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Volume I
Corrective Measure Study (CMS)
DYNO Port Ewen Plant
Port Ewen, New York

December 2000

CORRECTIVE MEASURE STUDY (CMS)
DYNO PORT EWEN PLANT
PORT EWEN, NEW YORK
VOLUME I

Prepared for:
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Dyno Nobel, Inc.

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December 2000

19305.001

TABLE OF CONTENTS

Page No.

TABLE OF CONTENTS (CONTINUED)

Page No.

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

1.0 INTRODUCTION

This Corrective Measures Study (CMS) has been prepared for the Dyno Nobel, Inc. (DYNO) Port Ewen, New York Plant pursuant to a letter from the New York State Department of Environmental Conservation (NYSDEC), dated July 11, 2000, and the requirements of the Part 373 Permit. The site location and property boundaries are shown on Figure 1-1.

A RCRA Facility Assessment (RFA) of the DYNO Port Ewen Plant was completed by A.T. Kearny in October 1993 and was revised by ECKENFELDER INC. in August 1994. The RFA identified 46 Solid Waste Management Units (SWMUs) and four Areas of Concern (AOCs). In addition, two additional SWMUs (Nos. 47 and 48) were identified after the RFA was completed. On April 15, 1996, DYNO entered into an Order on Consent with the NYSDEC, which stipulated, among other things, that 25 SWMUs and/or AOCs be the subject of a RCRA Facility Investigation (RFI). Additionally, a RCRA Facility Assessment Sampling Visit (RFA-SV) documented in the Sampling Visit Report (ECKENFELDER INC., February 1997) indicated that 12 additional SWMUs or AOCs required further investigation as part of an RFI and that 14 SWMUs were eliminated from further consideration as they do not contain concentrations of organic or inorganic constituents above the established screening criteria.

In response to the Order on Consent and the results of the RFA-SV, a RCRA Facility Investigation Work Plan (ECKENFELDER INC., April 1997) was submitted to and approved by the NYSDEC for the investigation of 34 SWMUs and four AOCs. The RCRA Facility Investigation Report (Eckenfelder/Brown and Caldwell, December 1999) was submitted in December 1999 and stated, among other things, that areas documented to contain constituent concentrations above the established screening criteria would be evaluated as part of a CMS. DYNO received a letter dated June 14, 2000 from the NYSDEC requesting that a Focused-Corrective Measures Study (F-CMS) be performed for 29 SWMUs and/or AOCs, in which the possibility of excavation and off-site disposal of the 29 SWMUs and/or AOCs would be evaluated.

A meeting was held on July 11, 2000 among representatives of DYNO, Hercules Incorporated (Hercules) and the NYSDEC at which it was agreed that a site-wide CMS would be conducted, rather than a F-CMS, for the SWMUs and AOCs at which constituent concentrations were detected above the established screening criteria. This approach was documented in a letter to DYNO from the NYSDEC, dated July 11, 2000. The letter required that a CMS be performed for the following SWMUs and AOCs:

SWMU No.	SWMU Name
1	Shooting Pond
2	Burning Cage/Incinerator
3	Copper Wire Burning Area
4	Iron Wire Burning Area
5	Wire Burning Area III
6-7	Open Burning Pads
8	Former Burning Area
9	Waste Powder Catch Basins - Building 2037
10	Waste Powder Catch Basins - Building 2048
11	Waste Powder Catch Basins - Building 2049
13	Former Waste Powder Catch Basins – Lead Azide Building
21	Lead Recycling Unit Area
22	Former Landfill
23	Former Dump
24	Former Wastewater Treatment Facility
26D,E & G	Burnable Waste Satellite Accumulation Areas (3 locations)
29	Drainage ditch (Downgrade of Building 2049)
30	Drainage ditch (Downgrade of Building 2036)
32	Old Dump (near water tower)
33	Mercury Fulminate Tanks Area
35	Stone Fence Dump
37	Former Shell Plant Drum Storage Area
39	Former Wastewater Discharge Area – Building 2009
40	Pilot Line Condensate Collection Sump
42	SAC Building Steam Collection Containers
46	Vacuum Line Condensate Collection Sump – Building 2059
47	Building 2058 Fuse Room
48	Mercury Fulminate Area
49	Building 2073 Sump*

AOC	AOC Name
A	Kerosene Tank Leak
B	Open Burning Pads Area
C	Open Detonation Pit
D	Detonation Test Building

* - SWMU No. 49 is currently being investigated and, therefore, is not addressed in this CMS.

The SWMU and AOC locations are shown on Figure 1-2. A description of these SWMUs and AOCs is provided in Appendix A.

This CMS evaluates remediation alternatives for the above list of SWMUs and AOCs. The CMS was completed in accordance with the letter referenced above, as well as Appendix II-C of the Part 373 Permit entitled "Scope of Work for a Corrective Measure Study," and includes:

- A description of the current situation which includes a list grouping the SWMUs and/or AOCs that may be addressed together for the purpose of this CMS due to their similar characteristics (Section 2.1);

- A description of the corrective action objectives and target cleanup levels (Section 2.2);

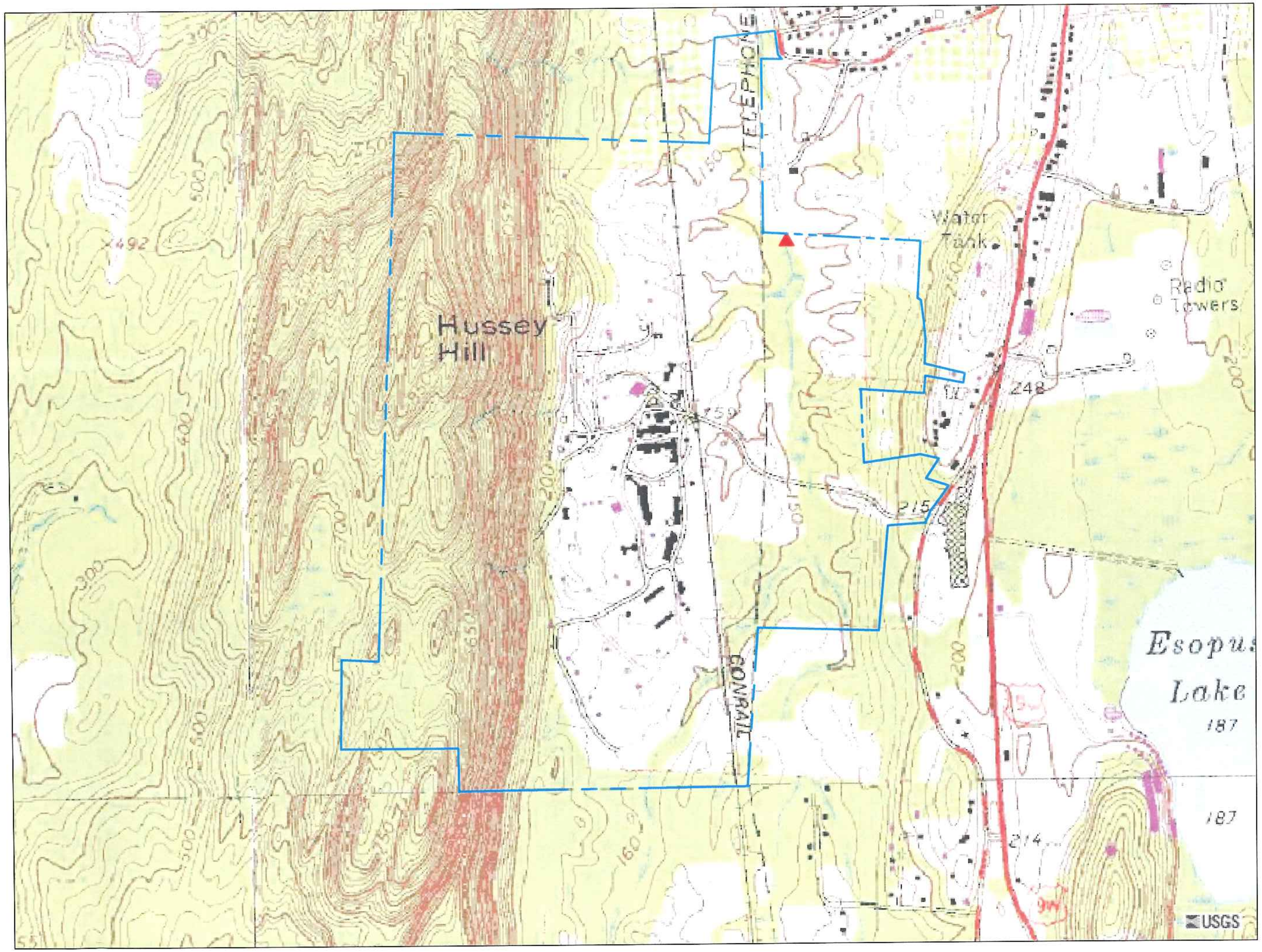
- A screening of technologies and list of technologies retained for further evaluation (Section 2.3);

- A description of the corrective measure alternatives (Section 2.4);

- An evaluation of the corrective measure alternatives with respect to the criteria set out in Appendix II-C of the Part 373 Permit (Section 3.0); and

- Justification and recommendation of the corrective measures for each SWMU and/or AOC grouping (Section 4.0).

Copies of the July 11, 2000 letter and the CMS Scope of work are included in Appendix B.



LEGEND:

APPROXIMATE PROPERTY BOUNDARY

SURFACE WATER SAMPLING LOCATION

NOTE:

SAMPLING LOCATION TO BE ADJUSTED TO REFLECT CORRECT PROPERTY LINE WHICH IS CURRENTLY BEING RESEARCHED.

1000 0 1000 2000

scale feet

MAP SOURCE: USGS

FIGURE 1-1

SITE MAP

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-54 12/18/00 PLOT 1=1 (19305-54.PCP)

2.0 IDENTIFICATION AND DEVELOPMENT OF CORRECTIVE MEASURE ALTERNATIVES (CMS TASK I)

CMS Task I includes a description of the current situation, establishment of corrective action objectives, screening of corrective measure technologies, and identification of the corrective measure alternatives.

2.1 DESCRIPTION OF CURRENT SITUATION

This section includes a description of the site, a brief summary of the RFA and RFI, a summary of the interim corrective measures previously implemented at the site, as well as a grouping of SWMUs and AOCs based on similar characteristics.

2.1.1 Site Location and Description

The DYNO Port Ewen Plant is located approximately one mile south of the Village of Port Ewen in Ulster County, New York. The site location and property boundaries are shown on Figure 1-1. The site is currently active and manufactures explosives, primers, and igniters. The entire property encompasses approximately 350 acres, 100 of which are developed. The site has been actively employed in the manufacture of explosive primers and igniters since 1912 when the facility was built by Brewster Explosives Company. The plant was purchased by Hercules in 1922. Hercules owned and operated the facility until 1985. IRECO, Inc. purchased the facility in June of 1985 and is the current owner and operator. In July of 1993, IRECO changed its name to Dyno Nobel, Inc. Additional details regarding site operations and history may be found in the RFA Report (A.T. Kearney, Inc., October 1993).

2.1.2 Site Investigation Summary

Site investigations have been conducted under two independent programs: the Resource Conservation and Recovery Act (RCRA) and the New York State Superfund Program. The reports generated from these investigations are listed in Table 2-1.

2.1.2.1 **RCRA Facility Assessment Summary.** An RFA, which included a Preliminary Review (PR) of available relevant documents and a Visual Site Inspection (VSI), was conducted by A.T. Kearney Inc., under contract to the U.S. Environmental Protection Agency. The original RFA report, prepared by A.T. Kearney in October 1993 has been revised by ECKENFELDER INC., on behalf of Hercules and DYNO and at the request of NYSDEC, to correct various factual errors.

The RFA Report presented a detailed description of the site history and operation and identified individual SWMUs and/or AOCs which potentially resulted in a release to the environment. These areas were identified through a review of file materials and visual inspections and were evaluated as to their potential to release hazardous waste or constituents to the environment. Based on this evaluation, the RFA Report documented those SWMUs and/or AOCs which either: a) required no further action; b) required confirmatory sampling (i.e., a RCRA Facility Assessment Sampling Visit (RFA-SV); c) required a RCRA Facility Investigation to collect information on a known or suspected release to the environment; or d) required that an Interim Corrective Measure (ICM) be implemented on an expedited basis.

On the basis of the RFA, 17 SWMUs and/or AOCs were targeted for the implementation of Interim Corrective Measures (discussed below) and 19 SWMUs and/or AOCs were targeted for a RFA-SV as documented in the Sampling Visit Report. Of the 19 SWMUs and/or AOCs evaluated under the RFA-SV, ten were determined to require further investigation as part of the RFI.

2.1.2.2 **Groundwater Investigation Summary.** Additional work completed on the basis of the RFA included a site-wide groundwater investigation to obtain a better understanding of the site hydrogeology (including groundwater flow direction, hydraulic conductivity, and vertical and horizontal gradients), estimate the horizontal extent of groundwater impacts in the vicinity of the Shell Plant, recommend the location of monitoring wells associated with the Shell Plant based on data obtained from the investigation, evaluate the potential for off-site migration of constituents that may be associated with the detonation (shooting) pond, and determine groundwater use in the vicinity of the site (including the use and location of private wells, as well as the availability of public water supplies). The results of this investigation are reported in the Groundwater Investigation Report, DYNO Nobel Inc. Site, Port Ewen, New York (ECKENFELDER INC., January 1996).

Data collected and reported in the Groundwater Investigation Report indicate that the active portion of the facility is underlain by 27 to 67 feet of low permeability silty clay and clay, which is subsequently underlain by a layer of sand and gravel over shale bedrock. Groundwater flow paths are predominantly vertical within the low permeability silty clay and clay deposits and primarily horizontal within the higher permeability sand and gravel deposits and upper fractured bedrock.

Water quality data collected from wells located throughout the facility indicate that there is a wide range in metals concentrations as determined from either filtered or unfiltered samples. This is a result of the collection of water samples from the low permeability silty clay and clay deposits and the resulting turbidity of the samples. As discussed in the Groundwater Investigation Report, the unfiltered samples were turbid even though low flow purging techniques were used to collect the samples. This turbidity resulted in metals concentrations that are not representative of surrounding groundwater. As a result, with the exception of mercury and silver, the total (unfiltered) metals concentrations exceed groundwater standards throughout the facility. The filtered samples, however, indicate exceedances only for barium and selenium at a few locations immediately downgradient of individual SWMUs.

The organic analytical data confirm the presence of trichloroethylene (TCE) and its degradation products in the vicinity of the Shell Plant (SWMUs 24, 30, and 37) at concentrations above Maximum Contaminant Levels (MCLs). However, volatile organics were not detected in wells and HydroPunch® samples located downgradient of these SWMUs. Volatile organic compounds were detected at a few locations scattered across the facility. However, the reported values were estimates below both their respective Practical Quantitation Limits (PQLs) and MCLs.

The cumulative data indicate that with the exception of SWMUs 24, 30, and 37 (i.e., the Shell Plant area) there are only minor exceedances of groundwater quality standards for barium and selenium at a few SWMUs. These exceedances are found in wells immediately downgradient of the SWMUs and do not represent a site wide impact. The data also indicate that while MCLs are exceeded adjacent to the Shell Plant, there are not detectable levels of volatile organics downgradient of the SWMU or east of the Conrail tracks.

The collected data demonstrate that the wetland area located to the east of the active portion of the facility is the local discharge point for groundwater flow, both in the shallow and deep overburden deposits. As a result, groundwater that may be impacted from site activities does not migrate east of the wetlands, which represent the headwaters to an unnamed tributary of Plantasie Creek. Migration of volatile organic and inorganic constituents, however, as evidenced by water quality data collected during the Groundwater Investigation and subsequent semi-annual groundwater sampling program (one round completed to date), is significantly limited by the low permeability silty clay and clay deposits. Groundwater data collected during the most recent sampling event (September 2000) and summarized in Tables 2-2 and 2-3, indicate that both volatile organic and inorganic constituents attributable to the SWMUs/AOCs are being attenuated by the low permeability deposits. For example, analytical results for monitoring well clusters MW-21 and MW-22, located downgradient of TCE impacted groundwater associated with the Shell Plant (see Figure 2-1), indicate non-detectable levels of TCE and other volatile organic compounds. Wells located directly downgradient of other SWMUs/AOCs (MW-2B, MW-15S, MW-15D, and MW-16S) continue to indicate elevated concentrations of inorganic constituents. However, the elevated constituent concentrations are localized in the vicinity of the SWMUs/AOCs and there are no exceedances of surface water quality standards in the surface water sample collected from the stream channel exiting the wetlands (SW-000815).

In addition to the above, data collected during the Groundwater Investigation indicate that potential receptors (i.e., properties located downgradient of the facility) are served by public water (Port Ewen Water Supply). The closest residences are approximately 2,700 feet from the facility and are located on the opposite side of the wetlands. As previously stated, groundwater beneath the facility discharges to the wetlands prior to reaching these off-site locations and water quality data collected from the stream channel exiting the wetlands, prior to leaving the site, does not contain constituent concentrations above water quality standards. The groundwater users nearest the facility (i.e., those not served by public water) are located approximately 3,000 feet upgradient and thus, are not subject to potential impacts from the site.

2.1.2.3 RCRA Facility Investigation Summary. The RFI was undertaken to define the horizontal and vertical extent of soils, which exceed the screening criteria for inorganic constituents. Thirty-eight SWMUs and AOCs were investigated in the RFI. The groundwater portion of the RFI was reported separately, as described in Section 2.1.2.2. The NYSDEC approved the RFI Report in a letter to DYNO dated July 11, 2000.

The soils data indicated exceedances of the inorganic screening criteria for soils associated with 28 individual SWMU or AOC locations, three SWMUs within one area with volatile organics in both soils and groundwater, eight areas at which there were no exceedances detected and three areas where no exceedances were detected but the areas contain former waste piles. The collected data further indicated that with some exceptions, metals concentrations exceeding the screening criteria are generally limited to the upper one foot of soil. Metals concentrations below this depth were shown to typically decrease significantly as the metals are attenuated by the silty clay and clay soils. Concentrations above the screening criteria were, however, measured at several locations. Most notably, these include SWMU 1, as well as the former burning areas (SWMUs 2 through 8, AOCs A and B). Concentrations in the center of the former detonation pond (SWMU No. 1) were measured above screening criteria 12 feet below the water surface (maximum depth sampled) while concentrations above screening criteria in the former burning areas were measured to depths of 6 feet below the ground surface.

Soil samples were collected at SWMU Nos. 2, 3, 6, 10, 13, 21, 22, 26D, 33, and 38S and AOC C in April 2000, to assess the leachability of the metals present at elevated concentrations within those SWMUs/AOCs. The samples were subjected to the toxicity characteristic leaching procedure (TCLP) and/or the synthetic precipitation leaching procedure (SPLP) and the extracts were analyzed for selected metals. The results are summarized in Table 2-9 and indicate that, at most locations, the metals exhibit a low degree of leachability. The TCLP results for lead are above the limit for a characteristic hazardous waste at SWMU Nos. 6 and 38S. Barium and selenium also exceeded the limits for a characteristic hazardous waste in one of the samples from SWMU No. 6, and mercury was slightly above the limit in the sample from AOC C. It should be noted that the samples were collected at locations corresponding to the highest total metal concentrations detected within the SWMUs/AOCs.

In summary, the work completed to date indicates the presence of SWMUs and/or AOCs that contain concentrations of inorganic or organic constituents above the established screening criteria (see Table 2-4). However, the collected data indicate that the exceedances of the screening criteria are typically limited to the proximity of the SWMU/AOC locations and there is no evidence to suggest the presence of site wide impacts. Furthermore, the low permeability silty clay and clay deposits underlying the site, coupled with the discharge area represented by the wetlands in the center of the topographic valley, significantly limit the potential for constituent migration beyond the facility boundaries. As also noted in the RFI Report, the screening criteria represent values determined on the basis of very conservative assumptions and do not necessarily indicate that corrective action is required to control risk of human exposure associated with these locations.

2.1.3 Interim Corrective Measures Summary

Interim corrective measures for explosives were undertaken during the period July 24, through October 7, 1996. This work was conducted to address health and safety concerns associated with areas of the facility which may contain explosives at reactive concentrations. A total of 17 SWMUs were screened by UXB International Inc. for primary and secondary explosives. Two locations (SWMU No. 41: Detonator Production Building Condensate Collection Sumps, and SWMU No. 48: Mercury Fulminate Area) were found to contain explosive quantities of both primary and secondary explosives. This material was removed until subsequent sampling indicated that explosive quantities were no longer present. Three locations (SWMU No. 1: Shooting Pond, and SWMU Nos. 38S and 38N: Suspected Grenade Disposal Areas North and South) were found to contain numerous caps and related debris that was collected in five gallon pails for disposal. These activities are documented in the report entitled "Documentation of Interim Corrective Measures (ICM) for Explosives, DYNO Nobel Facility, Port Ewen, New York" (ECKENFELDER INC., January 1997). The objectives of the ICM for explosives were met and the screened areas were deemed safe for further investigation in the RFA-SV and RFI.

The NYSDEC requested, in a letter dated August 21, 2000, that DYNO install a fence around SWMU Nos. 1, 22 and 35. A proposed fence design was submitted to the NYSDEC and approved in a letter dated August 30, 2000. Approximately 4,300 linear feet of chain-link fence was installed around the three SWMUs. The fence consists of 4-foot high galvanized steel chain-link fabric supported by driven posts installed on a nominal 10-foot spacing. A vehicle gate was provided for the access road to SWMU No. 22. Four personnel gates were installed for access to monitoring wells MW-8, MW-10, MW-17S and MW-18S, which were enclosed by the fence. Braces were provided at corners and gates and a tension wire was installed along the top of the fence for stability. Signs reading "Danger, Keep Out" were installed at intervals of no more than 30 feet. Installation was completed on October 13, 2000. A report documenting the fence construction activities (Hercules, Inc., 2000) was submitted to the NYSDEC.

2.1.4 Characteristics of SWMUs and AOCs

The purpose of this section is to group the SWMUs and/or AOCs that have similar characteristics for subsequent evaluation of corrective measure technologies and alternatives. Figure 1-2 depicts the location of each SWMU and AOC. The SWMUs and/or AOCs were grouped together based on information that resulted from the RFA and RFI, such as the maximum depth of soil in which constituents were detected above the screening criteria and the nature of the material deposited within each SWMU and/or AOC. The following groups were established:

- Group I – Heavy Metal Surface Deposition
- Group II – Landfills
- Group III – Shooting Pond
- Group IV – Wetlands

- Group V – Groundwater

In addition, the impacted areas associated with some SWMUs and/or AOCs overlap and these SWMUs/AOCs have been combined for evaluation purposes (e.g., SWMU Nos. 3 and 5).

Table 2-5 lists the SWMUs and AOCs that are categorized under each group listed above.

2.1.4.1 Heavy Metal Surface Deposition (HMSD). The SWMUs and/or AOCs in the HMSD group contain surface soils with concentrations of one or more heavy metals above the screening criteria established in the RFI. Exceedances of the screening criteria are generally limited to the upper 1 foot, but extend to depths ranging from 2 to 8 feet at several SWMUs/AOCs. Within this group of SWMUs and/or AOCs there are different characteristics that need to be taken into account when evaluating corrective measure alternatives. For example, some of the SWMUs and/or AOCs are situated within an active part of the site, whereas others are located in remote areas. Also, some of the SWMUs and/or AOCs are partially or completely covered by asphalt pavement, whereas others are entirely vegetated.

2.1.4.2 Landfills. The SWMUs and/or AOCs in the Landfill group are locations that were previously used for on-site disposal of various wastes as described in Appendix A. These landfills/dumps are no longer active. Because of the potential presence of explosive materials within these SWMUs, investigative activities were restricted to the perimeter and adjacent areas.

2.1.4.3 Shooting Pond. SWMU No. 1, referred to as the shooting pond, is evaluated separately in this CMS. The results of the RFI indicate that the sediments in the pond contain concentrations of metals above the screening criteria to depths of twelve feet or greater. Since SWMU No. 1 was previously used as a shooting pond, undetonated explosives are potentially present within the pond sediments.

2.1.4.4 **Wetlands.** This group consists of the wetlands which surround SWMU No. 1 and SWMU No. 22. For the purpose of this CMS, this area is referred to as SWMU No. 1/22. Much of the wetland area surface soils contain concentrations of metals in excess of the screening criteria.

2.1.4.5 **Groundwater.** The SWMUs and/or AOCs that are included in this group are proximal to groundwater monitoring wells, in which sample results exceed the groundwater protection standards. The low permeability silty clay and clay deposits underlying the site, coupled with the discharge area represented by the wetlands in the center of the topographic valley, significantly limit the potential for constituent migration beyond the facility boundaries. Water quality monitoring data indicate that: 1) groundwater adjacent to the wetlands has only minor exceedances of standards (most related to naturally occurring metals in the overburden deposits) and that surface water exiting the site does not have any exceedances of standards (i.e., the metals are being naturally attenuated); and 2) volatile organic constituents are localized in the vicinity of SWMU No. 37 and are being naturally attenuated.

2.2 CORRECTIVE ACTION OBJECTIVES AND TARGET CLEANUP LEVELS

2.2.1 Objectives

The following objectives have been developed based on the results of the RFA and RFI:

1. Eliminate or control direct contact soil exposures where established direct contact soil criteria are exceeded for current and anticipated future uses.

2. Remediate sediments in the Shooting Pond where established sediment quality criteria are exceeded.

3. Control migration of constituents in groundwater and/or surface water to potential human and environmental receptors.

4. Minimize risk/safety hazard to workers and site personnel during Corrective Measures Implementation (CMI).

This CMS evaluates a range of corrective measure alternatives, and their ability to fulfill the objectives listed above at the DYNO Port Ewen Plant.

2.2.2 Target Cleanup Levels

The target cleanup levels for groundwater are the groundwater quality standards listed in 6 NYCRR 373-2.6. The target cleanup levels for soil are described below. Unrestricted use and industrial use criteria are both considered in this CMS.

2.2.2.1 Unrestricted Use Soil Cleanup Levels. As part of the RFI, the NYSDEC approved the screening criteria for determining whether a CMS was required for each SWMU/AOC. The screening criteria for antimony, arsenic, barium, cadmium, chromium, selenium and silver were obtained from the USEPA Soil Screening Guidance: Technical Background Document (USEPA, 1996) for migration to groundwater based on a dilution-attenuation factor (DAF) of 20. The screening criterion for mercury was obtained from the USEPA Soil Screening Guidance for inhalation of volatiles. The screening criterion for lead was obtained from the Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (USEPA, 1994). Where screening criteria were not available for a specific analyte in these documents, the criteria were obtained from the New Jersey Residential Soil Cleanup Criteria (copper), the NYSDEC TAGM HWR-94-4046 (cobalt) or background sampling results (aluminum and potassium). The screening criteria are listed in Table 2-4. At the July 11, 2000 meeting, the NYSDEC indicated that these screening criteria shall be used as the unrestricted use target cleanup levels (TCLs) in the CMS.[1]

The migration to groundwater criteria are not considered appropriate for the evaluation of corrective measures at this site because the site is underlain by silty clay and clay deposits up

[1] In a conference call held on November 30, 2000, the NYSDEC clarified that unrestricted use TCLs are established by the New York State Department of Health and may not be the same as the screening criteria established in the RFI. The evaluation presented in Section 3.2 of this CMS is based on the RFI screening criteria. However, substitution of alternative unrestricted use criteria would not be expected to materially affect the evaluation or alter the conclusions.

to 67 feet thick and averaging 20 to 30 feet thick beneath the active portions of the plant. Clay minerals and other alumino-silicates provide surfaces on which other sorbents can form and are also significant sorbents in their own right (Environmental Inorganic Chemistry, Pergamon Press, 1988). Therefore, the geology of the site significantly limits the potential for impacts to groundwater. This is supported by the groundwater quality data collected from the site which indicate exceedances of a limited number of standards at groundwater monitoring wells located directly downgradient of individual SWMUs (see Groundwater Investigation Report, Eckenfelder Inc., January 1996 and Semi-Annual Groundwater Monitoring letter report, November 15, 2000). Further, as described in the above reports, groundwater at the site discharges to the wetlands east of the active portions of the facility and surface water samples collected from the stream channel exiting the facility do not exhibit any exceedances of surface water quality standards. Therefore, the individual SWMUs, some of which were present in the early to mid 1900s, are not impacting the site-wide groundwater quality and there is no evidence of elevated concentrations of constituents migrating off site. Further, the facility has been active since 1912 and the practices that lead to the presence of elevated concentrations of various constituents were discontinued at least a decade ago at the SWMUs in question. Therefore, it is anticipated, and continued verification will be obtained through the semi-annual groundwater monitoring program, that the groundwater concentrations are at equilibrium with the surrounding soil concentrations (i.e., further degradation of groundwater is not occurring).

The collected data thus indicate that the primary concern at this site is related to potential direct contact exposures. Impacts to groundwater are not a significant concern because of the site geology and hydrogeology (i.e., clay soils and on-site discharge of groundwater to surface water which is documented not to contain constituents above applicable water quality criteria) and the absence of potential receptors, as was described in Section 2.1.2.2.

2.2.2.2 Industrial Use Soil Cleanup Levels. The site has been used for explosives manufacturing for 88 years and is expected to remain as an industrial facility for the foreseeable future. Therefore, it is appropriate to consider soil cleanup criteria that have been developed based on industrial site use. It is recognized that institutional controls (i.e., deed restriction) are necessary in order to apply industrial use criteria. A notice would be placed in the deed to the property indicating that hazardous constituent concentrations in on-site soils exceed the levels established by the New York State Department of Health for unrestricted use of the property.

Several USEPA regions have developed Risk-Based Criteria (RBCs) for industrial sites. These criteria have been developed in accordance with the USEPA Soil Screening Guidance [USEPA, 1996] and the USEPA Risk Assessment Guidance for Superfund [USEPA, 1999]. Regions III, VI and IX have published soil cleanup levels for industrial use. These criteria were reviewed and the Region IX criteria were selected for use in this CMS because they provide soil cleanup levels for all of the constituents of concern.

The industrial use soil cleanup levels are listed in Table 2-6. Criteria are provided for the constituents that exceeded the unrestricted use TCLs with the exception of potassium. The RBCs developed by the USEPA do not include potassium. Potassium is the seventh most abundant element within the earth's crust and is an essential nutrient for plants and animals. It occurs naturally in clay minerals (alumino-silicates) such as those present at the site, and in its elemental form as a result of leaching from the surface of alumino-silicates (Environmental Inorganic Chemistry, Pergamon Press, 1988). Therefore, potassium was not included in the corrective measure evaluation.

2.3 SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES

Corrective measure technologies were identified and screened for each of the five groups of SWMUs and AOCs described in Section 2.1.4. Potentially applicable corrective measure technologies were identified in the RFI Task II Report (ECKENFELDER INC., August 1996). The technologies identified and described in that document were screened as part of this CMS. Descriptions of the previously identified technologies were included in Appendix A of the RFI Task II Report.

Several supplemental technologies were identified and included in the screening. A brief description of the supplemental technologies follows.

Soil Flushing

This in situ process involves the injection or spraying of the affected area with a washing solution. The constituent is transferred from the soil to the washing solution, which is then collected via an extraction well for treatment prior to reuse or disposal. The effectiveness of soil flushing is highly dependent on the permeability of the soil.

Phytoremediation

Phytoremediation is a broad term for the use and application of plants for treating media (i.e., soil, groundwater, surface water or sediment) with elevated levels of constituents in situ. When the media is soil and the primary constituents of concern are metals, phytoremediation is generally achieved through either phytoextraction or phytostabilization.

The term phytoextraction is used to define processes in which metals within soil are taken up into the root system and translocated into the smaller volumes of above-ground plant organs. In phytoextraction, plant species with metal hyperaccumulating abilities are used to maximize the mass of metals removed. The above-ground biomass is harvested and disposed of in a manner to minimize the volume of waste generated.

Instead of removing the metals from the soil, phytostabilization is used to render the metals less mobile. Phytostabilization immobilizes the metals within the soil through a combination of processes including reaction with soil amendments, adsorption or accumulation in the rhizosphere, and physical stabilization of the soil. As the goal of phytoremediation at the site is to reduce the metals concentrations in the soil to the target cleanup levels, phytoextraction is the process of primary interest.

Phytoextraction is dependent on several factors including agronomic factors (biomass production, adaptation to soil, etc.), depth of constituents exceeding cleanup criteria, phytotoxicity, etc. For example, the applicability of phytoextraction is related to the depth of the plant roots. As such, phytoextraction is not feasible when the depth of constituents exceeding cleanup criteria is greater than 1 to 2 feet. The actual depth depends on the plant species employed and various other factors.

Electrokinetics

This in situ process involves the insertion of electrodes into the subsurface and application of a low density current to the soil. The current mobilizes the constituents and forces the metal ions to migrate towards the electrodes. The constituents are then concentrated at the electrodes. The process can be enhanced by the addition of water and/or chemical solutions. Further treatment is necessary to remove or destroy the constituents.

The previously identified and supplemental technologies were categorized into three groups for screening: Containment, In-Situ Treatment and Removal/Ex-Situ Treatment/Disposal. As indicated in the CMS Scope of Work (see Appendix B) the purpose of the technology screening is to eliminate technologies that may prove infeasible to implement, that are unlikely to perform satisfactorily or reliably, or that do not achieve the corrective measure objectives within a reasonable time period. The technologies were screened on the basis of site characteristics, waste characteristics and technology limitations.

The technology screening is summarized in Table 2-7. Technologies that are dependent upon the transport of fluids (liquids or gases) through the soil were not retained for any of the SWMU/AOC groups because of the low permeability soil (silty clay and clay) which would render these technologies ineffective. Technologies that utilize heat or electricity were eliminated for all SWMU/AOC groups due to the presence of sensitive operations involving explosive materials at the plant and the safety hazard posed by such technologies. Intrusive technologies (including excavation) were not retained for the landfills for the same reason that sampling was not performed within these SWMUs (i.e., potential presence of undetonated explosives). Thus, the only technology retained for the landfills is capping. The technologies that were retained after screening are listed in Table 2-8.

Caps may be comprised of a variety of earthen and/or geosynthetic materials designed to create a barrier to direct contact; control runoff, erosion and/or dust, and/or restrict infiltration into underlying materials. In general, caps are classified as low permeability caps or permeable covers. The type of cap considered most appropriate for this site is a permeable cover. A permeable cover would be utilized as a barrier to direct contact and to control runoff, erosion and dust. A low permeability cap is not considered applicable to the SWMUs/AOCs at this site because migration of constituents in the subsurface is being controlled by the low permeability silty clay and clay deposits.

Monitored Natural Attenuation (MNA) is the only corrective measure technology retained for groundwater. MNA relies on naturally occurring processes to mitigate impacted groundwater and occurs as a result of several mechanisms. There are two primary types of mechanisms: (1) physical mechanisms including advection, dispersion, diffusion, and adsorption that either dilute or retard movement of dissolved phase constituents but do not reduce the mass of constituents, and (2) degradation mechanisms that result in lower dissolved phase organic and/or inorganic concentrations and reduction in migration as a result of reducing the total mass of organic constituents. One or more of these mechanisms occur in all cases. MNA includes a monitoring program to document that these processes are occurring and that the constituents of concern are not reaching potential receptors and/or migrating off site above acceptable concentrations.

MNA was retained as a corrective measure technology because, as noted previously, the site is underlain by silty clay and clay deposits up to 67 feet thick, and averaging 20 to 30 feet thick beneath the active portions of the plant. Further, clay minerals and other aluminosilcates provide surfaces on which other sorbents can form and are also significant sorbents in their own right (Environmental Inorganic Chemistry, Pergamon Press, 1988). Therefore, this site is well suited for MNA. In addition, as discussed in the Groundwater Investigation Report these silty clay and clay deposits possess low hydraulic conductivity and groundwater seepage velocity. The hydrogeology of the site dictates that groundwater flow in these silty clay and clay deposits is predominantly vertical, with discharge to the underlying sand and gravel and then back up through the silty clay and clay deposits to the wetland area located east of the active plant. Vertical seepage velocity calculations presented in the Groundwater Investigation Report for the silty clay and clay deposits indicate average velocities on the order of 0.61 feet/year. Therefore, there is also significant residence time for the mechanisms identified above to reduce constituent concentrations.

