10 inches will be used for placement of asphalt surface (6 inches of base, 2 inches of binder course, 2 inches of wearing course)
Assume clean gravel fill @ $20/cy

Gravel
Estimated volume of gravel is 32,100 cf (see attached Table A-5.1 and Figure A-5.3)

Gravel Fill Cost = 32,100 cf/ 27 cf/cy x $ 20 cy
= $ 23,778
Assume: $ 23,800

Assume productivity rate of 1100 cy per day. Assume 2 days for placement.

Geotextile
Estimated area for geotextile is 21,500 sf (see attached Table A-5.1 and Figure A-5.3) in upper site
Geotextile Cost = 21,500 sf x $ 0.27 /sf
= $ 5,805
Assume: $ 5,800

Productivity rate of 2400 sy per day. Assume 1 day for placement.

Clean Fill
Estimated volume of clean fill is calculated from the volume of material excavated from the upper site see Table 2-7) less the volume of gravel used as backfill less the volume for asphalt paving placement (top 10 inches) less the volume of clean soil removed from South Yard UST area for asphalt paving placement (top 10 inches from approx. 25 ft by 54 ft area).
Assume placement of an additional 6 inches across entire area to account for additional fill necessary to create 1% slope for surface water runoff.

Volume of soil excavated from the upper site:		4200 cy
Added volume for 1% slope	+	10750 cf
Volume of gravel added:	-	32100 cf
Volume for pavement placement:	-	17900 cf
Volume of soil from South Yard UST area:	-	1100 cf
Total:		2706 cy
Total assuming 20 percent compaction factor:		3247
	Assume:	3200 cy

Clean Fill Cost = 3200 cy x $ 15 /cy
= **$ 48,000**

Assume productivity of 975 cy per day for placement and 560 cy per day for compaction. Assume 6 days for placement and compaction (compaction & placement will be performed concurrently in different areas of the site).

Prepared By: PDP
Checked By: LJ

2. East Yard

Assume placement of geotextile @ $0.27 /sf between bottom of excavation and clean fill to provide a separation layer between the clean fill and the remaining contaminated overburden.
Assume that clean fill @ $15/cy will be used to backfill the excavation from the geotextile to 10 inches below final grade (i.e., 14 inches of fill will be placed; cost includes bringing fill to the site, backfilling, and compaction).
Assume top 10 inches will be used for placement of asphalt surface (6 inches of base, 2 inches of binder course, 2 inches of wearing course)
Assume that area beneath Cinder Block building is not excavated.
Assume placement of an additional 8 inches across entire area to account for additional fill necessary to create 1% slope for surface water runoff.

Geotextile

Estimated area for geotextile is 10,000 sf (see Table 2-7) less 500 sf beneath Cinder Block building.

Geotextile Cost = 9,500 sf x $ 0.27 /sf
= **$ 2,565**
Assume: $ 2,600

Productivity rate of 2400 sy per day. Assume one half day for placement.

Clean Fill

Estimated volume of clean fill is calculated from the volume of material excavated from the East Yard less the volume for placement of asphalt pavement (top 10 inches).

Volume of soil excavated from the East Yard:		19000 cf
Added volume for 1% slope	+	6333 cf
Volume for pavement placement:	-	7917 cf
Total:		17417 cf
Total assuming 20 percent compaction factor:		20900 cf
	Assume:	800 cy

Clean Fill Cost = 800 cy x $ 15 /cy
= **$ 12,000**

Assume productivity of 975 cy per day for placement and 560 cy per day for compaction. Assume 2 days for placement and compaction (compaction & placement will be performed concurrently in different areas of the site).

Assume total duration for backfill of Upper Site and East Yard of approximately 12 days. Assume that backfilling will be performed concurrently with excavation of other parts of the site.

Prepared By: PDP
Checked By: LT

Asphalt Cap

Assume total area for asphalt cap of 32,700 sf.
Cap shall consist of 6 inches of compacted NYSDOT Item No. 4 crushed stone, 2 inches of binder course, and 2 inches of wearing course.
Geogrid reinforcement shall be placed between the bituminous binder and wearing courses.
Assume crushed stone @ $25/cy (Means 1998, Item No. 022-308-1521).
Assume 2-inch binder course @ $3.68/sy (Means 1998, Item No. 025-104-0120).
Assume 2-inch wearing course @ $4.33/sy (Means 1998, Item No. 025-104-0380).
Assume geogrid @ $1.87/sy (based on Means cost for geotextile; Means 1998, Item No. 022-412-1510)
Assume location factor of 1.275.

1. Crushed Stone Placement

Volume of stone =		32,700	sf x	0.5 ft		
=		16350	cf			
=		600	cy			
Placement Cost =		600	cy x	$25 /cy x	1.275 location factor	
=	$	19,125				
Assume:	**$**	**19,100**				

Productivity rate of 750 cy per day. Assume 1 day for placement.

2. Binder Course Placement

Placement Cost =		32,700	sf /	9 sf/sy x	$3.68	/sy x	1.275 location factor
=	$	17,048					
Assume:	**$**	**17,000**					

Productivity rate of 6345 sy per day. Assume 1 day for placement.

3. Geogrid Placement

Placement Cost =		32,700	sf /	9 sf/sy x	$1.87	/sy x	1.275 location factor
=	$	8,663					
Assume:	**$**	**8,700**					

Productivity rate of 2400 sy per day. Assume 2 days for placement.

4. Wearing Course Placement

Placement Cost =		32,700	sf /	9 sf/sy x	$4.33	/sy x	1.275 location factor
=	$	20,059					
Assume:	**$**	**20,100**					

Productivity rate of 6345 sy per day. Assume 1 day for placement.

Total for Asphalt Cap Placement: $ 64,900

Assume Time for Asphalt Cap Placement of one week.

Alternative 5B - Limited Excavation/Off-Site Treatment/Off-Site Reuse/Asphalt Cap

Prepared By: PDP
Checked By: LI

Surface Water Runoff Control

1. Catchbasin Installation

Assume no additional excavation necessary for catch basin placement.
Assume cost for backfill of catchbasin is included in site backfill estimate.
Assume precast catchbasin (4 ft x 4 ft x 6 ft) @ $910 each (Means, 1998: Item No. 027 152 1120).
Assume frame & cover (18-inch diameter, light traffic, 100 lbs) @ $202 each set (Means, 1998; Item No. 027 152 1800).
Assume location factor of 1.275.
Assume 2 days for placement of catchbasins.

Cost per catchbasin:	$	1,418	
Assume:	**$**	**1,400**	**per catchbasin**

2. U-Shaped Perimeter Drain Installation

Assume no additional excavation necessary for drain installation.
Assume cost for backfill of drain is included in site backfill estimate.
Assume cost materials & installation of U-shaped (19 inch channel depth) perimeter drain @ $50/lf (ABT, Inc., 10/98).
Assume 1.5 weeks for placement of perimeter drain system.

Total length of perimeter drain is: 200 lf

Cost for placement: $ 10,000

3. Curb Installation

Assume length of curb is 650 feet.
Assume placement of concrete curbing around perimeter (see Figure 4-2 for curb placement locations) @ $5.40/lf (includes steel forms; Means, 1998: Item No. 025 254 0410).
Assume location factor of 1.275.
Assume production rate of 700 lf/day.

Cost for curb placement:	$	4,475
Assume:	**$**	**4,500**

4. Extension of Sidewalk and Curb

Assume 12 ft by 300 ft sidewalk extension from southeastern edge of East Yard to corner of Hollers Avenue.
Assume concrete sidewalk (3,000 psi concrete, 4 inches thick) @ $2.55/sf (Means, 1998; 025 128 0310).
Assume 4-inch bank run gravel base @ $0.44/sf (Means, 1998; 025 128 0450).
Assume placement of concrete curbing @ $5.40/lf (includes steel forms; Means, 1998; Item No. 025 254 0300).
Assume location factor of 1.275.
Assume production rate of 2500 sf per day for base material and 600 sf per day for concrete.
Assume production rate of 700 lf/day for placement of curb.

Cost for curb placement:	$	15,790
Assume:	**$**	**15,800**

Assume time for installation of surface water runoff controls of 4 weeks.

Alternative 5B - Limited Excavation/Off-Site Treatment/Off-Site Reuse/Asphalt Cap

Prepared By: PDP
Checked By: LT

Long-Term Monitoring

Assume annual sampling of 6 existing monitoring wells.
Assume no validation of sample data.
Assume preparation of a brief sampling report (data tabulation only) for each sampling event; no 5-year review report will be generated.

1. Analytical Cost

Total number of samples:

6	environmental samples
1	duplicate
1	trip blank (VOCs only)
1	field blank
1	MS
1	MSD
11	samples

Samples will be analyzed for:

VOCs	$	125	
SVOCs	$	250	
PCBs	$	150	
TAL ICP Metals	$	135	
Total:	$	660	per sample

Analytical Cost = 10 samples x $ 660 /sample + 1 trip blank x $ 125 /sample
= $6,725 per sampling event

Assume: $6,700 per sampling event

2. Sampling Cost

Assume 2 sampling technicians @ $25/hour.
Assume labor multiplier of 3.
Assume sampling performed over one 10-hour day.
Assume PPE @ $18 per person per half day.
Assume van rental @ $80 per day.
Assume per diem @ $120 per person per day.
Assume rental of H&S monitoring equipment and field measurement equipment @ $800.
Assume use of diposable bailers @ $20 per bailer.
Assume consumable supplies @ $100.
Assume sample shipment @ $150.

Total: $ 3,062
Assume: $ 3,100 per sampling event

3. Laboratory Procurement & Sampling Report Preparation

Assume one person @ $30 per hour for 3 days for preparation of Sampling Report.
Assume one person @ $35 per hour for 3 days for laboratory procurement.
Assume labor multiplier of 3.

Total: $ 4,680
Assume: $ 4,700 per sampling event

Total for Long-Term Monitoring: $ 14,500 per sampling event

Prepared By: PDP
Checked By: LT

Asphalt Cap Maintenance

Assume 2 persons @ $25 per hour for 6 hours per year inspecting for and patching cracks in asphalt surface.
Assume patching materials @ $100 per year.
Assume labor multiplier of 2.

