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ARCS II

FINAL REMEDIAL INVESTIGATION REPORT
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

VOLUME I

REMEDIAL PLANNING ACTIVITIES AT SELECTED UNCONTROLLED HAZARDOUS SUBSTANCE DISPOSAL SITES WITHIN EPA REGION II
(NY, NJ, PR, VI)

CDM Federal Programs Corporation

FINAL REMEDIAL INVESTIGATION REPORT
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

VOLUME I

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FOREST GLEN REMEDIAL INVESTIGATION
EXECUTIVE SUMMARY

SITE DESCRIPTION

The Forest Glen site is in Niagara Falls, Niagara County, New York. It is located in an area zoned for mixed residential, commercial, and industrial use. The 39-acre site is divided by East Gill Creek into two separate parcels of land. South of East Gill Creek is the 21-acre Forest Glen subdivision, which consists of 51 mobile homes and two permanent homes. The majority of the subdivision's acreage is characterized by residential development including paved roads and driveways, sod lawns, and ornamental trees and shrubs. The only undeveloped areas within the subdivision are the wooded lots located north and south of Edgewood Drive. Historical reports indicate that these forested areas, which had originally been targeted for residential development, were filled with construction and industrial waste. Access to the site is from Service Road, which is off Porter Road.

To the north of East Gill Creek is the site's northern aspect, which is an 18-acre, undeveloped, open field. A 1,300-foot-long berm, constructed of fill and natural materials, runs along most of the northern aspect's western boundary. Another significant feature within the northern aspect is the wooded wetland area, a low-lying depression of approximately of 1.5 acres, located in the southeastern corner of the northern aspect. City tax maps and historical records indicate that residential development of the northern aspect had been planned.

SITE HISTORY

Historical records and aerial photographs indicate that the Forest Glen site was originally a forested wetland. The subdivision remained wooded until the mid 1960s. A 1966 aerial photograph shows the subdivision cleared of trees. The photograph also indicates a length of East Gill Creek that previously ran through the subdivision was rerouted 400 feet to the north to its current location.

Anectodal reports from area residents state that illegal landfilling of industrial wastes occurred during the early 1970s in portions of the northern aspect. Drums and chemical wastes were also reportedly dumped in adjacent areas north and east of the area currently occupied by the subdivision. Anecdotal reports from local firemen describe the site during those years as a popular scavenger dumping area. Records from the Niagara Falls Fire Department report that a "dump" fire occurred at the site in 1972. The land that is now the subdivision was purchased in 1973 and was subsequently leveled and divided into mobile home lots. It is thought that waste materials landfilled in low-lying areas were redistributed throughout the northern portion of the subdivision during development of Forest Glen.

Installation of subdivision roads and utilities began in the mid-1970s. During these installation activities, ash, packets of white solid material, and small pieces of black plastic were noted in the utility excavations by construction workers. The sale of individual lots for mobile homes began in 1979. Fifty-three families were living in the subdivision by the mid-1980s.

Resident complaints of waste material migrating to the subdivision surface soil were commonly noted after periods of heavy rain or during construction activities. Drums also were discovered by residents at the ground surface east of Carrie Drive in an area where "odorous and sticky brown" deposits had been noted.

In 1987, EPA Region II was contacted by the Niagara County Health Department (NCHD) and the New York State Department of Environmental Conservation (NYSDEC) in regard to the Forest Glen site. In August, 1987, the EPA Region II Field Investigation Team (FIT) contractor, NUS, conducted an initial site inspection. Soil samples were submitted to a Contract Laboratory Program (CLP) laboratory for analysis of Hazardous Substance List (HSL) parameters. Based on the 1987 site inspection analytical results, EPA determined that additional investigatory activities were necessary at the site. At EPA's direction, FIT conducted a series of follow-up sampling programs from September, 1988 to April of 1989 to determine the extent of soil contamination. Analytical results from the FIT sampling events indicated that the areas of highest contamination were located in the northern portion of the subdivision. Soil samples collected from the northern portion of the subdivision and from the wooded lots north and south of Edgewood Drive, and sediment samples collected from East Gill Creek contained elevated concentrations of semivolatile polyaromatic hydrocarbons, semivolatile tentatively identified compounds, and inorganics. Solid waste material, present in the shallow subsurface soil, was also found to contain elevated levels of the semivolatile tentatively identified compounds. The tentatively identified compounds were later confirmed as aniline, benzothiazole, 2-mercaptobenzothiazole, phenothiazine, perylene, 2(3H)benzothiazole, and 2(3H)Benzothiazolethione.