As discussed above, the site hydrogeology is conducive to the use of MNA as a corrective measure technology. These same factors, however, significantly limit the effectiveness of other technologies such as groundwater extraction and treatment. For example, the low permeability of the silty clay and clay deposits limits the effective radius and extraction volumes of a groundwater extraction well. Similarly, the injection of air or nutrients into the silty clay and clay deposits would be ineffective due to the low permeability. Techniques that have been developed to enhance permeability (e.g., pneumatic fracturing) would also be ineffective due to the low liquid limit (i.e., softness) of the clay. Therefore, further evaluation of these technologies is not warranted and MNA is the only technology to be carried forward for further consideration.

2.4 IDENTIFICATION OF CORRECTIVE MEASURE ALTERNATIVES

The technologies retained for the heavy metal surface deposition group, the shooting pond and the wetlands form the corrective measure alternatives for further evaluation in Tasks II and III of the CMS. A description of each alternative is provided below. Because only one technology was retained for the landfills (capping) and for groundwater (MNA) those technologies represent the recommended alternative for those SWMU/AOC groups.

2.4.1 No Action

The no action alternative contains no additional measures[2] to address the risks/hazards posed by the SWMUs and AOCs at the site. Thus, the SWMUs and AOCs would remain in their present condition.

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2 Interim Corrective Measures were previously implemented at the site to address explosion hazards at certain SWMUs/AOCs and to restrict access to SWMU Nos. 1, 22 and 35. Refer to Section 2.1.3.

2.4.2 Permeable Cover

The permeable cover alternative may be applicable to the HMSD Group, the Shooting Pond and/or the Wetlands. This alternative would involve constructing a permeable cover over the areas that exceed the applicable cleanup criteria. The permeable cover may consist of soil, asphalt or other suitable materials. In general, a soil cover would be comprised of 6 to 18 inches of subsoil and 6 inches of topsoil over a geotextile. The geotextile would be placed upon the existing ground surface to identify the bottom of the permeable cover. The topsoil would be seeded to establish a vegetative cover. An asphalt cover would consist of a binder or wearing course of asphaltic concrete (typically 3 inches) over a base course of gravel (typically 4 to 6 inches). A permeable cover would require inspection and maintenance to ensure that it continues to function as a barrier restricting direct contact with the underlying soil. For the Shooting Pond, the permeable cover would consist of a geotextile overlain by a crushed stone layer (1 to 2 feet).

2.4.3 Stabilization/Fixation

Stabilization/fixation may be applicable to the HMSD Group and/or the Wetlands. This alternative would consist of rigorously mixing the soil exceeding the applicable screening criteria with Portland Cement or other reagents to stabilize the constituents. The mixing is achieved by using an auger and is performed in-situ, therefore requiring no excavation. The stabilized material would then be covered with top soil and vegetation or asphalt pavement.

Stabilization/fixation can also be done ex situ, which requires that the soil first be excavated. The excavated soil is then mixed in temporary impoundment or using a pug mill. The treated soil would be used as backfill and then covered with top soil and vegetation or asphalt pavement. At this site, there is no significant advantage to using the ex situ process and the in situ process is expected to be more cost-effective.

2.4.4 Phytoremediation

Phytoremediation may be applicable to the HMSD Group and/or the Wetlands. Phytoremediation would consist of planting and harvesting vegetation in order to extract the constituents from the soil. The vegetation used must be able to remediate soil containing heavy metals. An example of such vegetation is Indian Mustard Grass. In-situ phytoremediation would only be considered applicable to a particular SWMU/AOC if the vertical extent of constituents to be remediated is not greater than approximately 24 inches below the ground surface. The process would take a number of years to attain the cleanup levels and would require maintenance (i.e., harvesting plants, replacement plantings).

Where constituents are present at depths greater than 24 inches, it would be necessary to excavate the soil and spread it out in a remote area of the site for phytoremediation to be employed. This approach is generally not cost-effective unless the costs for disposal of the excavated soil or other forms of treatment are unusually high.

2.4.5 Excavation, On-Site Consolidation, and Capping

This alternative may be applicable to the HMSD Group, the Shooting Pond and/or the Wetlands. It would consist of excavating the soil that exceeds the cleanup criteria, hauling the soil to a designated area within the site (e.g., one of the existing landfill areas), grading and compacting the soil within the designated area, and constructing a cap atop the materials. The area that was excavated would be backfilled with clean fill and restored to its original appearance. The cap would be as described in Section 2.4.2. The cap would require inspection and maintenance to ensure that it continues to function as a barrier restricting direct contact with the underlying soil.

TCLP testing would be conducted to determine whether the excavated soil must be managed as a hazardous waste. This alternative would not be applicable to SWMUs/AOCs (or portions thereof) where the soil to be excavated exhibits the Toxicity Characteristic unless a Corrective Action Management Unit (CAMU) was established and technical standards are met.

2.4.6 Excavation and Off-Site Disposal

This alternative may be applicable to the HMSD Group, the Shooting Pond and the Wetlands. It would consist of excavating the soil that exceeds the cleanup criteria and transporting it to an off-site disposal facility, such as a landfill. The area that was excavated would be backfilled with clean fill and would be restored to its original appearance. TCLP testing would be conducted to determine whether the excavated soil must be managed as a hazardous waste. The soil may need to be additionally treated at the disposal facility prior to disposal.

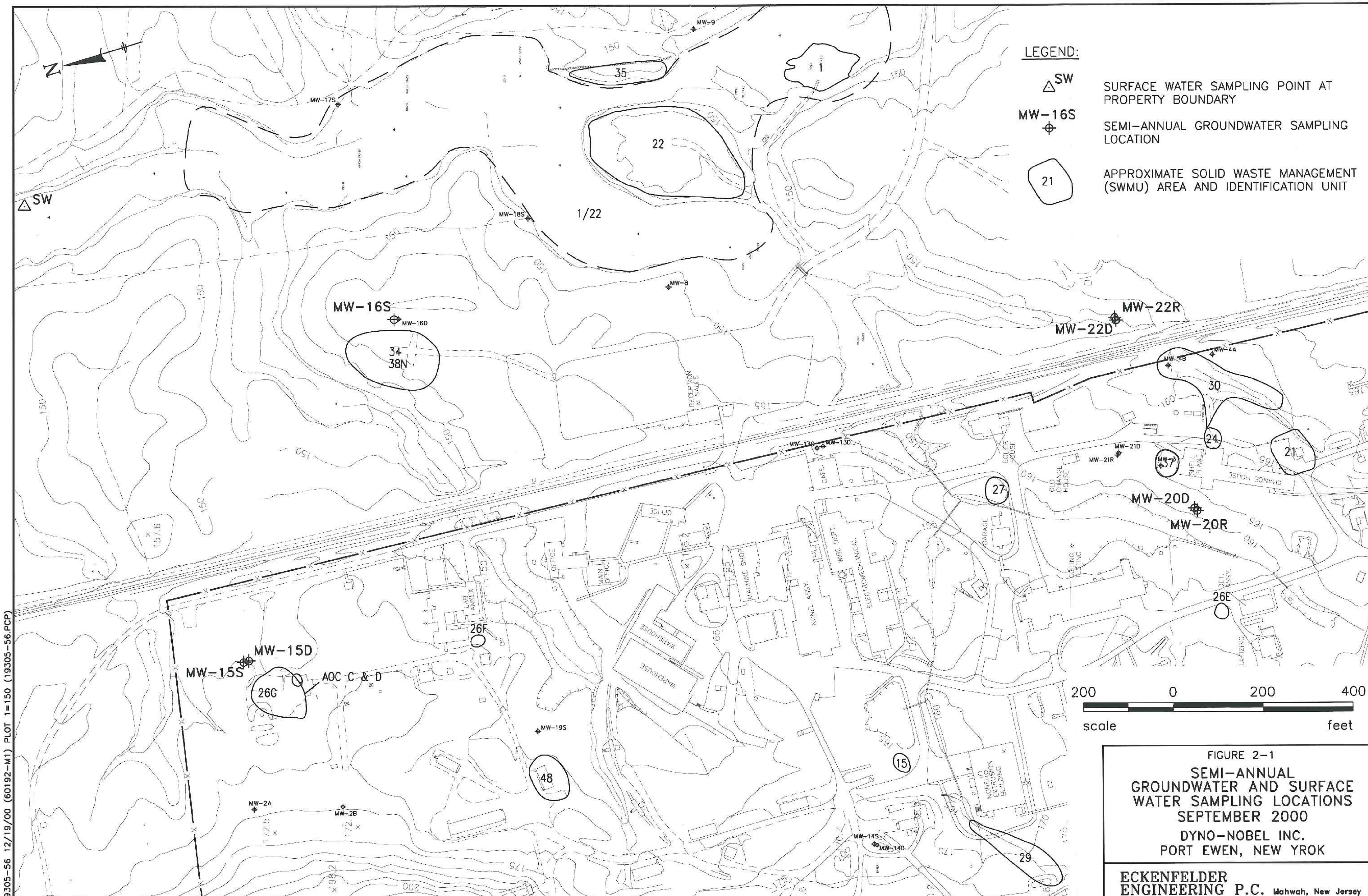


FIGURE 2-1
SEMI-ANNUAL GROUNDWATER AND SURFACE WATER SAMPLING LOCATIONS
SEPTEMBER 2000
DYNO-NOBEL INC.
PORT EWEN, NEW YROK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

TABLE 2-1

SUMMARY OF PREVIOUS INVESTIGATIONS AND REPORTS

Name of Investigation	Investigation/Reports By	Final Report Date
New York State Superfund Program		
Phase I Investigation	EA Science and Technology	December 1983
Phase II Investigation	Gibbs and Hill Inc.	July 1990
USEPA Resource Conservation and Recovery Act		
RCRA Facility Assessment (RFA)[a]	A.T. Kearney Inc. ECKENFELDER INC.	October 1993 August 1994[b]
Groundwater Investigation Report	ECKENFELDER INC.	January 1996
RFI Task II Report	ECKENFELDER INC.	August 1996
Documentation of Interim Corrective Measures	UXB International ECKENFELDER INC.	January 1997
Sampling Visit Report	ECKENFELDER INC.	February 1997
RCRA Facility Investigation (RFI) Report	ECKENFELDER/Brown and Caldwell	December 1999
Fence Construction Report	Hercules Incorporated	October 2000

a Includes a Preliminary Review (PR) and Visual Site Inspection (VSI).
b The A.T. Kearney report was revised and finalized, at the request of NYSDEC, by ECKENFELDER INC., on behalf of Hercules and DYNO.

TABLE 2-2
SEMI-ANNUAL GROUNDWATER SAMPLING RESULTS
VOLATILE ORGANIC CONSTITUENTS
AUGUST 2000

Sample Name	Sample Date	Acetone (µg/L)	Benzene (µg/L)	Bromo-dichloro-methane (µg/L)	Bromo-form (µg/L)	Bromo-methane (µg/L)	2-Butanone (µg/L)	Carbon disulfide (µg/L)	Carbon tetra-chloride (µg/L)	Chloro-benzene (µg/L)	Chloro-ethane (µg/L)	Chloro-form (µg/L)	Chloro-methane (µg/L)	Dibromo-chloro-methane (µg/L)
MW-21D	8/15/00	6 U	1 U	1 U	1 U	2 U	3 U	1 U	1 U	1 U	2 U	1 U	2 U	1 U
MW-21R	8/15/00	18 J	1 U	1 U	1 U	2 U	3 U	1 U	1 U	1 U	2 U	1 U	2 U	1 U
MW-22D	8/15/00	6 U	1 U	1 U	1 U	2 U	3 U	1 U	1 U	1 U	2 U	1 U	2 U	1 U
MW-22D-DUP	8/15/00	6 U	1 U	1 U	1 U	2 U	3 U	1 U	1 U	1 U	2 U	1 U	2 U	1 U
MW-22R	8/15/00	10 J	1 U	1 U	1 U	2 U	3 U	1 U	1 U	1 U	2 U	1 U	2 U	1 U
FB-000815	8/15/00	11 J	1 U	1 U	1 U	2 U	3 U	1 U	1 U	1 U	2 U	1 U	2 U	1 U
TB-000814	8/14/00	10 J	1 U	1 U	1 U	2 U	3 U	1 U	1 U	1 U	2 U	1 U	2 U	1 U

TABLE 2-2
SEMI-ANNUAL GROUNDWATER SAMPLING RESULTS
VOLATILE ORGANIC CONSTITUENTS
AUGUST 2000

Sample Name	Sample Date	1,1-Dichloro-ethane (µg/L)	1,2-Dichloro-ethane (µg/L)	1,1-Dichloro-ethene (µg/L)	cis-1,2-Dichloro-ethene (µg/L)	trans-1,2-Dichloro-ethene (µg/L)	1,2-Dichloro-propane (µg/L)	cis-1,3-Dichloro-propene (µg/L)	trans-1,3-Dichloro-propene (µg/L)	Ethyl-benzene (µg/L)	2-Hexanone (µg/L)	4-Methyl-2-pentanone (µg/L)
MW-21D	8/15/00	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	3 U
MW-21R	8/15/00	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	3 U
MW-22D	8/15/00	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	3 U
MW-22D-DUP	8/15/00	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	3 U
MW-22R	8/15/00	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	3 U
FB-000815	8/15/00	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	3 U
TB-000814	8/14/00	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3 U	3 U

TABLE 2-2
SEMI-ANNUAL GROUNDWATER SAMPLING RESULTS
VOLATILE ORGANIC CONSTITUENTS
AUGUST 2000

Sample Name	Sample Date	Methylene chloride (µg/L)	Styrene (µg/L)	1,1,2,2-Tetrachloro-ethane (µg/L)	Tetra-chloro-ethene (µg/L)	Toluene (µg/L)	1,1,1-Trichloro-ethane (µg/L)	1,1,2-Trichloro-ethane (µg/L)	Trichloro-ethene (µg/L)	Vinyl chloride (µg/L)	Xylene (Total) (µg/L)
MW-21D	8/15/00	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-21R	8/15/00	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-22D	8/15/00	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-22D-DUP	8/15/00	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-22R	8/15/00	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
FB-000815	8/15/00	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TB-000814	8/14/00	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

TABLE 2-3
SEMI-ANNUAL GROUNDWATER SAMPLING RESULTS
INORGANIC CONSTITUENTS
August 2000
(all values in ug/l)

Parameter	Water Quality Standard(a)	MW-2B 8/14/00	MW-15S 8/14/00	MW-15S-DUP 8/14/00	WW-15D 8/14/00	MW-16S 8/15/00	MW-16S-DUP 8/15/00	SW-000815 8/15/00	FB-000815 8/15/00
Aluminum, Soluble		25.6 J	20.5 J	27.8 J	33.1 J	21.4 J	20.9 J	31.6 J	42.5 J
Aluminum, Total		229	625	694	74.9 J	101 J	98.8 J	19 U	19 U
Antimony, Soluble		14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U
Antimony, Total	3	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U
Arsenic, Soluble		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Arsenic, Total	25	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Barium, Soluble		53.7 J	64.5 J	62.3 J	161	78.4 J	76.7 J	41.6 J	1.7 U
Barium, Total	1000	55.1 J	70.7 J	66.3 J	426	152	157	39.7 J	1.7 U
Beryllium, Soluble		1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U
Beryllium, Total		1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U
Cadmium, Soluble		3.6 U	3.6 U	3.6 U	3.6 U	10.5	10	3.6 U	3.6 U
Cadmium, Total	5	3.6 U	3.6 U	3.6 U	3.6 U	41.4	43	3.6 U	3.6 U
Calcium, Soluble		50600	125000	120000	35800	79900	78500	46000	156 J
Calcium, Total		57600	136000	137000	102000	86300	88100	52000	75.7 J
Chromium, Soluble		6.6 U	6.6 U	6.6 U	6.6 U	6.6 U	6.6 U	6.6 U	6.6 U
Chromium, Total	50	43.2	10.4 J	8.1 J	7.8 J	36.1	38.1	6.6 U	6.6 U
Cobalt, Soluble		9.2 J	12.7 J	16.5 J	7.1 U	7.1 U	7.1 U	7.1 U	7.1 U
Cobalt, Total		38.6 J	26.9 J	21.5 J	7.1 U	21.9 J	22.5 J	7.1 U	7.1 U
Copper, Soluble		3 J	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	13.1 J	8.8 J
Copper, Total	200	2.7 U	2.7 U	2.7 U	2.7 U	13.6 J	13.7 J	14.2 J	2.7 U
Iron, Soluble		12.3 J	27.3 J	35.2 J	6.9 J	38.5 J	28.8 J	102	33.4 J
Iron, Total	300	866	1440	1480	275	3150	3360	270	6.7 U
Lead, Soluble		9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U
Lead, Total	25	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U
Magnesium, Soluble		6900	33500	32500	9830	20800	20400	5450	36.7 J
Magnesium, Total		7340	35100	35200	15000	20800	20900	5770	18 U
Manganese, Soluble		6.2 J	18.6	20.1	2.5 U	655	647	53.7	4.2 J
Manganese, Total	300	176	1100	664	18.9	3880	3850	57.7	2.5 U
Mercury, Soluble		0.048 U	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U

TABLE 2-3
SEMI-ANNUAL GROUNDWATER SAMPLING RESULTS
INORGANIC CONSTITUENTS
August 2000
(all values in ug/l)

Parameter	Water Quality Standard(a)	MW-2B 8/14/00	MW-15S 8/14/00	MW-15S-DUP 8/14/00	WW-15D 8/14/00	MW-16S 8/15/00	MW-16S-DUP 8/15/00	SW-000815 8/15/00	FB-000815 8/15/00
Mercury, total	0.7	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U
Nickel, Soluble		8.4 U	8.4 U	8.4 U	8.4 U	11.8 J	9.6 J	8.4 U	8.4 U
Nickel, Total	100	30.9 J	13.1 J	9.4 J	8.4 U	30.8 J	32.2 J	8.4 U	8.4 U
Potassium, Soluble		1620	776	749	3400	979	954	464 J	230 U
Potassium, Total		1400	1400	1380	2740	1360	1330	571	230 U
Selenium, Soluble		226	70.4	62.3	398	3.5 U	3.5 U	3.5 U	3.5 U
Selenium, Total	10	220	61.9	57	374	3.5 U	3.5 U	3.5 U	3.5 U
Silver, Soluble		3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U
Silver, Total	50	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U
Sodium, Soluble		6980	97400	95500	12000	26900	26500	16800	300 U
Sodium, Total	20000	7140	90200	95400	11600	25800	25700	17100	300 U
Thallium, Soluble		9.5 U	9.5 U	9.5 U	9.5 U	9.5 U	9.5 U	9.5 U	9.5 U
Thallium, Total		9.5 U	9.5 U	9.5 U	9.5 U	9.5 U	9.5 U	9.5 U	9.5 U
Vanadium, Soluble		2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U
Vanadium, Total		2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U
Zinc, Soluble		128	74.9	63	8.6 U	144	143	12.4 J	23.8 J
Zinc, Total		84.4	64.9	67.5	8.6 U	302	312	8.6 U	8.6 U

(a) NYSDEC Water Quality Standard, Part 703.5. Blanks indicate no applicable standard.

[Boxed] Value exceeds applicable water quality standard. Soluble concentrations are compared to standards for total concentrations in the absence of a soluble standard.

TABLE 2-4
SOIL SCREENING CRITERIA

Constituent	Screening Criteria (mg/kg)
Aluminum	19,265
Antimony	5
Arsenic	29
Barium	1,600
Cadmium	8
Chromium	38
Cobalt	30
Copper	600
Lead	400
Mercury	10
Potassium	1,900
Selenium	5
Silver	34
Zinc	12,000
TPH	100

TABLE 2-5
SWMU/AOC GROUPINGS

GROUP 1 - HEAVY METAL SURFACE DEPOSITION (HMSD)

SWMU No. 2	SWMU No. 26G
SWMU No. 3	SWMU No. 27
SWMU No. 4	SWMU No. 29
SWMU No. 5	SWMU No. 33
SWMU No. 6	SWMU No. 39
SWMU No. 7	SWMU No. 40
SWMU No. 8	SWMU No. 42
SWMU No. 9	SWMU No. 46
SWMU No. 10	SWMU No. 47
SWMU No. 11	SWMU No. 49
SWMU No. 13	AOC A
SWMU No. 21	AOC B
SWMU No. 26D	AOC C
SWMU No. 26E	AOC D

GROUP 2 - LANDFILL

SWMU No. 22
SWMU No. 23
SWMU No. 32
SWMU No. 35
SWMU No. 48

GROUP 3 - SHOOTING POND

SWMU No. 1

GROUP 4 - WETLANDS

SWMU No. 1/22

GROUP 5 - GROUNDWATER

SWMU No. 24
SWMU No. 30
SWMU No. 37

TABLE 2-6
INDUSTRIAL USE SOIL CLEANUP CRITERIA

Constituent	EPA Region IX Risk Based Industrial Soil Cleanup Criteria (mg/kg)
Aluminum	100,000
Antimony	820
Arsenic	27
Barium	100,000
Cadmium	810
Chromium	100,000
Cobalt	100,000
Copper	76,000
Lead	1,000
Mercury	610
Selenium	10,000
Silver	10,000
Zinc	100,000

T/ 2-7

TECHNOLOGY SCREENING SUMMARY

Corrective Measures Study

Dyno Nobel - Port Ewen, NY

Technology Category	Technology	Potential Applicability					Comments
		Group 1[1]	Group 2[2]	Group 3[3]	Group 4[4]	Group 5[5]	
I. Containment							
	a. Cutoff Walls						Generally used in conjunction with groundwater extraction.
	b. Caps						
	- permeable	X	X	X	X		
	- low permeability						Infiltration control is not an objective.
II. In-Situ Treatment							
	a. Thermal						
	- vitrification						Not recommended due to the potential existence of active explosives.
	- six-phase heating						Not recommended due to the potential existence of active explosives.
	- dynamic underground stripping						Not recommended due to the potential existence of active explosives.
	- steam stripping						Ineffective due to the fine grain, clayey soils and therefore low permeability.
	b. Chemical Treatment						
	c. Stabilization/Fixation						
	- phytostabilization	X					
	- portland cement	X					
	- microencapsulation	X					
	d. Surfactant Flushing						Ineffective due to the fine grain, clayey soils and therefore low permeability.
	e. Soil Vapor Extraction						Ineffective due to the fine grain, clayey soils and therefore low permeability.
	f. Phytoremediation	X		X	X		
	g. Biological Treatment						Ineffective due to the fine grain, clayey soils and therefore low permeability and inorganic constituents.
	h. Passive/Reactive Walls						Ineffective due to the fine grain, clayey soils and therefore low permeability.
	i. Air Sparging						Ineffective due to the fine grain, clayey soils and therefore low permeability.
	j. Natural Attenuation					X	

[1]Heavy Metal Surface Deposition [2] Landfills [3] Shooting Pond [4] Wetlands [5] Groundwater

TA 2-7

TECHNOLOGY SCREENING SUMMARY

Corrective Measures Study

Dyno Nobel - Port Ewen, NY

Technology Category	Technology	Potential Applicability					Comments
		Group 1[1]	Group 2[2]	Group 3[3]	Group 4[4]	Group 5[5]	
III. Removal/Ex-Situ Treatment/Disposal							
	A. Removal						
	a. Excavation	X	X	X	X		
	b. Groundwater Extraction						Ineffective due to the fine grain, clayey soils.
	B. Ex-Situ Treatment						
	a. Stabilization/fixation	X					In-situ application is generally more cost effective.
	b. Phytoremediation	X					In-situ application is generally more cost effective.
	c. Soil washing						Ineffective due to the fine grain, clayey soils.
	d. Biological treatment						Ineffective due to the majority of the constituents consisting of metals.
	c. Chemical Extraction						Ineffective due to the fine grain, clayey soils.
	d. Thermal						
	- steam stripping						Ineffective due to the fine grain, clayey soils.
	- incineration						Not recommended due to the potential existence of active explosives.
	e. Asphalt Incorporation						Ineffective due to the fine grain, clayey soils.
	f. Soil Aeration/Bioventing						Ineffective due to the fine grain, clayey soils and therefore low permeability.
	C. Disposal						
	a. Off-Site Landfill	X	X	X	X		
	b. On-Site Consolidation	X	X	X	X		

[1]Heavy Metal Surface Deposition [2] Landfills [3] Shooting Pond [4] Wetlands [5] Groundwater

TABLE 2-8
Technologies Retained After Screening
Corrective Measures Study
Dyno Nobel - Port Ewen, NY

SWMU/AOC Group	Potentially Applicable Technology
Group 1 - Heavy Metal Surface Deposition (HMSD)	1) Permeable Cover 2) In-Situ Stabilization/Fixation 3) In-Situ Phytoremediation 4) Excavation, On-Site Consolidation & Capping 5) Excavation and Off-Site Disposal
Group 2 - Landfills	1) Permeable Cover
Group 3 - Shooting Pond	1) Permeable Cover 2) Excavation, On-Site Consolidation & Capping 3) Excavation and Off-Site Disposal
Group 4 - Wetlands	1) Permeable Cover 2) In-Situ Phytoremediation 3) Excavation, On-Site Consolidation & Capping 4) Excavation and Off-Site Disposal
Group 5 - Groundwater	1) Monitored Natural Attenuation

TABLE 2-9
TCLP/SPLP RESULTS
Corrective Measures Study
Dyno Nobel - Port Ewen, NY

	Lead			Selenium			Copper			Mercury			Silver			Aluminum		
Sample Number	Total Metal (mg/L)	TCLP (mg/L)	SPLP (mg/L)	Total Metal (mg/L)	TCLP (mg/L)	SPLP (mg/L)	Total Metal (mg/L)	TCLP (mg/L)	SPLP (mg/L)	Total Metal (mg/L)	TCLP (mg/L)	SPLP (mg/L)	Total Metal (mg/L)	TCLP (mg/L)	SPLP (mg/L)	Total Metal (mg/L)	TCLP (mg/L)	SPLP (mg/L)
02-01-1.0	4800*	0.39	0.054	6	---	<0.050												
02-14-1.0	560	0.99	0.46	43	<0.050	<0.050	27000		9.6									
03-10-1.0	2300	<0.050	<0.050	380	<0.050	<0.050	48000		1.1									
06-10-1.0	14000	29	0.36	7900*	3.6	5.6												
06-17-1.0	320	<0.050		50	<0.050	<0.050												
06-20-1.0	4600	110	<0.05	1000	0.41	0.10												
10-06-1.0										600	<0.020	<0.020						
10-20-1.0										5	<0.020							
13-09-1.0	190	<0.050								110	<0.020	<0.020						
21-01-1.0	27000	<0.050	<0.050	1300	<0.050	<0.050												
22-04-1.0	590	0.30	<0.050	31	<0.050	<0.050	33000		1.6	240	<0.020	<0.020				36000		1.3
26D-08-1.0	1800	<0.050	<0.050	140	<0.050	<0.050												
33-08-1.0	35		<0.050							52*	<0.020	<0.020	0.060		<0.010			
33-13-1.0										7400	0.069	0.046						
38S-08-1.0	240	8.6	0.200															
AOC-C-05-1.0	870	<0.050	<0.050	180	0.10	0.10	8800		<0.050	20	0.24	<0.020						

* A duplicate sample exists for this sample depth, therefore the highest of the two is shown here.

TABLE 2-9
TCLP/SPLP RESULTS
Corrective Measures Study
Dyno Nobel - Port Ewen, NY

	Chromium			Potassium			Antimony			Barium			Cadmium		
Sample Number	Total Metal (mg/L)	TCLP (mg/L)	SPLP (mg/L)	Total Metal (mg/L)	TCLP (mg/L)	SPLP (mg/L)	Total Metal (mg/L)	TCLP (mg/L)	SPLP (mg/L)	Total Metal (mg/L)	TCLP (mg/L)	SPLP (mg/L)	Total Metal (mg/L)	TCLP (mg/L)	SPLP (mg/L)
02-01-1.0															
02-14-1.0															
03-10-1.0													710		0.03
06-10-1.0	56		<0.050				9		<0.10	17000	1800	96			
06-17-1.0															
06-20-1.0															
10-06-1.0															
10-20-1.0															
13-09-1.0															
21-01-1.0							97		<0.10	6200	0.62	0.43			
22-04-1.0	46		<0.050	2300		<10									
26D-08-1.0															
33-08-1.0															
33-13-1.0															
38S-08-1.0															
AOC-C-05-1.0															

3.0 EVALUATION OF CORRECTIVE MEASURE ALTERNATIVES (CMS TASK II)

This section presents the evaluation of corrective measure alternatives for the following SWMU/AOC groups:

- Heavy Metal Surface Deposition
- Shooting Pond
- Wetlands

The corrective measure alternatives to be evaluated for the SWMUs and AOCs in these groups were described in Section 2.4. As was described in Section 2.3, an alternatives evaluation is not necessary for the landfills as capping was the only technology retained. Similarly, the only technology retained for groundwater was monitored natural attenuation so an alternatives evaluation is not necessary for groundwater.

3.1 GENERAL

The criteria for the evaluation of corrective measure alternatives are contained in the CMS Scope of Work (Appendix II-C of the Part 373 Permit) and include:

- Technical
- Environmental
- Human Health
- Institutional

The technical factors consider performance, reliability, implementability and safety. Further details on the evaluation criteria are provided in the CMS Scope of Work, which is included in Appendix B.

Cost estimates are provided for each alternative and include the capital and operation and maintenance (O&M) costs associated with implementation of the alternative. Capital costs include direct costs (i.e., costs for construction, equipment, site development, waste disposal, etc.) and indirect costs (i.e., engineering, administrative and legal costs; permitting costs; contingency allowances; etc.). O&M cost components account for operating labor costs, maintenance materials and labor costs, auxiliary materials and energy, disposal of residues, permit fees, and costs for inspections, monitoring and reporting, where applicable. The cost estimates were developed based on vendor estimates, published cost indices, and experience at similar sites. A present worth analysis was performed for alternatives with O&M costs so alternatives could be compared on an equivalent datum. The present worth analysis is based on a period of 30 years or less (depending on the implementation time of the alternative) and a discount rate of 4 percent (before taxes and after inflation).

The evaluation of corrective measures that would achieve the target cleanup levels for unrestricted use is presented in Section 3.2. The associated cost estimates are provided in Appendix D. The evaluation of corrective measures that would achieve the target cleanup levels for industrial use is presented in Section 3.3. The cost estimates for remediation to the industrial use soil cleanup criteria are provided in Appendix F. Cost estimates are also provided for construction and O&M of the permeable covers over the landfills (Appendix G) and for monitored natural attenuation of groundwater (Appendix H). The MNA cost estimate accounts for implementation of the semiannual monitoring program recommended in the RFI Report (which includes wells located along the site perimeter) plus monitoring immediately downgradient of the SWMUs/AOCs as stipulated by the NYSDEC in the conference call held on November 30, 2000.

3.2 CORRECTIVE MEASURES THAT WOULD ACHIEVE TARGET CLEANUP LEVELS FOR UNRESTRICTED USE

As noted in Section 2.2.2.1, the screening levels established in the RFI (see Table 2-4) were considered the target cleanup levels (TCLs) for unrestricted use in this CMS. The RFI established that lead, mercury, selenium and/or a number of other metals are present above these levels in soil or sediment at many of the SWMUs and AOCs investigated. A tabulation of the constituents exceeding the unrestricted use TCLs and their respective concentrations is provided for each SWMU/AOC in Appendix C.

The approximate area of exceedances of the unrestricted use TCLs at each SWMU/AOC is shown on Figures 3-1 through 3-20. These areas were established by drawing a line intersecting the midpoint between the outermost boring in which one or more exceedances were detected and the closest boring at which no exceedances were observed. Where adjacent buildings are known to have existed prior to the release, the area was not extended beyond the edge of the building. The areas shown on Figures 3-1 through 3-20 are approximate and would be refined during corrective measures implementation. The approximate surface area, approximate perimeter and estimated volume of soil and sediment containing exceedances of the unrestricted use TCLs are listed in Table 3-1.

The corrective measure alternatives that were described in Section 2.4 include:

- No Action
- Permeable Cover
- Stabilization/Fixation
- Phytoremediation
- Excavation and On-Site Consolidation
- Excavation and Off-Site Disposal

A permeable cover is an effective engineering control for restricting direct-contact exposures and migration of constituents via runoff, erosion, or dust. However, the constituent concentrations would remain above the TCLs and institutional controls would also be required to inform appropriate parties and prevent disturbance of the cover. The area containing exceedances of the unrestricted use TCLs is approximately 12 acres.

Stabilization/fixation is a treatment technology that could be applied in situ to reduce the mobility of the inorganic constituents. However, it would not reduce the constituent concentrations. Stabilization/fixation could also be applied ex situ and the treated soils redeposited on site. However, this approach likely would be less cost-effective than in-situ treatment and the same limitation would apply (i.e., constituent concentrations would not be reduced).

Phytoremediation is a treatment technology that could be employed in situ where exceedances of the TCLs are restricted to the upper 1 to 2 feet. However, it would not be effective for constituents at depths greater than 1 to 2 feet below ground surface and, where effective, it would require a long period of time (several years or more) to reduce constituent concentrations below the unrestricted use TCLs. As discussed in Section 2.4, phytoremediation generally is not cost-effective in comparison to off-site disposal if it needs to be applied ex situ (i.e., soils need to be excavated and spread out in shallow lifts for subsequent planting). If the estimated volume of soil and sediment with exceedances of the unrestricted use TCLs was excavated and spread in a 1-foot lift, it would occupy approximately 40 acres and would require extensive and repetitive planting and harvesting in efforts to achieve the TCLs.

Excavation and on-site consolidation would remove the soil containing constituents above unrestricted use TCLs from the designated SWMUs/AOCs, but the soil would remain on site (beneath a permeable cover). The constituent concentrations in the excavated/redeposited soil would remain above the TCLs and institutional controls (including deed restrictions) would be required.

The only alternative identified as part of CMS Task I that would be expected to attain the unrestricted use TCLs throughout the site is excavation and off-site disposal. As indicated in Table 3-1, the estimated volume of soil and sediment containing constituents at concentrations above the unrestricted use TCLs is 69,000 cubic yards. This quantity translates to over 5,000 truck trips. Treatment may be required for a portion of the soil/sediment to meet applicable standards for land disposal, based on TCLP testing. Treatment would likely consist of stabilization/fixation, which could be performed at the disposal facility prior to disposal.

As shown in Table 3-1, the estimated cost for excavation and off-site disposal is in the range of \$19 to \$32 million depending on the percentage of soil/sediment requiring disposal as a hazardous waste. The detailed cost estimates for each SWMU/AOC are provided in Appendix D.

Noteworthy is that the above-described remediation quantities and cost estimates do not include the landfills (SWMU Nos. 22, 23, 32, 35 and 48). There is no basis for estimating the quantity of soil/waste that would require excavation to attain the TCLs since, as outlined in the RFI Work Plan and approved by the NYSDEC, sampling was not conducted within the landfills due to the safety hazard posed by explosive materials that may be present. As was discussed in Section 2.3, excavation is not recommended for the landfills for the same reason that sampling was not conducted. Thus, even if excavation and off-site disposal was conducted for the HMSD Group, the Shooting Pond and the Wetlands, the entire site would not be remediated to unrestricted use standards and institutional controls would be required.

In conclusion, site cleanup to unrestricted use TCLs is not feasible due to the large volume of soil and sediment containing exceedances of the TCLs, the depths at which exceedances occur and the limitations imposed by the low permeability soil, sensitive plant operations and potential presence of undetonated explosives at certain SWMUs/AOCs.

The site has been used for explosives manufacturing for 88 years and is expected to remain as an industrial facility for the foreseeable future. Thus, it is appropriate to consider both cleanup criteria developed for industrial site use and alternatives that rely upon engineering and/or institutional controls to satisfy the corrective measure objectives. The remainder of this CMS focuses on remediation to the industrial use soil cleanup criteria identified in Section 2.2.2.2.

3.3 CORRECTIVE MEASURES THAT WOULD ACHIEVE TARGET CLEANUP LEVELS FOR INDUSTRIAL USE

Target cleanup levels (TCLs) for industrial use are listed in Table 2-6 and discussed in Section 2.2.2.2. A tabulation of the constituents exceeding the industrial use TCLs and their respective concentrations is provided for each SWMU/AOC in Appendix E.