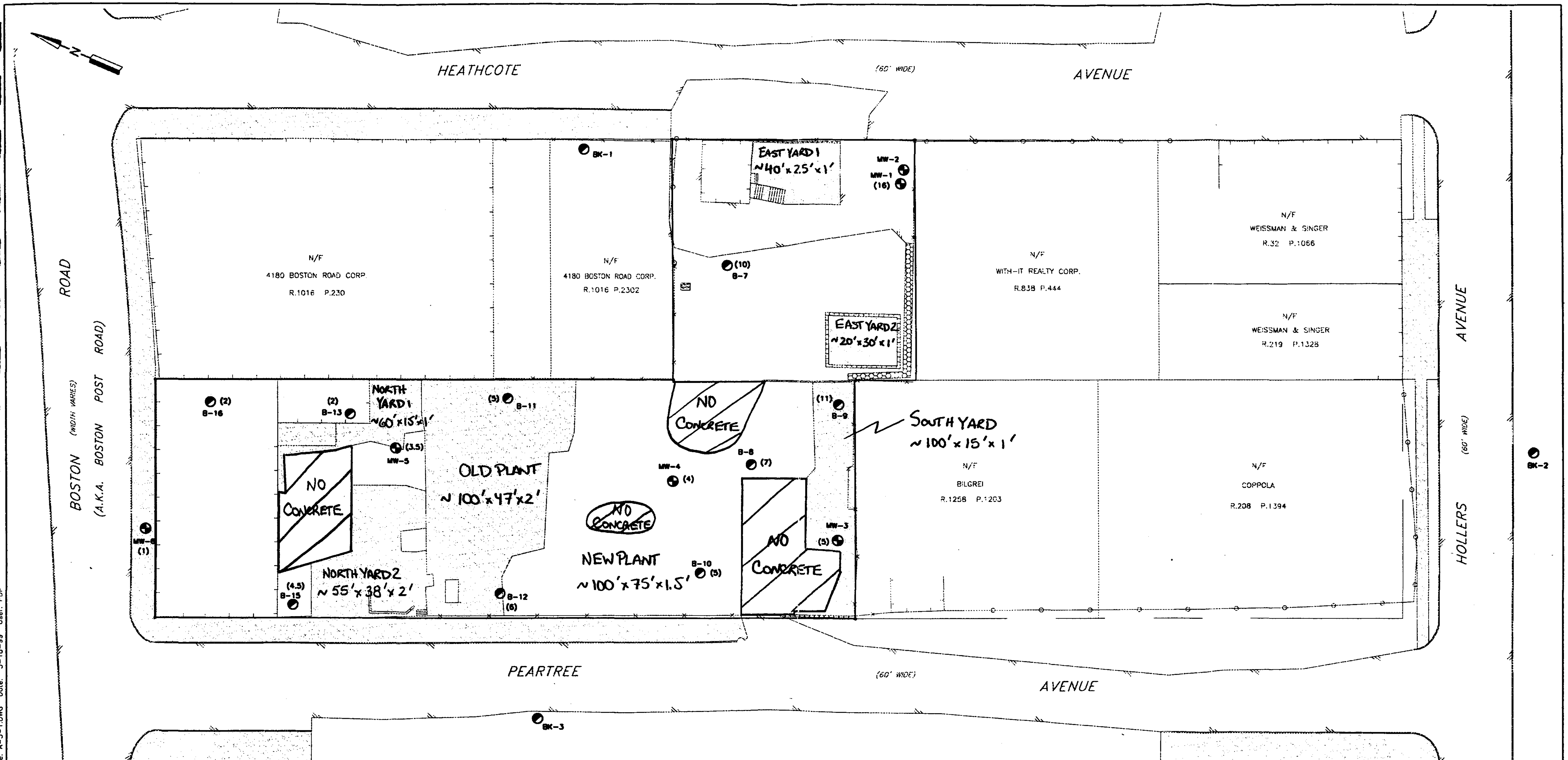
Total: $ 700 per year

TABLE A-5.1
HEXAGON LABORATORIES RI/FFS
GRAVEL BASE COURSE VOLUME ESTIMATE FOR ALTERNATIVES 5A AND 5B

Area Designation[1]	Dimensions			Gravel Volume (Cubic Feet)	Gravel Volume (Cubic Yards)
	Length (Feet)	Width (Feet)	Depth[2] (Feet)		
North Yard	39	80	1	3,120	116
Old Plant	70	100	1.5	10,500	389
New Plant #1[3]	--	--	--	5,183	192
-- Total New Plant #1 (inc. UST Excavation)	79	54	1.25	--	--
-- New Plant UST Excavation	10	12	1.25	--	--
New Plant #2	79	46	2.5	9,085	336
South Yard #1	25	29	1.25	906	34
South Yard #2	20	25	2	1,000	37
South Yard #3[4]	50	46	1	2,300	85
Total				**32,094**	**1,189**
			Assume:	**32,100**	**1,200**

Notes:

1. Refer to Figure A-4.3 for locations of Areas used in calculating gravel volume.
2. Gravel layer thickness corresponds to the thickness of saturated overburden. Gravel layer will be placed with a minimum thickness of 1 foot in areas where the saturated overburden thickness is less than 1 foot.
3. New Plant soil volume estimate does not include the New Plant UST excavation area since contaminated soil was removed from this area (and replaced with clean fill material) as part of the IRM. No soil removal is planned for this area as part of these alternatives.
4. Proposed maximum depth of soil removal in the upper site is 6 feet bgs in areas where depth to bedrock is greater than 6 feet bgs.
5. The South Yard UST excavation is not included in the contaminated soil volume estimate since contaminated soil was removed from this area (and replaced with clean fill material) as part of the IRM.
6. Area subdivisions were approximated as rectangular blocks to facilitate calculation of gravel volumes. Actual gravel volumes may vary based on subsurface conditions.



LEGEND

BK, B	SOIL BORING
MW	MONITORING WELL
	BUILDING EDGE
	HEXAGON PROPERTY LINE
	ADJOINING PROPERTY LINE
	CONCRETE
	CONCRETE CURB
	EDGE OF MACADAM
	MASONRY STONE WALL
	CONCRETE WALL
	CONCRETE STEPS
	CHAIN LINK FENCE
	METAL STOCKADE FENCE
N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
(3.5)	OVERBURDEN THICKNESS IN FEET (TYP.)
	OVERBURDEN THICKNESS ISOPACH (TYP.), 1 FT. CONTOUR INTERVAL

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by : TAMS CONSULTANTS, Inc.
The TAMS Building
655 Third Avenue, New York, New York

Prepared for : NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233

DESIGNED BY : PK
DRAWN BY : PDP
CHECKED BY : MT
SUBMITTED BY : PDP

HEXAGON LABORATORIES SITE

New York City
Bronx County, New York

ALTERNATIVES 5A AND 5B CONCRETE REMOVAL VOLUME ESTIMATE

DATE : MAY 1999
SCALE : AS SHOWN
DRAWING NO. : A-5.1

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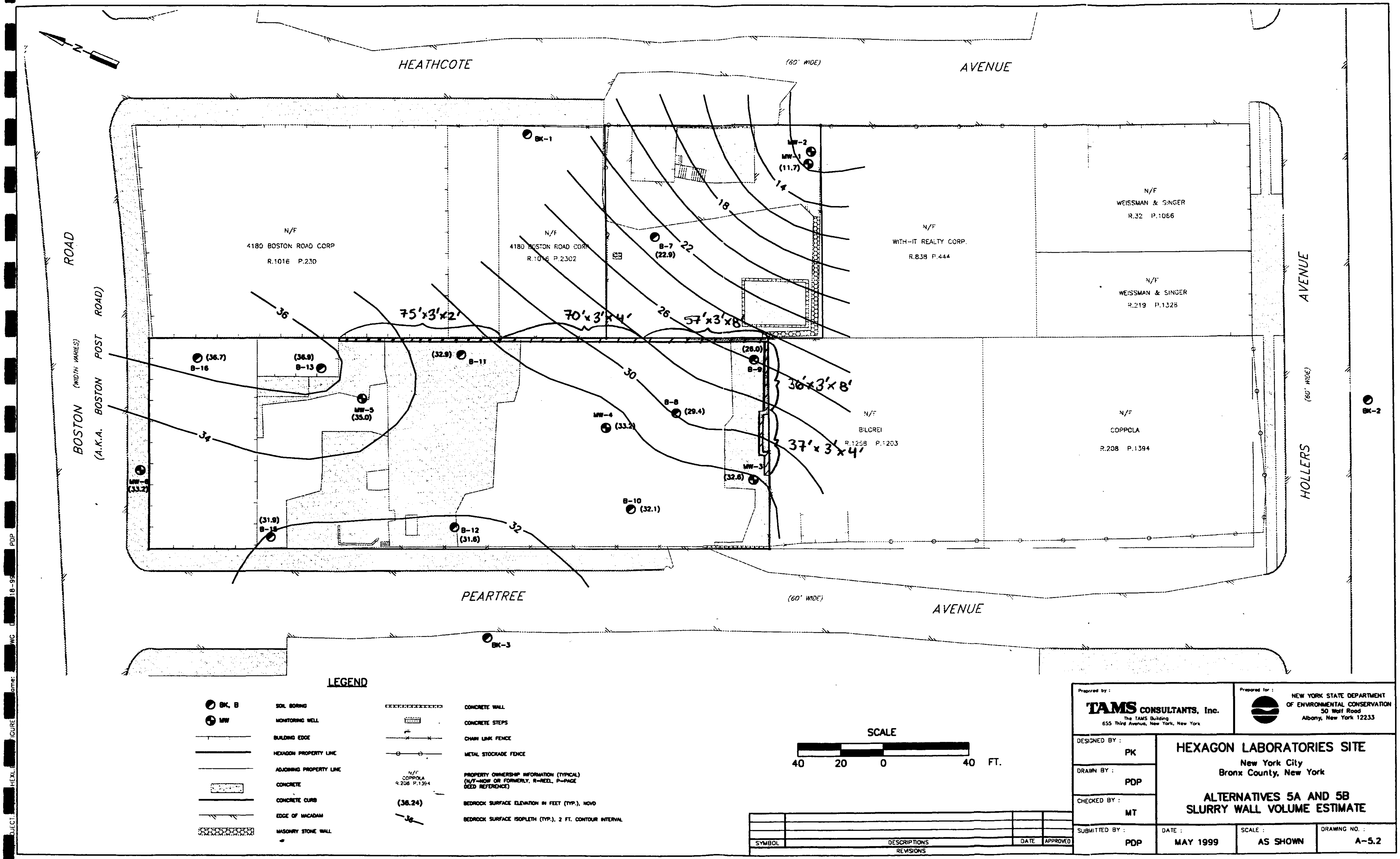
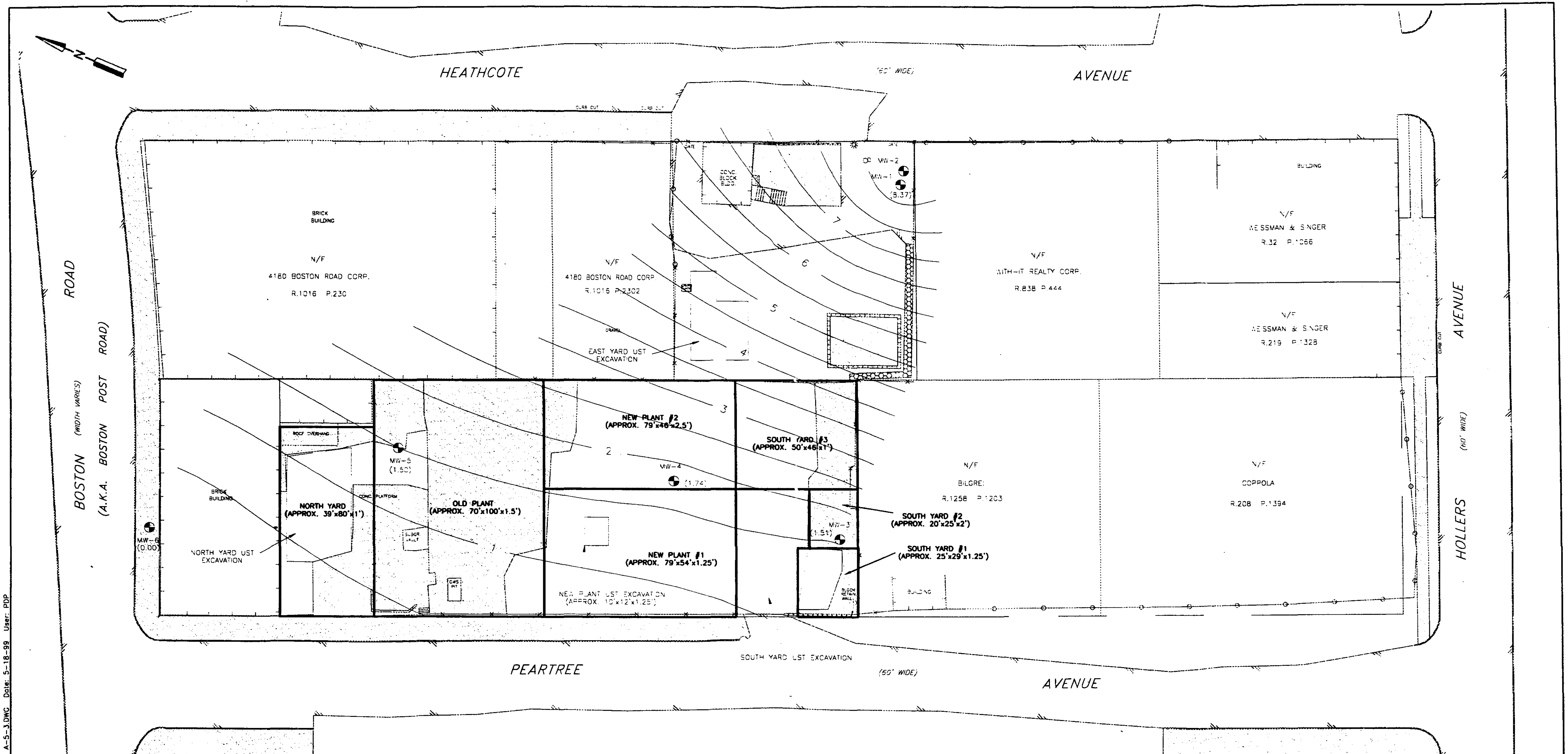