On July 21, 1989, ATSDR issued a Preliminary Health Assessment for the Forest Glen site. The assessment, which was based on the April 1989 confirmatory sampling results, concluded that there was a significant risk to human health for persons living in the subdivision. ATSDR determined that the significant health risk could occur from direct ingestion of and dermal contact with, site soils and wastes contaminated with aniline, benzothiazole, mercaptobenzothiazole and semivolatile PAHs. Potential health effects included allergic contact dermatitis, phototoxic skin reactions and cancer. ATSDR recommended that individuals be removed from the site due to this significant health risk. On July 31, 1989, ATSDR issued a Public Health Advisory in which it recommended relocating the residents of the subdivision. Based upon the ATSDR Public Health Assessment and Public Health Advisory, the USEPA, through its removal program and in conjunction with the Federal Emergency Management Agency (FEMA), implemented a temporary relocation program for the Forest Glen residents. Temporary relocation activities began immediately after the Public Health Advisory was issued.

On November 15, 1989, the Forest Glen site was placed on the Superfund National Priority List (NPL). Once the site was listed on the NPL, EPA released a Focused Feasibility Study (FFS) for the Forest Glen subdivision that evaluated the effectiveness of the available alternatives in responding to the potential onsite health threat. EPA then released a Proposed Remedial Action Plan (PRAP) stating that permanent resident relocation was the preferred remedial alternative.

A Record of Decision (ROD) issued in December, 1989 mandated permanent resident relocation as the remedial action for the Forest Glen site. The Federal Emergency Management Agency, on behalf of EPA, implemented all site-related remedial activities, which included the permanent relocation of all residents and the purchase of personal property. The resident relocation program was designated by the ROD as the first operable unit. The ROD also mandated that an RI/FS be conducted for the site as the second operable unit. In December, 1992, the last family was relocated, leaving the subdivision deserted. The Remedial Action Report, dated September 1993, documents the remedial activities performed at the site.

CDM Federal initiated RI field activities for the second operable unit in November, 1994. As part of the RI activities, CDM Federal reviewed historical information from federal, State, and local agencies regarding the Forest Glen site and other sites in the area regulated under CERCLA and the Resource Conservation and Recovery Act (RCRA). This historical information, along with aerial photographs and anecdotal reports from local residents, depicts the past disposal practices at the site and identifies potential contaminant source areas. Based on this information and CDM Federal's field investigation, six areas of concern (AOCs) were designated as discrete units because of their unique physical characteristics, waste disposal practices, and/or presence of visual contamination. The six areas of concern are as follows:

AOC 1 - Berm

The berm is located in the northern aspect. Approximately 1,300 feet long, 50 feet wide, and 11 feet high, it is bordered on the west and north by the Conrail Foote Railroad yard and to the east and south by the northern aspect. The berm, constructed of fill material and native soil excavated from the ground surface of the northern aspect, was reportedly built to act as a sound barrier for the residential area that had been planned. Drums of waste material were discovered along the berm and were subsequently removed during previous EPA investigations.

AOC 2 -Northern Aspect

This area consists of an 18-acre open field located north of the Forest Glen subdivision. A review of city tax and zoning maps revealed that the northern aspect was once targeted for residential development. According to historic records the field was leveled and top soil from the area was used to form the earthen berm that acts as much of the northern aspect's western boundary. The area is bounded to the south by East Gill Creek and the Service Road, to the north by the Conrail Foote Railroad yard, and to the east by Interstate 190. Anecdotal reports from area residents also suggest that illegal landfilling may have occurred in the northern aspect

throughout the years. These reports were later confirmed when drums containing chemical wastes were discovered and removed from the area during EPA removal actions in 1989.