The approximate area of exceedances of the industrial use TCLs at each SWMU/AOC is shown on Figures 3-21 through 3-31. These areas were established by drawing a line intersecting the midpoint between the outermost boring in which one or more exceedances were detected and the closest boring at which no exceedances were observed. Where adjacent buildings are known to have existed prior to the release, the area was not extended beyond the edge of the building. The areas shown on Figures 3-21 through 3-31 are approximate and would be refined during corrective measures implementation.

The evaluation of corrective measure alternatives for the Heavy Metal Surface Deposition (HMSD) Group, the Shooting Pond and the Wetlands is presented below.

3.3.1 Heavy Metal Surface Deposition Corrective Measure Alternatives

The alternatives to be evaluated for the HMSD Group include:

- No Action
- Permeable Cover
- Stabilization/Fixation
- Phytoremediation
- Excavation and On-Site Consolidation
- Excavation and Off-Site Disposal

3.3.1.1 HMSD Alternative 1 – No Action.

Technical Evaluation

Performance

The no action alternative is ineffective at eliminating or controlling the risks/hazards currently posed by the constituents present within the HMSD SWMUs/AOCs.

Reliability

There are no reliability issues as this alternative does not involve the application of any technologies.

Implementability

There are no implementability issues to be addressed for this alternative.

Safety

There are no safety issues to be addressed for this alternative.

Environmental Evaluation

Environmental receptors may potentially be exposed to constituents present in the shallow soil within the HMSD SWMUs/AOCs. The no action alternative would not eliminate or control this potential exposure pathway.

Human Health Evaluation

Unauthorized access to the plant site is restricted by fencing and security personnel, which minimizes the potential for trespassers to be exposed to constituents within the HMSD SWMUs/AOCs. Since the SWMUs/AOCs are not currently isolated by physical constraints such as fencing, the potential for exposure to site personnel exists (although it should be noted that activities at the site are restricted due to the sensitive operations). The no action alternative would not eliminate or control this potential exposure pathway.

Institutional Needs

The institutional needs for the no action alternative would include a deed notice plus measures to inform site personnel of the risk/hazard posed by the SWMUs/AOCs (e.g., signs, training) since the industrial use TCLs would continue to be exceeded.

Cost Estimate

The cost of the no action alternative includes the legal and administrative costs associated with the institutional controls. These costs are estimated to be in the range of $25,000 to $50,000.

3.3.1.2 HMSD Alternative 2 – Permeable Cover.

Technical Evaluation

Performance

A permeable cover would meet the objective of eliminating or controlling direct contact soil exposures. There does not exist any site characteristic or waste characteristic at the site that would impede the effectiveness of a permeable cover. With proper maintenance, the useful life of a permeable cover can be considered indefinite. Provided that adequate engineering and/or institutional controls are also implemented to prevent disturbance of the cover (i.e., fencing, signage, and/or training) and proper maintenance is performed to control erosion, a permeable cover provides a high degree of effectiveness for this application.

Reliability

Capping has been successfully employed as a remedial technology at numerous sites for many years. A permeable cover is highly reliable in that there are no operations, maintenance is straightforward and infrequent, and problems are readily identified. For example, the geotextile layer would become visible if significant erosion of the overlying soil had occurred and erosion could be addressed by replacing soil, re-seeding and, if necessary, installing additional materials to stabilize the soil (e.g., erosion control mats).

Implementability

In general, this alternative is not difficult to implement. The materials and services needed to construct a permeable cover are readily available. In addition, the implementation time is relatively fast and the beneficial results are immediate. However, the constructability at a number of the SWMUs/AOCs may prove to be more difficult than others due to their proximity to sensitive operations. Implementation of corrective measures for these SWMUs/AOCs would need to be scheduled during a scheduled plant shutdown or the operations in the vicinity of these SWMUs/AOCs would have to be suspended during the work.

Safety

The risk of an explosion occurring due to intrusive activities within the SWMUs and/or AOCs in the HMSD Group has been previously addressed by the Interim Corrective Measures conducted prior to the RFI. However, since the site continues to be used for explosives manufacturing, safety precautions must be followed. Sensitive operations would need to be shut down during implementation of corrective measures at a SWMU/AOC, in order to reduce the risk of explosion.

If regrading of soils within the SWMUs/AOCs is necessary, the risk of exposure due to inhalation of dust may be increased during the implementation period. Monitoring and dust controls would be used, if necessary, to control potential exposure to dust.

Environmental Evaluation

A permeable cover would create a barrier atop the constituents in the underlying soil, thereby minimizing the potential risk of exposure to environmental receptors. During remedial activities, short-term impacts to terrestrial biota and birds and an increase in noise levels may be expected to occur. However, no endangered or threatened species or sensitive environmental habitats have been identified at the site (see Appendix I). Existing vegetation and trees would be disturbed during construction, where present within the areas to be capped. Vegetation would be reestablished.

Human Health Evaluation

A permeable cover would minimize the potential for direct contact with constituents in the underlying soil. Capping is expected to result in minimal disturbance of existing soil and this alternative can be implemented in a relatively short time frame.

Institutional Needs

The institutional needs for this alternative would include a deed notice plus measures to restrict site personnel from potentially disturbing the permeable covers (e.g., signs, training). Implementing restrictions on worker activities should not pose a problem at this site since workers are accustomed to restrictions due to the nature of the facility.

Cost Estimate

The estimated costs for implementation of the permeable cover alternative at each of the HMSD SWMUs/AOCs are summarized in Table 3-2. The detailed cost estimates are provided in Appendix F.

3.3.1.3 HMSD Alternative 3 – Stabilization/Fixation.

Technical Evaluation

Performance

Stabilization/fixation of soil containing heavy metals has been widely used and is generally effective at reducing the leachability and bioavailability of most metals. However, the effectiveness of stabilization/fixation in controlling potential direct contact exposure to the constituents in the soil at the HMSD SWMUs/AOCs may be diminished by the type of soil present at the site. Soils with high clay content are difficult to mix and may be prone to breakage after the reagents are applied [USEPA, 1997]. In general, the useful life of this technology is uncertain as weathering of the treated material could result in exposure through erosion or fugitive dust.

Reliability

The reliability of stabilization/fixation varies depending on the construction equipment used and other factors such as the amount of water and reagent that is applied. The lack of complete and uniform mixing of the soil and the reagent is the most common problem. Therefore, the choice of mixing equipment and time allowed for mixing are crucial to the implementation of this alternative. Although stabilization/fixation does not require operation or maintenance, monitoring is recommended to assess long-term effectiveness.

Implementability

In-situ stabilization/fixation requires special construction equipment to mix the soil and the reagents. The depths to which treatment would need to be applied within the HMSD SWMUs/AOCs are relatively shallow. Thus, the implementation time would be relatively fast and the beneficial results would be realized immediately after implementation. However, the constructability at a number of the SWMUs/AOCs may prove to be more difficult than others due to their proximity to sensitive operations. Implementation of corrective measures for these SWMUs/AOCs would need to be scheduled during a scheduled plant shutdown or the operations in the vicinity of these SWMUs/AOCs would have to be suspended during the work.

<u>Safety</u>

The risk of an explosion occurring due to intrusive activities within the SWMUs and/or AOCs in the HMSD Group has been previously addressed by the Interim Corrective Measures conducted prior to the RFI. However, since the site continues to be used for explosives manufacturing, safety precautions must be followed. Sensitive operations would need to be shut down during implementation of corrective measures at a SWMU/AOC, in order to reduce the risk of explosion.

Because this alternative would disturb the soils within the SWMUs/AOCs, there is a risk of exposure due to inhalation of dust during the implementation period. Monitoring and dust controls would be used, if necessary, to control potential exposure to dust.

Environmental Evaluation

The stabilization/fixation alternative would minimize the potential risk of exposure to environmental receptors. During remedial activities, short-term impacts to terrestrial biota and birds and an increase in noise levels may be expected to occur. However, no endangered or threatened species or sensitive environmental habitats have been identified at the site (see Appendix I). Existing vegetation and trees would be disturbed during construction, where present within the areas to be treated. Vegetation would be reestablished.

Human Health Evaluation

Stabilization/fixation would minimize the potential for direct contact with constituents in the underlying soil. As noted in the technical evaluation, the performance of this alternative may be diminished by the clay soil and the long-term effectiveness is uncertain. There is a risk of exposure due to inhalation of dust during the implementation of this alternative.

Institutional Needs

The institutional needs for this alternative would include a deed notice. In addition, measures similar to those discussed for the permeable cover alternative (e.g., signs, training) are recommended to restrict site personnel from potentially disturbing the treated soil.

Cost Estimate

The estimated costs for implementation of the stabilization/fixation alternative at each of the HMSD SWMUs/AOCs are summarized in Table 3-3. The detailed cost estimates are provided in Appendix F.

3.3.1.4 HMSD Alternative 4 – Phytoremediation.

Technical Evaluation

Performance

Phytoremediation or more specifically, phytoextraction, can be considered to effectively eliminate or control potential direct contact exposure. Constituents amenable to phytoextraction include cadmium, chromium, cobalt, copper, lead, mercury, manganese, molybdenum, nickel, silver and zinc [USEPA, 2000]. The effectiveness of phytoextraction of metals is related to the ability to extract the constituents from the soil and to accumulate much higher levels of metals in the above ground portion of the plant [CH2Mhill, 1999]. With the use of the appropriate plants for the existing constituents and proper maintenance (i.e., harvesting, watering, and addition of soil amendments) phytoextraction can be a successful remediation alternative for the removal of heavy metals from soil [CH2Mhill, 1999]. Indian mustard is the plant used most often in metals extraction applications because it is a crop plant that responds to cultivation, produces high biomass, and is a metal accumulator [CH2Mhill, 1999].

Phytoextraction is generally limited to the immediate zone of the influence of the roots; thus, root depth determines the depth of phytoextraction. The root zones of most metal accumulators are limited to the top 1 foot of soil [USEPA, 2000]. Thus, the effectiveness of phytoextraction of metals varies depending on the depth of the constituents. Furthermore, the effectiveness of phytoextraction also varies depending on the concentration of the constituents. For example, phytoextraction applications in the field typically address lead concentrations in the range of 1,000 to 5,000 mg/kg. However, some species, including the widely used Indian mustard, have inhibited shoot and root growth at lead concentrations as low as 625 mg/kg [NandaKumar, 1995]. Additionally, levels of zinc as low as 300 mg/kg in soil have been found to be toxic to susceptible plants [Ebbs, 1998]. The useful life of this remediation technology is considered indefinite, if the proper maintenance, such as replanting, is performed.

Reliability

Phytoremediation requires a relatively high degree of maintenance, which is necessary for it to be effective. For example, phytoextraction with Indian mustard has required replanting on the order of approximately three crops in one growing season. In addition, phytoextraction would be less reliable at SWMUs/AOCs that have multiple target constituents, as plant species vary considerably in the metals they can tolerate [CH2Mhill, 1999].

Implementability

The materials needed to implement phytoextraction are readily available. This facilitates the constructability of phytoextraction. Although, the initial implementation time for this alternative is short, the time needed to reach the target cleanup levels is significant. This is because phytoextraction is a slow process that is dependent on many factors (e.g., actual biomass achieved, metal concentrations at the beginning of phytoremediation, etc.). In addition, the constructability of this alternative is not applicable to all SWMUs/AOCs in the HMSD Group. As discussed above, phytoextraction is generally limited to the immediate zone of the influence of the roots. Thus, for phytoextraction to be a candidate alternative, the constituents to be extracted must be within 1 to 2 feet of the ground surface. Also, the area must be in a location that can remain vegetated which excludes the paved portions of the site.

Safety

Safety concerns associated with this alternative include the potential for workers to be exposed to constituents in the soil during planting and harvesting activities. These concerns are typically addressed through the use of appropriate personal protective equipment and monitoring.

Environmental Evaluation

A long period of time is needed in order for the plants to have extracted enough of the constituents from the soil to see a significant reduction in concentration. Environmental receptors may continue to be exposed to constituents in the soil during this time period. Temporary measures such as fencing may be employed to minimize the potential exposure of most environmental receptors.

Human Health Evaluation

This remedial alternative is capable of controlling and/or eliminating potential direct contact exposure. However, the potential for site personnel to be exposed to constituents in the soil would continue to exist during the O&M period until the target cleanup levels are attained. Temporary measures such as fencing may be employed to minimize the potential exposure of most site personnel and protective equipment may be used by workers involved in the harvesting and replanting activities.

Institutional Needs

The institutional needs for this alternative would include a deed notice. In addition, measures similar to those discussed for the permeable cover alternative (e.g., signs, training) are recommended to restrict site personnel from potentially disturbing the soil during the O&M period until target cleanup levels are attained.

Cost Estimate

The estimated costs for implementation of the phytoremediation alternative at each of the HMSD SWMUs/AOCs are summarized in Table 3-4. The detailed cost estimates are provided in Appendix F.

3.3.1.5 HMSD Alternative 5 – Excavation, On-Site Consolidation, and Capping.

Technical Evaluation

Performance

Excavation, on-site consolidation and capping is a highly effective alternative for the control of direct contact exposure. There are no site or waste characteristics that would impede the effectiveness of this alternative, except that soil exhibiting the toxicity characteristic, if any, may need to be segregated and disposed off site. The soil containing constituents at concentrations above the industrial use TCLs would be excavated and consolidated at one or more of the existing landfills prior to construction of the permeable covers. The HMSD SWMUs/AOCs would be remediated such that no restrictions (other than a deed notice preventing residential use of the property) would be necessary. There is no significant long-term incremental risk associated with on-site consolidation of the excavated soils at the landfills. The effectiveness and useful life of permeable covers was described in Section 3.2.2.

Reliability

Excavation is a reliable alternative in that the designated soil is removed from the SWMU/AOC and no O&M is required. The reliability of permeable covers was described in Section 3.2.2. Additional sampling may be performed prior to and/or after excavation to refine the excavation limits and document that the TCLs have been attained.

Implementability

Excavation and on-site consolidation does not require specialized construction equipment and can be implemented in a relatively short timeframe. The depths to which excavation would need to be performed within the HMSD SWMUs/AOCs are relatively shallow. Thus, the implementation time would be relatively fast and the beneficial results would be realized immediately after implementation. However, as noted for the permeable cover and stabilization/fixation alternatives, the constructability at a number of the SWMUs/AOCs may prove to be more difficult than others due to their proximity to sensitive operations. Implementation of corrective measures for these SWMUs/AOCs would need to be scheduled during a scheduled plant shutdown or the operations in the vicinity of these SWMUs/AOCs would have to be suspended during the work.

This alternative does not significantly impact the implementability of the permeable covers at the landfills. The landfill best suited for consolidation of the soil that would be excavated from the HMSD SWMUs/AOCs is SWMU No. 23. That landfill is situated in a topographic depression and consolidation of the excavated soils at that location would not create steep slopes or significantly increase the potential for erosion.

Safety

The risk of an explosion occurring due to intrusive activities within the SWMUs and/or AOCs in the HMSD Group has been previously addressed by the Interim Corrective Measures conducted prior to the RFI. However, since the site continues to be used for explosives manufacturing, safety precautions must be followed. Sensitive operations would need to be shut down during implementation of corrective measures at a SWMU/AOC, in order to reduce the risk of explosion.

Because this alternative would disturb the soils within the SWMUs/AOCs, there is a risk of exposure due to inhalation of dust during the implementation period. Monitoring and dust controls would be used, if necessary, to control potential exposure to dust.

Environmental Evaluation

Excavation, on-site consolidation and capping would eliminate the risk of exposure to environmental receptors at the HMSD SWMUs/AOCs. In addition, there would be no significant incremental risk of exposure at the landfills, which will receive a permeable cover. As noted for the permeable cover and stabilization/fixation alternatives, short-term impacts to terrestrial biota and birds and an increase in noise levels may be expected to occur during the remedial activities. However, no endangered or threatened species or sensitive environmental habitats have been identified at the site (see Appendix I). Existing vegetation and trees would be disturbed during construction, where present within the areas to be excavated. Vegetation would be reestablished.

Human Health Evaluation

This alternative would eliminate the potential for direct contact with constituents in the HMSD SWMUs/AOCs. There is a risk of exposure due to inhalation of dust during the implementation of this alternative.

Institutional Needs

The institutional needs for this alternative include a deed notice preventing residential use of the property. In addition, the landfills will require institutional controls to restrict site personnel from potentially disturbing the permeable covers (e.g., signs, training).

Cost Estimate

The estimated costs for implementation of the excavation, on-site consolidation and capping alternative at each of the HMSD SWMUs/AOCs are summarized in Table 3-5. The cost indicated for SWMU No. 23 represents the incremental cost above the estimated cost for the permeable cover at this landfill without consolidation of excavation soils (refer to Table 3-7). The detailed cost estimates are provided in Appendix F (for the HMSD SWMUs/AOCs) and Appendix G (for the landfills).

3.3.1.6 HMSD Alternative 6 – Excavation and Off-Site Disposal.

Technical Evaluation

Performance

Excavation and off-site disposal is a highly effective alternative for the control of direct contact exposure. There are no site or waste characteristics that would impede the effectiveness of this alternative. The soil containing constituents at concentrations above the industrial use TCLs would be excavated and transported to an off-site disposal facility (i.e., landfill). The HMSD SWMUs/AOCs would be remediated such that no restrictions (other than a deed notice preventing residential use of the property) would be necessary.

Reliability

Excavation is a reliable alternative in that the designated soil is removed from the SWMU/AOC and no O&M is required. Additional sampling may be performed prior to and/or after excavation to refine the excavation limits and document that the TCLs have been attained.

Implementability

Excavation and off-site disposal does not require specialized construction equipment and can be implemented in a relatively short timeframe. The depths to which excavation would need to be performed within the HMSD SWMUs/AOCs are relatively shallow. Thus, the implementation time would be relatively fast and the beneficial results would be realized immediately after implementation. However, as noted for the excavation, on-site consolidation and capping alternative, the constructability at a number of the SWMUs/AOCs may prove to be more difficult than others due to their proximity to sensitive operations. Implementation of corrective measures for these SWMUs/AOCs would need to be scheduled during a scheduled plant shutdown or the operations in the vicinity of these SWMUs/AOCs would have to be suspended during the work.

Off-site facilities are generally available in the Northeast U.S. for disposing of hazardous and non-hazardous remediation wastes (i.e., soil) provided that the volume is not excessive. If necessary, treatment can be provided prior to disposal at the off-site facility. For example, stabilization/fixation may need to be employed to meet land disposal treatment standards for the metals.

Safety

As previously noted, the risk of explosion occurring due to intrusive activities within the SWMUs and/or AOCs in the HMSD Group has been previously addressed by the Interim Corrective Measures conducted prior to the RFI. However, since the site continues to be used for explosives manufacturing, safety precautions must be followed. Sensitive operations would need to be shut down during implementation of corrective measures at a SWMU/AOC, in order to reduce the risk of explosion.

Because this alternative would disturb the soils within the SWMUs/AOCs, there is a risk of exposure due to inhalation of dust during the implementation period. Monitoring and dust controls would be used, if necessary, to control potential exposure to dust.

Environmental Evaluation

Excavation and off-site disposal would eliminate the risk of exposure to environmental receptors at the HMSD SWMUs/AOCs. As noted for the excavation, on-site consolidation and capping alternative, short-term impacts to terrestrial biota and birds and an increase in noise levels may be expected to occur during the remedial activities. However, no endangered or threatened species or sensitive environmental habitats have been identified at the site (see Appendix I). Existing vegetation and trees would be disturbed during construction, where present within the areas to be excavated. Vegetation would be reestablished.

Human Health Evaluation

This alternative would eliminate the potential for direct contact with constituents in the HMSD SWMUs/AOCs. There is a risk of exposure due to inhalation of dust during the implementation of this alternative.

Institutional Needs

The institutional needs for this alternative include a deed notice preventing residential use of the property. No other institutional controls would be necessary as the soil containing constituents above the industrial use TCLs would be removed from the SWMUs/AOCs.

Cost Estimate

The estimated costs for implementation of the excavation and off-site disposal alternative at each of the HMSD SWMUs/AOCs are summarized in Table 3-6. The detailed cost estimates are provided in Appendix F.

3.3.2 Shooting Pond Corrective Measure Alternatives

The alternatives to be evaluated for the Shooting Pond include:

- No Action
- Permeable Cover
- Excavation, On-Site Consolidation, and Capping
- Excavation and Off-Site Disposal

3.3.2.1 Shooting Pond Alternative 1 – No Action.

Technical Evaluation

<u>Performance</u>

The no action alternative is ineffective at eliminating or controlling the risks/hazards currently posed by the constituents present within the Shooting Pond.

<u>Reliability</u>

There are no reliability issues as this alternative does not involve the application of any technologies.

<u>Implementability</u>

There are no implementability issues to be addressed for this alternative.

<u>Safety</u>

There are no safety issues to be addressed for this alternative.

Environmental Evaluation

Environmental receptors may potentially be exposed to constituents present in the sediment within the Shooting Pond. The fence that was constructed around SWMU Nos. 1, 22, and 35 serves to restrict access by some (but not all) animals. The no action alternative does not include any additional measures to minimize potential exposure to environmental receptors or to prevent migration of constituents via surface water.

Human Health Evaluation

Unauthorized access to the Shooting Pond is restricted by fencing and security personnel, which minimizes the potential for site personnel or trespassers to be exposed to constituents within this SWMU. The no action alternative does not include any additional measures to minimize potential direct contact exposure or to prevent migration of constituents via surface water.

Institutional Needs

The institutional needs for the no action alternative would include a deed notice plus measures to inform site personnel of the risk/hazard posed by the Shooting Pond (e.g., signs, training).

Cost Estimate

The cost of the no action alternative includes the legal and administrative costs associated with the institutional controls. These costs are estimated to be in the range of $25,000 to $50,000.

3.3.2.2 Shooting Pond Alternative 2 – Permeable Cover.

Technical Evaluation

Performance

A permeable cover would meet the objective of eliminating or controlling potential direct contact exposures to sediments in the Shooting Pond. There does not exist any site characteristic or waste characteristic that would impede the effectiveness of a permeable cover. The permeable cover for the Shooting Pond would consist of a layer of stone over a geotextile. This type of cap has been constructed at other sites containing soft sediments with low cohesive strength. The useful life of this type of cap can be considered indefinite and no maintenance is required.

Reliability

The permeable cover being considered for the Shooting Pond provides a high degree of reliability in that it does not involve complex operations and it is not dependent upon maintenance to maintain its effectiveness.

Implementability

Implementation of this alternative is relatively straightforward. It is expected that the pond could be temporarily dewatered by blocking or re-routing drainage into it and pumping out the water at a rate faster than the rate of groundwater recharge. Measures to control resuspension and potential transport of sediments would need to be employed during construction. Such measures would include the use of silt fences, hay bales and/or temporary berms. If necessary, the water pumped from the pond could be processed through a high rate sand filter before it is discharged to the stream channel exiting the pond.

3.3.2.2 Shooting Pond Alternative 2 – Permeable Cover.

Technical Evaluation

Performance

A permeable cover would meet the objective of eliminating or controlling potential direct contact exposures to sediments in the Shooting Pond. There does not exist any site characteristic or waste characteristic that would impede the effectiveness of a permeable cover. The permeable cover for the Shooting Pond would consist of a layer of stone over a geotextile. This type of cap has been constructed at other sites containing soft sediments with low cohesive strength. The useful life of this type of cap can be considered indefinite and no maintenance is required.

Reliability

The permeable cover being considered for the Shooting Pond provides a high degree of reliability in that it does not involve complex operations and it is not dependent upon maintenance to maintain its effectiveness.

Implementability

Implementation of this alternative is relatively straightforward. It is expected that the pond could be temporarily dewatered by blocking or re-routing drainage into it and pumping out the water at a rate faster than the rate of groundwater recharge. Measures to control resuspension and potential transport of sediments would need to be employed during construction. Such measures would include the use of silt fences, hay bales and/or temporary berms. If necessary, the water pumped from the pond could be processed through a high rate sand filter before it is discharged to the stream channel exiting the pond.

Safety

The area surrounding the Shooting Pond was addressed during the Interim Corrective Measures conducted prior to the RFI. However, there is a high potential for undetonated explosives to be present in the pond sediments, especially at depth. The permeable cover alternative represents a minimally intrusive approach to remediation of the Shooting Pond and the safety hazard would be minimized in comparison to more intrusive alternatives.

Environmental Evaluation

A permeable cover would create a barrier atop the constituents in the underlying sediments, thereby minimizing the potential risk of exposure to environmental receptors. During remedial activities, short-term impacts to terrestrial biota and birds and an increase in noise levels may be expected to occur. However, no endangered or threatened species or sensitive environmental habitats have been identified at the site (see Appendix I). Existing vegetation and trees in the work area adjacent to the pond would be disturbed during construction. Vegetation would be reestablished.

Human Health Evaluation

A permeable cover would minimize the potential for direct contact with constituents in the underlying sediment and also control potential resuspension of sediments and migration via surface water.

Institutional Needs

The institutional needs for this alternative would include a deed notice. The existing fence and signs would be maintained to restrict site personnel and trespassers from potentially disturbing the permeable cover.

Cost Estimate

The estimated costs for implementation of the permeable cover alternative at the Shooting Pond are summarized in Table 3-2. The detailed cost estimate is provided in Appendix F.

3.3.2.3 Shooting Pond Alternative 3 – Excavation, On-Site Consolidation, and Capping.

Technical Evaluation

Performance

Excavation, on-site consolidation and capping is a highly effective alternative for the control of direct contact exposures to sediments in the Shooting Pond. There are no site or waste characteristics that would impede the effectiveness of this alternative, except that sediments exhibiting the toxicity characteristic, if any, may need to be disposed off site. The sediment containing constituents at concentrations above the industrial use TCLs would be excavated and consolidated at one or more of the existing landfills prior to construction of the permeable covers. The Shooting Pond would be remediated such that no restrictions (other than a deed notice preventing residential use of the property) would be necessary. There is no significant long-term incremental risk associated with on-site consolidation of the excavated sediments at the landfills. The effectiveness and useful life of permeable covers was described in Section 3.2.2.

Reliability

Excavation is a reliable alternative in that the designated sediments are removed from the Shooting Pond and no O&M is required. The reliability of permeable covers was described in Section 3.2.2. Additional sampling may be performed prior to and/or after excavation to refine the excavation limits and document that the TCLs have been attained.

Implementability

Excavation and on-site consolidation does not require specialized construction equipment and can be implemented in a relatively short timeframe. The beneficial results would be realized immediately after implementation. It is expected that the pond could be temporarily dewatered by blocking or re-routing drainage into it and pumping out the water at a rate faster than the rate of groundwater recharge. Measures to control resuspension and potential transport of sediments would need to be employed during construction. Such measures would include the use of silt fences, hay bales and/or temporary berms. If necessary, the water pumped from the pond could be processed through a high rate sand filter before it is discharged to the stream channel exiting the pond.

This alternative does not significantly impact the implementability of the permeable covers at the landfills. The landfill best suited for consolidation of the sediment that would be excavated from the Shooting Pond is SWMU No. 22. That landfill is situated near the Shooting Pond and consolidation of the excavated sediments at that location would not create steep slopes or significantly increase the potential for erosion.

Safety

The area surrounding the Shooting Pond was addressed during the Interim Corrective Measures conducted prior to the RFI. However, there is a high potential for undetonated explosives to be present in the pond sediments, especially at depth. Because this alternative involves excavation to a depth of 12 feet or greater, safety precautions would need to be employed (e.g., special protective equipment, screening of excavated materials for the presence of explosives).

Environmental Evaluation

Excavation, on-site consolidation and capping would eliminate the risk of exposure to environmental receptors at the Shooting Pond. In addition, there would be no significant incremental risk of exposure at the landfills, which will receive a permeable cover. As noted for the permeable cover alternative, short-term impacts to terrestrial biota and birds and an increase in noise levels may be expected to occur during the remedial activities. However, no endangered or threatened species or sensitive environmental habitats have been identified at the site (see Appendix I). Existing vegetation would be disturbed during construction, where present within the areas to be excavated. Vegetation would be reestablished.

Human Health Evaluation

This alternative would eliminate the potential for direct contact with constituents in the sediments of the Shooting Pond.

Institutional Needs

The institutional needs for this alternative include a deed notice preventing residential use of the property. In addition, the landfills will require institutional controls to restrict site personnel from potentially disturbing the permeable covers (e.g., signs, training).

Cost Estimate

The estimated costs for implementation of the excavation, on-site consolidation and capping alternative at the Shooting Pond are summarized in Table 3-5. The cost indicated for SWMU No. 22 represents the incremental cost above the estimated cost for the permeable cover at this landfill without consolidation of excavated sediments (refer to Table 3-7). The detailed cost estimates are provided in Appendix F (for the Shooting Pond) and Appendix G (for the landfills).

3.3.2.4 Shooting Pond Alternative 4 – Excavation and Off-Site Disposal.

Technical Evaluation

Performance

Excavation and off-site disposal is a highly effective alternative for the control of direct contact exposures to sediments in the Shooting Pond. There are no site or waste characteristics that would impede the effectiveness of this alternative. The sediment containing constituents at concentrations above the industrial use TCLs would be excavated and transported to an off-site disposal facility (i.e., landfill). The Shooting Pond would be remediated such that no restrictions (other than a deed notice preventing residential use of the property) would be necessary.

Reliability

Excavation is a reliable alternative in that the designated soil is removed from the Shooting Pond and no O&M is required. Additional sampling may be performed prior to and/or after excavation to refine the excavation limits and document that the TCLs have been attained.

Implementability

Excavation and off-site disposal does not require specialized construction equipment and can be implemented in a relatively short timeframe. The beneficial results would be realized immediately after implementation. It is expected that the pond could be temporarily dewatered by blocking or re-routing drainage into it and pumping out the water at a rate faster than the rate of groundwater recharge. Measures to control resuspension and potential transport of sediments would need to be employed during construction. Such measures would include the use of silt fences, hay bales and/or temporary berms. If necessary, the water pumped from the pond could be processed through a high rate sand filter before it is discharged to the stream channel exiting the pond.

Off-site facilities are generally available in the Northeast U.S. for disposing of hazardous and non-hazardous remediation wastes (i.e., sediments) provided that the volume is not excessive. If necessary, treatment can be provided prior to disposal at the off-site facility. For example, stabilization/fixation may need to be employed to meet land disposal treatment standards for the metals.

Safety

The area surrounding the Shooting Pond was addressed during the Interim Corrective Measures conducted prior to the RFI. However, there is a high potential for undetonated explosives to be present in the pond sediments, especially at depth. Because this alternative involves excavation to a depth of 12 feet or greater, safety precautions would need to be employed (e.g., special protective equipment, screening of excavated materials for the presence of explosives).

Environmental Evaluation

Excavation and off-site disposal would eliminate the risk of exposure to environmental receptors at the Shooting Pond. As noted for the excavation, on-site consolidation and capping alternative, short-term impacts to terrestrial biota and birds and an increase in noise levels may be expected to occur during the remedial activities. However, no endangered or threatened species or sensitive environmental habitats have been identified at the site (see Appendix I). Existing vegetation would be disturbed during construction, where present within the areas to be excavated. Vegetation would be reestablished.

Human Health Evaluation

This alternative would eliminate the potential for direct contact with constituents in the sediments within the Shooting Pond.

Institutional Needs

The institutional needs for this alternative include a deed notice preventing residential use of the property. No other institutional controls would be necessary as the sediments containing constituents above the industrial use TCLs would be removed from the SWMUs/AOCs.

Cost Estimate

The estimated costs for implementation of the excavation and off-site disposal alternative at the Shooting Pond are summarized in Table 3-6. The detailed cost estimates are provided in Appendix F.

3.3.3 Wetlands Corrective Measure Alternatives

The alternatives to be evaluated for the Wetlands include:

- No Action
- Permeable Cover
- Phytoremediation
- Excavation and On-Site Consolidation
- Excavation and Off-Site Disposal

3.3.3.1 Wetlands Alternative 1 – No Action.

Technical Evaluation

<u>Performance</u>

The no action alternative is ineffective at eliminating or controlling the risks/hazards currently posed by the constituents present within the Wetlands.

Reliability

There are no reliability issues as this alternative does not involve the application of any technologies.

Implementability

There are no implementability issues to be addressed for this alternative.

Safety

There are no safety issues to be addressed for this alternative.

Environmental Evaluation

Environmental receptors may potentially be exposed to constituents present in the soil. The fence that was constructed around SWMU Nos. 1, 22, and 35 serves to restrict access by some (but not all) animals. The no action alternative does not include any additional measures to minimize potential exposure to environmental receptors or to prevent migration of constituents via surface water.

Human Health Evaluation

Unauthorized access to the Wetlands area is restricted by fencing and security personnel, which minimizes the potential for site personnel or trespassers to be exposed to constituents within this SWMU. The no action alternative does not include any additional measures to minimize potential direct contact exposure or to prevent migration of constituents via surface water.

Institutional Needs

The institutional needs for the no action alternative would include a deed notice plus measures to inform site personnel of the risk/hazard posed by the Wetlands area (e.g., signs, training) since the industrial use TCLs would continue to be exceeded.

Cost Estimate

The cost of the no action alternative includes the legal and administrative costs associated with the institutional controls. These costs are estimated to be in the range of $25,000 to $50,000.

3.3.3.2 Wetlands Alternative 2 – Permeable Cover.

Technical Evaluation

Performance

A permeable cover would meet the objective of eliminating or controlling direct contact soil exposures. There does not exist any site characteristic or waste characteristic at the site that would impede the effectiveness of a permeable cover. With proper maintenance, the useful life of a permeable cover can be considered indefinite. Provided that adequate engineering and/or institutional controls are also implemented to prevent disturbance of the cover (i.e., fencing, signage, and/or training) and proper maintenance is performed to control erosion, a permeable cover provides a high degree of effectiveness for this application.

Reliability

Capping has been successfully employed as a remedial technology at numerous sites for many years. A permeable cover is highly reliable in that there are no operations, maintenance is straightforward and infrequent, and problems are readily identified. For example, the geotextile layer would become visible if significant erosion of the overlying soil had occurred and erosion could be addressed by replacing soil, re-seeding and, if necessary, installing additional materials to stabilize the soil (e.g., erosion control mats).

Implementability

In general, this alternative is not difficult to implement. The materials and services needed to construct a permeable cover are readily available. In addition, the implementation time is relatively fast and the beneficial results are immediate.

A permit(s) would need to be obtained from the U.S. Army Corps of Engineers and/or the NYSDEC prior to conducting work in the wetlands. This could delay implementation of the corrective measures.

Safety

The risk of an explosion occurring due to intrusive activities within the Wetlands has been previously addressed by the Interim Corrective Measures conducted prior to the RFI..

If regrading of soils within the Wetlands is necessary, the risk of exposure due to inhalation of dust may be increased during the implementation period. Monitoring and dust controls would be used, if necessary, to control potential exposure to dust.

Environmental Evaluation

A permeable cover would create a barrier atop the constituents in the underlying soil, thereby minimizing the potential risk of exposure to environmental receptors. During remedial activities, short-term impacts to terrestrial biota and birds and an increase in noise levels may be expected to occur. However, no endangered or threatened species or sensitive environmental habitats have been identified at the site (see Appendix I). Existing vegetation would be disturbed during construction, where present within the areas to be capped. Wetlands vegetation would be reestablished.

Human Health Evaluation

A permeable cover would minimize the potential for direct contact with constituents in the underlying soil. Capping is expected to result in minimal disturbance of existing soil and this alternative can be implemented in a relatively short time frame.

Institutional Needs

The institutional needs for this alternative would include a deed notice. The existing fence and signs would be maintained to restrict site personnel and trespassers from potentially disturbing the permeable cover.

Cost Estimate

The estimated costs for implementation of the permeable cover alternative at the Wetlands area are summarized in Table 3-2. The detailed cost estimates are provided in Appendix F.

3.3.3.3 Wetlands Alternative 3 – Phytoremediation.

Technical Evaluation

Performance

Phytoremediation or more specifically, phytoextraction, can be considered to effectively eliminate or control potential direct contact exposure. Constituents amenable to phytoextraction include cadmium, chromium, cobalt, copper, lead, mercury, manganese, molybdenum, nickel, silver and zinc [USEPA, 2000]. The effectiveness of phytoextraction of metals is related to the ability to extract the constituents from the soil and to accumulate much higher levels of metals in the above ground portion of the plant [CH2Mhill, 1999]. With the use of the appropriate plants for the existing constituents and proper maintenance (i.e., harvesting, watering, and addition of soil amendments) phytoextraction can be a successful remediation alternative for the removal of heavy metals from soil [CH2Mhill, 1999]. Indian mustard is the plant used most often in metals extraction applications because it is a crop plant that responds to cultivation, produces high biomass, and is a metal accumulator [CH2Mhill, 1999].