HEATHCOTE AVENUE (60' WIDE)
PEARTREE AVENUE (60' WIDE)
HOLLERS AVENUE (60' WIDE)
BOSTON ROAD (WIDTH VARIES) (A.K.A. BOSTON POST ROAD)
N/F 4180 BOSTON ROAD CORP R.1016 P.230
N/F 4180 BOSTON ROAD CORP R.1016 P.2302
N/F WITH-IT REALTY CORP. R.838 P.444
N/F WEISSMAN & SINGER R.32 P.1066
N/F WEISSMAN & SINGER R.219 P.1326
N/F BILCREI R.1258 P.1203
N/F COPPOLA R.208 P.1394
BK-1
BK-2
BK-3
MW-1
MW-2 (11.7)
MW-3 (32.6)
MW-4 (33.2)
MW-5 (35.0)
MW-6 (33.2)
B-7 (22.9)
B-8 (29.4)
B-9 (26.0)
B-10 (32.1)
B-11 (32.9)
B-12 (31.6)
B-13 (36.9)
B-15 (31.9)
B-16 (36.7)
14
18
22
26
30
32
34
36
75'x3'x2'
70'x3'x4'
57'x3'x6'
36'x3'x8'
37'x3'x4'
LEGEND
BK, B SOIL BORING
MW MONITORING WELL
BUILDING EDGE
HEXAGON PROPERTY LINE
ADJOINING PROPERTY LINE
CONCRETE
CONCRETE CURB
EDGE OF MACADAM
MASONRY STONE WALL
CONCRETE WALL
CONCRETE STEPS
CHAIN LINK FENCE
METAL STOCKADE FENCE
N/F COPPOLA R.208 P.1394 PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F-NOW OR FORMERLY, R-REEL, P-PAGE DEED REFERENCE)
(36.24) BEDROCK SURFACE ELEVATION IN FEET (TYP.), NGVD
BEDROCK SURFACE ISOPLETH (TYP.), 2 FT. CONTOUR INTERVAL
SCALE
40 20 0 40 FT.
SYMBOL
DESCRIPTIONS
DATE
APPROVED
REVISIONS
Prepared by :
TAMS CONSULTANTS, Inc.
The TAMS Building
655 Third Avenue, New York, New York
Prepared for :
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233
DESIGNED BY : PK
DRAWN BY : PDP
CHECKED BY : MT
SUBMITTED BY : PDP
HEXAGON LABORATORIES SITE
New York City
Bronx County, New York
ALTERNATIVES 5A AND 5B
SLURRY WALL VOLUME ESTIMATE
DATE : MAY 1999
SCALE : AS SHOWN
DRAWING NO. : A-5.2



LEGEND

MW	MONITORING WELL
	BUILDING EDGE
	HEXAGON PROPERTY LINE
	ADJOINING PROPERTY LINE
	CONCRETE
	CONCRETE CURB
	EDGE OF MACADAM
	MASONRY STONE WALL
	CONCRETE WALL
	CONCRETE STEPS
	CHAIN LINK FENCE
	METAL STOCKADE FENCE
N/F COPPOLA R.208 P.1394	PROPERTY OWNERSHIP INFORMATION (TYPICAL) (N/F=NOW OR FORMERLY, R=REEL, P=PAGE DEED REFERENCE)
(36.24)	SATURATED OVERBURDEN THICKNESS IN FEET (TYP.)
5	SATURATED OVERBURDEN ISOPACH (TYP.), 0.5 FT. CONTOUR INTERVAL

NOTES

1. GRAVEL VOLUME ESTIMATE SUBDIVISIONS ARE APPROXIMATED AS RECTANGULAR BLOCKS TO FACILITATE THE VOLUME CALCULATION. ACTUAL GRAVEL VOLUME MAY VARY BASED ON SUBSURFACE CONDITIONS.
2. REFER TO TABLE A-5.1 FOR CORRESPONDING GRAVEL VOLUME CALCULATION.

SCALE

40 20 0 40 FT.

SYMBOL	DESCRIPTIONS	DATE	APPROVED
	REVISIONS		

Prepared by: **TAMS CONSULTANTS, Inc.** The TAMS Building, 655 Third Avenue, New York, New York

Prepared for: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, 50 Wolf Road, Albany, New York 12233

DESIGNED BY: PK
DRAWN BY: PDP
CHECKED BY: MT
SUBMITTED BY: PDP

HEXAGON LABORATORIES SITE
New York City
Bronx County, New York

ALTERNATIVES 5A AND 5B GRAVEL BASE COURSE VOLUME ESTIMATE

DATE: MAY 1999
SCALE: AS SHOWN
DRAWING NO.: A-5.3

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APPENDIX B

EVALUATION SCORING

TABLE B-1.1
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 1: NO ACTION

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

Analysis Factor	Basis for Evaluation	Score
1. Compliance with Chemical-Specific SCGs	Meets chemical-specific SCGs	Yes (4) ___ No (0) 0
2. Compliance with Action-Specific SCGs	Meets action-specific SCGs	Yes (3) 3 No (0) ___
3. Compliance with Location-Specific SCGs	Meets location-specific SCGs	Yes (3) 3 No (0) ___
		TOTAL 6/10

TABLE B-1.2
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 1: NO ACTION

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Analysis Factor	Basis for Evaluation	Score
1. Site Use after Remediation	Unrestricted use of land and water (If yes, go to end of table)	Yes (20) ____ No (0) 0
2. Human Health and Environment Exposure after Remediation	Acceptable exposure to contaminants via air	Yes (3) 3 (1) No (0) ____
	Acceptable exposure to contaminants via groundwater/ surface water (2)	Yes (4) N/A No (0) N/A
	Acceptable exposure to contaminants via sediment/soils	Yes (3) ____ No (0) 0
3. Magnitude of Residual Public Health Risks	Health Risk ≤ 10^{-6}	Yes (5) ____
	Health Risk ≤ 10^{-5}	Yes (2) 2 (3)
4. Magnitude of Residual Environmental Risks	Less than acceptable	Yes (5) ____
	Slightly greater than acceptable	Yes (3) ____
	Significant remaining risk	Yes (0) 0
		TOTAL 5/20

Notes:

1. The human health risk associated with inhalation of fugitive dust and volatile emissions has not been quantified. However, air monitoring performed at the site during the IRM suggests that exposure to volatile emissions is within acceptable limits.
2. Contaminated groundwater will be addressed as part of a separate feasibility study. The groundwater-related criteria are considered not applicable (N/A), and, therefore, no alternative can achieve a maximum score of 20 for this criterion.
3. Surface soil was determined to represent unacceptable human health risk (i.e. > 10^{-6}) for the site worker future-use exposure scenario as part of the remedial investigation. Risk associated with exposure to subsurface soil was not quantified.

TABLE B-1.3
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 1: NO ACTION

SHORT-TERM EFFECTIVENESS

Analysis Factor	Basis for Evaluation	Score
1. Protection of Community during Remedial Actions	Significant short-term risks to the community (If no, go to Factor 2)	Yes (0) ___ No (4) 4
	Risk easily controlled	Yes (1) ___ No (0) ___
	Risk mitigation impacts community lifestyle	Yes (0) ___ No (2) ___
2. Environmental Impacts	Significant short-term risks to the environment (If no, go to Factor 3)	Yes (0) ___ No (4) 4
	Mitigative methods are reliable	Yes (3) ___ No (0) ___
3. Duration of Remediation	Time required to implement remedy	≤ 2 yrs (1) 1 > 2 yrs (0) ___
	Required duration of mitigative measures for short-term risk	≤ 2 yrs (1) 1 > 2 yrs (0) ___
		TOTAL 10/10

TABLE B-1.4
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 1: NO ACTION

LONG-TERM EFFECTIVENESS AND PERMANENCE[1]

Analysis Factor	Basis for Evaluation	Score	
1. Treatment or Land Disposal	On-site treatment	Yes (3)	N/A
	Off-site treatment	Yes (1)	N/A
	On-site or off-site land disposal	Yes (0)	N/A
2. Permanence of Alternative	Remedy is classified as permanent (on-site or off-site destruction or separation/treatment or solidification/ chemical fixation of inorganic waste) (If yes, go to Factor 4)	Yes (3)	
		No (0)	0
3. Duration of Remedy	Expected lifetime or duration of the effectiveness of the remedy	25-30 yrs (3)	
		20-25 yrs (2)	
		15-20 yrs (1)	
		<15 yrs (0)	0
4. Quantity and Nature of Residuals	Quantity of untreated waste remaining at the site	None (3)	
		≤ 25 % (2)	
		25-50% (1)	
		≥ 50% (0)	0
	Treated residuals remain on site (If no, go to Factor 5)	Yes (0)	N/A
		No (2)	N/A
	Treated residuals are toxic	Yes (0)	N/A
		No (1)	N/A
	Treated residuals are mobile	Yes (0)	N/A
		No (1)	N/A
5. Adequacy and Reliability of Controls	i. Duration of operation and maintenance	< 5 yrs (1)	
		> 5 yrs (0)	0
	ii. Environmental control requirement if no go to 5.iv	Yes (0)	0
		No (1)	
	iii. Reliability of environmental controls: -- Moderate to Very Confident	Yes (1)	
	-- Somewhat to Not Confident	Yes (0)	0
	iv. Duration of long-term monitoring	Minimum (2)	
		Moderate (1)	
		Extensive (0)	0
		TOTAL	**0/15**

Note:
1. The No Action alternative does not involve any remedial action or environmental control. Therefore, treatment-related criteria used in evaluating the long-term effectiveness and permanence of this alternative are not applicable (N/A).

TABLE B-1.5
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 1: NO ACTION

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME[1]

Analysis Factor	Basis for Evaluation	Score	
1. Volume Reduction (If subtotal = 10, go to Factor 3)	Quantity of hazardous waste destroyed or treated	99-100% (8)	
		90-99% (7)	
		80-90% (6)	
		60-80% (4)	
		40-60% (2)	
		20-40% (1)	
		< 20% (0)	0
	Are there untreated or concentrated residual wastes produced as result (If no, go to Factor 2)	Yes (0)	
		No (2)	2
	Disposal of untreated or concentrated wastes:		
	-- Off-site land disposal	Yes (0)	
	-- On-site land disposal	Yes (1)	
	-- Off-site destruction or treatment	Yes (2)	
2. Mobility Reduction [1]	Quantity of waste immobilized after destruction/ treatment	90-100% (2)	N/A
		60-90% (1)	N/A
		< 60% (0)	N/A
	Method of immobilization:		
	-- Containment	Yes (0)	N/A
	-- Alternative treatment	Yes (3)	N/A
	(If not applicable, go to 3)		
3. Irreversibility of Destruction or Treatment or Immobilization of Hazardous Waste	Completely irreversible	Yes (5)	
	Irreversible for most of the hazardous waste constituents	Yes (3)	
	Irreversible for some of the hazardous waste constituents	Yes (2)	
	Reversible for most of the hazardous waste constituents	Yes (0)	0
		TOTAL	**2/20**

Note:
1. The No Action alternative does not involve any remedial action or environmental control. Therefore, treatment-related criteria used in evaluating the reduction in toxicity, mobility, and volume of this alternative are not applicable (N/A); the maximum score possible is 15.