AOC 3 - Wooded Wetland

This is a 1.5-acre low-lying wooded wetland area located in the southeastern part of the northern aspect. The area is characterized as a palustrine forest broad leaved deciduous wetland. It is bounded on the north and west by the northern aspect, on the south by East Gill Creek, and on the east by Service Road. An intermittent streambed, a potential contaminant migration pathway, was also noted in the area.

AOC 4 - East Gill Creek

East Gill Creek is a narrow, shallow, low flowing creek that serves as the subdivision's northern boundary. Subdivision runoff is directed into the creek via two outfalls. Aerial photographs indicate that a section of the creek was rerouted from its original location, the area now between Lisa Lane and Carrie Drive, 400 feet north to its current location sometime in the late 1960s. The creek flows onto the site from the east, after being directed under Interstate-190 by a series of culverts. It then flows westward across the northern portion of the subdivision and is directed off the site through a culvert under the Conrail Foote Railroad yard. The creek emerges through another culvert located west of the railroad yard, before it is directed underground through another westward-flowing culvert.

AOC 5 - Edgewood Drive Wooded Lots

This area of concern consists of the two wooded, undeveloped lots located to the north and south of Edgewood Drive. The lots are bisected by Edgewood Drive and are both bounded by T Mark drive to the west and Service Road to the east. The north lot is approximately 3 acres in size and is bounded to the north by East Gill Creek. The south lot is approximately 3.3 acres in size and extends approximately 250 feet to the south of Edgewood Drive. Aerial photographs and anecdotal reports from residents suggest illegal landfilling occurred in the wooded areas over the years. Surface soil samples collected from the western end of both lots during the previous EPA site investigations indicated elevated levels of semivolatile organic compounds and heavy metals. Stressed vegetation and topographical depressions noted in these areas during CDM Federal's initial site characterization further suggested that illegal landfilling activities could have occurred in both lots.

AOC 6 - Forest Glen Subdivision

This area includes the abandoned residential subdivision located in the southwest corner of the site; it consists of 51 mobile homes situated on 10 acres. The subdivision is bounded by T Mark Drive to the east, the Conrail Foote Railroad yard to the west, Lisa Lane to the south, and East Gill Creek to the north. The subdivision is accessed via Edgewood Drive. The majority of the

subdivision's acreage is characterized by residential development including paved roads and driveways, sod lawns, and ornamental trees and shrubs. The mobile homes have been heavily vandalized; however, their individual base frames and chassis remain intact.

REMEDIAL INVESTIGATION FIELD INVESTIGATION

The field investigation at the site was conducted in two phases, initial site characterization and field data collection. Based on the conclusions of the initial site characterization study, CDM Federal reevaluated and redesigned the subsequent field data collection phase to more clearly define site conditions and to investigate newly identified potential areas of concern. Both phases of the field investigation were conducted according to EPA-approved project plans.

The initial site characterization included the following activities.

Geophysical Survey. The geophysical survey was designed to screen subsurface conditions and to detect and identify any buried drums and waste. Electromagnetic surveys were conducted in the northern aspect and a seismic refraction survey was conducted in the subdivision.

Drive-Point Soil Boring Program. The drive-point soil boring program was designed to characterize soil contamination, to gather data on the subsurface geology and overburden groundwater flow, and to refine proposed monitoring well locations. A total of 34 drive-point borings were drilled in the subdivision and northern aspect.

The field data collection included the following activities.

Test Pit Sampling. CDM Federal excavated 12 test pits in the northern aspect. The test pit locations were selected based on electromagnetic anomalies delineated during the geophysical surveys.

Soil Boring Program. The soil boring program was designed to characterize and delineate the nature and extent of subsurface soil contamination in the site AOCs. Soil borings were drilled in the berm, northern aspect, and the Edgewood Drive wooded lots. A total of 21 soil borings were drilled.

Surface Soil Sampling. Surface soil samples were collected from the northern aspect, subdivision, and the Edgewood Drive wooded lots to characterize the nature and extent of surface soil contamination. A total of 48 surface soil samples were collected.