Phytoextraction is generally limited to the immediate zone of the influence of the roots; thus, root depth determines the depth of phytoextraction. The root zones of most metal accumulators are limited to the top 1 foot of soil [USEPA, 2000]. Thus, the effectiveness of phytoextraction of metals varies depending on the depth of the constituents. Furthermore, the effectiveness of phytoextraction also varies depending on the concentration of the constituents. For example, phytoextraction applications in the field typically address lead concentrations in the range of 1,000 to 5,000 mg/kg. However, some species, including the widely used Indian mustard, have inhibited shoot and root growth at lead concentrations as low as 625 mg/kg [NandaKumar, 1995]. Additionally, levels of zinc as low as 300 mg/kg in soil have been found to be toxic to susceptible plants [Ebbs, 1998]. The useful life of this remediation technology is considered indefinite, if the proper maintenance, such as replanting, is performed.

Reliability

Phytoremediation requires a relatively high degree of maintenance, which is necessary for it to be effective. For example, phytoextraction with Indian mustard has required replanting on the order of approximately three crops in one growing season. In addition, phytoextraction would be less reliable at SWMUs/AOCs that have multiple target constituents, as plant species vary considerably in the metals they can tolerate [CH2Mhill, 1999].

Implementability

The materials needed to implement phytoextraction are readily available. This facilitates the constructability of phytoextraction. Although, the initial implementation time for this alternative is short, the time needed to reach the target cleanup levels is significant. This is because phytoextraction is a slow process that is dependent on many factors (e.g., actual biomass achieved, metal concentrations at the beginning of phytoremediation, etc.). In addition, the constructability of this alternative is not applicable to sections of the Wetlands area. As discussed above, phytoextraction is generally limited to the immediate zone of the influence of the roots. Thus, for phytoextraction to be a candidate alternative, the constituents to be extracted must be within 1 to 2 feet of the ground surface.

In addition, it is expected that a permit(s) would need to be obtained from the U.S. Army Corps of Engineers and/or the NYSDEC prior to working in the wetlands. This could delay implementation of the corrective measures.

Safety

Safety concerns associated with this alternative include the potential for workers to be exposed to constituents in the soil during planting and harvesting activities. These concerns are typically addressed through the use of appropriate personal protective equipment and monitoring.

Environmental Evaluation

A long period of time is needed in order for the plants to have extracted enough of the constituents from the soil to see a significant reduction in concentration. Environmental receptors may continue to be exposed to constituents in the soil during this time period. The currently existing fence aids to minimize the potential exposure of some environmental receptors.

Human Health Evaluation

This remedial alternative is capable of controlling and/or eliminating potential direct contact exposure. However, the potential for site personnel to be exposed to constituents in the soil would continue to exist during the O&M period until the target cleanup levels are attained.

The currently existing fence aids to minimize the potential exposure of most site personnel and protective equipment may be used by workers involved in the harvesting and replanting activities.

Institutional Needs

The institutional needs for this alternative would include a deed notice. The existing fence and signs would be maintained to restrict site personnel and trespassers from potentially disturbing the permeable cover.

Cost Estimate

The estimated costs for implementation of the phytoremediation alternative at the Wetlands area are summarized in Table 3-4. The detailed cost estimates are provided in Appendix F.

3.3.3.4 Wetlands Alternative 4 – Excavation, On-Site Consolidation and Capping.

Technical Evaluation

<u>Performance</u>

Excavation, on-site consolidation and capping is a highly effective alternative for the control of direct contact exposure. There are no site or waste characteristics that would impede the effectiveness of this alternative, except that soil exhibiting the toxicity characteristic, if any, may need to be segregated and disposed off site. The soil containing constituents at concentrations above the industrial use TCLs would be excavated and consolidated at one or more of the existing landfills prior to construction of the permeable covers. The Wetlands area would be remediated such that no restrictions (other than a deed notice preventing residential use of the property) would be necessary. There is no significant long-term incremental risk associated with on-site consolidation of the excavated soils at the landfills. The effectiveness and useful life of permeable covers was described in Section 3.2.2.

Reliability

Excavation is a reliable alternative in that the designated soil is removed from the Wetlands area and no O&M is required. The reliability of permeable covers was described in Section 3.2.2. Additional sampling may be performed prior to and/or after excavation to refine the excavation limits and document that the TCLs have been attained.

Implementability

Excavation and on-site consolidation does not require specialized construction equipment and can be implemented in a relatively short timeframe. The depths to which excavation would need to be performed within the Wetlands are relatively shallow. Thus, the implementation time would be relatively fast and the beneficial results would be realized immediately after implementation.

A permit(s) would need to be obtained from the U.S. Army Corps of Engineers and/or the NYSDEC prior to conducting work in the wetlands. This could delay implementation of the corrective measures.

This alternative does not significantly impact the implementability of the permeable covers at the landfills. The landfill best suited for consolidation of the soil that would be excavated from the Wetlands area is SWMU No. 22. That landfill is situated adjacent to the Wetlands area and consolidation of the excavated soils at that location would not create steep slopes or significantly increase the potential for erosion.

Safety

The risk of an explosion occurring due to intrusive activities within the Wetlands has been previously addressed by the Interim Corrective Measures conducted prior to the RFI.

Because this alternative would disturb the soils within the Wetlands, there is a risk of exposure due to inhalation of dust during the implementation period. Monitoring and dust controls would be used, if necessary, to control potential exposure to dust.

Environmental Evaluation

Excavation, on-site consolidation and capping would eliminate the risk of exposure to environmental receptors at the Wetlands. In addition, there would be no significant incremental risk of exposure at the landfills, which will receive a permeable cover. As noted for the permeable cover, short-term impacts to terrestrial biota and birds and an increase in noise levels may be expected to occur during the remedial activities. However, no endangered or threatened species or sensitive environmental habitats have been identified at the site (see Appendix I). Existing vegetation would be disturbed during construction, where present within the areas to be excavated. Wetlands would be reestablished.

Human Health Evaluation

This alternative would eliminate the potential for direct contact with constituents in the Wetlands area. There is a risk of exposure due to inhalation of dust during the implementation of this alternative.

Institutional Needs

The institutional needs for this alternative include a deed notice preventing residential use of the property. In addition, the landfills will require institutional controls to restrict site personnel from potentially disturbing the permeable covers (e.g., signs, training).

Cost Estimate

The estimated costs for implementation of the excavation, on-site consolidation and capping alternative at the Wetlands area are summarized in Table 3-5. The cost indicated for SWMU No. 22 represents the incremental cost above the estimated cost for the permeable cover at this landfill without consolidation of excavation soils (refer to Table 3-7). The detailed cost estimates are provided in Appendix F (for the Wetlands) and Appendix G (for the landfills).

3.3.3.5 Wetlands Alternative 5 – Excavation and Off-Site Disposal.

Technical Evaluation

Performance

Excavation and off-site disposal is a highly effective alternative for the control of direct contact exposure. There are no site or waste characteristics that would impede the effectiveness of this alternative. The soil containing constituents at concentrations above the industrial use TCLs would be excavated and transported to an off-site disposal facility (i.e., landfill). The Wetlands would be remediated such that no restrictions (other than a deed notice preventing residential use of the property) would be necessary.

Reliability

Excavation is a reliable alternative in that the designated soil is removed from the Wetlands area and no O&M is required. Additional sampling may be performed prior to and/or after excavation to refine the excavation limits and document that the TCLs have been attained.

Implementability

Excavation and off-site disposal does not require specialized construction equipment and can be implemented in a relatively short timeframe. The depths to which excavation would need to be performed within the Wetlands are relatively shallow. Thus, the implementation time would be relatively fast and the beneficial results would be realized immediately after implementation.

A permit(s) would need to be obtained from the U.S. Army Corps of Engineers and/or the NYSDEC prior to working in the wetlands. This could delay implementation of the corrective measures.

Off-site facilities are generally available in the Northeast U.S. for disposing of hazardous and non-hazardous remediation wastes (i.e., soil) provided that the volume is not excessive. If necessary, treatment can be provided prior to disposal at the off-site facility. For example, stabilization/fixation may need to be employed to meet land disposal treatment standards for the metals.

Safety

As previously noted, the risk of explosion occurring due to intrusive activities within the Wetlands has been previously addressed by the Interim Corrective Measures conducted prior to the RFI.

Because this alternative would disturb the soils within the SWMUs/AOCs, there is a risk of exposure due to inhalation of dust during the implementation period. Monitoring and dust controls would be used, if necessary, to control potential exposure to dust.

Environmental Evaluation

Excavation and off-site disposal would eliminate the risk of exposure to environmental receptors at the Wetlands area. As noted for the excavation, on-site consolidation and capping alternative, short-term impacts to terrestrial biota and birds and an increase in noise levels may be expected to occur during the remedial activities. However, no endangered or threatened species or sensitive environmental habitats have been identified at the site (see Appendix I). Existing vegetation and trees would be disturbed during construction, where present within the areas to be excavated. Vegetation would be reestablished.

Human Health Evaluation

This alternative would eliminate the potential for direct contact with constituents in the Wetlands area. There is a risk of exposure due to inhalation of dust during the implementation of this alternative.

Institutional Needs

The institutional needs for this alternative include a deed notice preventing residential use of the property. No other institutional controls would be necessary as the soil containing constituents above the industrial use TCLs would be removed from the SWMUs/AOCs.

Cost Estimate

The estimated costs for implementation of the excavation and off-site disposal alternative at each of the Wetlands are summarized in Table 3-6. The detailed cost estimates are provided in Appendix F.

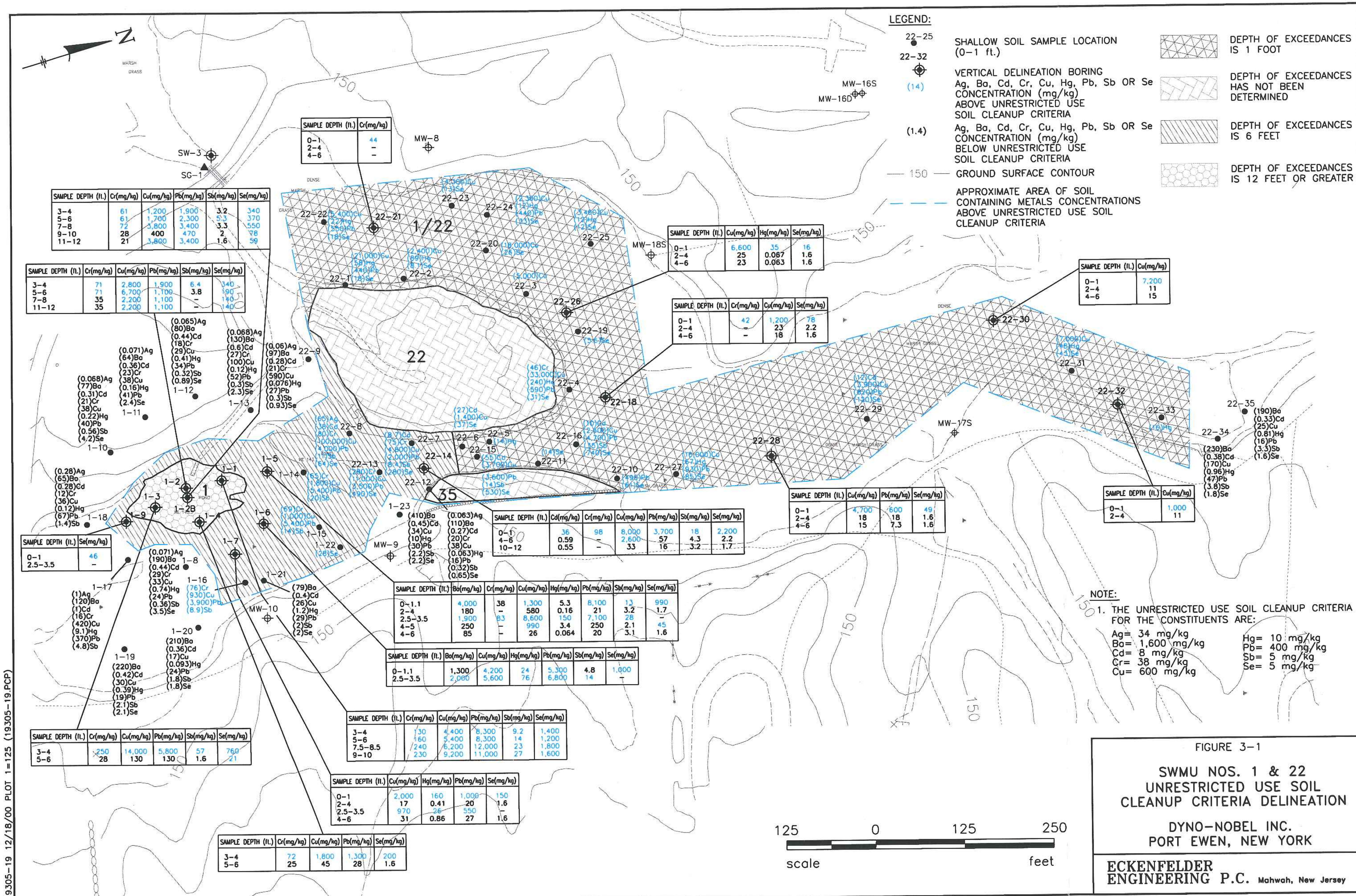
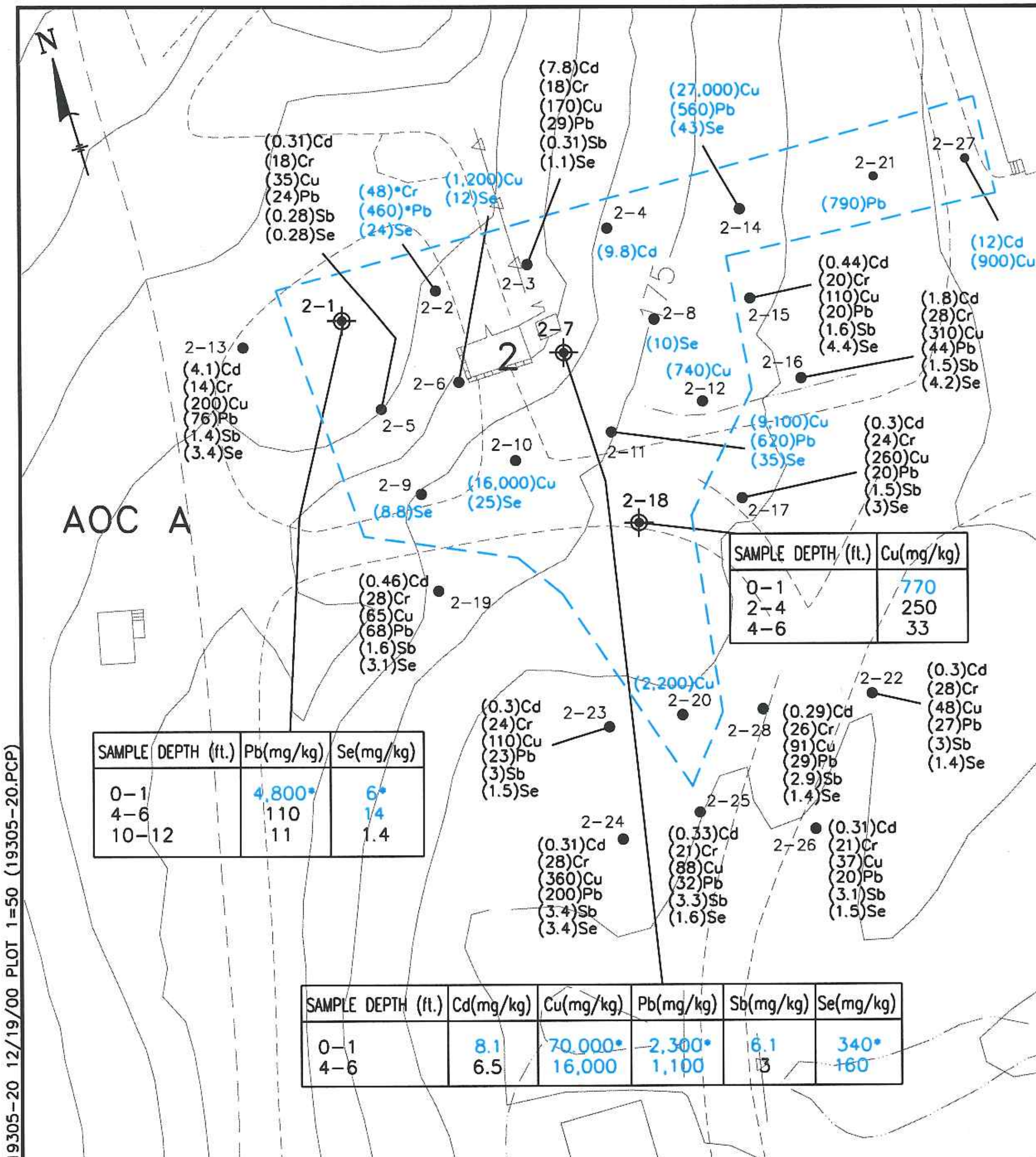


FIGURE 3-1

SWMU NOS. 1 & 22
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey



SAMPLE DEPTH (ft.)	Pb(mg/kg)	Se(mg/kg)
0-1	4,800*	6*
4-6	110	14
10-12	11	1.4

SAMPLE DEPTH (ft.)	Cu(mg/kg)
0-1	770
2-4	250
4-6	33

SAMPLE DEPTH (ft.)	Cd(mg/kg)	Cu(mg/kg)	Pb(mg/kg)	Sb(mg/kg)	Se(mg/kg)
0-1	8.1	70,000*	2,300*	6.1	340*
4-6	6.5	16,000	1,100	13	160

LEGEND:

- ● 2-3 — SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
- 2-7 ⌖ — VERTICAL DELINEATION BORING
- (12) — Cd, Cr, Cu, Pb, Sb OR Se CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA
- (1.5) — Cd, Cr, Cu, Pb, Sb OR Se CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERIA
- —175— GROUND SURFACE CONTOUR
- – – – APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA
- * TWO SAMPLES WERE ANALYZED AT THIS SAMPLE LOCATION. THE CONCENTRATION SHOWN REPRESENTS THE GREATER OF THE TWO SAMPLING RESULTS.

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE:

Cd= 8 mg/kg Pb= 400 mg/kg
Cr= 38 mg/kg Sb= 5 mg/kg
Cu= 600 mg/kg Se= 5 mg/kg

0 50 100
scale feet

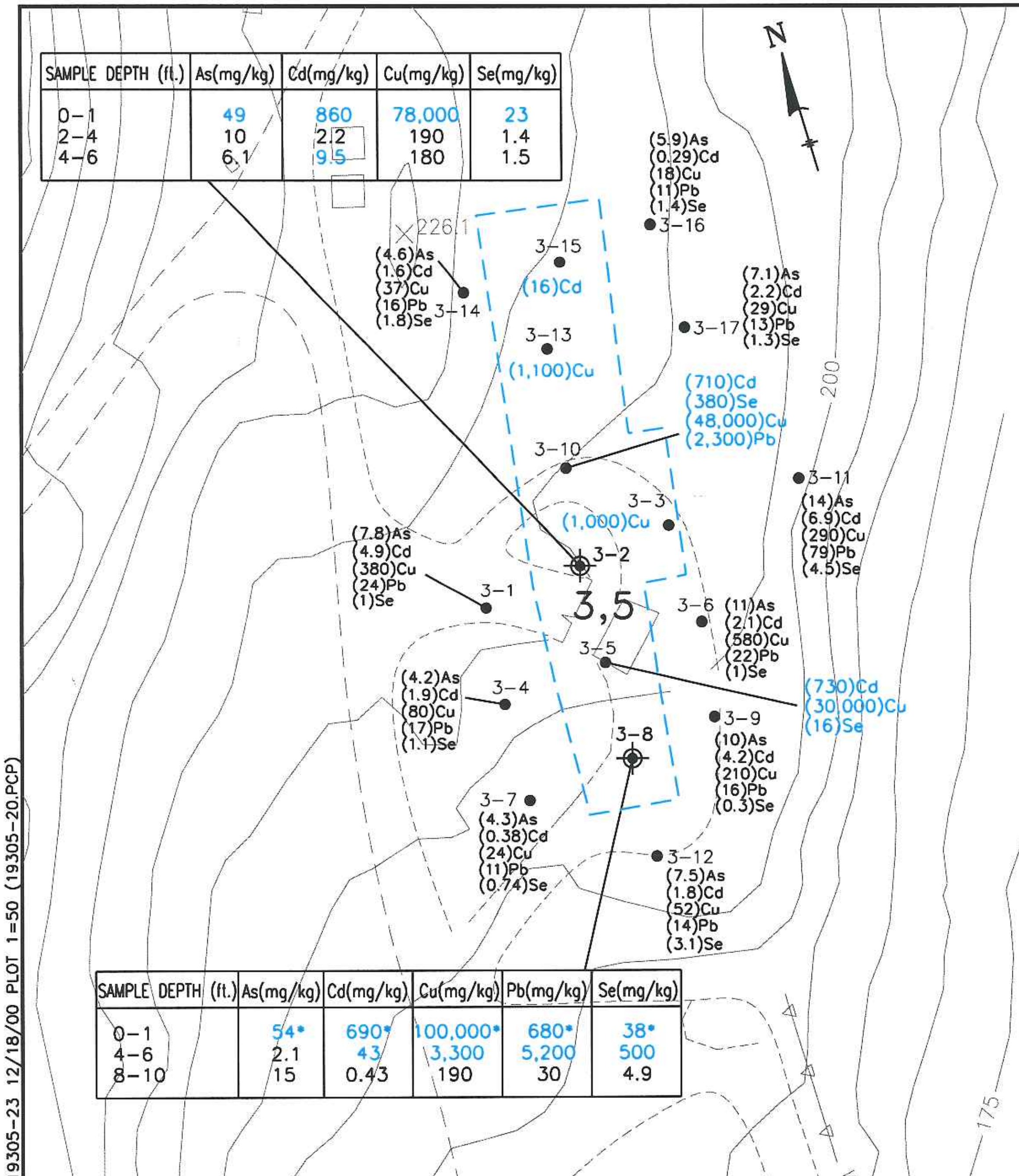
FIGURE 3-2

SWMU NO. 2 & AOC A UNRESTRICTED USE SOIL CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-20 12/19/00 PLOT 1=50 (19305-20.PCP)



SAMPLE DEPTH (ft.)	As(mg/kg)	Cd(mg/kg)	Cu(mg/kg)	Se(mg/kg)
0-1	49	860	78,000	23
2-4	10	2.2	190	1.4
4-6	6.1	9.5	180	1.5

SAMPLE DEPTH (ft.)	As(mg/kg)	Cd(mg/kg)	Cu(mg/kg)	Pb(mg/kg)	Se(mg/kg)
0-1	54*	690*	100,000*	680*	38*
4-6	2.1	43	3,300	5,200	500
8-10	15	0.43	190	30	4.9

LEGEND:

- ● 3-16 — SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
- 3-2 — VERTICAL DELINEATION BORING
- (16) — As, Cd, Cu, Pb OR Se CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA
- (1.8) — As, Cd, Cu, Pb OR Se CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERIA
- 200 — GROUND SURFACE CONTOUR
- 226.1 × — GROUND SURFACE ELEVATION
- — — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA
- * — TWO SAMPLES WERE ANALYZED AT THIS SAMPLE LOCATION. THE CONCENTRATION SHOWN REPRESENTS THE GREATER OF THE TWO SAMPLING RESULTS.

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE:

As= 29 mg/kg Pb= 400 mg/kg
Cd= 8 mg/kg Se= 5 mg/kg
Cu= 600 mg/kg

50 0 50
scale feet

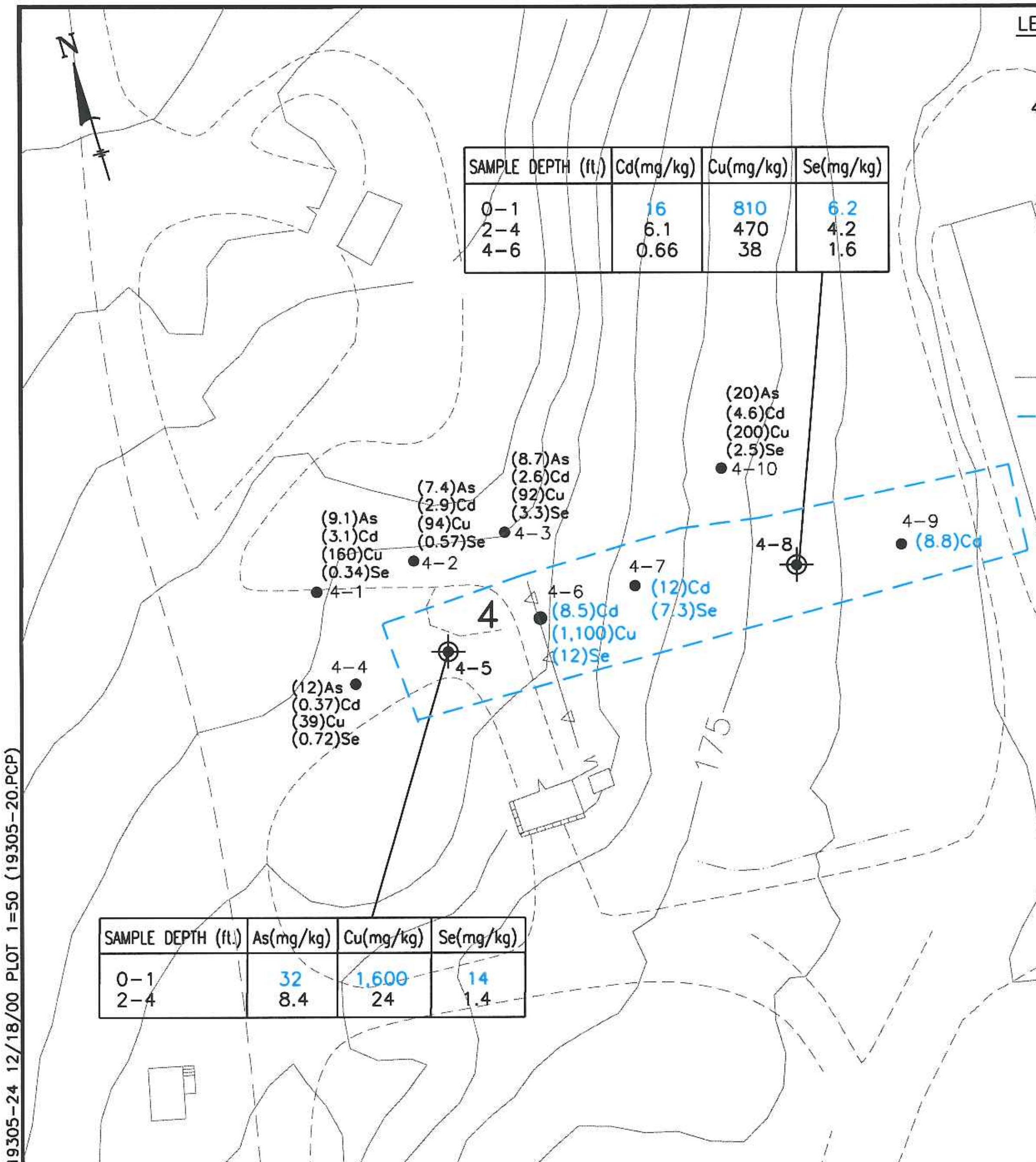
FIGURE 3-3

SWMU NOS. 3 & 5
UNRESTRICTED USE SOIL CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-23 12/18/00 PLOT 1=50 (19305-20.PCP)



SAMPLE DEPTH (ft.)	Cd(mg/kg)	Cu(mg/kg)	Se(mg/kg)
0-1	16	810	6.2
2-4	6.1	470	4.2
4-6	0.66	38	1.6

SAMPLE DEPTH (ft.)	As(mg/kg)	Cu(mg/kg)	Se(mg/kg)
0-1	32	1,600	14
2-4	8.4	24	1.4

LEGEND:

- ● 4-2 — SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
- ⊕ 4-5 — VERTICAL DELINEATION BORING
- (16) — As, Cd, Cu OR Se CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA
- (1.4) — As, Cd, Cu OR Se CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERIA
- —175— GROUND SURFACE CONTOUR
- — — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE:

   As= 29 mg/kg
   Cd= 8 mg/kg
   Cu= 600 mg/kg
   Se= 5 mg/kg

0 50 100

scale feet

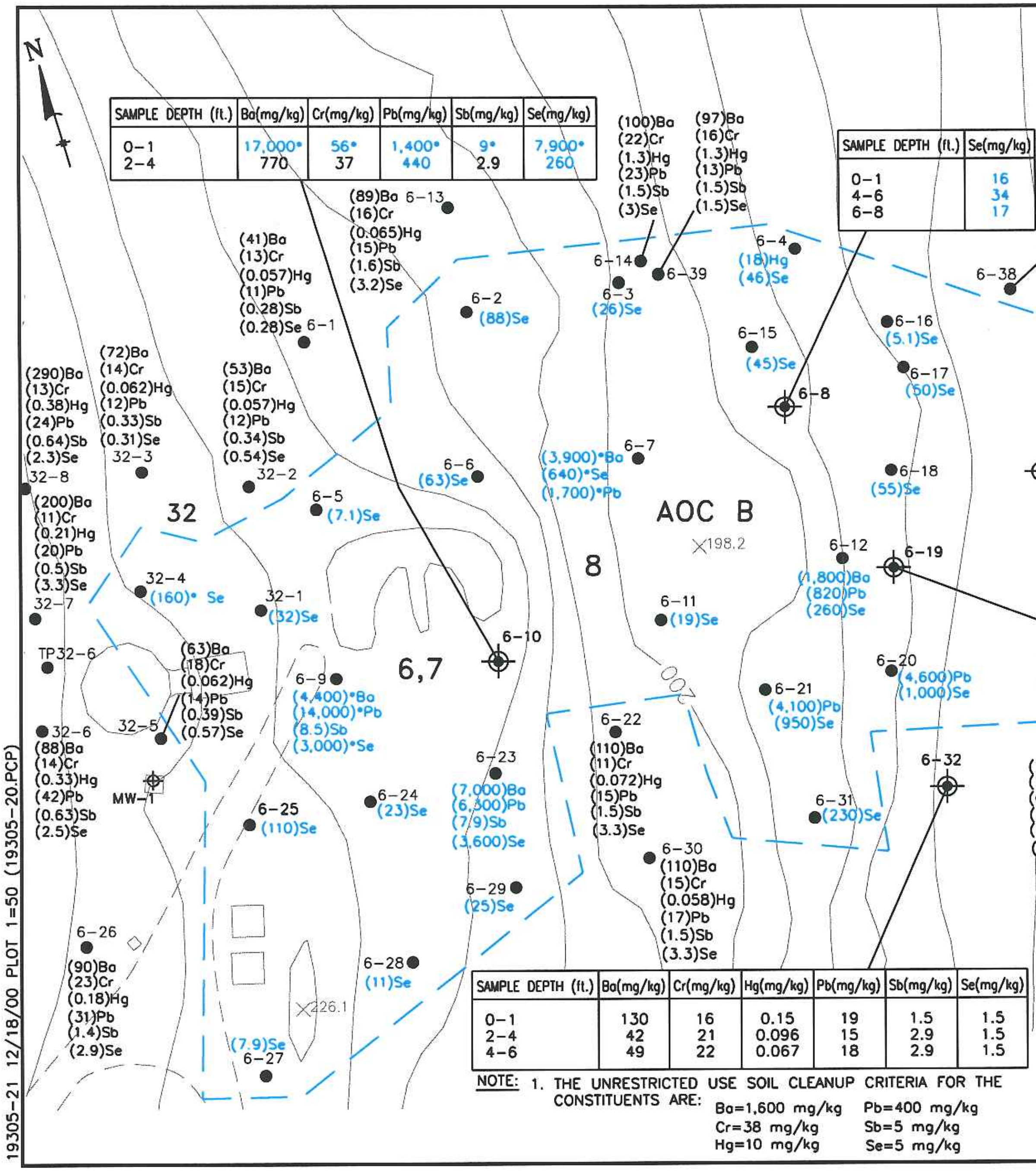
FIGURE 3-4

SWMU NO. 4 UNRESTRICTED USE SOIL CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-24 12/18/00 PLOT 1=50 (19305-20.PCP)



6-10:

SAMPLE DEPTH (ft.)	Ba(mg/kg)	Cr(mg/kg)	Pb(mg/kg)	Sb(mg/kg)	Se(mg/kg)
0-1	17,000*	56*	1,400*	9*	7,900*
2-4	770	37	440	2.9	260

6-8:

SAMPLE DEPTH (ft.)	Se(mg/kg)
0-1	16
4-6	34
6-8	17

6-36:

SAMPLE DEPTH (ft.)	Pb(mg/kg)	Se(mg/kg)
0-1	1,000	930
4-6	19	6.1

6-19:

SAMPLE DEPTH (ft.)	Pb(mg/kg)	Sb(mg/kg)	Se(mg/kg)
0-1	780	1.5	240
2-4	8,000	11	1,700

6-32:

SAMPLE DEPTH (ft.)	Ba(mg/kg)	Cr(mg/kg)	Hg(mg/kg)	Pb(mg/kg)	Sb(mg/kg)	Se(mg/kg)
0-1	130	16	0.15	19	1.5	1.5
2-4	42	21	0.096	15	2.9	1.5
4-6	49	22	0.067	18	2.9	1.5

NOTE: 1. THE UNRESTRICTED USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE: Ba=1,600 mg/kg Pb=400 mg/kg Cr=38 mg/kg Sb=5 mg/kg Hg=10 mg/kg Se=5 mg/kg

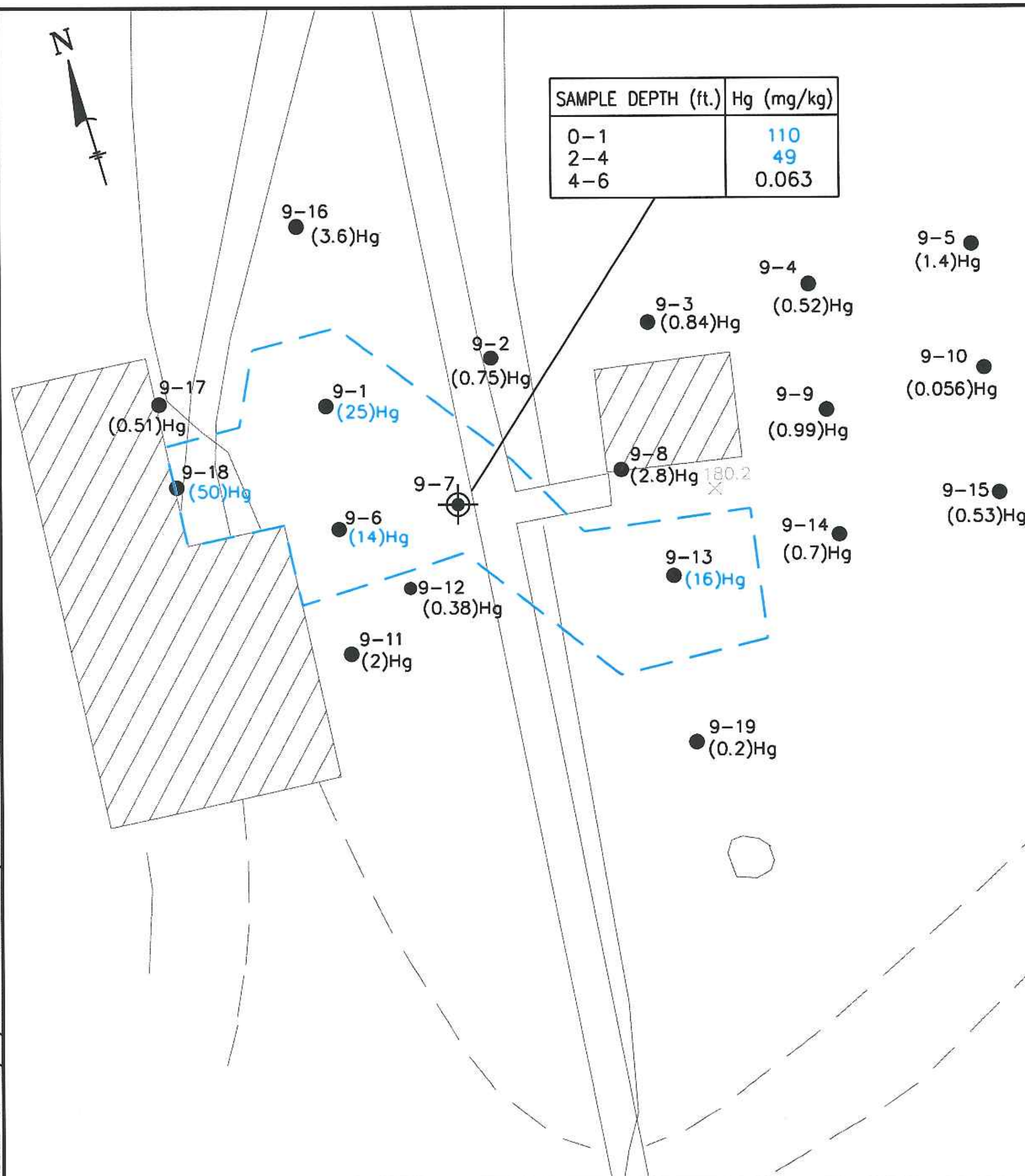
FIGURE 3-5

SWMU NOS. 6,7,8,32 & AOC B UNRESTRICTED USE SOIL CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-21 12/18/00 PLOT 1=50 (19305-20.PCP)



SAMPLE DEPTH (ft.)	Hg (mg/kg)
0-1	110
2-4	49
4-6	0.063

LEGEND:

- 9-3 ● SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
- 9-7 ⊕ VERTICAL DELINEATION BORING
- (16) Hg CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERION
- (1.4) Hg CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERION
- 180.2 × GROUND SURFACE ELEVATION
- — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA
- EXISTING STRUCTURE

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERION FOR Hg IS 10 mg/kg.