TABLE B-1.6
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 1: NO ACTION

IMPLEMENTABILITY

Analysis Factor	Basis for Evaluation	Score
1. Technical Feasibility	Ability to construct technology:	
	-- Not difficult; No uncertainties	Yes (3) 3
	-- Somewhat difficult; No uncertainties	Yes (2)
	-- Very difficult; Significant Uncertainties	Yes (1)
	Reliability of technology:	
	-- Very reliable in meeting process efficiencies or performance goals	Yes (3) 3
	-- Somewhat reliable in meeting process efficiencies or performance goals	Yes (2)
	Probability of schedule delays:	
	-- Unlikely	Yes (2) 2
	-- Somewhat likely	Yes (1)
	Need for additional remedial action	
	-- None anticipated	Yes (2)
	-- Some may be necessarry	Yes (1) 1
2. Administrative Feasibility	Coordination with other agencies:	
	-- Minimal coordination required	Yes (2) 2
	-- Normal coordination required	Yes (1)
	-- Extensive coordination required	Yes (0)
3. Availability of Services and Materials	Technologies are commercially available for site-specific application	Yes (1) 1
		No (0)
	More than one vendor is available to bid	Yes (1) 1
		No (0)
	Necessary equipment and specialists are available	Yes (1) 1
		No (0)
		TOTAL 14/15

TABLE B-2A.1
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2A: CONTAINMENT (ASPHALT CAP)

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

Analysis Factor	Basis for Evaluation	Score
1. Compliance with Chemical-Specific SCGs	Meets chemical-specific SCGs	Yes (4) ____ No (0) 0
2. Compliance with Action-Specific SCGs	Meets action-specific SCGs	Yes (3) 3 No (0) ____
3. Compliance with Location-Specific SCGs	Meets location-specific SCGs	Yes (3) 3 No (0) ____
		TOTAL 6/10

TABLE B-2A.2
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2A: CONTAINMENT (ASPHALT CAP)

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Analysis Factor	Basis for Evaluation	Score
1. Site Use after Remediation	Unrestricted use of land and water (If yes, go to end of table)	Yes (20) ____ No (0) 0
2. Human Health and Environment Exposure after Remediation	Acceptable exposure to contaminants via air	Yes (3) 3 No (0) ____
	Acceptable exposure to contaminants via groundwater/ surface water [1]	Yes (4) N/A No (0) N/A
	Acceptable exposure to contaminants via sediment/soils	Yes (3) 3 No (0) ____
3. Magnitude of Residual Public Health Risks	Health Risk ≤ 10^{-6}	Yes (5) 5
	Health Risk ≤ 10^{-5}	Yes (2) ____
4. Magnitude of Residual Environmental Risks	Less than acceptable	Yes (5) ____
	Slightly greater than acceptable	Yes (3) ____
	Significant remaining risk [2]	Yes (0) 0
		TOTAL 11/20

Note:
1. Contaminated groundwater will be addressed as part of a separate feasibility study. The groundwater-related criteria are considered not applicable (N/A), and, therefore, no alternative can achieve a maximum score of 20 for this criterion.
2. Capping reduces vertical migration of contamination from the unsaturated overburden to groundwater. It has no significant impact on lateral mobility of contaminants due to groundwater flow.

TABLE B-2A.3
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2A: CONTAINMENT (ASPHALT CAP)

SHORT TERM EFFECTIVENESS

Analysis Factor	Basis for Evaluation	Score	
1. Protection of Community during Remedial Actions	Significant short-term risks to the community (If no, go to Factor 2)	Yes (0)	
		No (4)	4
	Risk easily controlled	Yes (1)	
		No (0)	
	Risk mitigation impacts community lifestyle	Yes (0)	
		No (2)	
2. Environmental Impacts	Significant short-term risks to the environment (If no, go to Factor 3)	Yes (0)	
		No (4)	4
	Mitigative methods are reliable	Yes (3)	
		No (0)	
3. Duration of Remediation	Time required to implement remedy	≤ 2 yrs (1)	1
		> 2 yrs (0)	
	Required duration of mitigative measures for short-term risk	≤ 2 yrs (1)	1
		> 2 yrs (0)	
		TOTAL	**10/10**

TABLE B-2A.4
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2A: CONTAINMENT (ASPHALT CAP)

LONG-TERM EFFECTIVENESS AND PERMANENCE

Analysis Factor	Basis for Evaluation	Score
1. Treatment or Land Disposal	On-site treatment	Yes (3)
	Off-site treatment	Yes (1)
	On-site or off-site land disposal	Yes (0) 0
2. Permanence of Alternative	Remedy is classified as permanent (on-site or off-site destruction or separation/treatment or solidification/ chemical fixation of inorganic waste) (If yes, go to Factor 4)	Yes (3) No (0) 0
3. Duration of Remedy	Expected lifetime or duration of the effectiveness of the remedy	25-30 yrs (3) 3 20-25 yrs (2) 15-20 yrs (1) <15 yrs (0)
4. Quantity and Nature of Residuals	Quantity of untreated waste left at the site	None (3) ≤ 25 % (2) 25-50% (1) ≥ 50% (0) 0
	Treated residuals remain on site (If no, go to Factor 5)	Yes (0) No (2) 2
	Treated residuals are toxic	Yes (0) No (1)
	Treated residuals are mobile	Yes (0) No (1)
5. Adequacy and Reliability of Controls	i. Duration of operation and maintenance	< 5 yrs (1) > 5 yrs (0) 0
	ii. Environmental control requirement if no go to 5.iv	Yes (0) 0 No (1)
	iii. Reliability of environmental controls: -- Moderate to Very Confident -- Somewhat to Not Confident	Yes (1) 1 Yes (0)
	iv. Duration of long-term monitoring	Minimum (2) Moderate (1) Extensive (0) 0
		TOTAL 6/15

TABLE B-2A.5
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2A: CONTAINMENT (ASPHALT CAP)

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

Analysis Factor	Basis for Evaluation	Score
1. Volume Reduction (If subtotal = 10, go to Factor 3)	Quantity of hazardous waste destroyed or treated	99-100% (8) ___ 90-99% (7) ___ 80-90% (6) ___ 60-80% (4) ___ 40-60% (2) ___ 20-40% (1) ___ < 20% (0) 0
	Are there untreated or concentrated residual wastes produced as result (If no, go to Factor 2)	Yes (0) ___ No (2) 2
	Disposal of untreated or concentrated wastes: -- Off-site land disposal -- On-site land disposal -- Off-site destruction or treatment	 Yes (0) ___ Yes (1) ___ Yes (2) ___
2. Mobility Reduction	Quantity of waste immobilized after destruction/ treatment	90-100% (2) ___ 60-90% (1) ___ < 60% (0) 0[(1)]
	Method of immobilization: -- Containment -- Alternative treatment (If not applicable, go to 3)	 Yes (0) 0 Yes (3) ___
3. Irreversibility of Destruction or Treatment or Immobilization of Hazardous Waste	Completely irreversible	Yes (5) ___
	Irreversible for most of the hazardous waste constituents	Yes (3) ___
	Irreversible for some of the hazardous waste constituents	Yes (2) ___
	Reversible for most of the hazardous waste constituents	Yes (0) 0
		TOTAL 2/20

Note:
1. Capping reduces vertical migration of contamination from the unsaturated overburden to groundwater. It has no significant impact on lateral mobility of contaminants due to groundwater flow.

TABLE B-2A.6
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2A: CONTAINMENT (ASPHALT CAP)

IMPLEMENTABILITY

Analysis Factor	Basis for Evaluation	Score
1. Technical Feasibility	Ability to construct technology:	
	-- Not difficult; No uncertainties	Yes (3) 3
	-- Somewhat difficult; No uncertainties	Yes (2)
	-- Very difficult; Significant Uncertainties	Yes (1)
	Reliability of technology:	
	-- Very reliable in meeting process efficiencies or performance goals	Yes (3) 3
	-- Somewhat reliable in meeting process efficiencies or performance goals	Yes (2)
	Probability of schedule delays:	
	-- Unlikely	Yes (2) 2
	-- Somewhat likely	Yes (1)
	Need for additional remedial action	
	-- None anticipated	Yes (2) 2
	-- Some may be necessarry	Yes (1)
2. Administrative Feasibility	Coordination with other agencies:	
	-- Minimal coordination required	Yes (2)
	-- Normal coordination required	Yes (1) 1
	-- Extensive coordination required	Yes (0)
3. Availability of Services and Materials	Technologies are commercially available for site-specific application	Yes (1) 1
		No (0)
	More than one vendor is available to bid	Yes (1) 1
		No (0)
	Necessary equipment and specialists are available	Yes (1) 1
		No (0)
		TOTAL 14/15

TABLE B-2B.1
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2B: CONTAINMENT (CONCRETE CAP)

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

Analysis Factor	Basis for Evaluation	Score
1. Compliance with Chemical-Specific SCGs	Meets chemical-specific SCGs	Yes (4) ____ No (0) 0
2. Compliance with Action-Specific SCGs	Meets action-specific SCGs	Yes (3) 3 No (0) ____
3. Compliance with Location-Specific SCGs	Meets location-specific SCGs	Yes (3) 3 No (0) ____
		TOTAL 6/10

TABLE B-2B.2
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2B: CONTAINMENT (CONCRETE CAP)

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Analysis Factor	Basis for Evaluation	Score
1. Site Use after Remediation	Unrestricted use of land and water (If yes, go to end of table)	Yes (20) ____ No (0) 0
2. Human Health and Environment Exposure after Remediation	Acceptable exposure to contaminants via air	Yes (3) 3 No (0) ____
	Acceptable exposure to contaminants via groundwater/ surface water (1)	Yes (4) N/A No (0) N/A
	Acceptable exposure to contaminants via sediment/soils	Yes (3) 3 No (0) ____
3. Magnitude of Residual Public Health Risks	Health Risk $\leq 10^{-6}$	Yes (5) 5
	Health Risk $\leq 10^{-5}$	Yes (2) ____
4. Magnitude of Residual Environmental Risks	Less than acceptable	Yes (5) ____
	Slightly greater than acceptable	Yes (3) ____
	Significant remaining risk (2)	Yes (0) 0
		TOTAL 11/20

Note:
1. Contaminated groundwater will be addressed as part of a separate feasibility study. The groundwater-related criteria are considered not applicable (N/A), and, therefore, no alternative can achieve a maximum score of 20 for this criterion.
2. Capping reduces vertical migration of contamination from the unsaturated overburden to groundwater. It has no significant impact on lateral mobility of contaminants due to groundwater flow.

TABLE B-2B.3
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2B: CONTAINMENT (CONCRETE CAP)

SHORT TERM EFFECTIVENESS

Analysis Factor	Basis for Evaluation	Score
1. Protection of Community during Remedial Actions	Significant short-term risks to the community (If no, go to Factor 2)	Yes (0) ____ No (4) 4
	Risk easily controlled	Yes (1) ____ No (0) ____
	Risk mitigation impacts community lifestyle	Yes (0) ____ No (2) ____
2. Environmental Impacts	Significant short-term risks to the environment (If no, go to Factor 3)	Yes (0) ____ No (4) 4
	Mitigative methods are reliable	Yes (3) ____ No (0) ____
3. Duration of Remediation	Time required to implement remedy	≤ 2 yrs (1) 1 > 2 yrs (0) ____
	Required duration of mitigative measures for short-term risk	≤ 2 yrs (1) 1 > 2 yrs (0) ____
		TOTAL 10/10

TABLE B-2B.4
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2B: CONTAINMENT (CONCRETE CAP)

LONG-TERM EFFECTIVENESS AND PERMANENCE

Analysis Factor	Basis for Evaluation	Score	
1. Treatment or Land Disposal	On-site treatment	Yes (3)	
	Off-site treatment	Yes (1)	
	On-site or off-site land disposal	Yes (0)	0
2. Permanence of Alternative	Remedy is classified as permanent (on-site or off-site destruction or separation/treatment or solidification/ chemical fixation of inorganic waste) (If yes, go to Factor 4)	Yes (3)	
		No (0)	0
3. Duration of Remedy	Expected lifetime or duration of the effectiveness of the remedy	25-30 yrs (3)	3
		20-25 yrs (2)	
		15-20 yrs (1)	
		<15 yrs (0)	
4. Quantity and Nature of Residuals	Quantity of untreated waste left at the site	None (3)	
		≤ 25 % (2)	
		25-50% (1)	
		≥ 50% (0)	0
	Treated residuals remain on site (If no, go to Factor 5)	Yes (0)	
		No (2)	2
	Treated residuals are toxic	Yes (0)	
		No (1)	
	Treated residuals are mobile	Yes (0)	
		No (1)	
5. Adequacy and Reliability of Controls	i. Duration of operation and maintenance	< 5 yrs (1)	
		> 5 yrs (0)	0
	ii. Environmental control requirement if no go to 5.iv	Yes (0)	0
		No (1)	
	iii. Reliability of environmental controls:		
	-- Moderate to Very Confident	Yes (1)	1
	-- Somewhat to Not Confident	Yes (0)	
	iv. Duration of long-term monitoring	Minimum (2)	
		Moderate (1)	
		Extensive (0)	0
		TOTAL	**6/15**

TABLE B-2B.5
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2B: CONTAINMENT (CONCRETE CAP)

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

Analysis Factor	Basis for Evaluation	Score
1. Volume Reduction (If subtotal = 10, go to Factor 3)	Quantity of hazardous waste destroyed or treated	99-100% (8) ___ 90-99% (7) ___ 80-90% (6) ___ 60-80% (4) ___ 40-60% (2) ___ 20-40% (1) ___ < 20% (0) 0
	Are there untreated or concentrated residual wastes produced as result (If no. go to Factor 2)	Yes (0) ___ No (2) 2
	Disposal of untreated or concentrated wastes: -- Off-site land disposal -- On-site land disposal -- Off-site destruction or treatment	 Yes (0) ___ Yes (1) ___ Yes (2) ___
2. Mobility Reduction	Quantity of waste immobilized after destruction/ treatment	90-100% (2) ___ 60-90% (1) ___ < 60% (0) 0[(1)]
	Method of immobilization: -- Containment -- Alternative treatment (If not applicable, go to 3)	 Yes (0) 0 Yes (3) ___
3. Irreversibility of Destruction or Treatment or Immobilization of Hazardous Waste	Completely irreversible	Yes (5) ___
	Irreversible for most of the hazardous waste constituents	Yes (3) ___
	Irreversible for some of the hazardous waste constituents	Yes (2) ___
	Reversible for most of the hazardous waste constituents	Yes (0) 0
		TOTAL 2/20

Note:
1. Capping reduces vertical migration of contamination from the unsaturated overburden to groundwater. It has no significant impact on lateral mobility of contaminants due to groundwater flow.