Surface Water/Sediment Sampling. Two rounds of surface water and sediment samples were collected from East Gill Creek. Additionally, 10 sediment samples were collected from the intermittent streambed in the wooded wetland.

Monitoring Well Installation and Groundwater Sampling. CDM Federal installed nine shallow bedrock and nine deep bedrock monitoring wells. An overburden monitoring well and

a perched water monitoring well were also installed at one well cluster. Two rounds of samples were collected from the wells to evaluate the nature and extent of groundwater contamination.

Ecological Assessment and Wetlands Delineation. An ecological assessment was performed to characterize the ecosystems present at the site and to determine if site contamination was potential impacting the ecological community.

Analyses Performed. Based on the sampling results of previous EPA investigations and discussions with EPA technical staff, CDM Federal developed an analytical list of site-specific compounds that are not included on the TCL/TAL list. These site-specific compounds are collectively referred to as the targeted organic compounds and consists of the following compounds: benzothiazole; 2-mercaptobenzothiazole; anilinobenzothiazole; diphenylamine; N,N'-diphenyl-1,4-benzenediamine; phenyl isothiocyanate; aniline; phenothiazine; and perylene. All samples collected during the RI field investigation were analyzed for the Forest Glen targeted organic compounds, target compound list organics, and target analyte list inorganic analytes. Soil and sediment samples were also analyzed for pH and physical parameters. Groundwater and surface water samples were also analyzed for conventional water quality parameters.

ENVIRONMENTAL SETTING

The Forest Glen site is generally flat with the ground elevation increasing toward to the north. Local variations in topography occur along East Gill Creek, the northern aspect berm, surface drainage features, and several soil mounds. Surface elevations range from 591 feet above mean sea level (amsl) in the subdivision to 608 feet amsl in the northern aspect (including the approximately 11-foot-high berm).

The entire site, excluding the paved subdivision and northern aspect berm, is classified as wetland. Ponded water is seasonally present throughout the undeveloped areas of the site. East Gill Creek flows onto the site from the east and flows westward across the northern portion of the subdivision forming its northern boundary.

Geology

The city of Niagara Falls is located within the Erie-Ontario Lowlands Physiographic Province. The geomorphology of this area is the product of the advance and subsequent retreat of the Laurentides continental glacier between 20,000 and 30,000 years ago. As the ice sheet advanced, the underlying rock units were scoured and eroded. Much of the material picked up by the glacier was deposited as terminal moraine material. The remainder was deposited as ground moraine along the base of the glacier. This material, commonly known as lodgment till, is compact and generally very impermeable. The resulting topography is generally flat due to the scouring effect of the glacier, and poorly drained due to the impermeability of the glacial lacustrine clay and glacial till.

The region surrounding the Forest Glen site exhibits glacial geomorphology, although evidence of manmade modification is apparent. The regional overburden consists of glaciolacustrine deposits (clay), and clay till deposits overlying the Lockport dolomite. The underlying Lockport dolomite bedrock consists of approximately 150 feet of upper Silurian Lockport Dolomite overlying approximately 120 feet of middle Silurian limestones and shales (Clinton Group) including the impermeable Rochester Shale. Below the Clinton Group is approximately 130 feet of lower Silurian interbedded limestone and sandstone. Underlying the interbedded limestone and sandstone is the upper Ordovician Queenstone Shale. The bedrock beneath the site and throughout the region dips gently to the south at 29 feet per mile.

Hydrogeology

Regionally, the Lockport Dolomite is the major water-producing formation of the area. At Forest Glen, site hydrogeology is defined by three hydrostratigraphic zones: perched overburden water, shallow bedrock, and deep bedrock.

Overburden Zone - The overburden consists of the glacial lacustrine clay deposits, fill, where encountered, and the basal clay till and extends approximately from zero to 20 feet BGS. Due to the low permeability of the overburden materials, perched groundwater conditions were encountered in two drive-point soil borings (DP-013 and DP-017), and within the fill material in the berm and the test pits. Since perched conditions were not aerially extensive, this report focuses on the shallow and deep bedrock groundwater zones.