20 0 20

scale feet

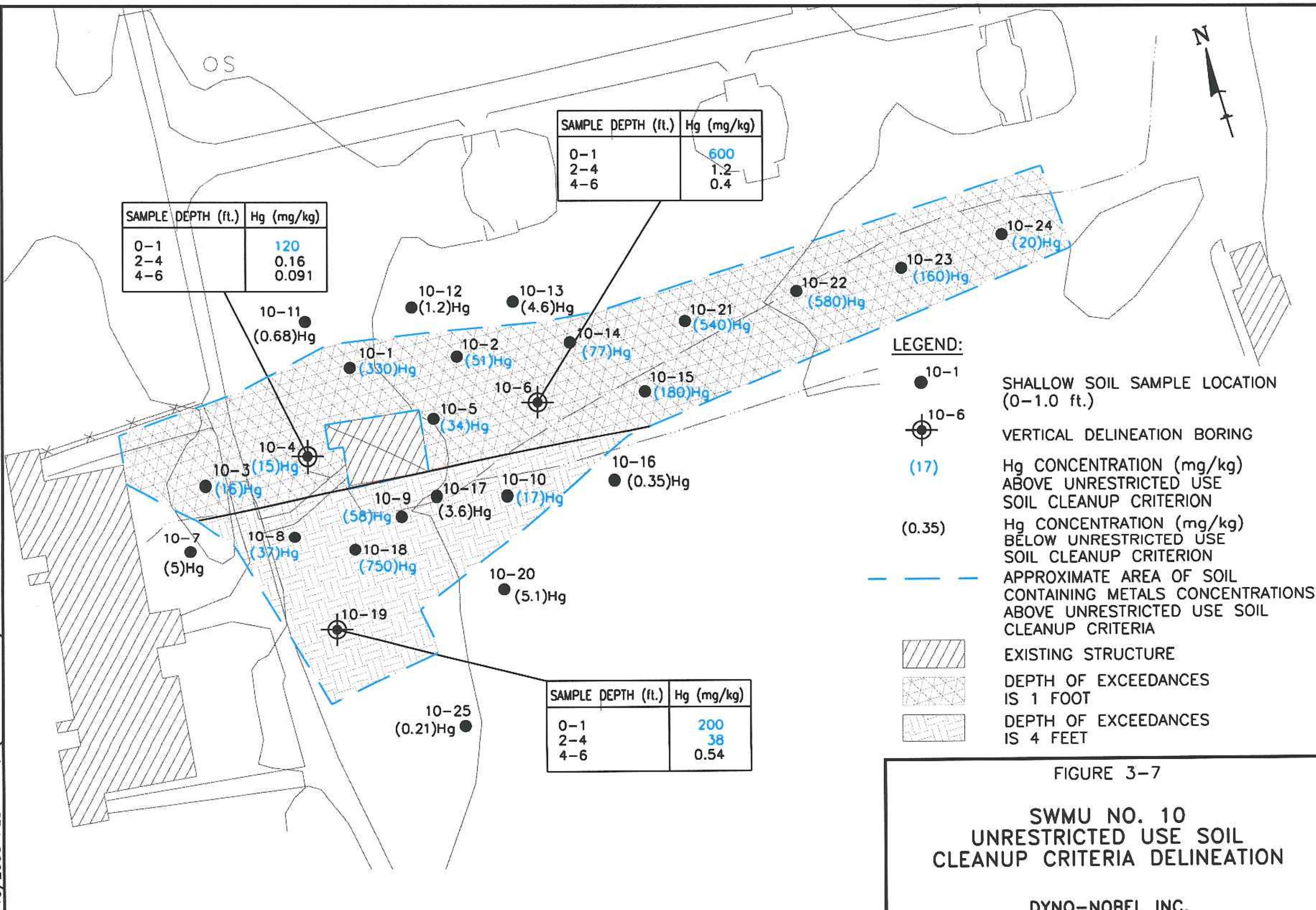
FIGURE 3-6

SWMU NO. 9
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-01 12/18/2000 PLOT 1=20 (19035-01.PCP)



SAMPLE DEPTH (ft.)	Hg (mg/kg)
0-1	120
2-4	0.16
4-6	0.091

SAMPLE DEPTH (ft.)	Hg (mg/kg)
0-1	600
2-4	1.2
4-6	0.4

SAMPLE DEPTH (ft.)	Hg (mg/kg)
0-1	200
2-4	38
4-6	0.54

LEGEND:

10-1 — SHALLOW SOIL SAMPLE LOCATION (0-1.0 ft.)

10-6 — VERTICAL DELINEATION BORING

(17) — Hg CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERION

(0.35) — Hg CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERION

— — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

EXISTING STRUCTURE

DEPTH OF EXCEEDANCES IS 1 FOOT

DEPTH OF EXCEEDANCES IS 4 FEET

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERION FOR Hg IS 10 mg/kg.

40 0 40

scale feet

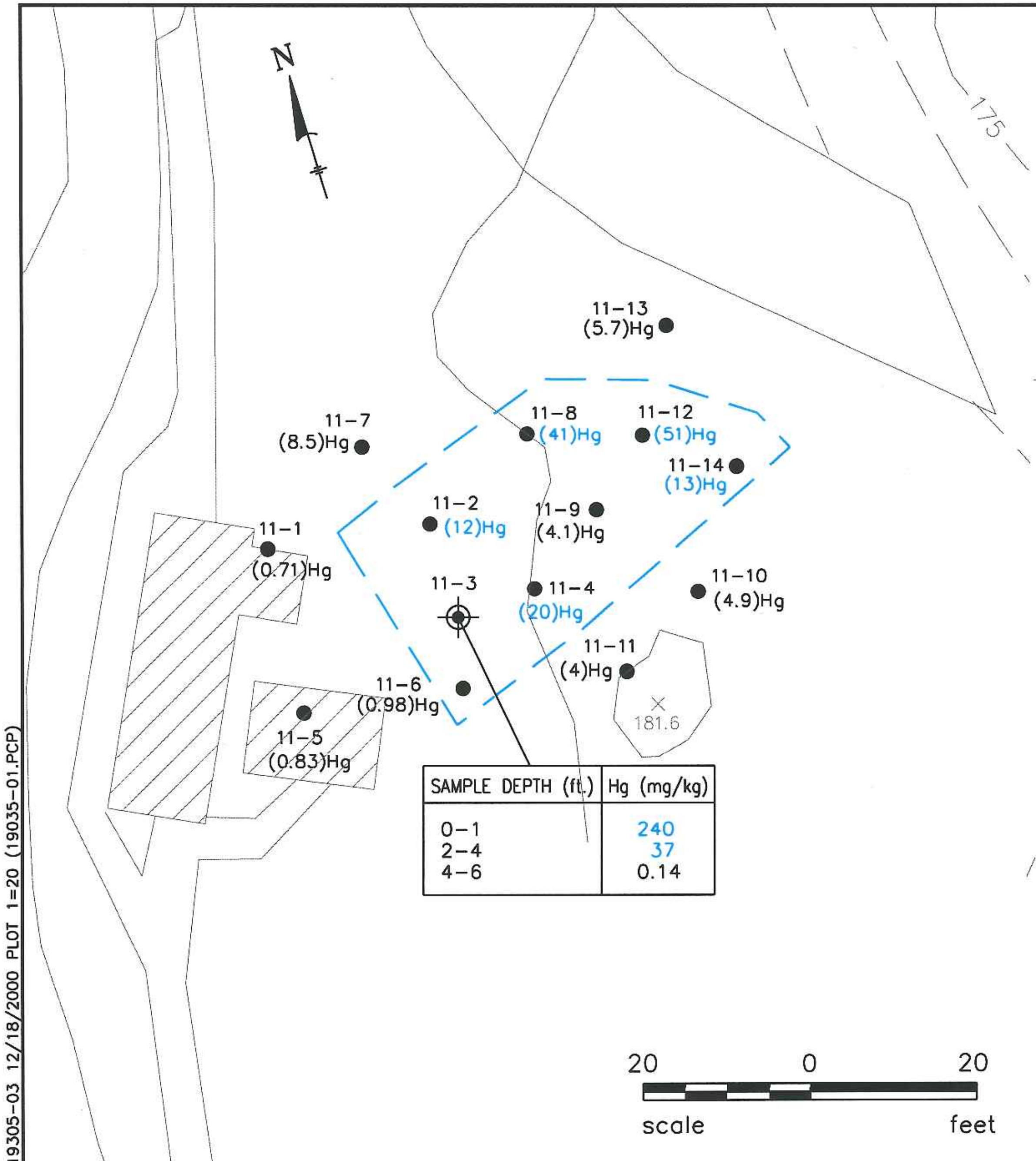
FIGURE 3-7

SWMU NO. 10
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-02 12/19/2000 PLOT 1=40 (19305-02.PCP)



SAMPLE DEPTH (ft.)	Hg (mg/kg)
0-1	240
2-4	37
4-6	0.14

LEGEND:

- 11-1 ● SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
- 11-3 ⊕ VERTICAL DELINEATION BORING
- (12) Hg CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERION
- (4.9) Hg CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERION
- 181.6 × GROUND SURFACE ELEVATION
- —175— GROUND SURFACE CONTOUR
- — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA
- ▨ EXISTING STRUCTURE

NOTES:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERION FOR Hg IS 10 mg/kg.

FIGURE 3-8

SWMU NO. 11
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-03 12/18/2000 PLOT 1=20 (19035-01.PCP)

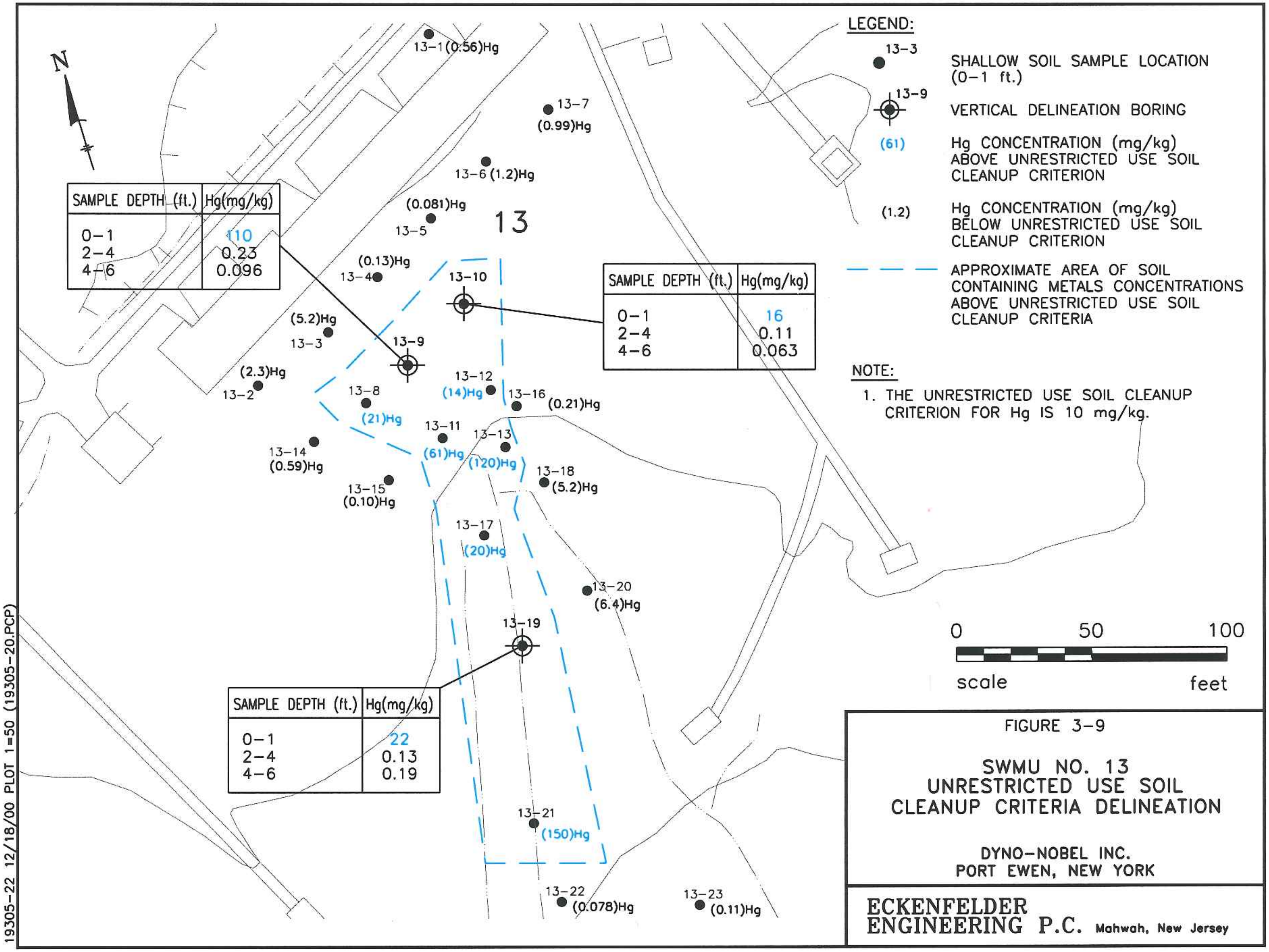


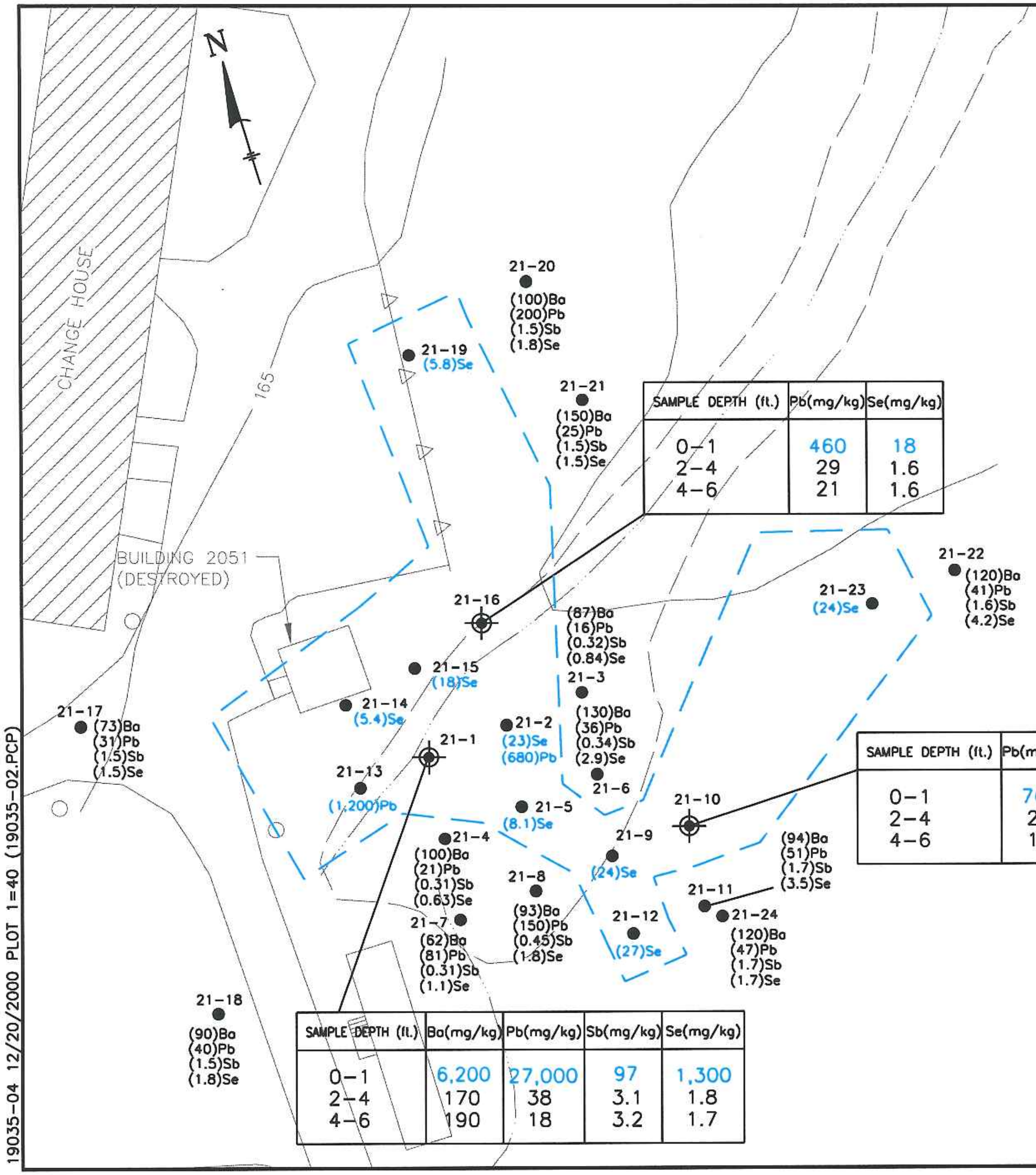
FIGURE 3-9

SWMU NO. 13
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-22 12/18/00 PLOT 1=50 (19305-20.PCP)



SAMPLE DEPTH (ft.)	Pb(mg/kg)	Se(mg/kg)
0-1	460	18
2-4	29	1.6
4-6	21	1.6

SAMPLE DEPTH (ft.)	Pb(mg/kg)	Se(mg/kg)
0-1	760	120
2-4	20	1.6
4-6	17	1.6

SAMPLE DEPTH (ft.)	Ba(mg/kg)	Pb(mg/kg)	Sb(mg/kg)	Se(mg/kg)
0-1	6,200	27,000	97	1,300
2-4	170	38	3.1	1.8
4-6	190	18	3.2	1.7

LEGEND:

21-21 ● SHALLOW SOIL SAMPLE LOCATION (0-1.0 ft.)

21-16 ⌖ VERTICAL DELINEATION BORING

(24) Ba, Pb, Sb OR Se CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

(210) Ba, Pb, Sb OR Se CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERIA

— — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

165 GROUND SURFACE CONTOUR

EXISTING STRUCTURE

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE:

Ba= 1,600 mg/kg Sb= 5 mg/kg
Pb= 400 mg/kg Se= 5 mg/kg

40 0 40
scale feet

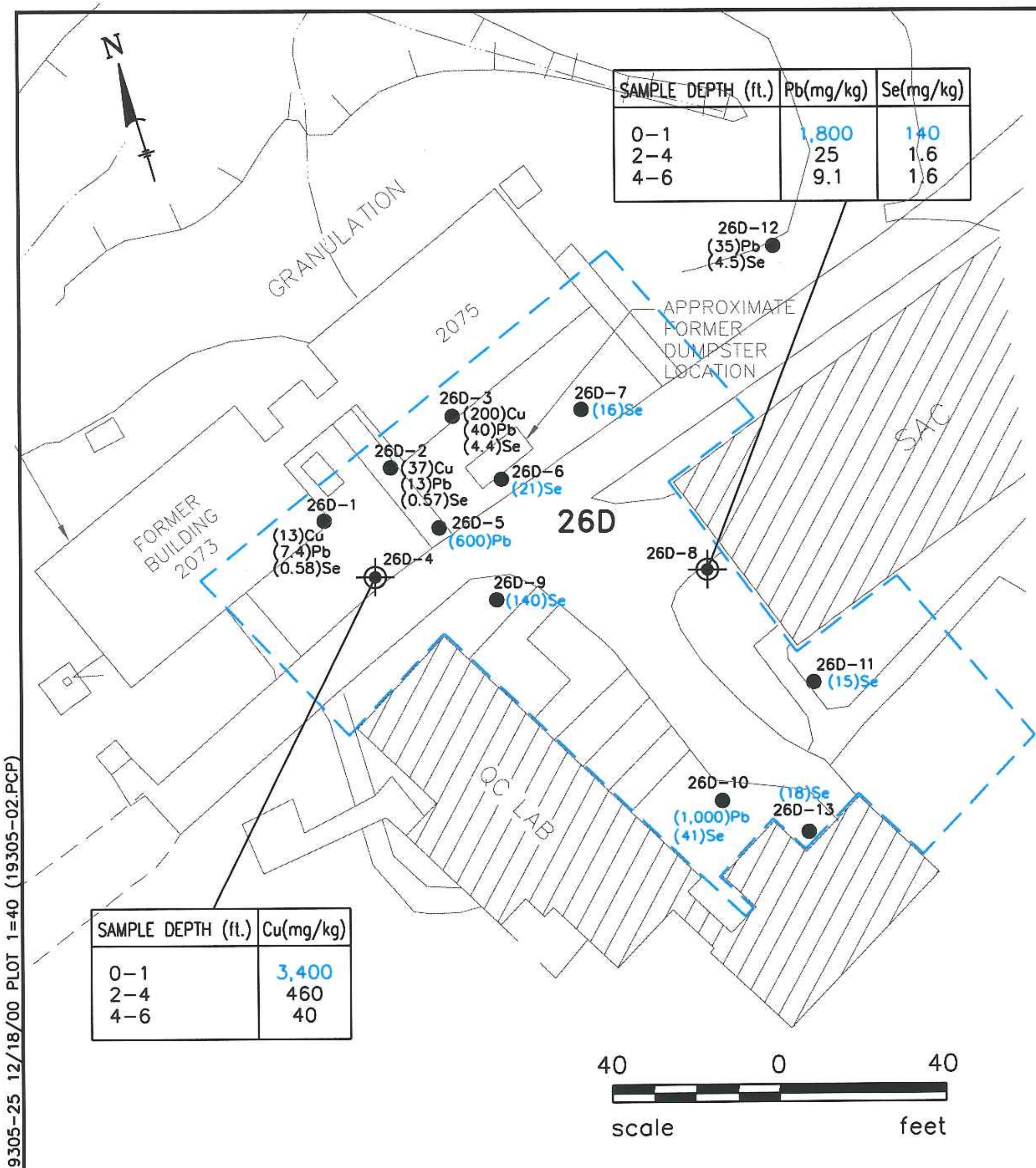
FIGURE 3-10

SWMU NO. 21
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER
ENGINEERING P.C. Mahwah, New Jersey

19035-04 12/20/2000 PLOT 1=40 (19035-02.PCP)



SAMPLE DEPTH (ft.)	Pb(mg/kg)	Se(mg/kg)
0-1	1,800	140
2-4	25	1.6
4-6	9.1	1.6

SAMPLE DEPTH (ft.)	Cu(mg/kg)
0-1	3,400
2-4	460
4-6	40

LEGEND:

26D-12 ● SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)

26D-8 ⊕ VERTICAL DELINEATION BORING

(21) Cu, Pb OR Se CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

(7.4) Cu, Pb OR Se CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERIA

— — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

EXISTING STRUCTURE

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE:

Cu= 600 mg/kg
Pb= 400 mg/kg
Se= 5 mg/kg

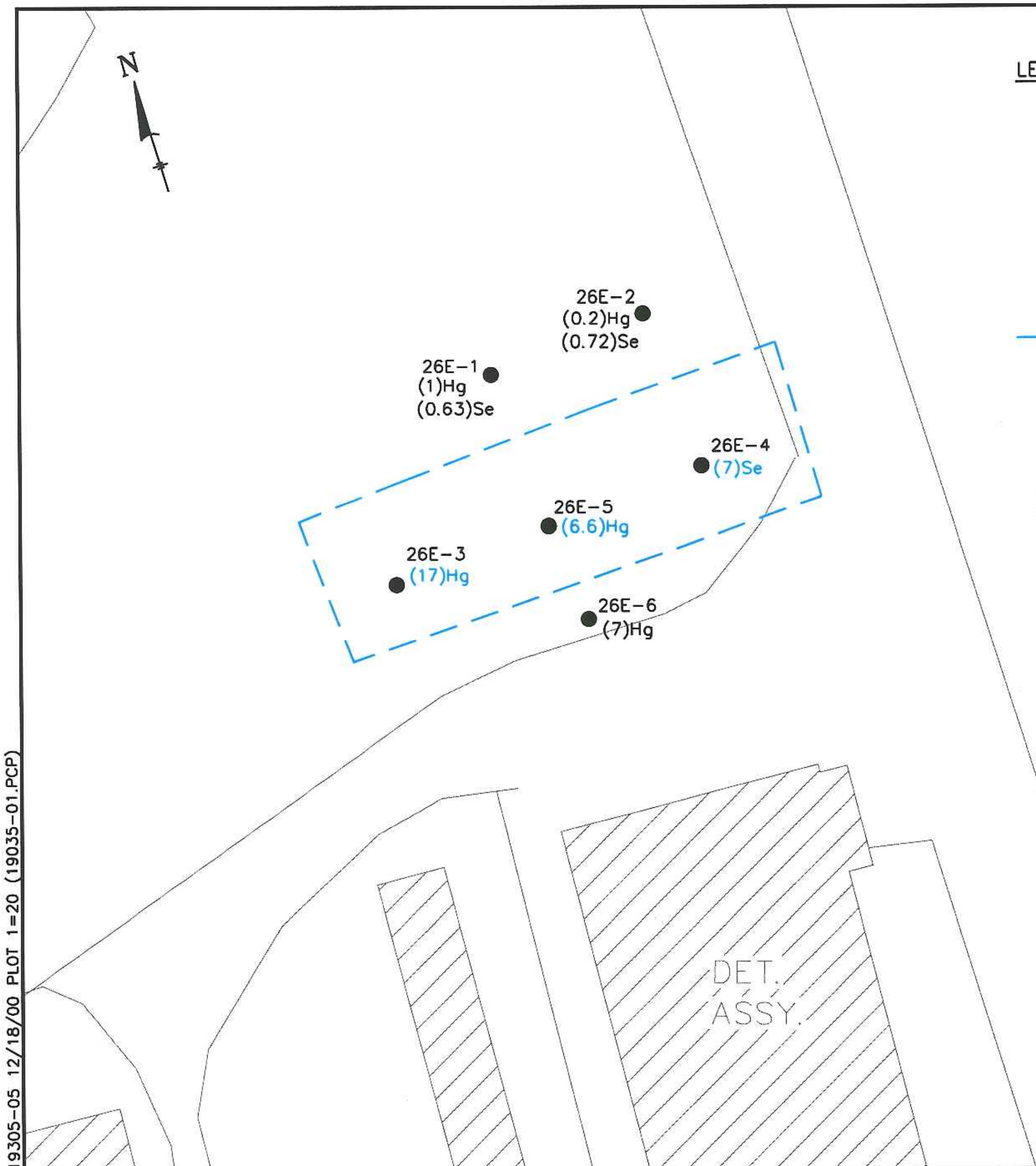
FIGURE 3-11

SWMU NO. 26D
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWER, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-25 12/18/00 PLOT 1=40 (19305-02.PCP)



LEGEND:

● 26E-1 SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)

(7) Hg or Se CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

(1) Hg or Se CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERIA

— — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

EXISTING STRUCTURE

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE:
   Hg = 10 mg/kg
   Se = 5 mg/kg

20 0 20
scale feet

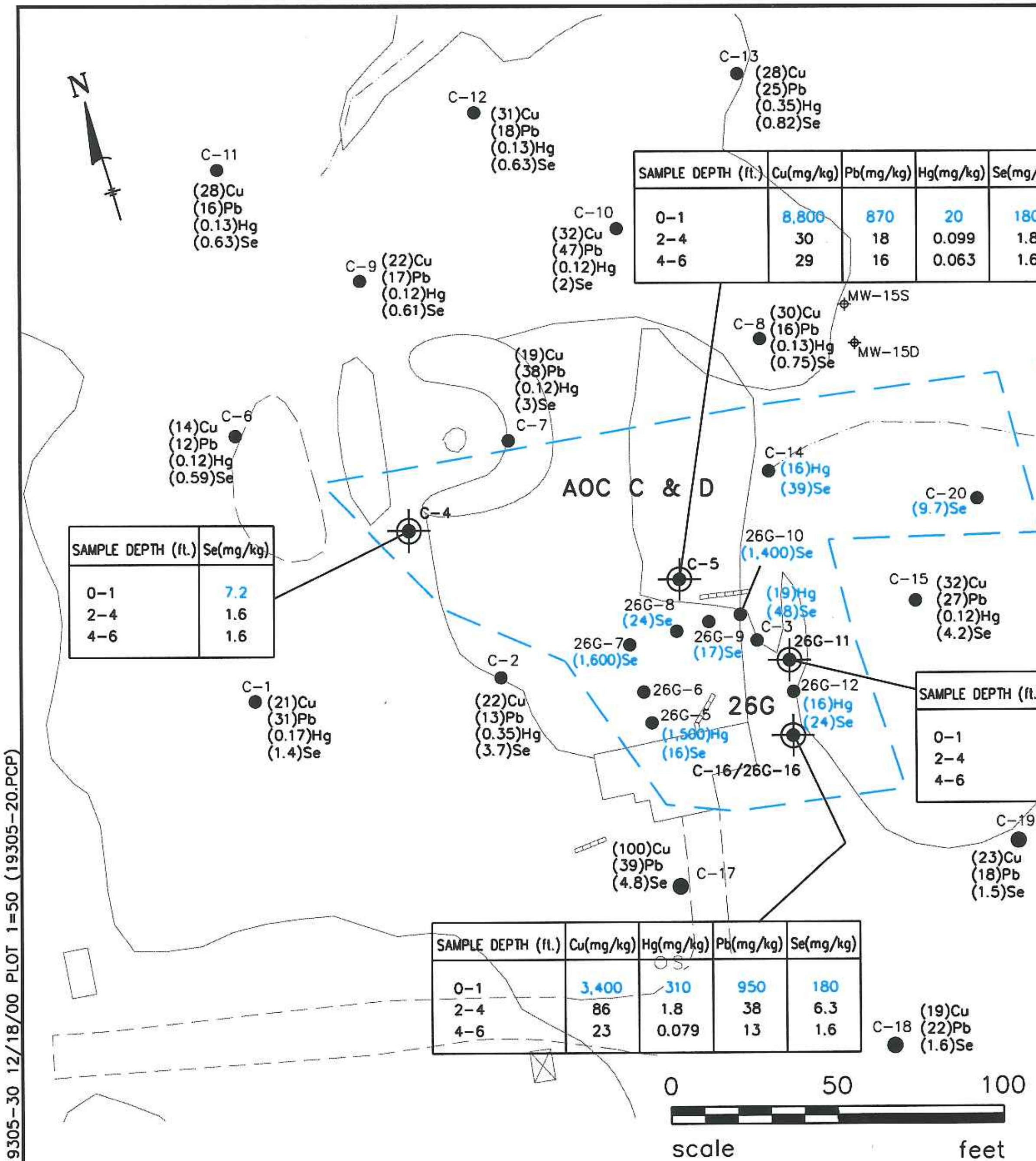
FIGURE 3-12

SWMU NO. 26E
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-05 12/18/00 PLOT 1=20 (19035-01.PCP)



SAMPLE DEPTH (ft.)	Se(mg/kg)
0-1	7.2
2-4	1.6
4-6	1.6

SAMPLE DEPTH (ft.)	Cu(mg/kg)	Pb(mg/kg)	Hg(mg/kg)	Se(mg/kg)
0-1	8,800	870	20	180
2-4	30	18	0.099	1.8
4-6	29	16	0.063	1.6

SAMPLE DEPTH (ft.)	Hg(mg/kg)	Se(mg/kg)
0-1	17	23
2-4	0.062	4.3
4-6	0.062	1.6

SAMPLE DEPTH (ft.)	Cu(mg/kg)	Hg(mg/kg)	Pb(mg/kg)	Se(mg/kg)
0-1	3,400	310	950	180
2-4	86	1.8	38	6.3
4-6	23	0.079	13	1.6

LEGEND:

C-8 — SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)

26G-11 — VERTICAL DELINEATION BORING

(16) — Cu, Pb, Hg OR Se CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

(1.4) — Cu, Pb, Hg OR Se CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERIA

APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE:
   - Cu = 600 mg/kg
   - Pb = 400 mg/kg
   - Hg = 10 mg/kg
   - Se = 5 mg/kg

FIGURE 3-13

SWMU NO. 26G & AOC C&D
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-30 12/18/00 PLOT 1=50 (19305-20.PCP)