TABLE B-2B.6
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2B: CONTAINMENT (CONCRETE CAP)

IMPLEMENTABILITY

Analysis Factor	Basis for Evaluation	Score
	Ability to construct technology:	
	-- Not difficult; No uncertainties	Yes (3) 3
	-- Somewhat difficult; No uncertainties	Yes (2)
	-- Very difficult; Significant Uncertainties	Yes (1)
	Reliability of technology:	
	-- Very reliable in meeting process efficiencies or performance goals	Yes (3) 3
1. Technical Feasibility	-- Somewhat reliable in meeting process efficiencies or performance goals	Yes (2)
	Probability of schedule delays:	
	-- Unlikely	Yes (2) 2
	-- Somewhat likely	Yes (1)
	Need for additional remedial action	
	-- None anticipated	Yes (2) 2
	-- Some may be necessarry	Yes (1)
	Coordination with other agencies:	
2. Administrative Feasibility	-- Minimal coordination required	Yes (2)
	-- Normal coordination required	Yes (1) 1
	-- Extensive coordination required	Yes (0)
	Technologies are commercially available for site-specific application	Yes (1) 1
		No (0)
3. Availability of Services and Materials	More than one vendor is available to bid	Yes (1) 1
		No (0)
	Necessary equipment and specialists are available	Yes (1) 1
		No (0)
		TOTAL 14/15

TABLE B-2C.1
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2C: CONTAINMENT (RCRA MULTIMEDIA CAP)

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

Analysis Factor	Basis for Evaluation	Score
1. Compliance with Chemical-Specific SCGs	Meets chemical-specific SCGs	Yes (4) ____ No (0) 0
2. Compliance with Action-Specific SCGs	Meets action-specific SCGs	Yes (3) 3 No (0) ____
3. Compliance with Location-Specific SCGs	Meets location-specific SCGs	Yes (3) 3 No (0) ____
		TOTAL 6/10

TABLE B-2C.2
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2C: CONTAINMENT (RCRA MULTIMEDIA CAP)

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Analysis Factor	Basis for Evaluation	Score
1. Site Use after Remediation	Unrestricted use of land and water (If yes, go to end of table)	Yes (20) ____ No (0) 0
2. Human Health and Environment Exposure after Remediation	Acceptable exposure to contaminants via air	Yes (3) 3 No (0) ____
	Acceptable exposure to contaminants via groundwater/ surface water (1)	Yes (4) N/A No (0) N/A
	Acceptable exposure to contaminants via sediment/soils	Yes (3) 3 No (0) ____
3. Magnitude of Residual Public Health Risks	Health Risk $\leq 10^{-6}$	Yes (5) 5
	Health Risk $\leq 10^{-5}$	Yes (2) ____
4. Magnitude of Residual Environmental Risks	Less than acceptable	Yes (5) ____
	Slightly greater than acceptable	Yes (3) ____
	Significant remaining risk (2)	Yes (0) 0
		TOTAL 11/20

Note:

1. Contaminated groundwater will be addressed as part of a separate feasibility study. The groundwater-related criteria are considered not applicable (N/A), and, therefore, no alternative can achieve a maximum score of 20 for this criterion.
2. Capping reduces vertical migration of contamination from the unsaturated overburden to groundwater. It has no significant impact on lateral mobility of contaminants due to groundwater flow.

TABLE B-2C.3
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2C: CONTAINMENT (RCRA MULTIMEDIA CAP)

SHORT TERM EFFECTIVENESS

Analysis Factor	Basis for Evaluation	Score	
1. Protection of Community during Remedial Actions	Significant short-term risks to the community (If no, go to Factor 2)	Yes (0)	
		No (4)	4
	Risk easily controlled	Yes (1)	
		No (0)	
	Risk mitigation impacts community lifestyle	Yes (0)	
		No (2)	
2. Environmental Impacts	Significant short-term risks to the environment (If no, go to Factor 3)	Yes (0)	
		No (4)	4
	Mitigative methods are reliable	Yes (3)	
		No (0)	
3. Duration of Remediation	Time required to implement remedy	≤ 2 yrs (1)	1
		> 2 yrs (0)	
	Required duration of mitigative measures for short-term risk	≤ 2 yrs (1)	1
		> 2 yrs (0)	
		TOTAL	**10/10**

TABLE B-2C.4
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2C: CONTAINMENT (RCRA MULTIMEDIA CAP)

LONG-TERM EFFECTIVENESS AND PERMANENCE

Analysis Factor	Basis for Evaluation	Score
1. Treatment or Land Disposal	On-site treatment	Yes (3) ___
	Off-site treatment	Yes (1) ___
	On-site or off-site land disposal	Yes (0) 0
2. Permanence of Alternative	Remedy is classified as permanent (on-site or off-site destruction or separation/treatment or solidification/ chemical fixation of inorganic waste) (If yes, go to Factor 4)	Yes (3) ___ No (0) 0
3. Duration of Remedy	Expected lifetime or duration of the effectiveness of the remedy	25-30 yrs (3) 3 20-25 yrs (2) ___ 15-20 yrs (1) ___ <15 yrs (0) ___
4. Quantity and Nature of Residuals	Quantity of untreated waste left at the site	None (3) ___ ≤ 25 % (2) ___ 25-50% (1) ___ ≥ 50% (0) 0
	Treated residuals remain on site (If no, go to Factor 5)	Yes (0) ___ No (2) 2
	Treated residuals are toxic	Yes (0) ___ No (1) ___
	Treated residuals are mobile	Yes (0) ___ No (1) ___
5. Adequacy and Reliability of Controls	i. Duration of operation and maintenance	< 5 yrs (1) ___ > 5 yrs (0) 0
	ii. Environmental control requirement if no go to 5.iv	Yes (0) 0 No (1) ___
	iii. Reliability of environmental controls: -- Moderate to Very Confident -- Somewhat to Not Confident	Yes (1) 1 Yes (0) ___
	iv. Duration of long-term monitoring	Minimum (2) ___ Moderate (1) ___ Extensive (0) 0
		TOTAL 6/15

TABLE B-2C.5
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2C: CONTAINMENT (RCRA MULTIMEDIA CAP)

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

Analysis Factor	Basis for Evaluation	Score
1. Volume Reduction (If subtotal = 10, go to Factor 3)	Quantity of hazardous waste destroyed or treated	99-100% (8) ___ 90-99% (7) ___ 80-90% (6) ___ 60-80% (4) ___ 40-60% (2) ___ 20-40% (1) ___ < 20% (0) 0
	Are there untreated or concentrated residual wastes produced as result (If no, go to Factor 2)	Yes (0) ___ No (2) 2
	Disposal of untreated or concentrated wastes: -- Off-site land disposal -- On-site land disposal -- Off-site destruction or treatment	 Yes (0) ___ Yes (1) ___ Yes (2) ___
2. Mobility Reduction	Quantity of waste immobilized after destruction/ treatment	90-100% (2) ___ 60-90% (1) ___ < 60% (0) 0[1]
	Method of immobilization: -- Containment -- Alternative treatment (If not applicable, go to 3)	 Yes (0) 0 Yes (3) ___
3. Irreversibility of Destruction or Treatment or Immobilization of Hazardous Waste	Completely irreversible	Yes (5) ___
	Irreversible for most of the hazardous waste constituents	Yes (3) ___
	Irreversible for some of the hazardous waste constituents	Yes (2) ___
	Reversible for most of the hazardous waste constituents	Yes (0) 0
		TOTAL 2/15

Note:
1. Capping reduces vertical migration of contamination from the unsaturated overburden to groundwater. It has no significant impact on lateral mobility of contaminants due to groundwater flow.

TABLE B-2C.6
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 2C: CONTAINMENT (RCRA MULTIMEDIA CAP)

IMPLEMENTABILITY

Analysis Factor	Basis for Evaluation	Score
1. Technical Feasibility	Ability to construct technology:	
	-- Not difficult; No uncertainties	Yes (3) 3
	-- Somewhat difficult; No uncertainties	Yes (2)
	-- Very difficult; Significant Uncertainties	Yes (1)
	Reliability of technology:	
	-- Very reliable in meeting process efficiencies or performance goals	Yes (3) 3
	-- Somewhat reliable in meeting process efficiencies or performance goals	Yes (2)
	Probability of schedule delays:	
	-- Unlikely	Yes (2) 2
	-- Somewhat likely	Yes (1)
	Need for additional remedial action	
	-- None anticipated	Yes (2) 2
	-- Some may be necessarry	Yes (1)
2. Administrative Feasibility	Coordination with other agencies:	
	-- Minimal coordination required	Yes (2)
	-- Normal coordination required	Yes (1) 1
	-- Extensive coordination required	Yes (0)
3. Availability of Services and Materials	Technologies are commercially available for site-specific application	Yes (1) 1
		No (0)
	More than one vendor is available to bid	Yes (1) 1
		No (0)
	Necessary equipment and specialists are available	Yes (1) 1
		No (0)
		TOTAL 14/15

TABLE B-3.1
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 3: IN-SITU TREATMENT OF ORGANIC CONTAMINANTS/EX-SITU TREATMENT OF METAL CONTAMINANTS/ON-SITE DISPOSAL

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

Analysis Factor	Basis for Evaluation	Score
1. Compliance with Chemical-Specific SCGs	Meets chemical-specific SCGs	Yes (4) ____ No (0) 0 [1]
2. Compliance with Action-Specific SCGs	Meets action-specific SCGs such as technology standards for incineration or landfill.	Yes (3) 3 No (0) ____
3. Compliance with Location-Specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act.	Yes (3) 3 No (0) ____
		TOTAL 6/10

Note:
1. Alternative does not meet SCGs for metals COCs since these metals are neither destroyed or removed in the solidification/ stabilization process.

TABLE B-3.2
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 3: IN-SITU TREATMENT OF ORGANIC CONTAMINANTS/EX-SITU TREATMENT OF METAL CONTAMINANTS/ON-SITE DISPOSAL

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Analysis Factor	Basis for Evaluation	Score
1. Site Use after Remediation	Unrestricted use of land and water [1] (If yes, go to end of table)	Yes (20) ____ No (0) 0
2. Human Health and Environment Exposure after Remediation	Acceptable exposure to contaminants via air	Yes (3) 3 No (0) ____
	Acceptable exposure to contaminants via groundwater/ surface water [1]	Yes (4) N/A No (0) N/A
	Acceptable exposure to contaminants via sediment/soils	Yes (3) 3 No (0) ____
3. Magnitude of Residual Public Health Risks	Health Risk $\leq 10^{-6}$	Yes (5) 5
	Health Risk $\leq 10^{-5}$	Yes (2) ____
4. Magnitude of Residual Environmental Risks	Less than acceptable	Yes (5) 5
	Slightly greater than acceptable	Yes (3) ____
	Significant remaining risk	Yes (0) ____
		TOTAL 16/20

Note:
1. Remaining saturated overburden and groundwater will be addressed as part of a separate feasibility study. The groundwater-related criteria are considered not applicable (N/A), and, therefore, no alternative can achieve a maximum score of 20 for this criterion.