Shallow Bedrock Zone - This zone is encountered at depths from 16 to 28 feet BGS and is the first zone of highly fractured Lockport Dolomite bedrock where significant core drilling water loss occurred. Groundwater in this zone flows both vertically and horizontally through an interconnecting system of closely spaced joints and bedding plane fractures.

Deep Bedrock Zone - This zone is encountered at depths of 40 to 45 feet BGS. Although literature states that each fracture can be treated as a discrete, confined, homogeneous anisotropic aquifer at this depth, some vertically oriented closed and open fractures containing mineralization were observed while coring this zone. It is probable that hydraulic communication occurs between the shallow and deep bedrock zones beneath the site.

Ecology

The site can be partitioned into four broad habitat categories: residential, wetland, aquatic, and disturbed upland successional habitat. Nearly all of the non-residential areas of the site have been determined by the April 1995 wetland delineation to be wetland areas. The following wetlands were found at the site: palustrine, forested, broad-leaved, deciduous wetland; palustrine scrub-shrub, broad-leaved, deciduous wetland; and emergent wetland.

Wildlife usage of the site was evidenced by diurnal observations made during field activities. Numerous onsite wildlife observations have been made including direct observations of birds,

mammals, fish, amphibians, insects, and arachnids, as well as evidence of wildlife usage such as tracks, nests, scat, runways, and browsed vegetation.

APPROACH TO THE EVALUATION OF CONTAMINATION

CDM Federal focused the characterization of the six AOCs on those constituents that were identified as contaminants of concern (COCs) in the Forest Glen soil, sediment, surface water, and groundwater. COCs were determined by the following criteria: 1) exceedance of regulatory screening criteria or naturally occurring background levels; 2) frequency of exceedance; and 3) magnitude of exceedance.

ANALYTICAL RESULTS

The analytical results of the Forest Glen investigation, presented by AOC, are discussed below.

AOC 1- Berm

Within this AOC, the highest levels of contamination were generally detected in those samples collected from the central berm locations where heavily stained fill material was encountered. Targeted organic compounds were detected to concentrations up to 1,100,000 ppb (2-mercaptobenzothiazole) and PAH detections exceeded New York State screening levels by more than 60 times (benzo(a)pyrene). Other semivolatile detections (phenol) exceeded the screening levels by more than 300 times. Generally, inorganic contamination was detected at concentrations between two to four times the background screening criteria. However, mercury concentrations in this area ranged to 135 times the cleanup objective.

AOC 2 - Northern Aspect

In the northern aspect, the highest observed contaminant concentrations and screening criteria exceedances were noted in samples associated with fill material. Fill material was primarily noted in test pit sample locations in close proximity to the berm. Targeted organic compounds were detected in the northern aspect fill at concentrations ranging to 27,000 ppb (2-anilinobenzothiazole) while PAH detections exceeded New York State screening levels by more than 40 times (benzo(a)pyrene). Inorganic analytes in this area were generally detected at concentrations between one or two times above the background screening criteria. However, mercury concentrations in the fill ranged over 25 times the cleanup objective.

AOC 3- Wooded Wetland

In general, PAH, pesticide and PCB contamination was found throughout the wooded wetland. The highest semivolatile organic compound concentrations were generally from locations WTSD05 and WTSD06. No pattern for inorganic contamination was observed in the wooded

wetland. Several inorganic analytes were detected at concentrations above their respective state sediment screening criteria. However, it should be noted that most of the wooded wetland inorganic detections were below their respective background detections.

AOC 4 - East Gill Creek

The highest detections of targeted organic and semivolatile organic compounds were generally in the two downstream sediment samples. East Gill Creek receives both storm water and surface water run off from the site. Analytical results suggest that surface soil contamination has been transported, via storm water and surface water runoff, into East Gill Creek. As the highest contaminants have been observed in the downstream samples, it appears that East Gill Creek is acting as a transport mechanism which is permitting the offsite migration of organic contaminants.

Surface water quality in East Gill Creek was generally characterized by pesticide concentrations at or exceeding State surface water screening criteria. The two pesticides which exceeded the criteria, alpha-BHC and beta-BHC, were commonly detected in the wooded wetland (AOC 3) sediment samples. It is suspected that an intermittent stream located in the wooded wetland, which flows into East Gill Creek during certain times of the year, could be acting as a contaminant migration pathway.