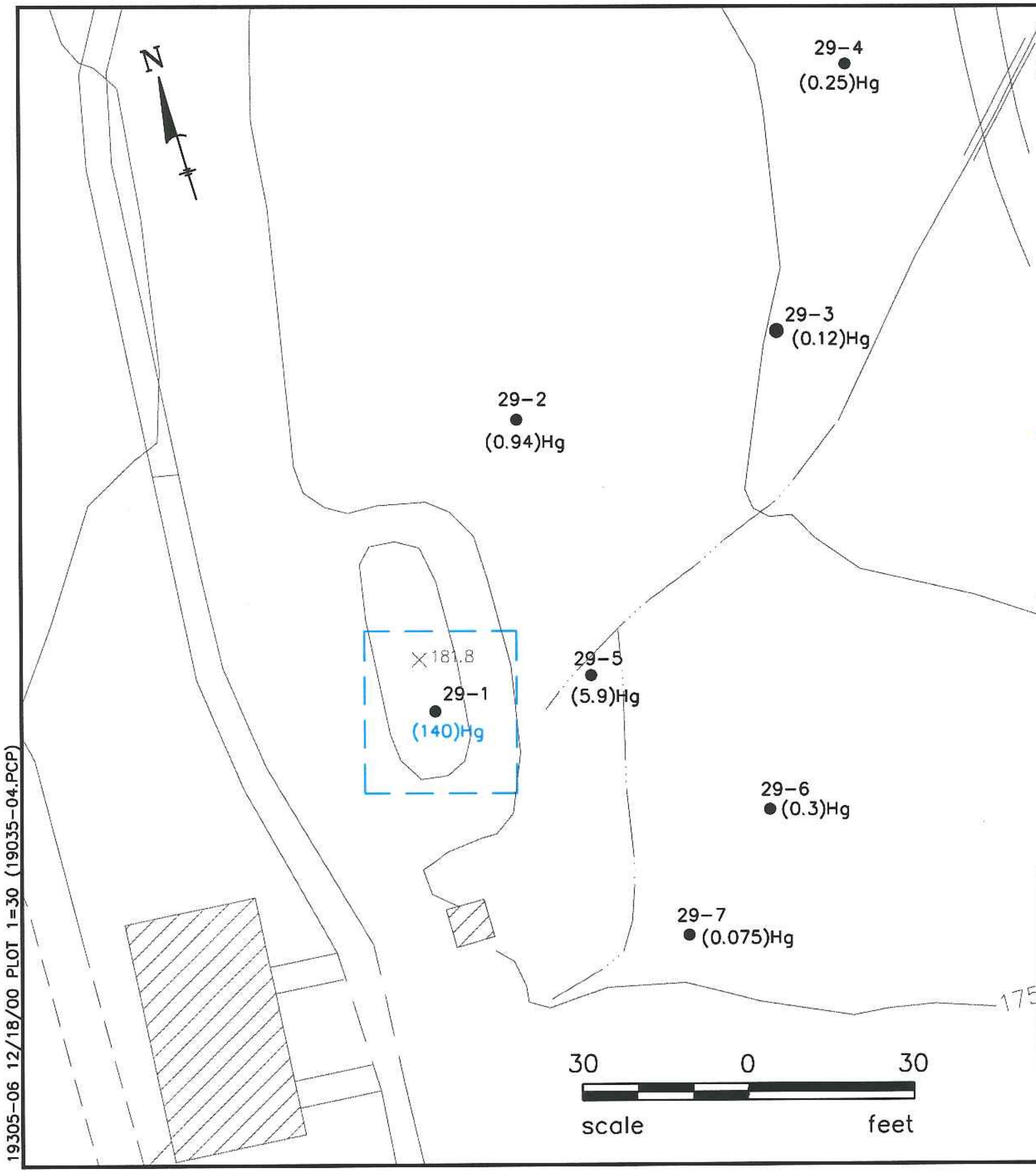


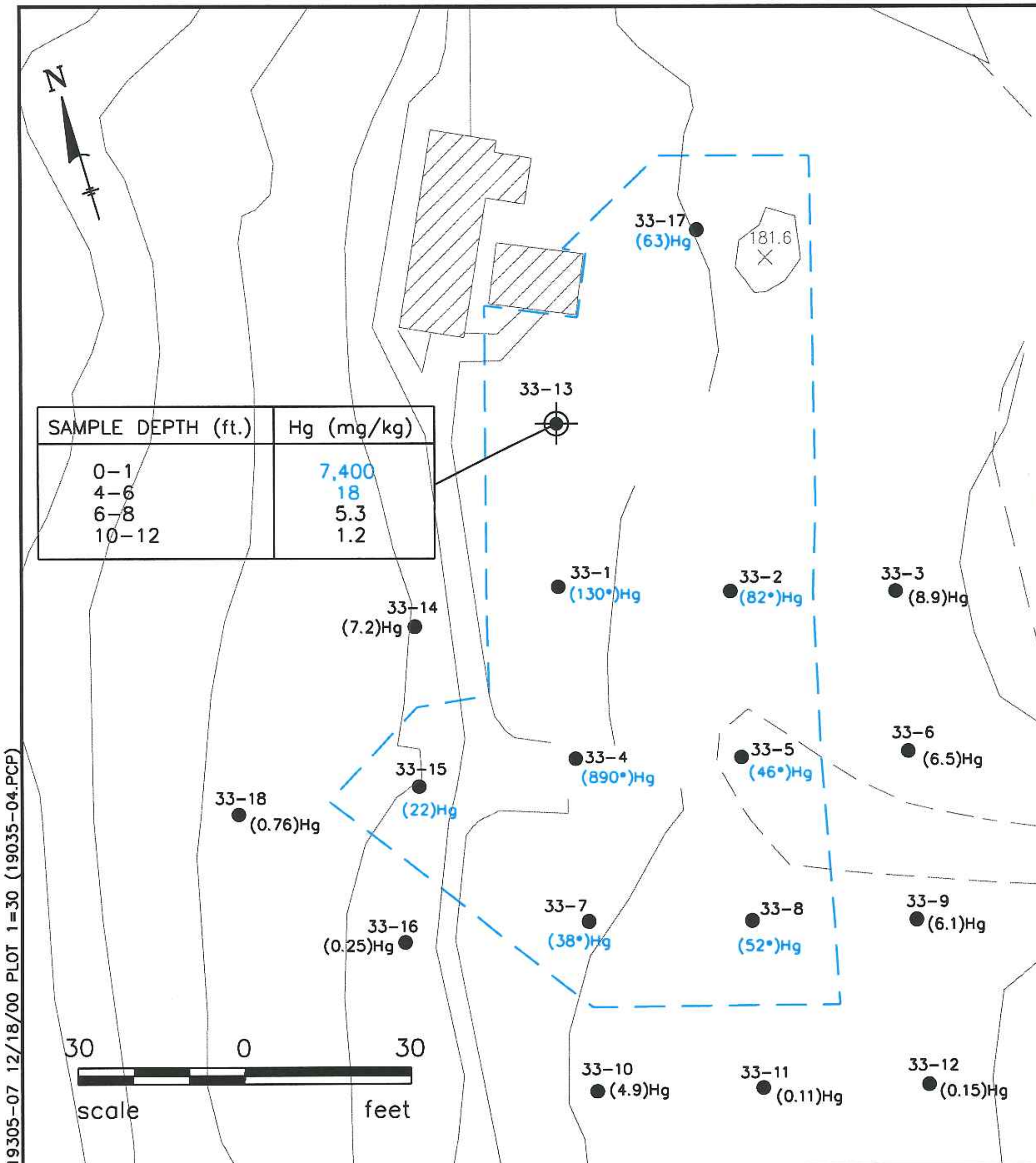
FIGURE 3-14

SWMU NO. 29
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-06 12/18/00 PLOT 1=30 (19035-04.PCP)



SAMPLE DEPTH (ft.)	Hg (mg/kg)
0-1	7,400
4-6	18
6-8	5.3
10-12	1.2

LEGEND:

● 33-1	SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
⌖ 33-13	VERTICAL DELINEATION BORING
(63)	Hg CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERION
(6.5)	Hg CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERION
181.6 ×	GROUND SURFACE ELEVATION
*	TWO SAMPLES WERE ANALYZED AT THIS SAMPLE LOCATION. THE CONCENTRATION SHOWN REPRESENTS THE GREATER OF THE TWO SAMPLING RESULTS.
— — —	APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA
▨	EXISTING STRUCTURE

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERION FOR Hg IS 10 mg/kg.

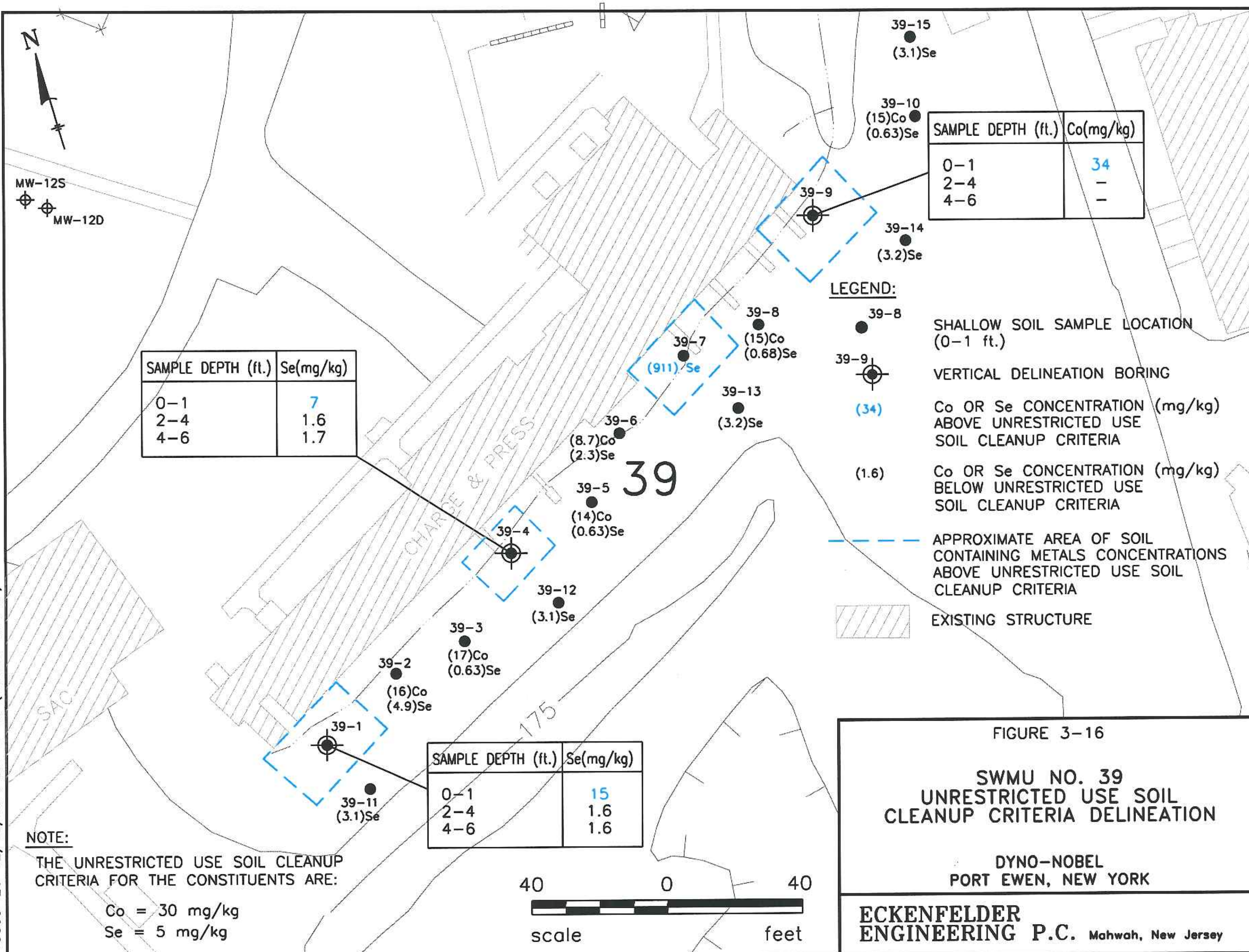
FIGURE 3-15

SWMU NO. 33
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-07 12/18/00 PLOT 1=30 (19035-04.PCP)



SAMPLE DEPTH (ft.)	Co(mg/kg)
0-1	34
2-4	-
4-6	-

SAMPLE DEPTH (ft.)	Se(mg/kg)
0-1	7
2-4	1.6
4-6	1.7

SAMPLE DEPTH (ft.)	Se(mg/kg)
0-1	15
2-4	1.6
4-6	1.6

NOTE:

THE UNRESTRICTED USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE:

Co = 30 mg/kg
Se = 5 mg/kg

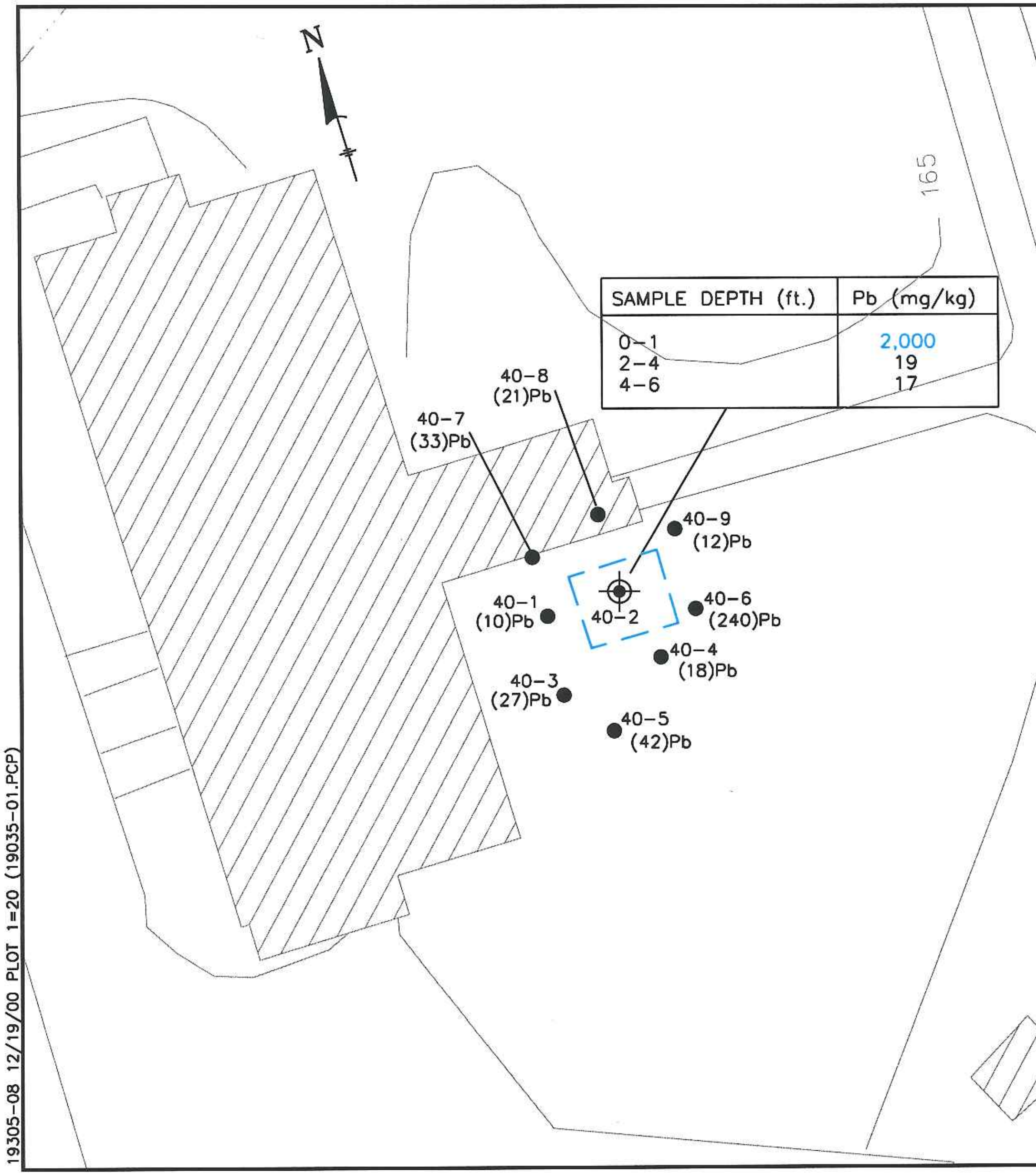
FIGURE 3-16

SWMU NO. 39
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-26 12/18/00 PLOT 1=40 (19305-02.PCP)



SAMPLE DEPTH (ft.)	Pb (mg/kg)
0-1	2,000
2-4	19
4-6	17

LEGEND:

- 40-7 ● SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
- 40-2 ⊕ VERTICAL DELINEATION BORING
- (2,000) Pb CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERION
- (10) Pb CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERION
- —165— GROUND SURFACE CONTOUR
- — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA
- ▨ EXISTING STRUCTURE

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERION FOR Pb IS 400 mg/kg.

20 0 20

scale feet

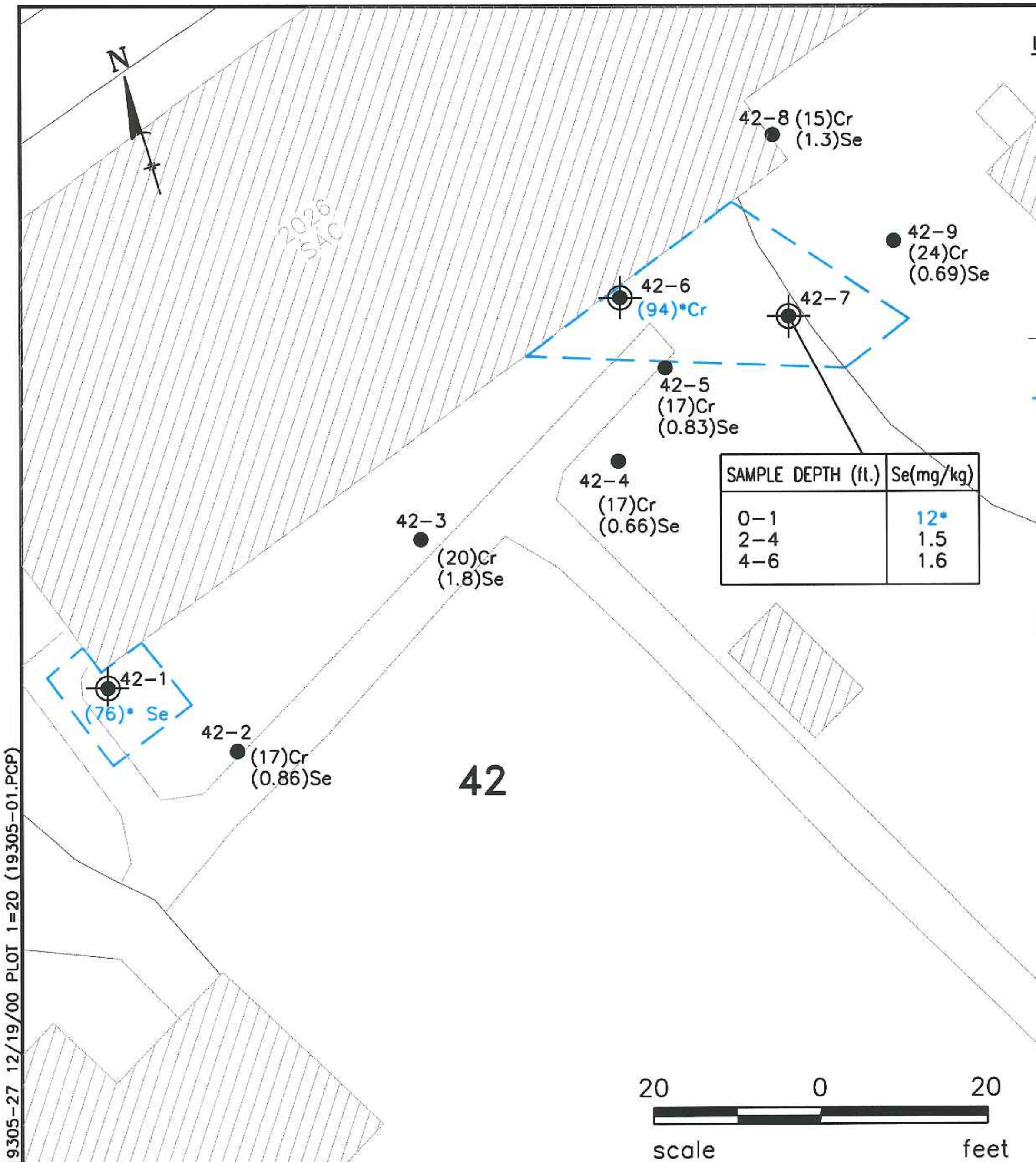
FIGURE 3-17

SWMU NO. 40
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-08 12/19/00 PLOT 1=20 (19035-01.PCP)



SAMPLE DEPTH (ft.)	Se(mg/kg)
0-1	12*
2-4	1.5
4-6	1.6

LEGEND:

- 42-9 ● SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
- 42-7 ⊕ VERTICAL DELINEATION BORING
- (94) Cr OR Se CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA
- (76) Cr OR Se CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERIA
- —175— GROUND SURFACE CONTOUR
- — — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA
- EXISTING STRUCTURE
- * TWO SAMPLES WERE ANALYZED AT THIS SAMPLE LOCATION. THE CONCENTRATION SHOWN REPRESENTS THE GREATER OF THE TWO SAMPLING RESULTS.

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE:

   Cr = 38mg/kg
   Se = 5mg/kg

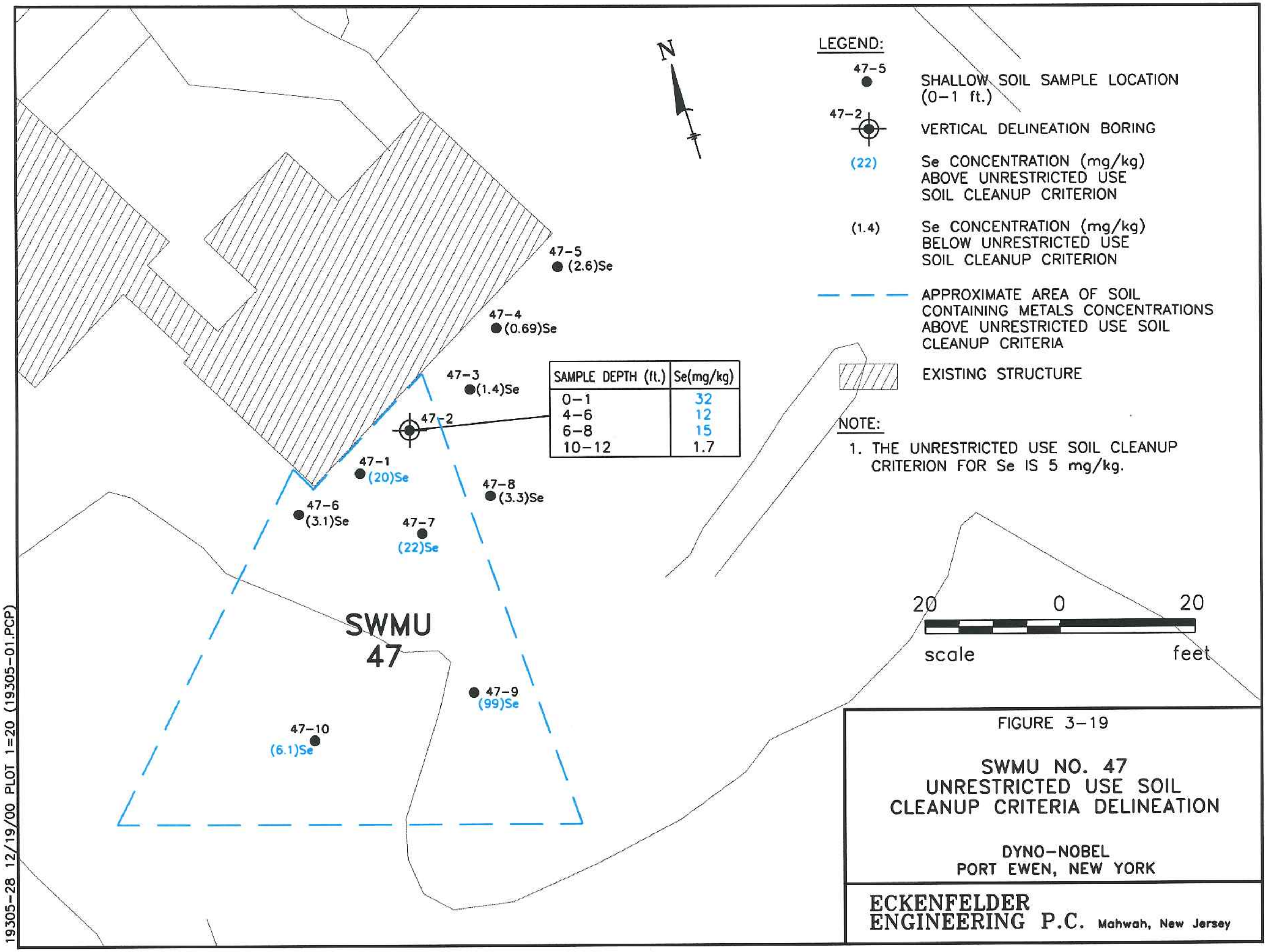
FIGURE 3-18

SWMU NO. 42 UNRESTRICTED USE SOIL CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-27 12/19/00 PLOT 1=20 (19305-01.PCP)



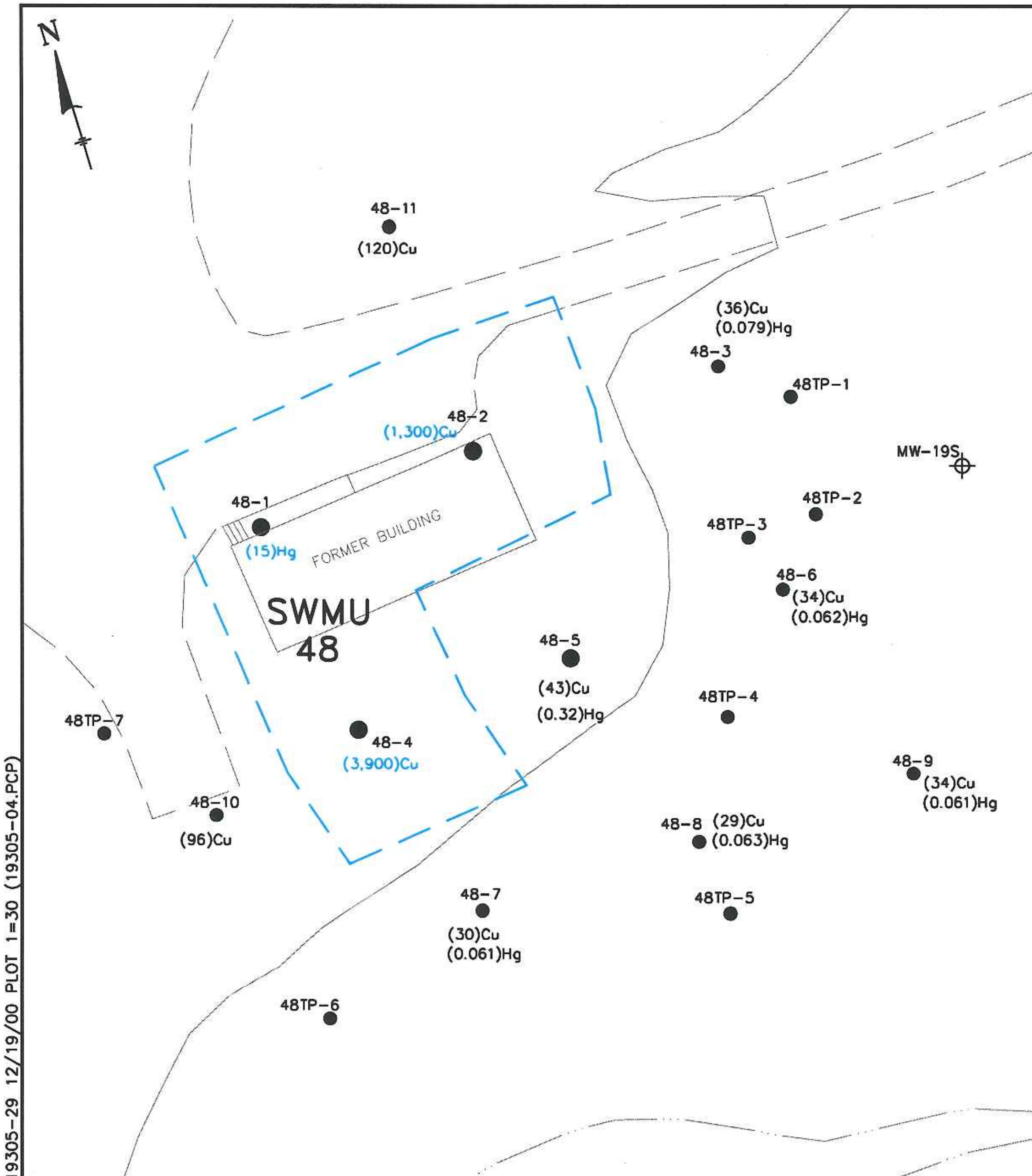
SAMPLE DEPTH (ft.)	Se(mg/kg)
0-1	32
4-6	12
6-8	15
10-12	1.7

FIGURE 3-19

SWMU NO. 47
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey



LEGEND:

48-3 ● SHALLOW SOIL SAMPLE LOCATION

(15) Cu OR Hg CONCENTRATION (mg/kg) ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

(36) Cu OR Hg CONCENTRATION (mg/kg) BELOW UNRESTRICTED USE SOIL CLEANUP CRITERIA

— — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE UNRESTRICTED USE SOIL CLEANUP CRITERIA

NOTE:

1. THE UNRESTRICTED USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE:
   Cu = 600 mg/kg
   Hg = 10 mg/kg

30 0 30

scale feet

FIGURE 3-20

SWMU NO. 48
UNRESTRICTED USE SOIL
CLEANUP CRITERIA DELINEATION

DYNO-NOBEL
PORT EWEN, NEW YORK

ECKENFELDER
ENGINEERING P.C. Mahwah, New Jersey

19305-29 12/19/00 PLOT 1=30 (19305-04.PCP)

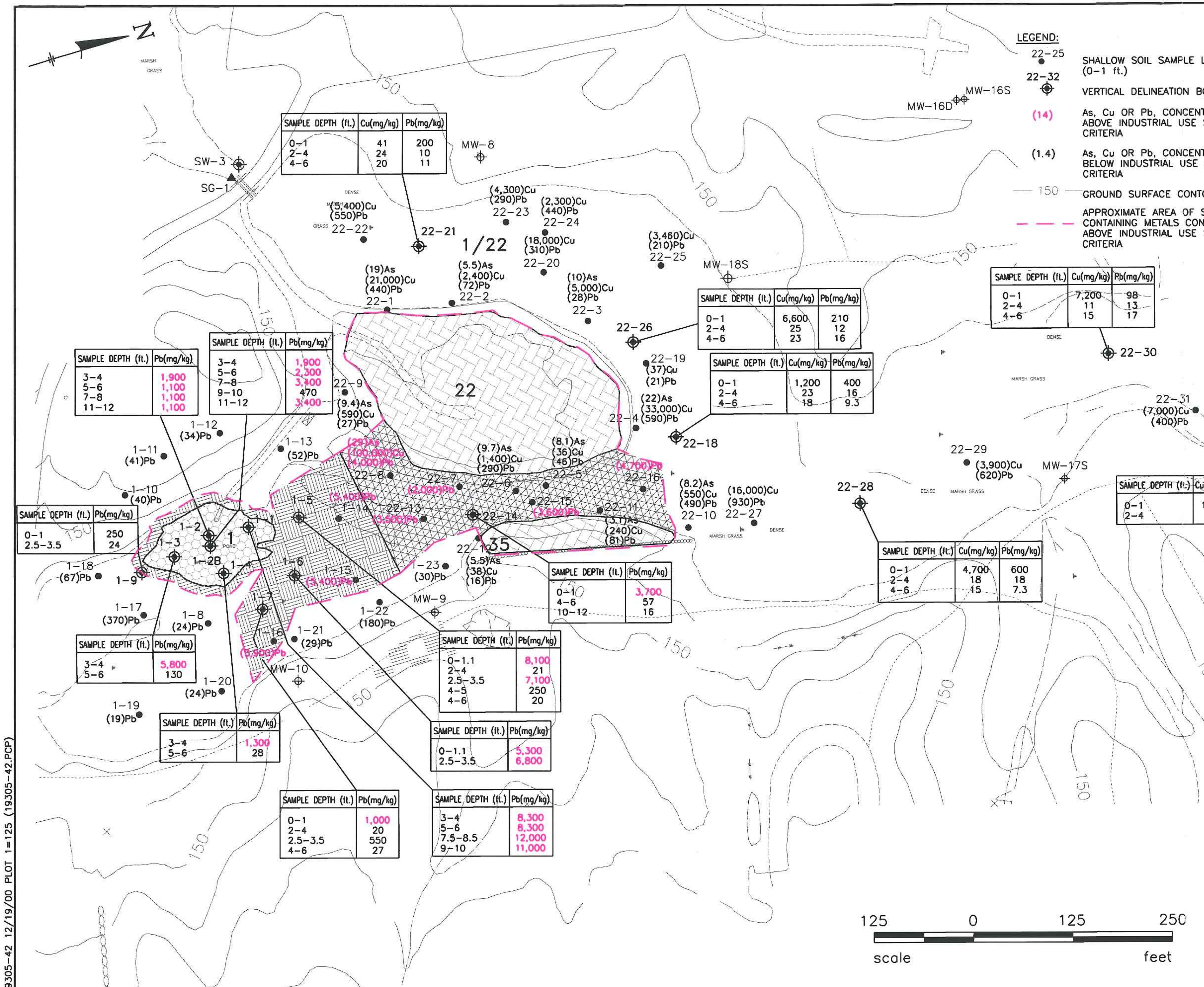


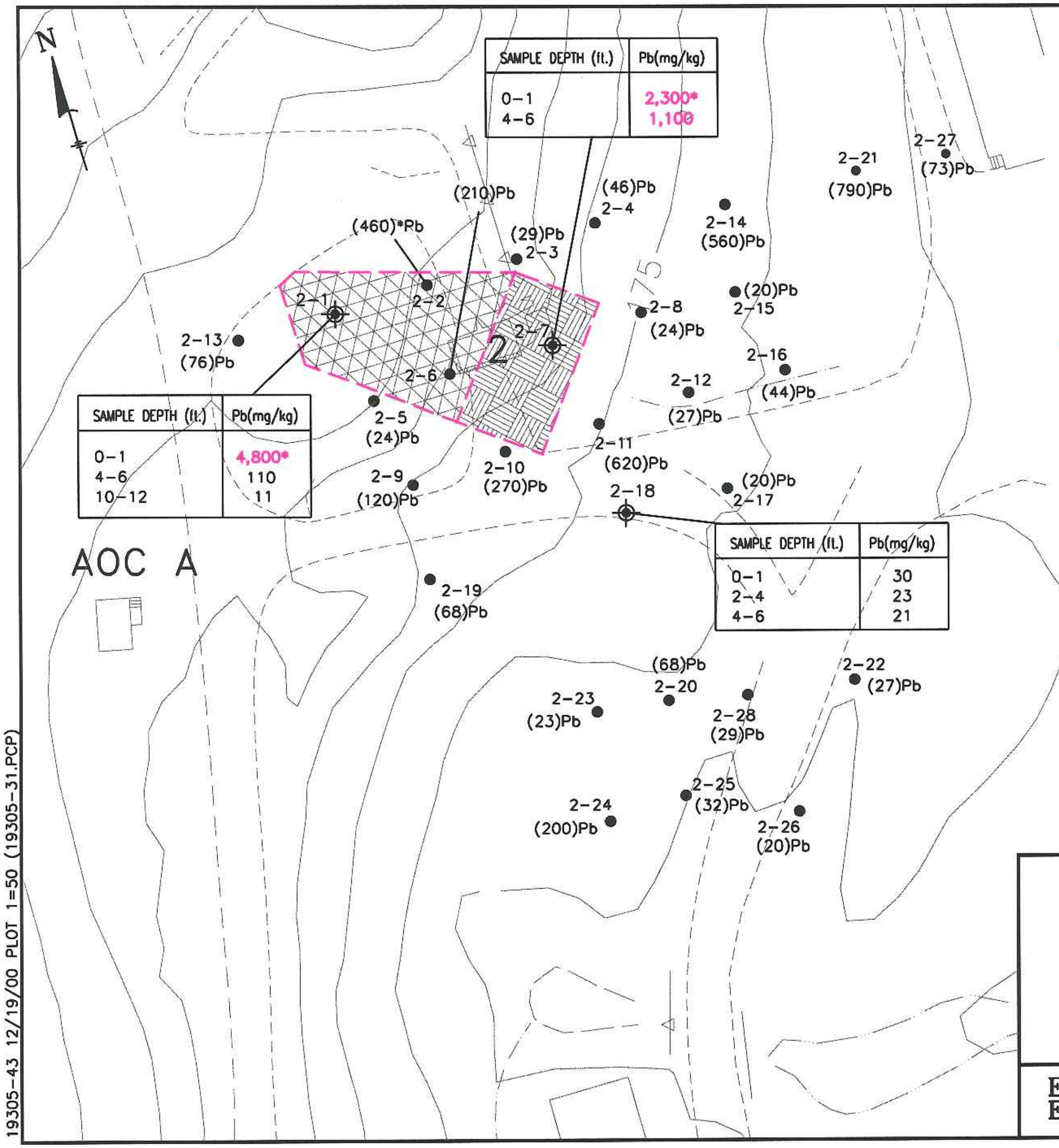
FIGURE 3-21

SWMU NOS. 1 & 22
INDUSTRIAL USE SOIL CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-42 12/19/00 PLOT 1=125 (19305-42.PCP)



SAMPLE DEPTH (ft.)	Pb(mg/kg)
0-1	2,300*
4-6	1,100

SAMPLE DEPTH (ft.)	Pb(mg/kg)
0-1	4,800*
4-6	110
10-12	11

SAMPLE DEPTH (ft.)	Pb(mg/kg)
0-1	30
2-4	23
4-6	21

LEGEND:

● 2-3	SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
2-7 ⊕	VERTICAL DELINEATION BORING
(12)	Pb CONCENTRATION (mg/kg) ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERION
(1.5)	Pb CONCENTRATION (mg/kg) BELOW INDUSTRIAL USE SOIL CLEANUP CRITERION
—175—	GROUND SURFACE CONTOUR
— — —	APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERIA
(hatched)	DEPTH OF EXCEEDANCES IS 6 FEET
(cross-hatched)	DEPTH OF EXCEEDANCES IS 1 FOOT
*	TWO SAMPLES WERE ANALYZED AT THIS SAMPLE LOCATION. THE CONCENTRATION SHOWN REPRESENTS THE GREATER OF THE TWO SAMPLING RESULTS.