TABLE B-3.3
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 3: IN-SITU TREATMENT OF ORGANIC CONTAMINANTS/EX-SITU TREATMENT OF METAL CONTAMINANTS/ON-SITE DISPOSAL

SHORT-TERM EFFECTIVENESS

Analysis Factor	Basis for Evaluation	Score	
1. Protection of Community during Remedial Actions	Significant short-term risks to the community (If no, go to Factor 2)	Yes (0)	0
		No (4)	
	Risk easily controlled	Yes (1)	1
		No (0)	
	Risk mitigation impacts community lifestyle	Yes (0)	
		No (2)	2
2. Environmental Impacts	Significant short-term risks to the environment (If no, go to Factor 3)	Yes (0)	
		No (4)	4
	Mitigative methods are reliable	Yes (3)	
		No (0)	
3. Duration of Remediation	Time required to implement remedy	≤ 2 yrs (1)	1
		> 2 yrs (0)	
	Required duration of mitigative measures for short-term risk	≤ 2 yrs (1)	1
		> 2 yrs (0)	
		TOTAL	**9/10**

TABLE B-3.4
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 3: IN-SITU TREATMENT OF ORGANIC CONTAMINANTS/EX-SITU TREATMENT OF METAL CONTAMINANTS/ON-SITE DISPOSAL

LONG-TERM EFFECTIVENESS AND PERMANENCE

Analysis Factor	Basis for Evaluation	Score
1. Treatment or Land Disposal	On-site treatment	Yes (3) 3
	Off-site treatment	Yes (1) ___
	On-site or off-site land disposal	Yes (0) ___
2. Permanence of Alternative	Remedy is classified as permanent (on-site or off-site destruction or separation/treatment or solidification/ chemical fixation of inorganic waste) (If yes, go to Factor 4)	Yes (3) 3 No (0) ___
3. Duration of Remedy	Expected lifetime or duration of the effectiveness of the remedy	25-30 yrs (3) ___ 20-25 yrs (2) ___ 15-20 yrs (1) ___ <15 yrs (0) ___
4. Quantity and Nature of Residuals	Quantity of untreated waste remaining at the site [1]	None (3) 3 ≤ 25 % (2) ___ 25-50% (1) ___ ≥ 50% (0) ___
	Treated residuals remain on site (If no, go to Factor 5)	Yes (0) 0 No (2) ___
	Treated residuals are toxic	Yes (0) ___ No (1) 1
	Treated residuals are mobile	Yes (0) ___ No (1) 1
5. Adequacy and Reliability of Controls	i. Duration of operation and maintenance	< 5 yrs (1) 1 > 5 yrs (0) ___
	ii. Environmental control requirement if no go to 5.iv	Yes (0) ___ No (1) 1
	iii. Reliability of environmental controls: -- Moderate to Very Confident -- Somewhat to Not Confident	Yes (1) ___ Yes (0) ___
	iv. Duration of long-term monitoring	Minimum (2) ___ Moderate (1) ___ Extensive (0) 0
		TOTAL 13/15

Note:
1. Remaining saturated overburden and groundwater contamination will be addressed as part of a separate feasibility study.

TABLE B-3.5
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 3: IN-SITU TREATMENT OF ORGANIC CONTAMINANTS/EX-SITU TREATMENT OF METAL CONTAMINANTS/ON-SITE DISPOSAL

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

Analysis Factor	Basis for Evaluation	Score	
1. Volume Reduction (If subtotal = 10, go to Factor 3)	Quantity of hazardous waste destroyed or treated	99-100% (8)	8
		90-99% (7)	
		80-90% (6)	
		60-80% (4)	
		40-60% (2)	
		20-40% (1)	
		< 20% (0)	
	Are there untreated or concentrated residual wastes produced as result (If no, go to Factor 2)	Yes (0)	
		No (2)	2
	Disposal of untreated or concentrated wastes:		
	-- Off-site land disposal	Yes (0)	
	-- On-site land disposal	Yes (1)	
	-- Off-site destruction or treatment	Yes (2)	
2. Mobility Reduction	Quantity of waste immobilized after destruction/ treatment	90-100% (2)	
		60-90% (1)	
		< 60% (0)	
	Method of immobilization:		
	-- Containment	Yes (0)	
	-- Alternative treatment	Yes (3)	
	(If not applicable, go to 3)		
3. Irreversibility of Destruction or Treatment or Immobilization of Hazardous Waste	Completely irreversible	Yes (5)	
	Irreversible for most of the hazardous waste constituents	Yes (3)	3
	Irreversible for some of the hazardous waste constituents	Yes (2)	
	Reversible for most of the hazardous waste constituents	Yes (0)	
		TOTAL	**13/15**

TABLE B-3.6
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 3: IN-SITU TREATMENT OF ORGANIC CONTAMINANTS/EX-SITU TREATMENT OF METAL CONTAMINANTS/ON-SITE DISPOSAL

IMPLEMENTABILITY

Analysis Factor	Basis for Evaluation	Score
1. Technical Feasibility	Ability to construct technology:	
	-- Not difficult; No uncertainties	Yes (3)
	-- Somewhat difficult; No uncertainties	Yes (2)
	-- Very difficult; Significant Uncertainties	Yes (1) 1
	Reliability of technology[1]:	
	-- Very reliable in meeting process efficiencies or performance goals	Yes (3)
	-- Somewhat reliable in meeting process efficiencies or performance goals	Yes (2) 2
	Probability of schedule delays:	
	-- Unlikely	Yes (2)
	-- Somewhat likely	Yes (1) 1
	Need for additional remedial action	
	-- None anticipated	Yes (2) 2
	-- Some may be necessarry	Yes (1)
2. Administrative Feasibility	Coordination with other agencies:	
	-- Minimal coordination required	Yes (2)
	-- Normal coordination required	Yes (1)
	-- Extensive coordination required	Yes (0) 0
3. Availability of Services and Materials	Technologies are commercially available for site-specific application	Yes (1) 1
		No (0)
	More than one vendor is available to bid[2]	Yes (1) 1
		No (0)
	Necessary equipment and specialists are available	Yes (1) 1
		No (0)
		TOTAL 9/15

Note:

1. Effectiveness of Fenton's reaction-based in-situ oxidation and solidification/stabilization in treating the COCs will be established by bench-scale testing prior to full-scale implementation at the site.
2. Availability of vendors who provide Fenton's reaction-based in-situ oxidation is limited, and a competitive bid may not be possible for this service. Several vendors are available to provide solidification/stabilization services.

TABLE B-4A.1
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4A: EXCAVATION/OFF-SITE DISPOSAL

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

Analysis Factor	Basis for Evaluation	Score
1. Compliance with Chemical-Specific SCGs	Meets chemical-specific SCGs	Yes (4) 4 No (0) ____
2. Compliance with Action-Specific SCGs	Meets action-specific SCGs	Yes (3) 3 No (0) ____
3. Compliance with Location-Specific SCGs	Meets location-specific SCGs	Yes (3) 3 No (0) ____
		TOTAL 10/10

TABLE B-4A.2
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4A: EXCAVATION/OFF-SITE DISPOSAL

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Analysis Factor	Basis for Evaluation	Score
1. Site Use after Remediation	Unrestricted use of land and water [1] (If yes, go to end of table)	Yes (20) ____ No (0) 0
2. Human Health and Environment Exposure after Remediation	Acceptable exposure to contaminants via air	Yes (3) 3 No (0) ____
	Acceptable exposure to contaminants via groundwater/ surface water [1]	Yes (4) N/A No (0) N/A
	Acceptable exposure to contaminants via sediment/soils	Yes (3) 3 No (0) ____
3. Magnitude of Residual Public Health Risks	Health Risk $\leq 10^{-6}$	Yes (5) 5
	Health Risk $\leq 10^{-5}$	Yes (2) ____
4. Magnitude of Residual Environmental Risks	Less than acceptable	Yes (5) 5
	Slightly greater than acceptable	Yes (3) ____
	Significant remaining risk	Yes (0) ____
		TOTAL 16/20

Note:
1. Remaining saturated overburden and groundwater will be addressed as part of a separate feasibility study. The groundwater-related criteria are considered not applicable (N/A), and, therefore, no alternative can achieve a maximum score of 20 for this criterion.

TABLE B-4A.3
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4A: EXCAVATION/OFF-SITE DISPOSAL

SHORT TERM EFFECTIVENESS

Analysis Factor	Basis for Evaluation	Score
1. Protection of Community during Remedial Actions	Significant short-term risks to the community (If no, go to Factor 2)	Yes (0) 0 No (4)
	Risk easily controlled	Yes (1) 1 No (0)
	Risk mitigation impacts community lifestyle	Yes (0) No (2) 2
2. Environmental Impacts	Significant short-term risks to the environment (If no, go to Factor 3)	Yes (0) 0 No (4)
	Mitigative methods are reliable	Yes (3) 3 No (0)
3. Duration of Remediation	Time required to implement remedy	≤ 2 yrs (1) 1 > 2 yrs (0)
	Required duration of mitigative measures for short-term risk	≤ 2 yrs (1) 1 > 2 yrs (0)
		TOTAL 8/10

TABLE B-4A.4
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4A: EXCAVATION/OFF-SITE DISPOSAL

LONG-TERM EFFECTIVENESS AND PERMANENCE

Analysis Factor	Basis for Evaluation	Score
1. Treatment or Land Disposal	On-site treatment Off-site treatment On-site or off-site land disposal [1]	Yes (3) ___ Yes (1) ___ Yes (0) 0
2. Permanence of Alternative	Remedy is classified as permanent (on-site or off-site destruction or separation/treatment or solidification/ chemical fixation of inorganic waste) (If yes. go to Factor 4)	Yes (3) ___ No (0) 0
3. Duration of Remedy	Expected lifetime or duration of the effectiveness of the remedy	25-30 yrs (3) 3 20-25 yrs (2) ___ 15-20 yrs (1) ___ <15 yrs (0) ___
4. Quantity and Nature of Residuals	Quantity of untreated waste remaining at the site [2]	None (3) 3 ≤ 25 % (2) ___ 25-50% (1) ___ ³ 50% (0) ___
	Treated residuals remain on site (If no, go to Factor 5)	Yes (0) ___ No (2) 2
	Treated residuals are toxic	Yes (0) ___ No (1) ___
	Treated residuals are mobile	Yes (0) ___ No (1) ___
5. Adequacy and Reliability of Controls	i. Duration of operation and maintenance	< 5 yrs (1) 1 > 5 yrs (0) ___
	ii. Environmental control requirement if no go to 5.iv	Yes (0) ___ No (1) 1
	iii. Reliability of environmental controls: -- Moderate to Very Confident -- Somewhat to Not Confident	 Yes (1) ___ Yes (0) ___
	iv. Duration of long-term monitoring	Minimum (2) 2 Moderate (1) ___ Extensive (0) ___
		TOTAL 12/15

Note:

1. Hazardous soil generated as part of this alternative will be treated and disposed of at an off-site hazardous waste disposal facility. However, because the volume of hazardous soil is estimated to be less than 2 percent of the total contaminated soil volume, it was considered secondary to the off-site disposal (without treatment) of non-hazardous soil in this alternative evaluation.
2. Remaining saturated overburden and groundwater contamination will be addressed as part of a separate feasibility study.