AOC 5 -Edgewood Drive Wooded Wetlands

Generally, the highest levels of contamination were in the surface soil and were associated with fill material. Surface soil contamination in was primarily characterized by semivolatile PAHs at concentrations above the State screening criteria including, benzo(a)pyrene, concentrations over 1400 times the screening criteria, dibenzo(a)anthracene, concentrations over 1100 times the screening criteria, benzo(a)anthracene, concentrations over 440 times the screening criteria, and chrysene, concentrations more than 230 times the screening criteria.

Semivolatile PAH contaminant levels generally decreased in the subsurface soil. As with the surface soil, contaminant detections were generally limited to samples collected from the western end of both lots and were associated with heavily stained fill material. PAH compounds detected above state soil cleanup objectives included, benzo(a)pyrene, concentrations more than 680 times above its screening criteria, benzo(a)anthracene, concentrations up to 250 times its screening criteria, chrysene, concentrations up to 125 times above its criteria, benzo(b)fluoranthene, concentrations more than 80 times above its criteria, and benzo(k)fluoranthene, concentrations more than 70 times above its screening criteria.

AOC 6 - Subdivision

Within this AOC, the highest levels of contamination was associated with fill material. In the northern end of the subdivision, targeted organic compounds were detected up to concentrations of 330,000 ppb (2-anilinobenzothiazole) while PAH compounds were detected at concentrations

that exceeded state screening criteria by more than 40 times (benzo(a)pyrene). Additionally, phenol was detected in the surface soil samples at concentrations up to 260 times the screening criteria. While elevated levels of targeted organic and semivolatile organic compounds were detected in the surface soils, contaminant concentrations were significantly less than what had been historically reported. Contaminant concentrations may have been reduced by flooding conditions, resulting from leaking trailer pipes, and the subsequent surface water runoff.

In the subsurface fill material of this AOC, targeted organic compounds were detected up to concentrations of 50,000 ppb (2-mercaptobenzothiazole). PAH compounds were detected at concentrations that exceeded State screening criteria by more than 2780 times (benzo(a)pyrene). Inorganic analytes in this area were generally detected at concentrations between eight or nine times above the background screening. However, mercury concentrations in the fill samples ranged over 250 times the state cleanup objective. The number and contaminant concentrations of organic compound detections generally decreased in the subsurface soil samples. Contaminant concentrations, however were noted to increase in the subsurface fill samples. Contaminant concentrations, if detected at all, were significantly lower in samples collected below the fill layer.

No targeted organic compound detections or organic screening criteria exceedances were noted in the southern portion of the subdivision.

GROUNDWATER INVESTIGATION RESULTS

Groundwater Flow

Groundwater at the site flows both vertically and horizontally through an interconnected system of closely spaced joints and bedding plant fractures. Groundwater flow in the shallow bedrock zone closely follows the top of bedrock elevation contours toward a bedrock surface depression beneath the MW-5 cluster. The groundwater high at MW-7S results in localized flow to the east, toward MW-5S, and south toward MW-8S. This causes the local flow to deviate from the expected regional flow to the west. Groundwater in the deep bedrock zone generally flows to the west/southwest with MW-1D being upgradient of the site and MW-7D and 8D being downgradient.

Vertical groundwater flow at each monitoring well cluster was downward, as evidenced by the higher groundwater elevations of the shallow wells versus those of the deep wells. This indicates that the site is located in a groundwater recharge area.

Groundwater Contamination

Analytical results from both sampling rounds indicated that the groundwater was contaminated with volatile organic compounds and inorganics. Site soil contamination appears to have migrated vertically to the underlying groundwater. This suggests that the overburden clay layer, found throughout the site, may have been breached during illegal landfilling activities.

Volatile organic compounds were consistently detected in the wells downgradient of the fill areas. While volatile organic compounds were not commonly detected in soil samples collected during the RI field investigation, their presence in the site soils and fill materials was documented during previous site investigations.