NOTE:

1. THE INDUSTRIAL USE SOIL CLEANUP CRITERION FOR Pb IS 1,000 mg/kg.

0 50 100

scale feet

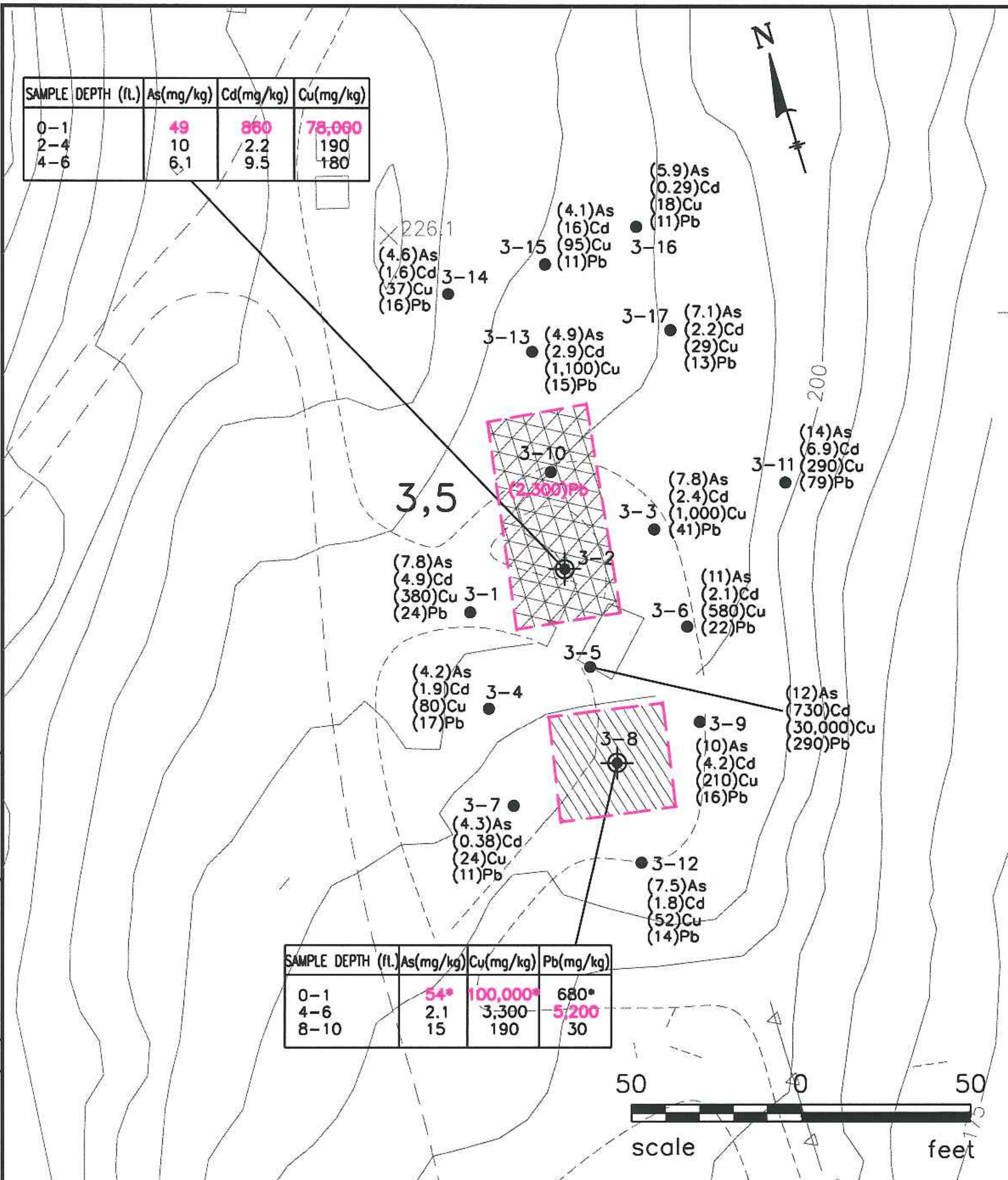
FIGURE 3-22

SWMU NO. 2 & AOC A
INDUSTRIAL USE SOIL CLEANUP
CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-43 12/19/00 PLOT 1=50 (19305-31.PCP)



SAMPLE DEPTH (ft.)	As(mg/kg)	Cd(mg/kg)	Cu(mg/kg)
0-1	49	860	78,000
2-4	10	2.2	190
4-6	6.1	9.5	180

SAMPLE DEPTH (ft.)	As(mg/kg)	Cu(mg/kg)	Pb(mg/kg)
0-1	54*	100,000*	680*
4-6	2.1	3,300	5,200
8-10	15	190	30

LEGEND:

- 3-16 ● SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
- 3-2 VERTICAL DELINEATION BORING
- (16) As, Cd, Cu OR Pb CONCENTRATION (mg/kg) ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERIA
- (1.8) As, Cd, Cu OR Pb CONCENTRATION (mg/kg) BELOW INDUSTRIAL USE SOIL CLEANUP CRITERIA
- 200 GROUND SURFACE CONTOUR
- 226.1 × GROUND SURFACE ELEVATION
- APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERIA
- * TWO SAMPLES WERE ANALYZED AT THIS SAMPLE LOCATION. THE CONCENTRATION SHOWN REPRESENTS THE GREATER OF THE TWO SAMPLING RESULTS.
- DEPTH OF EXCEEDANCES IS 1 FOOT
- DEPTH OF EXCEEDANCES IS 6 FEET MINIMUM

NOTE:

1. THE INDUSTRIAL USE SOIL CLEANUP CRITERIA FOR THE CONSTITUENTS ARE:

As= 27 mg/kg Cu= 76,000 mg/kg
Cd= 810 mg/kg Pb= 1,000 mg/kg

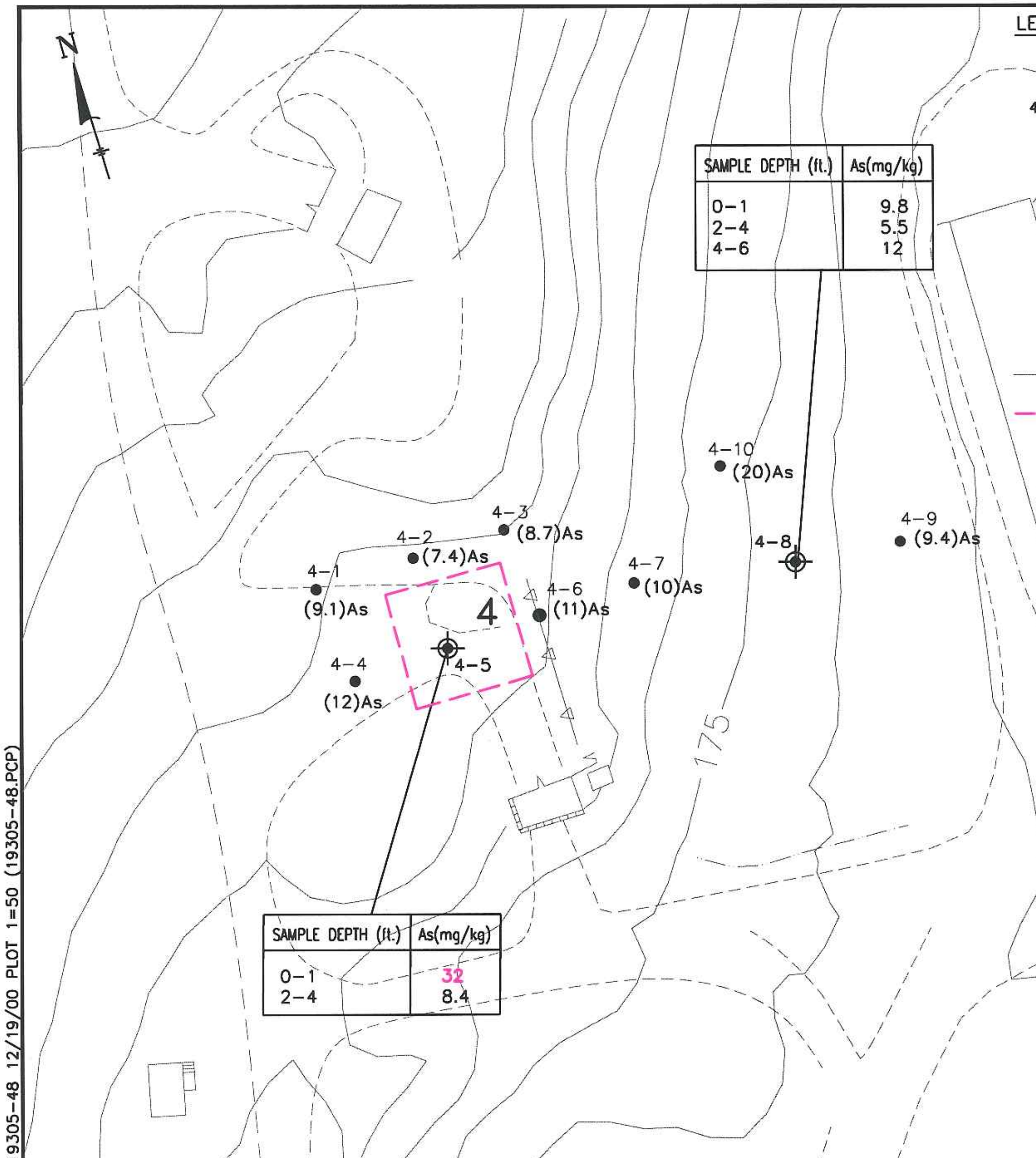
FIGURE 3-23

SWMU NOS. 3 & 5 INDUSTRIAL USE SOIL CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-44 12/19/00 PLOT 1=50 (19305-31.PCP)



LEGEND:

- 4-2 ● SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
- 4-5 ⊕ VERTICAL DELINEATION BORING
- (32) As CONCENTRATION (mg/kg) ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERION
- (7.4) As CONCENTRATION (mg/kg) BELOW INDUSTRIAL USE SOIL CLEANUP CRITERION
- —175— GROUND SURFACE CONTOUR
- — — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERIA

NOTE:

1. THE INDUSTRIAL USE SOIL CLEANUP CRITERION FOR As IS 27 mg/kg.

0 50 100

scale feet

FIGURE 3-24

SWMU NO. 4
INDUSTRIAL USE SOIL CLEANUP
CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER
ENGINEERING P.C. Mahwah, New Jersey

19305-48 12/19/00 PLOT 1=50 (19305-48.PCP)

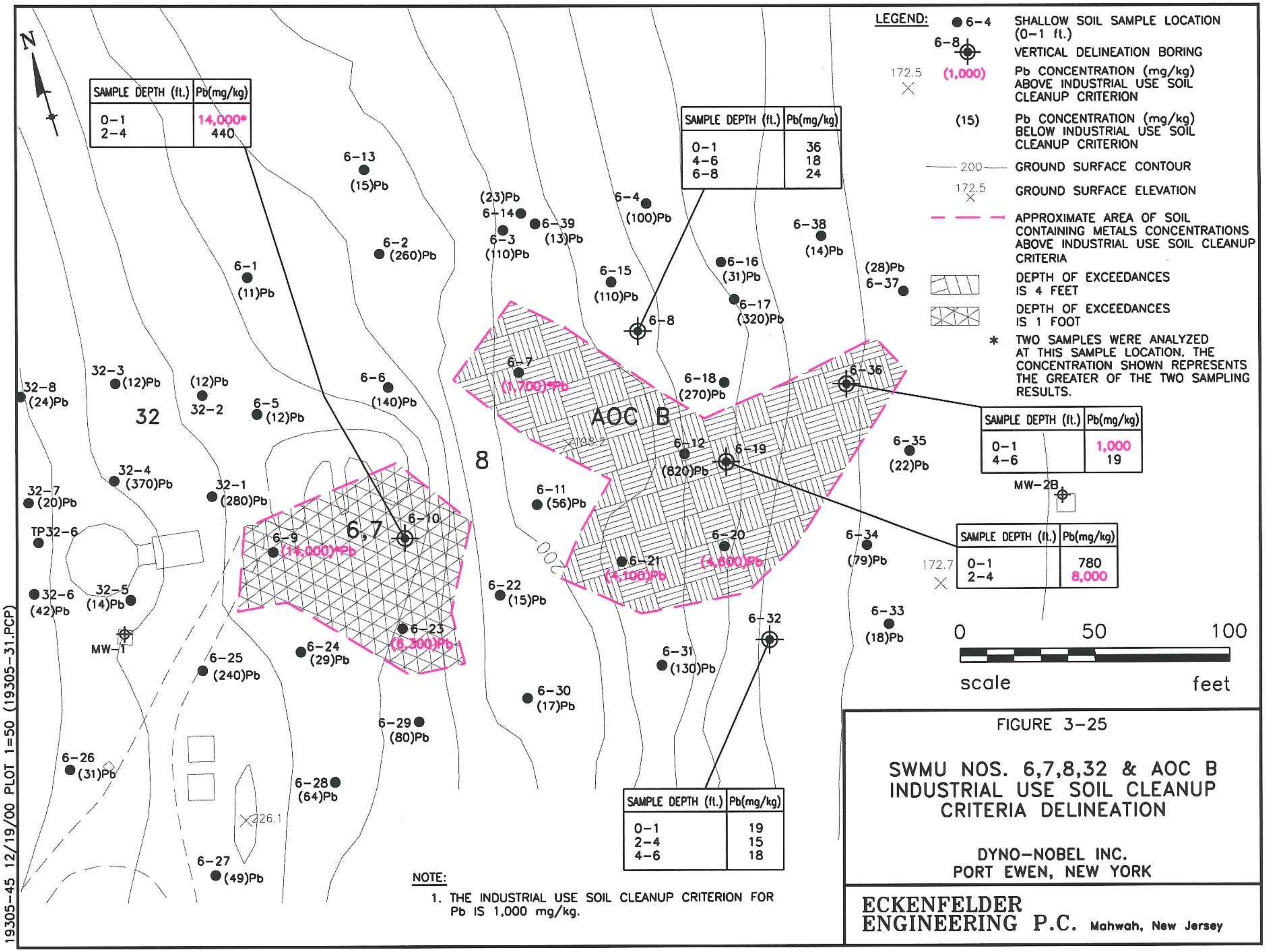
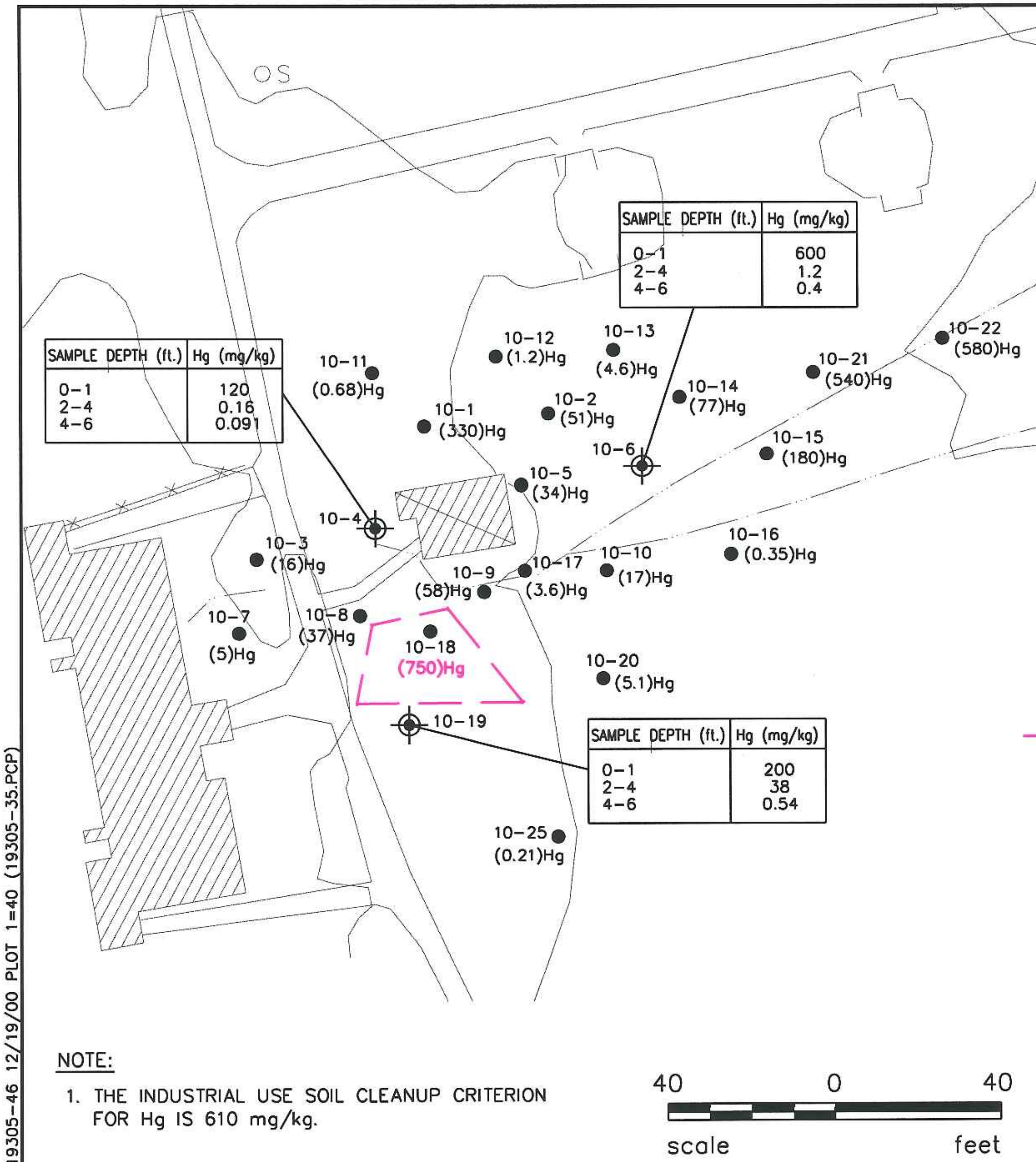


FIGURE 3-25

SWMU NOS. 6,7,8,32 & AOC B
INDUSTRIAL USE SOIL CLEANUP
CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey



LEGEND:

- 10-1 ● SHALLOW SOIL SAMPLE LOCATION (0-1.0 ft.)
- 10-19 ⌖ VERTICAL DELINEATION BORING
- (750) Hg CONCENTRATION (mg/kg) ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERION
- (0.35) Hg CONCENTRATION (mg/kg) BELOW INDUSTRIAL USE SOIL CLEANUP CRITERION
- — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERIA
- ▨ EXISTING STRUCTURE

NOTE:

1. THE INDUSTRIAL USE SOIL CLEANUP CRITERION FOR Hg IS 610 mg/kg.

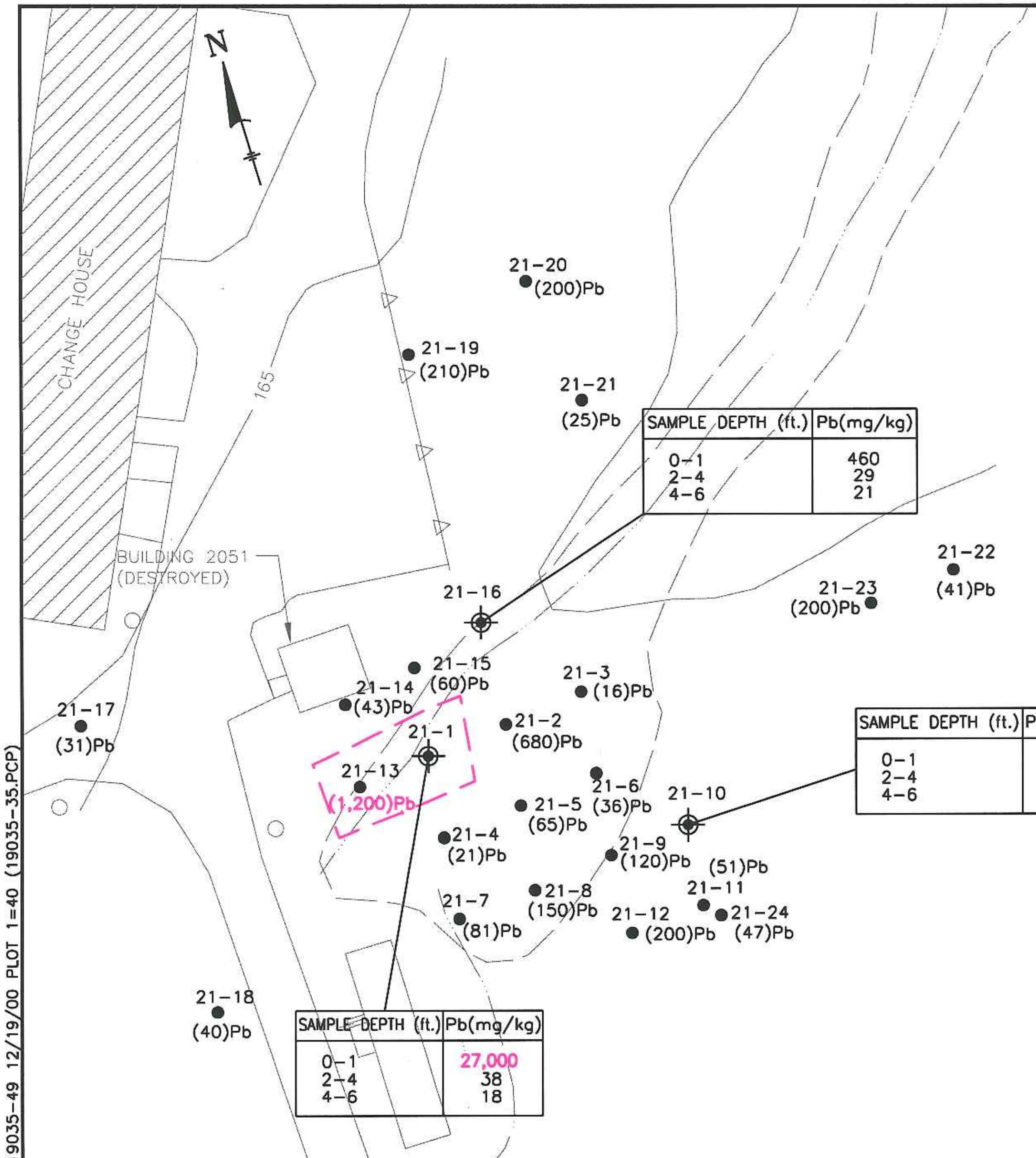
FIGURE 3-26

SWMU NO. 10 INDUSTRIAL USE SOIL CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-46 12/19/00 PLOT 1=40 (19305-35.PCP)



LEGEND:

- 21-21 ● SHALLOW SOIL SAMPLE LOCATION (0-1.0 ft.)
- 21-16 ⊕ VERTICAL DELINEATION BORING
- (2,700) Pb CONCENTRATION (mg/kg) ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERION
- (210) Pb CONCENTRATION (mg/kg) BELOW INDUSTRIAL USE SOIL CLEANUP CRITERION
- — — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERIA
- —165— GROUND SURFACE CONTOUR
- ▨ EXISTING STRUCTURE

NOTE:

1. THE INDUSTRIAL USE SOIL CLEANUP CRITERION FOR Pb IS 1,000 mg/kg.

40 0 40

scale feet

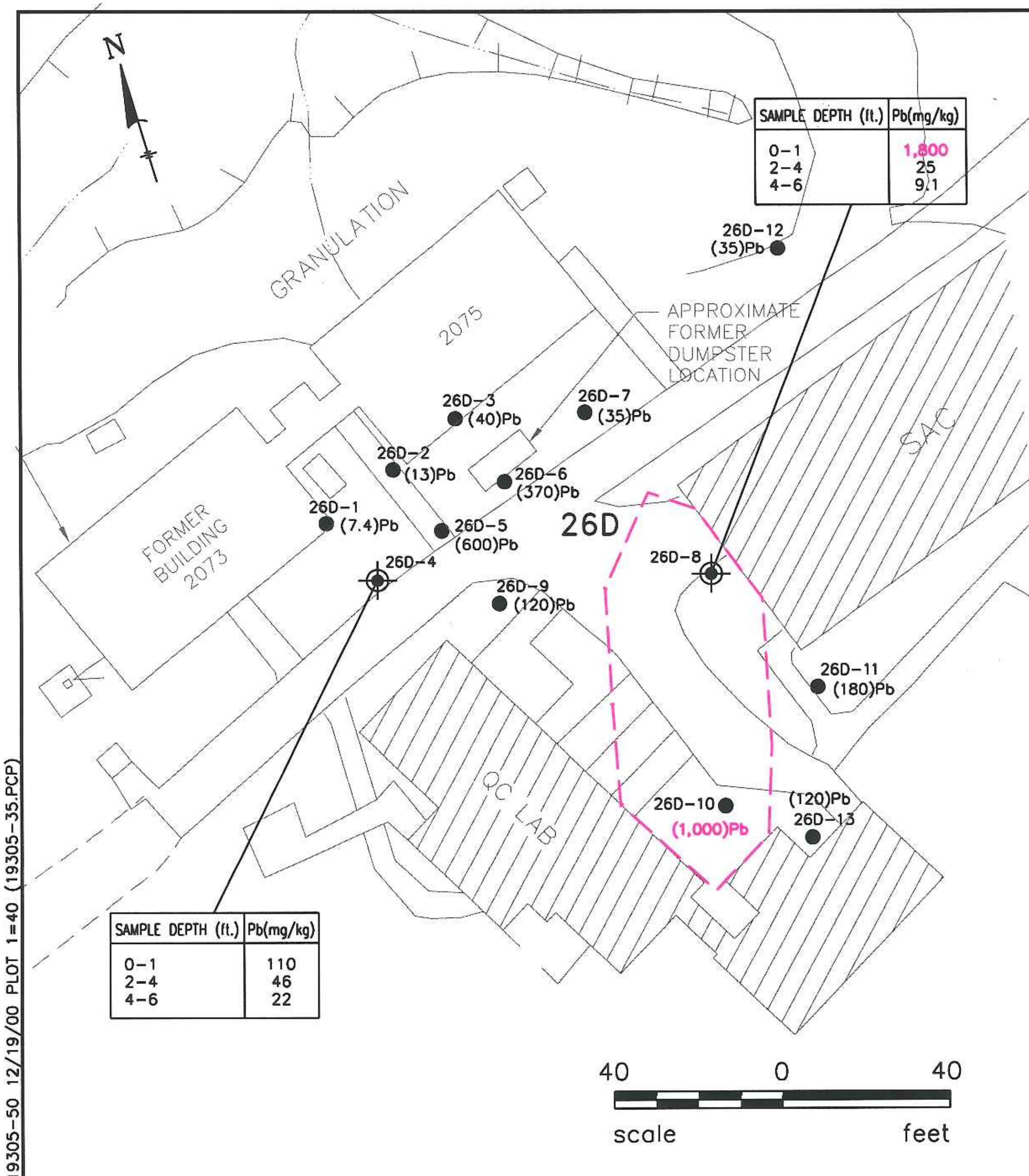
FIGURE 3-27

SWMU NO. 21
INDUSTRIAL USE SOIL CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19035-49 12/19/00 PLOT 1=40 (19035-35.PCP)



LEGEND:

26D-12 (●)	SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
26D-8 (⊕)	VERTICAL DELINEATION BORING
(1,800)	Pb CONCENTRATION (mg/kg) ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERION
(7.4)	Pb CONCENTRATION (mg/kg) BELOW INDUSTRIAL USE SOIL CLEANUP CRITERION
— — —	APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERIA
(hatched)	EXISTING STRUCTURE

NOTE:

1. THE INDUSTRIAL USE SOIL CLEANUP CRITERION FOR Pb IS 1,000 mg/kg.

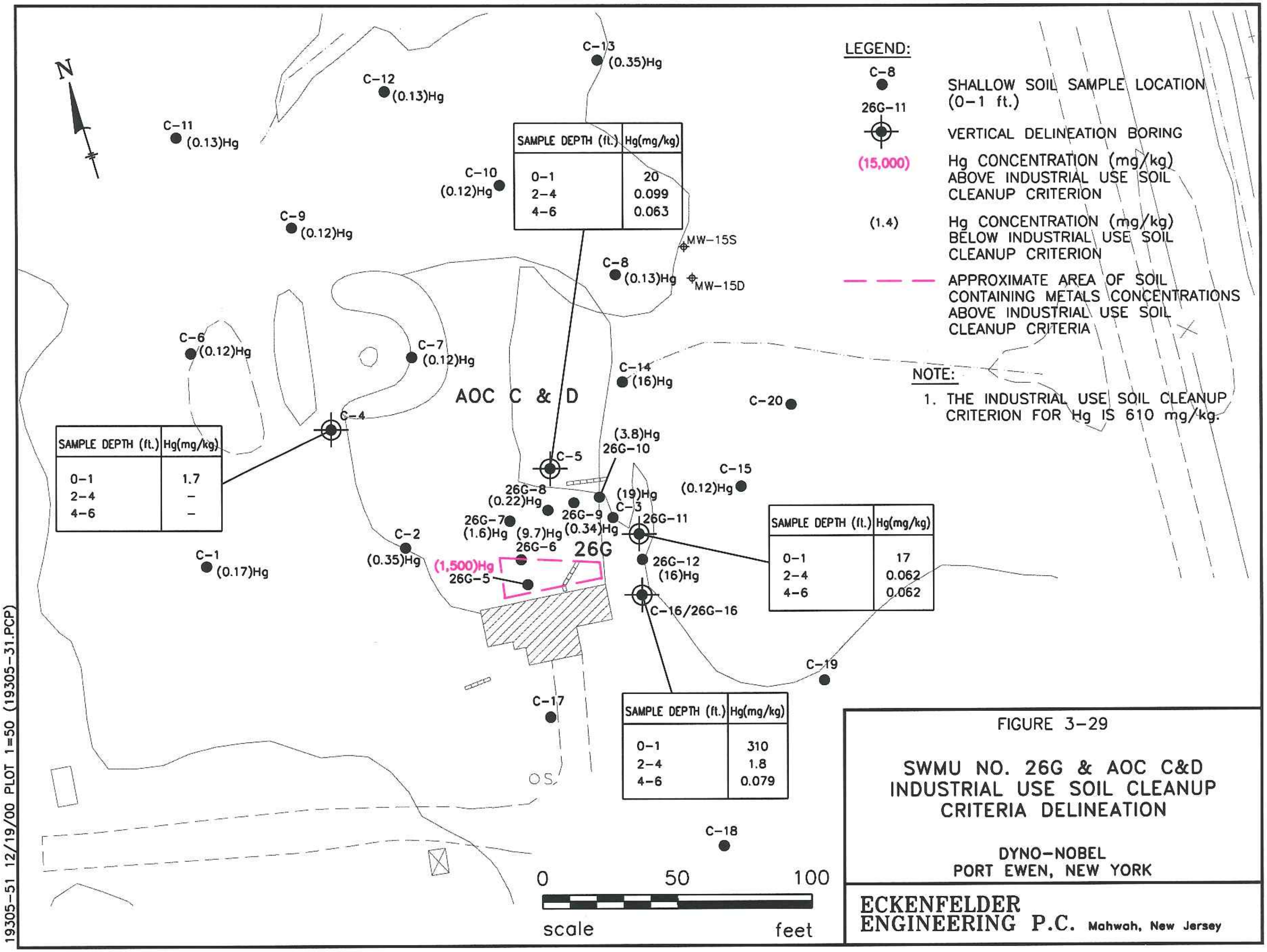
FIGURE 3-28

SWMU NO. 26D
INDUSTRIAL USE SOIL CLEANUP
CRITERIA DELINEATION

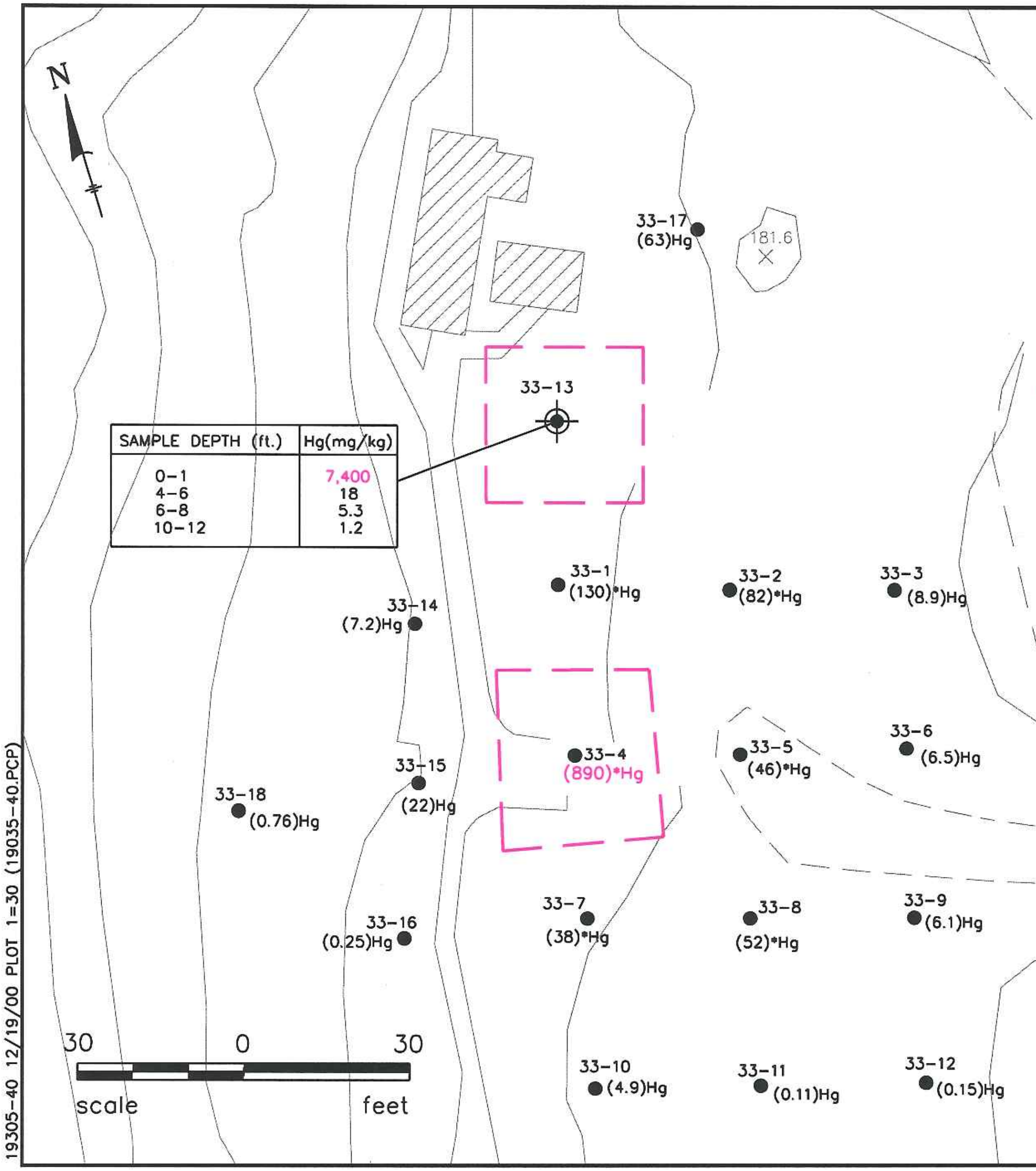
DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER
ENGINEERING P.C. Mahwah, New Jersey

19305-50 12/19/00 PLOT 1=40 (19305-35.PCP)



19305-51 12/19/00 PLOT 1=50 (19305-31.PCP)



SAMPLE DEPTH (ft.)	Hg(mg/kg)
0-1	7,400
4-6	18
6-8	5.3
10-12	1.2

LEGEND:

● 33-1	SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
⊕ 33-13	VERTICAL DELINEATION BORING
(7,400)	Hg CONCENTRATION (mg/kg) ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERION
(6.5)	Hg CONCENTRATION (mg/kg) BELOW INDUSTRIAL USE SOIL CLEANUP CRITERION
181.6 ×	GROUND SURFACE ELEVATION
— — —	APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERIA
//////	EXISTING STRUCTURE
*	TWO SAMPLES WERE ANALYZED AT THIS SAMPLE LOCATION. THE CONCENTRATION SHOWN REPRESENTS THE GREATER OF THE TWO SAMPLING RESULTS.