TABLE B-4A.5
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4A: EXCAVATION/OFF-SITE DISPOSAL

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

Analysis Factor	Basis for Evaluation	Score	
1. Volume Reduction	Quantity of hazardous waste destroyed or treated	99-100% (8)	
		90-99% (7)	
		80-90% (6)	
		60-80% (4)	
		40-60% (2)	
		20-40% (1)	
		< 20% (0)	0
	Are there untreated or concentrated residual wastes produced as result (If no, go to Factor 2)	Yes (0)	
		No (2)	2
	Disposal of untreated or concentrated wastes:		
	-- Off-site land disposal	Yes (0)	
	-- On-site land disposal	Yes (1)	
	-- Off-site destruction or treatment	Yes (2)	
2. Mobility Reduction	Quantity of waste immobilized after destruction/ treatment	90-100% (2)	2
		60-90% (1)	
		< 60% (0)	
	Method of immobilization:		
	-- Containment	Yes (0)	0
	-- Alternative treatment	Yes (3)	
	(If not applicable, go to 3)		
3. Irreversibility of Destruction or Treatment or Immobilization of Hazardous Waste	Completely irreversible	Yes (5)	
	Irreversible for most of the hazardous waste constituents	Yes (3)	
	Irreversible for some of the hazardous waste constituents	Yes (2)	
	Reversible for most of the hazardous waste constituents	Yes (0)	0
		TOTAL	**4/15**

TABLE B-4A.6
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4A: EXCAVATION/OFF-SITE DISPOSAL

IMPLEMENTABILITY

Analysis Factor	Basis for Evaluation	Score
1. Technical Feasibility	Ability to construct technology:	
	-- Not difficult; No uncertainties	Yes (3)
	-- Somewhat difficult; No uncertainties	Yes (2) 2
	-- Very difficult: Significant Uncertainties	Yes (1)
	Reliability of technology:	
	-- Very reliable in meeting process efficiencies or performance goals	Yes (3) 3
	-- Somewhat reliable in meeting process efficiencies or performance goals	Yes (2)
	Probability of schedule delays:	
	-- Unlikely	Yes (2)
	-- Somewhat likely	Yes (1) 1
	Need for additional remedial action	
	-- None anticipated	Yes (2) 2
	-- Some may be necessarry	Yes (1)
2. Administrative Feasibility	Coordination with other agencies:	
	-- Minimal coordination required	Yes (2)
	-- Normal coordination required	Yes (1) 1
	-- Extensive coordination required	Yes (0)
3. Availability of Services and Materials	Technologies are commercially available for site-specific application	Yes (1) 1
		No (0)
	More than one vendor is available to bid	Yes (1) 1
		No (0)
	Necessary equipment and specialists are available	Yes (1) 1
		No (0)
		TOTAL 12/15

TABLE B-4B.1
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4B: EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

Analysis Factor	Basis for Evaluation	Score
1. Compliance with Chemical-Specific SCGs	Meets chemical-specific SCGs	Yes (4) 4 No (0)
2. Compliance with Action-Specific SCGs	Meets action-specific SCGs	Yes (3) 3 No (0)
3. Compliance with Location-Specific SCGs	Meets location-specific SCGs	Yes (3) 3 No (0)
		TOTAL 10/10

TABLE B-4B.2
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4B: EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Analysis Factor	Basis for Evaluation	Score
1. Site Use after Remediation	Unrestricted use of land and water [1] (If yes, go to end of table)	Yes (20) ____ No (0) 0
2. Human Health and Environment Exposure after Remediation	Acceptable exposure to contaminants via air	Yes (3) 3 No (0) ____
	Acceptable exposure to contaminants via groundwater/ surface water [1]	Yes (4) N/A No (0) N/A
	Acceptable exposure to contaminants via sediment/soils	Yes (3) 3 No (0) ____
3. Magnitude of Residual Public Health Risks	Health Risk $\leq 10^{-6}$	Yes (5) 5
	Health Risk $\leq 10^{-5}$	Yes (2) ____
4. Magnitude of Residual Environmental Risks	Less than acceptable	Yes (5) 5
	Slightly greater than acceptable	Yes (3) ____
	Significant remaining risk	Yes (0) ____
		TOTAL 16/20

Note:
1. Remaining saturated overburden and groundwater will be addressed as part of a separate feasibility study. The groundwater-related criteria are considered not applicable (N/A), and, therefore, no alternative can achieve a maximum score of 20 for this criterion.

TABLE B-4B.3
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4B: EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL

SHORT TERM EFFECTIVENESS

Analysis Factor	Basis for Evaluation	Score
1. Protection of Community during Remedial Actions	Significant short-term risks to the community (If no. go to Factor 2)	Yes (0) 0 No (4)
	Risk easily controlled	Yes (1) 1 No (0)
	Risk mitigation impacts community lifestyle	Yes (0) No (2) 2
2. Environmental Impacts	Significant short-term risks to the environment (If no, go to Factor 3)	Yes (0) 0 No (4)
	Mitigative methods are reliable	Yes (3) 3 No (0)
3. Duration of Remediation	Time required to implement remedy	≤ 2 yrs (1) 1 > 2 yrs (0)
	Required duration of mitigative measures for short-term risk	≤ 2 yrs (1) 1 > 2 yrs (0)
		TOTAL 8/10

TABLE B-4B.4
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4B: EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL

LONG-TERM EFFECTIVENESS AND PERMANENCE

Analysis Factor	Basis for Evaluation	Score
1. Treatment or Land Disposal	On-site treatment	Yes (3) ____
	Off-site treatment	Yes (1) 1
	On-site or off-site land disposal	Yes (0) ____
2. Permanence of Alternative	Remedy is classified as permanent (on-site or off-site destruction or separation/treatment or solidification/ chemical fixation of inorganic waste) (If yes, go to Factor 4)	Yes (3) 3 No (0) ____
3. Duration of Remedy	Expected lifetime or duration of the effectiveness of the remedy	25-30 yrs (3) ____ 20-25 yrs (2) ____ 15-20 yrs (1) ____ <15 yrs (0) ____
4. Quantity and Nature of Residuals	Quantity of untreated waste remaining at the site [1]	None (3) 3 ≤ 25 % (2) ____ 25-50% (1) ____ ≥ 50% (0) ____
	Treated residuals remain on site (If no, go to Factor 5)	Yes (0) ____ No (2) 2
	Treated residuals are toxic	Yes (0) ____ No (1) ____
	Treated residuals are mobile	Yes (0) ____ No (1) ____
5. Adequacy and Reliability of Controls	i. Duration of operation and maintenance	< 5 yrs (1) 1 > 5 yrs (0) ____
	ii. Environmental control requirement if no go to 5.iv	Yes (0) ____ No (1) 1
	iii. Reliability of environmental controls: -- Moderate to Very Confident -- Somewhat to Not Confident	 Yes (1) ____ Yes (0) ____
	iv. Duration of long-term monitoring	Minimum (2) 2 Moderate (1) ____ Extensive (0) ____
		TOTAL **13/15**

Note:
1. Remaining saturated overburden and groundwater contamination will be addressed as part of a separate feasibility study.

TABLE B-4B.5
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4B: EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

Analysis Factor	Basis for Evaluation	Score
1. Volume Reduction (If subtotal = 10, go to Factor 3)	Quantity of hazardous waste destroyed or treated	99-100% (8) 8 90-99% (7) ___ 80-90% (6) ___ 60-80% (4) ___ 40-60% (2) ___ 20-40% (1) ___ < 20% (0) ___
	Are there untreated or concentrated residual wastes produced as result (If no, go to Factor 2)	Yes (0) ___ No (2) 2
	Disposal of untreated or concentrated wastes: -- Off-site land disposal -- On-site land disposal -- Off-site destruction or treatment	 Yes (0) ___ Yes (1) ___ Yes (2) ___
2. Mobility Reduction	Quantity of waste immobilized after destruction/treatment	90-100% (2) ___ 60-90% (1) ___ < 60% (0) ___
	Method of immobilization: -- Containment -- Alternative treatment (If not applicable, go to 3)	 Yes (0) ___ Yes (3) ___
3. Irreversibility of Destruction or Treatment or Immobilization of Hazardous Waste	Completely irreversible	Yes (5) 5
	Irreversible for most of the hazardous waste constituents	Yes (3) ___
	Irreversible for some of the hazardous waste constituents	Yes (2) ___
	Reversible for most of the hazardous waste constituents	Yes (0) ___
		TOTAL 15/15

TABLE B-4B.6
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 4B: EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL

IMPLEMENTABILITY

Analysis Factor	Basis for Evaluation	Score
1. Technical Feasibility	*Ability to construct technology:*	
	-- Not difficult; No uncertainties	Yes (3) ___
	-- Somewhat difficult; No uncertainties	Yes (2) 2
	-- Very difficult; Significant Uncertainties	Yes (1) ___
	Reliability of technology:	
	-- Very reliable in meeting process efficiencies or performance goals	Yes (3) 3
	-- Somewhat reliable in meeting process efficiencies or performance goals	Yes (2) ___
	Probability of schedule delays:	
	-- Unlikely	Yes (2) ___
	-- Somewhat likely	Yes (1) 1
	Need for additional remedial action	
	-- None anticipated	Yes (2) 2
	-- Some may be necessarry	Yes (1) ___
2. Administrative Feasibility	Coordination with other agencies:	
	-- Minimal coordination required	Yes (2) ___
	-- Normal coordination required	Yes (1) 1
	-- Extensive coordination required	Yes (0) ___
3. Availability of Services and Materials	Technologies are commercially available for site-specific application	Yes (1) 1 No (0) ___
	More than one vendor is available to bid	Yes (1) 1 No (0) ___
	Necessary equipment and specialists are available	Yes (1) 1 No (0) ___
		TOTAL 12/15

TABLE B-5A.1
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5A: LIMITED EXCAVATION/OFF-SITE DISPOSAL/ASPHALT CAP

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

Analysis Factor	Basis for Evaluation	Score
1. Compliance with Chemical-Specific SCGs	Meets chemical-specific SCGs [1]	Yes (4) ____ No (0) 0
2. Compliance with Action-Specific SCGs	Meets action-specific SCGs	Yes (3) 3 No (0) ____
3. Compliance with Location-Specific SCGs	Meets location-specific SCGs	Yes (3) 3 No (0) ____
		TOTAL 6/10

Note:
1. The majority of the contaminated unsaturated overburden (approx. 75%) is removed from the site and disposed, and, as such, meets SCGs for the site. However, because approximately 25% of the unsaturated contaminated soil remains, this alternative is not considered to meet chemical-specific SCGs.

TABLE B-5A.2
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5A: LIMITED EXCAVATION/OFF-SITE DISPOSAL/ASPHALT CAP

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Analysis Factor	Basis for Evaluation	Score
1. Site Use after Remediation	Unrestricted use of land and water [(1)] (If yes, go to end of table)	Yes (20) ____ No (0) 0
2. Human Health and Environment Exposure after Remediation	Acceptable exposure to contaminants via air	Yes (3) 3 No (0) ____
	Acceptable exposure to contaminants via groundwater/ surface water [(1)]	Yes (4) N/A No (0) N/A
	Acceptable exposure to contaminants via sediment/soils	Yes (3) 3 No (0) ____
3. Magnitude of Residual Public Health Risks	Health Risk $\leq 10^{-6}$	Yes (5) 5
	Health Risk $\leq 10^{-5}$	Yes (2) ____
4. Magnitude of Residual Environmental Risks	Less than acceptable	Yes (5) ____
	Slightly greater than acceptable	Yes (3) 3
	Significant remaining risk	Yes (0) ____
		TOTAL 14/20

Note:

1. Remaining saturated overburden and groundwater will be addressed as part of a separate feasibility study. The groundwater-related criteria are considered not applicable (N/A), and, therefore, no alternative can achieve a maximum score of 20 for this criterion.

TABLE B-5A.3
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5A: LIMITED EXCAVATION/OFF-SITE DISPOSAL/ASPHALT CAP

SHORT TERM EFFECTIVENESS

Analysis Factor	Basis for Evaluation	Score	
1. Protection of Community during Remedial Actions	Significant short-term risks to the community (If no, go to Factor 2)	Yes (0)	0
		No (4)	
	Risk easily controlled	Yes (1)	1
		No (0)	
	Risk mitigation impacts community lifestyle	Yes (0)	
		No (2)	2
2. Environmental Impacts	Significant short-term risks to the environment (If no, go to Factor 3)	Yes (0)	0
		No (4)	
	Mitigative methods are reliable	Yes (3)	3
		No (0)	
3. Duration of Remediation	Time required to implement remedy	≤ 2 yrs (1)	1
		> 2 yrs (0)	
	Required duration of mitigative measures for short-term risk	≤ 2 yrs (1)	1
		> 2 yrs (0)	
		TOTAL	**8/10**

TABLE B-5A.4
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5A: LIMITED EXCAVATION/OFF-SITE DISPOSAL/ASPHALT CAP

LONG-TERM EFFECTIVENESS AND PERMANENCE

Analysis Factor	Basis for Evaluation	Score
1. Treatment or Land Disposal	On-site treatment	Yes (3) ___
	Off-site treatment	Yes (1) ___
	On-site or off-site land disposal	Yes (0) 0 (1)
2. Permanence of Alternative	Remedy is classified as permanent (on-site or off-site destruction or separation/treatment or solidification/ chemical fixation of inorganic waste) (If yes, go to Factor 4)	Yes (3) ___
		No (0) 0
3. Duration of Remedy	Expected lifetime or duration of the effectiveness of the remedy	25-30 yrs (3) 3
		20-25 yrs (2) ___
		15-20 yrs (1) ___
		<15 yrs (0) ___
4. Quantity and Nature of Residuals	Quantity of untreated waste remaining at the site	None (3) ___
		≤ 25 % (2) 2
		25-50% (1) ___
		^{3} 50% (0) ___
	Treated residuals remain on site (If no, go to Factor 5)	Yes (0) ___
		No (2) 2
	Treated residuals are toxic	Yes (0) ___
		No (1) ___
	Treated residuals are mobile	Yes (0) ___
		No (1) ___
5. Adequacy and Reliability of Controls	i. Duration of operation and maintenance	< 5 yrs (1) ___
		> 5 yrs (0) 0
	ii. Environmental control requirement if no go to 5.iv	Yes (0) 0
		No (1) ___
	iii. Reliability of environmental controls: -- Moderate to Very Confident	Yes (1) 1
	-- Somewhat to Not Confident	Yes (0) ___
	iv. Duration of long-term monitoring	Minimum (2) ___
		Moderate (1) ___
		Extensive (0) 0
		TOTAL 8/15

Note:

1. Hazardous soil generated as part of this alternative will be treated and disposed of at an off-site hazardous waste disposal facility. However, because the volume of hazardous soil is estimated to be less than 2 percent of the total contaminated soil volume, it was considered secondary to the off-site disposal (without treatment) of non-hazardous soil in this alternative evaluation.