Inorganic analytes were widely detected in both rounds of groundwater sampling. Chromium, nickel, and lead, however, were the only analytes with concentrations that exceeded State and Federal drinking water standards. All three analytes were widely detected in the site surface and subsurface soils, with the highest analytes concentrations noted in the fill material. The highest inorganic concentrations were generally detected in samples collected from source area wells and from wells downgradient of the subdivision and Edgewood Drive fill areas.

Volatile organic compounds and inorganic analytes were noted in the offsite well MW-8S at concentrations that exceeded state and federal drinking water standards. Since the same contaminants were detected in onsite wells at higher concentrations, it appears that contamination is migrating offsite.

SUMMARY OF CONTAMINANT FATE AND TRANSPORT

The majority of the chemicals of concern detected in the surface water, sediment, soils, and groundwater of the site can be grouped into three general categories that describe their persistence and mobility in the environment:

Group 1 — Persistent, non-volatile, and very slowly degradable organic chemicals such as PCBs, Pesticides, PAHs and many of the targeted organics. These chemicals strongly sorb to soils and are relatively immobile. Concentrations present in soils will persist into the future, with very slow degradation of the organics. This group represents the majority of chemical contamination detected in soils and sediments during the remedial investigation. The PAHs and targeted organic compounds will remain in the soil for years.

Group 2 — Volatile, soluble, degradable contaminants such as volatile organic compounds. These chemicals do not sorb strongly to soils and are relatively mobile in groundwater. Their persistence will be determined by their rates of biodegradation, and their mobility by their retardation coefficients (Kd) and the velocity of groundwater. These chemicals, VOCs, are the constituents of concern in the groundwater. Although they reached the water table through releases to soils, very few traces of the VOCs remain in site soils that were sampled.

Group 3 — Low volatility, soluble, degradable such as the phenols. These chemicals show low soil adsorption and are relatively mobile in soils. Phenols biodegrade quite rapidly in water and in soil. The high concentration of

phenols (up to 9,700 ug/kg in the berm) still remaining in the subsurface soils suggest that microbial populations in the soil have been destroyed by high concentration spills which would have reduced or prevented the compound's normally rapid degradation in soils. At the Forest Glen site, phenol has displayed abnormally moderate to high adsorption to the soils. It is expected however, that the phenols have and will continue to leach to groundwater due to their high solubilities . They will not be detected in the groundwater in high concentrations since they degrade rapidly (hours to days). However, the concentrations in the soils are expected to decrease.

CONCLUSIONS

The significant findings of the RI investigation were as follows.

- Analytical data collected during this RI, combined with historical data, suggests that the primary source of contamination is the fill material. Fill material was encountered in discrete areas of the northwest section of the northern aspect, the berm, the western edge of the Edgewood Drive lots, and the northern and central sections of the subdivision.

- Surface soils of the subdivision and Edgewood Drive wooded lots contain elevated levels of targeted organic, PAH semivolatiles, phenol and inorganics.

- Subsurface soils of the berm, northern aspect, Edgewood Drive wooded lots, and the subdivision contain elevated levels of targeted organic compounds, PAH semivolatiles, phenol and inorganics.

- Contaminant concentrations, if detected at all, were significantly lower in analytical samples collected below the fill layer.

- Sediment in the wooded wetland contain PAHs, pesticides and PCBs at concentrations that exceed sediment screening criteria.

- Downstream sediment samples in East Gill Creek contain elevated levels of the site-specific targeted organic compounds. It appears that East Gill Creek is acting as a transport mechanism which is permitting the offsite migration of organic contaminants.

- Site groundwater contains elevated concentrations of volatile organics and inorganics. Analytes detected in the soil, during this investigation or historically, were similar to those found in groundwater. This suggests that soil contamination has migrated vertically to the underlying groundwater. It is possible that the overburden clay layer, found throughout the site, may have been breached during landfilling activities. It is also possible that contaminants are migrating through the clay layer in areas where the natural horizon has been thinned as result of landfilling activities.

- Volatile organic compounds and inorganic analytes were noted in the offsite well at concentrations that exceeded State and Federal drinking water standards. Since the same contaminants were detected in onsite wells at higher concentrations, it appears that contamination may migrating offsite.