NOTE:

1. THE INDUSTRIAL USE SOIL CLEANUP CRITERION FOR Hg IS 610 mg/kg.

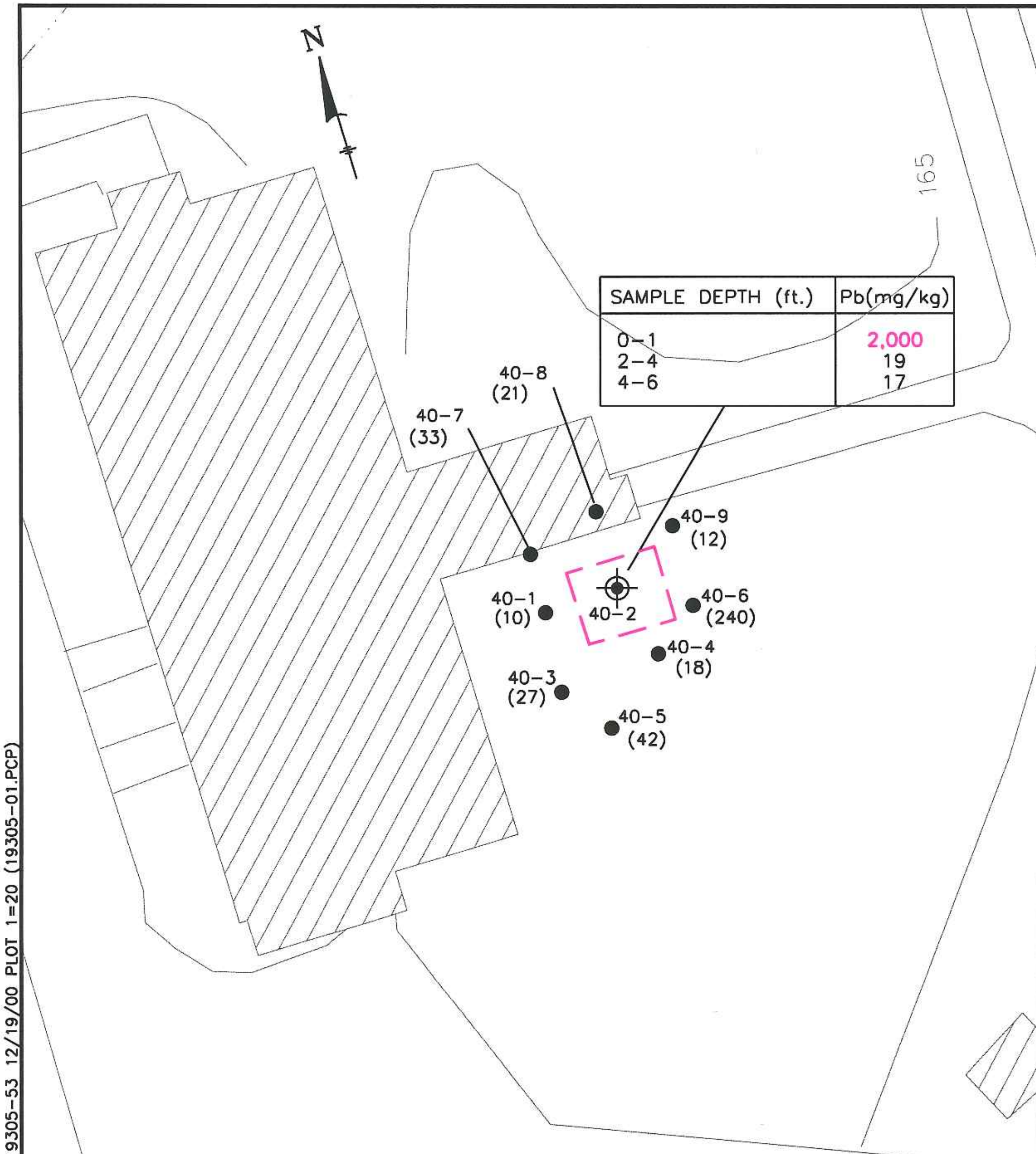
FIGURE 3-30

SWMU NO. 33
INDUSTRIAL USE SOIL CLEANUP CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-40 12/19/00 PLOT 1=30 (19035-40.PCP)



SAMPLE DEPTH (ft.)	Pb(mg/kg)
0-1	2,000
2-4	19
4-6	17

LEGEND:

- ● 40-7 — SHALLOW SOIL SAMPLE LOCATION (0-1 ft.)
- ⊕ 40-2 — VERTICAL DELINEATION BORING
- (2,000) — Pb CONCENTRATION (mg/kg) ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERION
- (10) — Pb CONCENTRATION (mg/kg) BELOW INDUSTRIAL USE SOIL CLEANUP CRITERION
- —165— — GROUND SURFACE CONTOUR
- — — — APPROXIMATE AREA OF SOIL CONTAINING METALS CONCENTRATIONS ABOVE INDUSTRIAL USE SOIL CLEANUP CRITERIA
- EXISTING STRUCTURE

NOTE:

1. THE INDUSTRIAL USE SOIL CLEANUP CRITERION FOR Pb IS 1,000 mg/kg.

20 0 20

scale feet

FIGURE 3-31

SWMU NO. 40
INDUSTRIAL USE SOIL CLEANUP
CRITERIA DELINEATION

DYNO-NOBEL INC.
PORT EWEN, NEW YORK

ECKENFELDER ENGINEERING P.C. Mahwah, New Jersey

19305-53 12/19/00 PLOT 1=20 (19305-01.PCP)

TABLE 3-1
Excavation and Off-Site Disposal Cost Estimates Summary
Unrestricted Use Soil Cleanup Criteria
Corrective Measure Study
Dyno Nobel - Port Ewen, NY

SWMU/AOC	Surface Area (SF)	Perimeter (LF)	Volume (CY)	If Waste Is Hazardous Estimated Capital Cost	If Waste Is Non-Hazardous Estimated Capital Cost
SWMU No. 1	13,000	500	6,000	$ 3,300,000	$ 2,000,000
SWMU No. 1/22	310,000	5,200	31,000	$ 15,000,000	$ 9,000,000
SWMU Nos. 2 & AOC A	20,000	700	4,400	$ 1,800,000	$ 1,100,000
SWMU Nos. 3 & 5	7,800	400	1,700	$ 750,000	$ 460,000
SWMU No. 4	7,300	400	300	$ 140,000	$ 90,000
SWMU Nos. 6,7,8,32 & AOC B	59,000	1,100	18,000	$ 7,300,000	$ 4,300,000
SWMU No. 9	1,600	200	200	$ 100,000	$ 62,000
SWMU No. 10	14,000	600	1,000	$ 430,000	$ 260,000
SWMU No. 11	1,400	100	200	$ 91,000	$ 59,000
SWMU No. 13	11,000	600	400	$ 190,000	$ 110,000
SWMU No. 21	12,000	700	500	$ 270,000	$ 200,000
SWMU No. 26D	16,000	600	600	$ 300,000	$ 190,000
SWMU No. 26 E	1,300	200	50	$ 30,000	$ 23,000
SWMU No. 26G & AOC C & D	18,000	600	700	$ 310,000	$ 190,000
SWMU No. 29	1,000	100	40	$ 25,000	$ 18,000
SWMU No. 33	11,000	500	2,500	$ 1,100,000	$ 600,000
SWMU No. 39	2,600	400	100	$ 52,000	$ 35,000
SWMU No. 40	100	100	5	$ 10,000	$ 10,000
SWMU No. 42	700	200	30	$ 17,000	$ 18,000
SWMU No. 47	3,100	200	900	$ 420,000	$ 250,000
SWMU No. 48	5,200	300	200	$ 90,000	$ 62,000
TOTAL:	**520,000**	**14,000**	**69,000**	**$ 32,000,000**	**$ 19,000,000**

TABLE 3-2
Permeable Cover Cost Estimates Summary
Industrial Use Soil Cleanup Criteria
Corrective Measures Study
Dyno Nobel - Port Ewen, NY

SWMU/AOC	Surface Area (SF)	Perimeter (LF)	Volume (CY)	Estimated Capital Cost	Estimated Annual Cost	Estimated Present Worth
SWMU No. 1	13,000	500	6,000	$ 150,000	----	----
SWMU No. 1/22	79,000	1,900	6,500	$ 690,000	$ 4,000	$ 800,000
SWMU Nos. 2 & AOC A	4,400	300	500	$ 22,000	$ 300	$ 27,000
SWMU Nos. 3 & 5	3,500	300	400	$ 18,000	$ 200	$ 21,000
SWMU No. 4	1,600	100	60	$ ~~16,000~~ 22,000	$ ~~100~~ 500	$ ~~18,000~~ 31,000
SWMU Nos. 6,7,8,32 & AOC B	17,000	800	1,900	$ 70,000	$ 900	$ 90,000
SWMU No. 10	700	100	30	$ 12,000	$ 100	$ 14,000
SWMU No. 21	800	100	30	$ 12,000	$ 100	$ 14,000
SWMU No. 26D	3,400	200	100	$ 18,000	$ 300	$ 23,000
SWMU No. 26G & AOC C & D	500	90	20	$ 11,000	$ 100	$ 13,000
SWMU No. 33	2,000	200	80	$ 18,000	$ 200	$ 21,000
SWMU No. 40	100	40	5	$ 10,000	$ 50	$ 11,000

1,047,000

TABLE 3-3
Stabilization/Fixation Cost Estimates Summary
Industrial Use Soil Cleanup Criteria
Corrective Measures Study
Dyno Nobel - Port Ewen, NY

SWMU/AOC	Surface Area (SF)	Perimeter (LF)	Volume (CY)	Estimated Capital Cost
SWMU Nos. 2 & AOC A	4,400	300	500	$ 59,000
SWMU Nos. 3 & 5	3,500	300	400	$ 59,000
SWMU No. 4	1,600	100	60	$ 32,000
SWMU Nos. 6,7,8,32 & AOC B	17,000	800	1,900	$ 160,000
SWMU No. 10	700	100	30	$ 24,000
SWMU No. 21	800	100	30	$ 24,000
SWMU No. 26D	3,400	200	100	$ 42,000
SWMU No. 26G & AOC C & D	500	90	20	$ 24,000
SWMU No. 33	2,000	200	80	$ 30,000
SWMU No. 40	100	40	5	$ 22,000

TABLE 3-4
Phytoremediation Cost Estimates Summary
Industrial Use Soil Cleanup Criteria
Corrective Measures Study
Dyno Nobel - Port Ewen, NY

SWMU/AOC	Surface Area (SF)	Perimeter (LF)	Volume (CY)	Estimated Capital Cost	Estimated Cost per Year	Estimated Present Worth
SWMU No. 1/22	79,000	1,900	6,500	$ 41,000	$ 110,000	$ 1,100,000
SWMU No. 10	700	100	30	$ 2,700	$ 9,900	$ 97,000
SWMU No. 21	800	100	30	$ 2,800	$ 8,700	$ 89,000
SWMU No. 26G & AOC C &D	500	90	20	$ 2,700	$ 9,900	$ 97,000
SWMU No. 40	100	40	5	$ 2,600	$ 6,000	$ 61,000

TABLE 3-5
Excavation, On-Site Consolidation and Capping Cost Estimates Summary
Industrial Use Soil Cleanup Criteria
Corrective Measures Study
Dyno Nobel - Port Ewen, NY

SWMU/AOC	Surface Area (SF)	Perimeter (LF)	Volume (CY)	Estimated Capital Cost	Estimated Annual Cost	Estimated Present Worth
SWMU No. 1	13,000	500	6,000	$ 540,000	$ -	$ -
SWMU No. 1/22	79,000	1,900	6,500	$ ~~490,000~~ 500,000	$ -	$ -
SWMU Nos. 2 & AOC A	4,400	300	500	$ 43,000	$ -	$ -
SWMU Nos. 3 & 5	3,500	300	400	$ 44,000	$ -	$ -
SWMU No. 4	1,600	100	60	$ 19,000	$ -	$ -
SWMU Nos. 6,7,8,32 & AOC B	17,000	800	1,900	$ 140,000	$ -	$ -
SWMU No. 10	700	100	30	$ 9,700	$ -	$ -
SWMU No. 21	800	100	30	$ 10,000	$ -	$ -
SWMU No. 22	66,000	900	----	$ 340,000	$ 5,700	$ 440,000
SWMU No. 23	24,000	800	----	$ 180,000	$ 2,000	$ 220,000
SWMU No. 26D	3,400	200	100	$ 25,000	$ -	$ -
SWMU No. 26G & AOC C & D	500	90	20	$ 9,000	$ -	$ -
SWMU No. 33	2,000	200	80	$ 18,000	$ -	$ -
SWMU No. 40	100	40	5	$ 7,600	$ -	$ -

TABLE 3-6
Excavation and Off-Site Disposal Cost Estimates Summary
Industrial Use Soil Cleanup Criteria
Corrective Measures Study
Dyno Nobel - Port Ewen, NY

SWMU/AOC	Surface Area (SF)	Perimeter (LF)	Volume (CY)	If Waste Is Hazardous Estimated Capital Cost	If Waste Is Non-Hazardous Estimated Capital Cost
SWMU No. 1	13,000	500	6,000	$3,300,000	$ 2,000,000
SWMU No. 1/22	79,000	1,900	6,500	$3,200,000	$ 1,900,000
SWMU Nos. 2 & AOC A	4,400	300	500	$ 220,000	$ 140,000
SWMU Nos. 3 & 5	3,500	300	400	$ 200,000	$ 120,000
SWMU No. 4	1,600	100	60	$ 39,000	$ 30,000
SWMU Nos. 6,7,8,32 & AOC B	17,000	800	1,900	$ 820,000	$ 500,000
SWMU No. 10	700	100	30	$ ~~21,000~~ 71,000	$ ~~15,000~~ 45,000
SWMU No. 21	800	100	30	$ 21,000	$ 15,000
SWMU No. 26D	3,400	200	100	$ 64,000	$ 46,000
SWMU No. 26G & AOC C & D	500	90	20	$ ~~16,000~~ 25,000	$ ~~12,000~~ 16,000
SWMU No. 33	2,000	200	80	$ 44,000	$ 31,000
SWMU No. 40	100	40	5	$ 10,000	$ 8,900
SWMU No 11	200	25	7	11,000	10,000

TABLE 3-7
Landfill Cover Cost Estimates Summary
Corrective Measures Study
Dyno Nobel - Port Ewen, NY

SWMU/AOC	Surface Area (SF)	Perimeter (LF)	Estimated Capital Cost	Estimated Annual Cost	Estimated Present Worth
SWMU No. 22 (Landfill)	66,000	900	$ 240,000	$ 3,000	$ 290,000
SWMU No. 23 (Landfill)	24,000	800	$ 110,000	$ 1,000	$ 130,000
SWMU No. 32 (Landfill)	14,000	600	$ 86,000	$ 800	$ 100,000
SWMU No. 35 (Landfill)	10,000	500	$ 61,000	$ 600	$ 70,000
SWMU No. 48 (Landfill)	6,200	600	$ 41,000	$ 300	$ 46,000

As described in Sections 3.3.1.1, 3.3.2.1, and 3.3.3.1, the no action alternatives do not satisfy the corrective measure objectives and, therefore, are not protective of human health and the environment. As a result, the no action alternatives were not carried through to the comparative analysis.

4.2 HEAVY METAL SURFACE DEPOSITION

Excluding no action, the alternatives that were evaluated in CMS Task II for the HMSD Group include:

- Permeable Cover
- Stabilization/Fixation
- Phytoremediation
- Excavation, On-Site Consolidation, and Capping
- Excavation and Off-Site Disposal

Certain SWMUs and AOCs within the HMSD Group possess differing characteristics which effect the performance, reliability, implementability and/or safety of the corrective measure alternatives. The following characteristics were taken into account before recommending corrective measure alternatives for the SWMUs/AOCs in this group:

- location within the plant site (active vs. remote area);
- proximity to other SWMUs/AOCs;
- constituents exceeding target cleanup levels;
- vertical extent of exceedances;
- volume of soil exceeding the target cleanup levels

Based on these characteristics, the SWMUs/AOCs were divided into three subgroups, as follows:

- HMSD 1 Subgroup - SWMU No. 2 & AOC A, SWMU Nos. 3 & 5, SWMU No. 4 and SWMU Nos. 6, 7, 8, 32 & AOC B

- HMSD 2 Subgroup - SWMU No. 10, SWMU No. 26G & AOC C & D and SWMU No. 33

- HMSD 3 Subgroup - SWMU No. 21, SWMU No. 26D and SWMU No. 40

The recommended alternative for each subgroup and justification for the recommendation are provided below.

4.2.1 HMSD 1 Subgroup

These SWMUs and AOCs are all located in close proximity to each other in the northwest portion of the site. The constituents exceeding the industrial use TCLs at one or more of the SWMUs/AOCs within this subgroup include lead, selenium, arsenic, copper and cadmium. The SWMUs/AOCs at which each constituent exceeds its TCL are as follows:

	Constituent				
SWMU/AOC	Lead	Selenium	Arsenic	Copper	Cadmium
2 & A	*	*			
3 & 5	*		*	*	*
4			*		
6,7,8,32 & B	*				

* indicates that the target cleanup levels were exceeded in at least one sampling location for that constituent at the SWMU/AOC.

The alternatives that may be applicable to this subgroup include permeable cover; stabilization/fixation; excavation, on-site consolidation and capping; and excavation and off-site disposal. Phytoremediation is not considered applicable because exceedances of the TCLs occur at depths of 4 to 6 feet at a number of locations within the SWMUs/AOCs. Based on the technical, human health and environmental evaluation presented in

Section 3.3.1, the recommended alternative for the HMSD 1 Subgroup is a permeable cover consisting of a geotextile overlain by 6 to 18 inches of clean fill, 6 inches of topsoil and vegetation. The justification for this recommendation is as follows:

- A permeable cover is a proven effective, reliable barrier that eliminates the direct contact exposure pathway for potential human and environmental receptors.

- In addition to providing a direct-contact barrier, a permeable cover would protect against erosion of the underlying soil containing constituents at concentrations above target cleanup criteria.

- There are no specific site or waste characteristics that would significantly impede the effectiveness of a permeable cover.

- The permeable cover would require minimal maintenance to establish/maintain the vegetative cover and can be expected to become self-sustaining with time.

- The SWMUs/AOCs are located in remote areas of the site, which minimizes the potential for disturbance of the cover by site workers.

- The permeable cover alternative is readily implementable and does not require specialized equipment that would be required for stabilization/fixation.

- Stabilization/fixation is less effective in clayey soils and the long-term effectiveness of this technology is unproven.

- The excavation alternatives have higher short-term environmental risks than the permeable cover alternative due to the potential for release of constituents to adjacent areas during implementation.

- On-site consolidation at the nearby landfill (SWMU No. 32) is not practicable due to the existing topography. Consolidation at SWMU No. 22 or 23 would require extensive trucking of excavated soils through the facility increasing potential short-term risks associated with spills and accidents.

- Off-site disposal would require approximately 200 truck trips, take longer to implement than the other alternatives, and has the greatest potential for short-term impacts associated with off-site tracking, spills and accidents.

4.2.2 HMSD 2 Subgroup

The HMSD 2 Subgroup includes SWMU No. 10, SWMU No. 26G & AOC C & D, and SWMU No. 33. The only constituent that exceeds the industrial use TCLs in this subgroup is mercury. The alternatives that may be applicable to this subgroup include permeable cover; stabilization/fixation; phytoremediation (except for SWMU No. 33); excavation, on-site consolidation and capping; and excavation and off-site disposal. Phytoremediation is not applicable to SWMU No. 33 as a portion of the area is paved.

Based on the technical, human health and environmental evaluation presented in Section 3.3.1, the recommended alternative for the HMSD 2 Subgroup is excavation and off-site disposal. The justification for this recommendation is as follows:

- The excavation alternatives can be implemented in a short timeframe (approximately one week) and the beneficial results are immediate.

- Since the excavation alternatives would remove the soils containing constituent concentrations above the target cleanup levels, their effectiveness is permanent and reliability is not an issue (i.e., no O&M would be required). There are no specific site or waste characteristics that would impede the effectiveness of the excavation alternatives.

- Short-term environmental risks associated with the excavation alternatives (i.e., release of constituents to adjacent areas) can be controlled using conventional measures such as silt fencing, hay bales and wetting.

- Short-term safety risks associated with the excavation alternatives have been minimized as a result of the Interim Corrective Measures that were implemented to address potential explosion hazards. If necessary, the excavation activities can be scheduled during a plant shutdown period to so that sensitive operations are not being conducted in the vicinity of the excavation work.

- The quantity of soil to be remediated is relatively small (approximately 120 cubic yards) and therefore would not require extensive trucking of excavated soils through the facility.

- The constituent of concern at SWMU Nos. 10, 26G and 33 and AOCs C and D (mercury) is potentially more mobile (i.e., may volatilize) than the other inorganic constituents of concern at the site. Off-site disposal would provide greater protection against potential short- and long-term environmental risks than on-site consolidation.

- Stabilization/fixation is less effective in clayey soils and the long-term effectiveness of this technology is unproven.

- Phytoremediation would require a substantially longer time to attain the target cleanup criteria than the other alternatives (the actual time is uncertain) and O&M requirements (harvesting, replanting and testing) are more extensive than the other alternatives.

- The effectiveness of phytoremediation in addressing the combination of constituents present within the SWMUs is uncertain because the uptake of a particular constituent can be reduced in the presence of other constituents.

- The SWMUs/AOCs are located in active areas of the site where there is greater potential for disturbance of a permeable cover.

4.2.3 HMSD 3 Subgroup

The HMSD 3 Subgroup includes SWMU No. 21, SWMU No. 26D and SWMU No. 40. The only constituent that exceeds the industrial use TCLs in this subgroup is lead. The alternatives that may be applicable to this subgroup include permeable cover; stabilization/fixation; phytoremediation (except for SWMU No. 26D); excavation, on-site consolidation and capping; and excavation and off-site disposal. Phytoremediation is not applicable to SWMU No. 26D as a portion of the area is paved.

Based on the technical, human health and environmental evaluation presented in Section 3.3.1, the recommended alternative for the HMSD 3 Subgroup is excavation, on-site consolidation and capping. The justification for this recommendation is as follows:

- The excavation alternatives can be implemented in a short timeframe (approximately one week) and the beneficial results are immediate.

- Since the excavation alternatives would remove the soils containing constituent concentrations above the target cleanup levels, their effectiveness is permanent and reliability is not an issue (i.e., no O&M would be required). There are no specific site or waste characteristics that would impede the effectiveness of the excavation alternatives and the available data suggest that the soils likely will not exhibit the Toxicity Characteristic.

- Short-term environmental risks associated with the excavation alternatives (i.e., release of constituents to adjacent areas) can be controlled using conventional measures such as silt fencing, hay bales and wetting.

- Short-term safety risks associated with the excavation alternatives have been minimized as a result of the Interim Corrective Measures that were implemented to address potential explosion hazards. If necessary, the excavation activities can be scheduled during a plant shutdown period to so that sensitive operations are not being conducted in the vicinity of the excavation work.

- The SWMUs are located in the general vicinity of SWMU No. 23 for which capping (permeable cover) has been recommended, and the excavated soils can be readily transported to and redeposited at that landfill prior to construction of the permeable cover.

- The constituent of concern at SWMU Nos. 21, 26D and 40 (lead) has low mobility and there is no significant incremental environmental risk associated with on-site consolidation of the excavated soils at the nearby landfill, which will receive a permeable cover.

- Stabilization/fixation is less effective in clayey soils and the long-term effectiveness of this technology is unproven.

- Phytoremediation would require a substantially longer time to attain the target cleanup criteria than the other alternatives (the actual time is uncertain) and O&M requirements (harvesting, replanting and testing) are more extensive than the other alternatives.

- The effectiveness of phytoremediation in addressing the combination of constituents present within the SWMUs is uncertain because the uptake of a particular constituent can be reduced in the presence of other constituents.

- The SWMUs/AOCs are located in active areas of the site where there is greater potential for disturbance of a permeable cover.

4.3 SHOOTING POND

The only constituent exceeding the industrial use TCL at the Shooting Pond is lead. The estimated volume of sediments containing lead concentrations above the TCL is 6,000 cubic yards. The alternatives that may be applicable to this SWMU include permeable cover; excavation, on-site consolidation and capping; and excavation and off-site disposal.

Based on the technical, human health and environmental evaluation presented in Section 3.3.2, the recommended alternative for the Shooting Pond is a permeable cover consisting of a coarse stone layer underlain by geotextile. The justification for this recommendation is as follows:

- A permeable cover is a proven effective, reliable barrier that eliminates the direct contact exposure pathway for potential human and environmental receptors.

- In addition to providing a direct-contact barrier, a permeable cover would protect against potential resuspension of sediments and subsequent transport/redeposition via surface water. Furthermore, the constituent of concern at this SWMU (lead) has low mobility.

- There are no specific site or waste characteristics that would significantly impede the effectiveness of a permeable cover.

- The permeable cover would be self-sustaining (i.e., no maintenance requirements) as the geotextile and stone would be resistant to erosion and degradation.

- The permeable cover alternative can be implemented more quickly than the excavation alternatives without the need for specialized labor and equipment that would be required for excavation (i.e., screening for explosive materials). The beneficial results are immediate.

- Removal of sediments containing constituent concentrations above the target cleanup criteria would require extensive excavation to a depth of at least 12 feet and complicated handling requirements to both screen for explosive materials and dewater the sediments for subsequent treatment and disposal.

- The excavation alternatives have higher short-term environmental risks than the permeable cover alternative due to the potential for release of constituents to adjacent areas during implementation.

- The excavation alternatives have higher short-term safety risks than the permeable cover alternative due to the possibility of encountering explosive materials during implementation.

- The excavation alternatives would have a longer implementation time than the permeable cover alternative (approximately two months versus one-to-two weeks).

- The excavation alternatives would be significantly more costly than the permeable cover alternative without significant additional benefit.

- Considering the shooting pond and surrounding wetlands together, the surface area of the shooting pond makes up only 14 percent of the total surface area exceeding the target cleanup levels. As described below (see Section 4.4 - Wetlands) excavation is considered feasible and practicable for the wetlands. In combination, these alternatives will reduce the exceedance area by 86 percent while minimizing short-term risks and providing a high degree of long-term effectiveness and reliability.

4.4 WETLANDS

The constituents that exceed the industrial use TCLs in one or more of the samples collected within the Wetlands include lead, copper and arsenic. The estimated volume of soil containing constituent concentrations above the TCLs is 6,500 cubic yards. The alternatives that may be applicable to the Wetlands include permeable cover; phytoremediation; excavation, on-site consolidation and capping; and excavation and off-site disposal.

Based on the technical, human health and environmental evaluation presented in Section 3.3.3, the recommended alternative for the Wetlands is excavation, on-site consolidation and capping. The excavated soil would be redeposited at the adjacent landfills, SWMU Nos. 22 and 35, and the excavated area would be restored with clean fill and wetland vegetation. The justification for this recommendation is as follows:

- The permeable cover alternative has the shortest implementation time, the lowest short-term safety and environmental risks, and would address the pathways of concern (direct contact exposure and potential erosion of sediments and subsequent transport/redeposition via surface water). However, it would result in a permanent loss of wetlands. Mitigation measures would be required to offset the loss, increasing the cost of this alternative.

- Phytoremediation would require a substantially longer time to attain the target cleanup criteria than the excavation alternatives (the actual time is uncertain) and O&M requirements (harvesting, replanting and testing) are more extensive than the other alternatives.

- The effectiveness of phytoremediation in addressing the combination of constituents present within the wetlands is uncertain because the uptake of a particular constituent can be reduced in the presence of other constituents.

- *Phragmites* may compete with the desirable plantings and reduce the effectiveness of phytoremediation.

- The excavation alternatives can be implemented in a relatively short timeframe (approximately one month) and the beneficial results are immediate.

- Since the excavation alternatives would remove the soils containing constituent concentrations above the target cleanup levels, their effectiveness is permanent and reliability is not an issue (i.e., no O&M would be required). There are no specific site or waste characteristics that would impede the effectiveness of the excavation alternatives and the available data suggest that the soils likely will not exhibit the Toxicity Characteristic.

- The wetland impacts associated with the excavation alternatives are temporary and the wetlands would be restored in place.

- Short-term environmental risks associated with the excavation alternatives (i.e., release of constituents to adjacent areas) can be controlled using conventional measures such as silt fencing, hay bales and temporary berms.

- Excavation within the wetland area poses far less safety risk than the shooting pond. The wetland area adjacent to the pond was found not to contain reactive quantities of explosive materials during the Interim Corrective Measures.

- There is no significant incremental environmental risk associated with on-site consolidation of excavated soils at the adjacent landfills, which will receive a permeable cover.

- On-site consolidation of excavated soils at the adjacent landfills is more readily implementable than off-site disposal at significantly less cost.

- Off-site disposal would require approximately 475 truck trips, take longer to implement than on-site consolidation, and has greater potential for short-term impacts associated with off-site tracking, spills and accidents.

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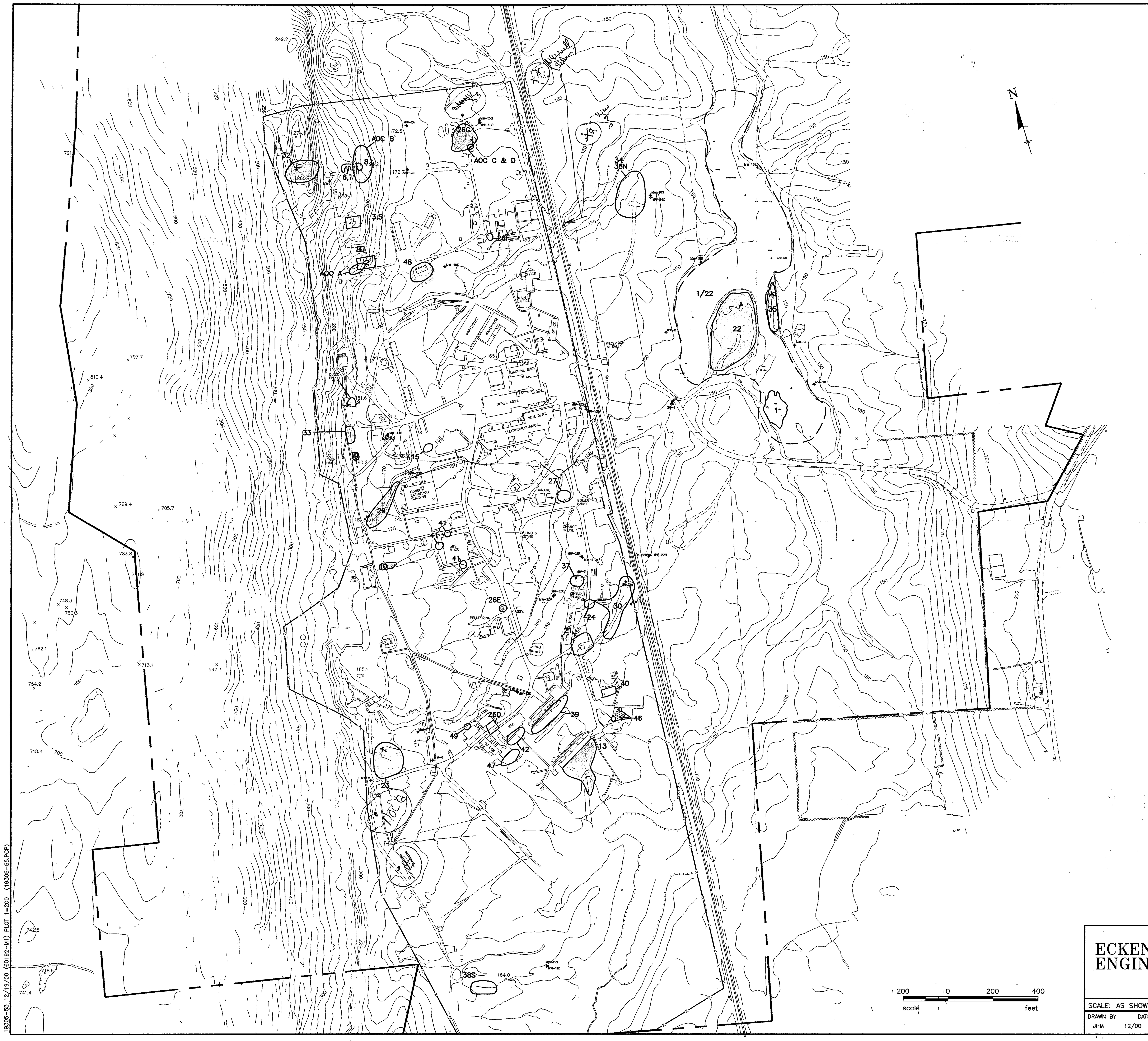

SWMU

1. SHOOTING POND
2. BURNING CAGE/INCINERATOR
3. COPPER WIRE BURNING AREA
4. IRON WIRE BURNING AREA
5. WIRE BURNING AREA
6–7. OPEN BURNING PADS
8. FORMER BURNING AREA
9. WASTE POWDER CATCH BASINS–BUILDING 2037
10. WASTE POWDER CATCH BASINS–BUILDING 2048
11. WASTE POWDER CATCH BASINS–BUILDING 2049
13. FORMER WASTE POWDER CATCH BASINS–LEAD AZIDE BUILDING
15. WASTE POWDER MAGAZINE–BUILDING 9216
21. LEAD RECYCLING UNIT AREA
22. FORMER LANDFILL
23. FORMER DUMP
24. FORMER WASTEWATER TREATMENT FACILITY
26. BURNABLE WASTE SATELLITE ACCUMULATION AREAS
27. SANITARY SEWER SYSTEM (NOT ILLUSTRATED ON THIS DRAWING)
29. DRAINAGE DITCH (DOWNGRADE OF BUILDING 2049)
30. DRAINAGE DITCH (DOWNGRADE OF BUILDING 2036)
32. OLD DUMP (NEAR WATER TOWER)
33. MERCURY FULMINATE TANKS AREA
34. OLD WASTE BURNING GROUNDS (NEAR SHOOTING POND)
35. STONE FENCE DUMP
37. FORMER SHELL PLANT DRUM STORAGE AREA
38. GRENADE DISPOSAL AREA
39. FORMER WASHWATER DISCHARGE AREA–BUILDING 2009
40. PILOT LINE CONDENSATE COLLECTION SUMP
41. DETONATOR PRODUCTION BUILDING CONDENSATE COLLECTION SUMPS
42. SAC BUILDING STEAM COLLECTION CONTAINERS
46. VACUUM LINE CONDENSATE COLLECTION SUMP (BUILDING 2059)
47. BUILDING 2058 AREA
48. MERCURY FULMINATE AREA
49. BUILDING 2073 SUMP

1/22. COMBINED AREA FOR SWMU'S 1 & 22

AOC

A KEROSENE TANK LEAK
B OPEN BURNING PADS AREA
C OPEN DETONATION PIT
D DETONATION TEST BUILDING

LEGEND:

MW–12S — MONITORING WELL LOCATION
23 — SOLID WASTE MANAGEMENT UNITS
☆ — PLANT PRODUCTION WELL LOCATION
— · · — APPROXIMATE PROPERTY BOUNDARIES

200 0 200 400
scale feet

NO.	REVISIONS	REV'D BY	DATE	APPRO'D BY

ECKENFELDER ENGINEERING P.C.
Mahwah, New Jersey

SCALE: AS SHOWN

DYNO–NOBEL INC.
PORT EWEN, NEW YORK

SWMU AND AOC LOCATIONS

DRAWN BY	DATE	CHECKED BY	APPROVED BY	JOB NUMBER	DRAWING NUMBER
JHM	12/00	NC	JRC	19305.001	FIGURE 1–2

19305–55 12/19/00 (60192–M1) PLOT 1=200 (19305–55.PCP)