TABLE B-5A.5
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5A: LIMITED EXCAVATION/OFF-SITE DISPOSAL/ASPHALT CAP

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

Analysis Factor	Basis for Evaluation	Score
1. Volume Reduction	Quantity of hazardous waste destroyed or treated	99-100% (8) ___ 90-99% (7) ___ 80-90% (6) ___ 60-80% (4) ___ 40-60% (2) ___ 20-40% (1) ___ < 20% (0) 0[1]
	Are there untreated or concentrated residual wastes produced as result (If no, go to Factor 2)	Yes (0) ___ No (2) 2
	Disposal of untreated or concentrated wastes: -- Off-site land disposal -- On-site land disposal -- Off-site destruction or treatment	 Yes (0) ___ Yes (1) ___ Yes (2) ___
2. Mobility Reduction	Quantity of waste immobilized after destruction/ treatment	90-100% (2) 2 60-90% (1) ___ < 60% (0) ___
	Method of immobilization: -- Containment -- Alternative treatment (If not applicable, go to 3)	 Yes (0) 0 Yes (3) ___
3. Irreversibility of Destruction or Treatment or Immobilization of Hazardous Waste	Completely irreversible	Yes (5) ___
	Irreversible for most of the hazardous waste constituents	Yes (3) ___
	Irreversible for some of the hazardous waste constituents	Yes (2) ___
	Reversible for most of the hazardous waste constituents	Yes (0) 0
		TOTAL 4/20

Note:
1. Hazardous soil generated as part of this alternative will be treated and disposed of at an off-site hazardous waste disposal facility. However, because the volume of hazardous soil is estimated to be less than 2 percent of the total contaminated soil volume, it was considered secondary to the off-site disposal (without treatment) of non-hazardous soil in this alternative evaluation.

TABLE B-5A.6
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5A: LIMITED EXCAVATION/OFF-SITE DISPOSAL/ASPHALT CAP

IMPLEMENTABILITY

Analysis Factor	Basis for Evaluation	Score
1. Technical Feasibility	Ability to construct technology:	
	-- Not difficult; No uncertainties	Yes (3)
	-- Somewhat difficult; No uncertainties	Yes (2) 2
	-- Very difficult; Significant Uncertainties	Yes (1)
	Reliability of technology:	
	-- Very reliable in meeting process efficiencies or performance goals	Yes (3) 3
	-- Somewhat reliable in meeting process efficiencies or performance goals	Yes (2)
	Probability of schedule delays:	
	-- Unlikely	Yes (2)
	-- Somewhat likely	Yes (1) 1
	Need for additional remedial action	
	-- None anticipated	Yes (2) 2
	-- Some may be necessarry	Yes (1)
2. Administrative Feasibility	Coordination with other agencies:	
	-- Minimal coordination required	Yes (2)
	-- Normal coordination required	Yes (1) 1
	-- Extensive coordination required	Yes (0)
3. Availability of Services and Materials	Technologies are commercially available for site-specific application	Yes (1) 1
		No (0)
	More than one vendor is available to bid	Yes (1) 1
		No (0)
	Necessary equipment and specialists are available	Yes (1) 1
		No (0)
		TOTAL 12/15

TABLE B-5B.1
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5B: LIMITED EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL/ASPHALT CAP

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS, CRITERIA, AND GUIDELINES

Analysis Factor	Basis for Evaluation	Score
1. Compliance with Chemical-Specific SCGs	Meets chemical-specific SCGs (1)	Yes (4) ____ No (0) 0
2. Compliance with Action-Specific SCGs	Meets action-specific SCGs	Yes (3) 3 No (0) ____
3. Compliance with Location-Specific SCGs	Meets location-specific SCGs	Yes (3) 3 No (0) ____
		TOTAL 6/10

Note:
1. The majority of the contaminated unsaturated overburden (approx. 75%) is removed from the site and treated, and, as such, meets SCGs. However, because approximately 25% of the unsaturated contaminated soil remains, this alternative is not considered to meet chemical-specific SCGs.

TABLE B-5B.2
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5B: LIMITED EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL/ASPHALT CAP

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Analysis Factor	Basis for Evaluation	Score
1. Site Use after Remediation	Unrestricted use of land and water [1] (If yes, go to end of table)	Yes (20) ____ No (0) 0
2. Human Health and Environment Exposure after Remediation	Acceptable exposure to contaminants via air	Yes (3) 3 No (0) ____
	Acceptable exposure to contaminants via groundwater/ surface water [1]	Yes (4) N/A No (0) N/A
	Acceptable exposure to contaminants via sediment/soils	Yes (3) 3 No (0) ____
3. Magnitude of Residual Public Health Risks	Health Risk $\leq 10^{-6}$	Yes (5) 5
	Health Risk $\leq 10^{-5}$	Yes (2) ____
4. Magnitude of Residual Environmental Risks	Less than acceptable	Yes (5) ____
	Slightly greater than acceptable	Yes (3) 3
	Significant remaining risk	Yes (0) ____
		TOTAL 14/20

Note:
1. Remaining saturated overburden and groundwater will be addressed as part of a separate feasibility study. The groundwater-related criteria are considered not applicable (N/A), and, therefore, no alternative can achieve a maximum score of 20 for this criterion.

TABLE B-5B.3
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5B: LIMITED EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL/ASPHALT CAP

SHORT TERM EFFECTIVENESS

Analysis Factor	Basis for Evaluation	Score	
1. Protection of Community during Remedial Actions	Significant short-term risks to the community (If no, go to Factor 2)	Yes (0)	0
		No (4)	
	Risk easily controlled	Yes (1)	1
		No (0)	
	Risk mitigation impacts community lifestyle	Yes (0)	
		No (2)	2
2. Environmental Impacts	Significant short-term risks to the environment (If no, go to Factor 3)	Yes (0)	0
		No (4)	
	Mitigative methods are reliable	Yes (3)	3
		No (0)	
3. Duration of Remediation	Time required to implement remedy	≤ 2 yrs (1)	1
		> 2 yrs (0)	
	Required duration of mitigative measures for short-term risk	≤ 2 yrs (1)	1
		> 2 yrs (0)	
		TOTAL	**8/10**

TABLE B-5B.4
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5B: LIMITED EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL/ASPHALT CAP

LONG-TERM EFFECTIVENESS AND PERMANENCE

Analysis Factor	Basis for Evaluation	Score	
1. Treatment or Land Disposal	On-site treatment	Yes (3)	
	Off-site treatment	Yes (1)	1
	On-site or off-site land disposal	Yes (0)	
2. Permanence of Alternative	Remedy is classified as permanent (on-site or off-site destruction or separation/treatment or solidification/ chemical fixation of inorganic waste) (If yes, go to Factor 4)	Yes (3)	3
		No (0)	
3. Duration of Remedy	Expected lifetime or duration of the effectiveness of the remedy	25-30 yrs (3)	
		20-25 yrs (2)	
		15-20 yrs (1)	
		<15 yrs (0)	
4. Quantity and Nature of Residuals	Quantity of untreated waste remaining at the site	None (3)	
		≤ 25 % (2)	2
		25-50% (1)	
		≥ 50% (0)	
	Treated residuals remain on site (If no, go to Factor 5)	Yes (0)	
		No (2)	2
	Treated residuals are toxic	Yes (0)	
		No (1)	
	Treated residuals are mobile	Yes (0)	
		No (1)	
5. Adequacy and Reliability of Controls	i. Duration of operation and maintenance	< 5 yrs (1)	
		> 5 yrs (0)	0
	ii. Environmental control requirement if no go to 5.iv	Yes (0)	0
		No (1)	
	iii. Reliability of environmental controls:		
	-- Moderate.to Very Confident	Yes (1)	1
	-- Somewhat to Not Confident	Yes (0)	
	iv. Duration of long-term monitoring	Minimum (2)	
		Moderate (1)	
		Extensive (0)	0
		TOTAL	9/15

TABLE B-5B.5
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5B: LIMITED EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL/ASPHALT CAP

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

Analysis Factor	Basis for Evaluation	Score	
1. Volume Reduction (If subtotal = 10, go to Factor 3)	Quantity of hazardous waste destroyed or treated	99-100% (8)	
		90-99% (7)	
		80-90% (6)	
		60-80% (4)	4
		40-60% (2)	
		20-40% (1)	
		< 20% (0)	
	Are there untreated or concentrated residual wastes produced as result (If no, go to Factor 2)	Yes (0)	
		No (2)	2
	Disposal of untreated or concentrated wastes:		
	-- Off-site land disposal	Yes (0)	
	-- On-site land disposal	Yes (1)	
	-- Off-site destruction or treatment	Yes (2)	
2. Mobility Reduction	Quantity of waste immobilized after destruction/ treatment	90-100% (2)	2
		60-90% (1)	
		< 60% (0)	
	Method of immobilization: (1)		
	-- Containment	Yes (0)	
	-- Alternative treatment	Yes (3)	3
	(If not applicable, go to 3)		
3. Irreversibility of Destruction or Treatment or Immobilization of Hazardous Waste	Completely irreversible	Yes (5)	
	Irreversible for most of the hazardous waste constituents (1)	Yes (3)	3
	Irreversible for some of the hazardous waste constituents	Yes (2)	
	Reversible for most of the hazardous waste constituents	Yes (0)	
		TOTAL	**14/20**

Note:
1. The majority of the contaminated unsaturated overburden (approx. 75%) is removed from the site and treated (irreversible) However, approximately 25% of the contaminated unsaturated overburden is capped in place.

TABLE B-5B.6
HEXAGON LABORATORIES RI/FFS
ALTERNATIVE 5B: LIMITED EXCAVATION/OFF-SITE TREATMENT/OFF-SITE DISPOSAL/ASPHALT CAP

IMPLEMENTABILITY

Analysis Factor	Basis for Evaluation	Score
1. Technical Feasibility	Ability to construct technology:	
	-- Not difficult; No uncertainties	Yes (3) ____
	-- Somewhat difficult; No uncertainties	Yes (2) 2
	-- Very difficult; Significant Uncertainties	Yes (1) ____
	Reliability of technology:	
	-- Very reliable in meeting process efficiencies or performance goals	Yes (3) 3
	-- Somewhat reliable in meeting process efficiencies or performance goals	Yes (2) ____
	Probability of schedule delays:	
	-- Unlikely	Yes (2) ____
	-- Somewhat likely	Yes (1) 1
	Need for additional remedial action	
	-- None anticipated	Yes (2) 2
	-- Some may be necessarry	Yes (1) ____
2. Administrative Feasibility	Coordination with other agencies:	
	-- Minimal coordination required	Yes (2) ____
	-- Normal coordination required	Yes (1) 1
	-- Extensive coordination required	Yes (0) ____
3. Availability of Services and Materials	Technologies are commercially available for site-specific application	Yes (1) 1 No (0) ____
	More than one vendor is available to bid	Yes (1) 1 No (0) ____
	Necessary equipment and specialists are available	Yes (1) 1 No (0) ____
		TOTAL 12/15