1.0 INTRODUCTION

1.1 PURPOSE OF THE REPORT

This Final Remedial Investigation Report for the Forest Glen Superfund Site (Forest Glen) in Niagara Falls, Niagara County, New York, has been prepared by CDM Federal Programs Corporation (CDM Federal) for the United States Environmental Protection Agency (EPA), Region II, as authorized under the ARCS II contract 68-W9-0024, Work Assignment number 053-2L3U. The remedial investigation/feasibility study (RI/FS) was conducted in accordance with the Final Work Plan dated December 1993 and the Revised Final Project Operations Plan approved by EPA on August 19, 1994. This Final RI is a revised version of the Draft RI, submitted April 1996, which has been modified to address EPA comments dated September 13, 1996.

1.2 SITE DESCRIPTION

The Forest Glen site is in Niagara Falls, Niagara County, New York (Figure 1-1). It is located in an area zoned for mixed residential, commercial, and industrial use. Shopping malls, fast food restaurants, and commercial businesses are to the southeast and southwest of the site along Porter and Packard Roads. The 120-unit Expressway Village mobile home park, located 500 feet south of Forest Glen's southern boundary, is approximately 19 acres in size. The site is also bounded to the north by property owned by the Power Authority of the State of New York (PASNY), to the east by Interstate Highway 190 and Service Road, and to the west by the Conrail Foote Railroad yard. Two other sites containing hazardous wastes are also in the vicinity: CECOS, a regulated hazardous waste landfill, south of the Forest Glen site, and the New Road Landfill, once investigated by the New York State Department of Environmental Conservation (NYSDEC), to the west of the Conrail Foote Railroad yard. Figure 1-2 is a site map.

The 39-acre site is divided by East Gill Creek into two separate parcels of land. South of East Gill Creek is the 21-acre Forest Glen subdivision, which consists of 51 mobile homes and two permanent homes. The majority of the subdivision's acreage is characterized by residential development including paved roads and driveways, sod lawns, and ornamental trees and shrubs. The only undeveloped areas within the subdivision are the wooded lots located north and south of Edgewood Drive. Historical reports indicate that these forested areas, which had originally been targeted for residential development, were filled with construction and industrial waste. Access to the site is from Service Road, which is off Porter Road.

To the north of East Gill Creek is the site's northern aspect, which is an 18-acre, undeveloped, open field. A 1,300-foot-long berm, constructed of fill and natural materials, runs along most of the northern aspect's western boundary. Another significant feature within the northern aspect is the wooded wetland area, a low-lying depression of approximately of 1.5 acres, located in the southeastern corner of the northern aspect. City tax maps and historical records indicate that residential development of the northern aspect had been planned.

1.3 SITE HISTORY

Historical records and aerial photographs indicate that the Forest Glen site was originally a forested wetland. During the late 1950s and the early 1960s, the area surrounding the site was impacted by several major construction projects including construction of the Niagara Expressway (Interstate 190), expansion of the railroad yard adjacent to the west side of the site, and construction of Power Authority conduits located to the west of the site. Maps and aerial photographs indicate a subdivision or trailer park, thought to be temporary housing for Power Authority workers, was located in the northern aspect. It is suspected the housing area was removed to allow for construction of Interstate 190.

The subdivision remained wooded until the mid 1960s. A 1966 aerial photograph shows the subdivision cleared of trees. The photograph also indicates a length of East Gill Creek that previously ran through the subdivision was rerouted 400 feet to the north to its current location.

Anecdotal reports from area residents state that illegal landfilling of industrial wastes occurred during the early 1970s in portions of the northern aspect. Drums and chemical wastes were also reportedly dumped in adjacent areas north and east of the area currently occupied by the subdivision. A 1972 aerial photograph reveals that the cleared, low-lying areas of the site and portions of the former East Gill Creek bed had been filled. Anecdotal reports from local firemen describe the site during those years as a popular scavenger dumping area. Records from the Niagara Falls Fire Department report that a "dump" fire occurred at the site in 1972.

Before 1973, portions of the area were owned by Michigan-Mayne Realty, PASNY, and three individuals, Ernest Booth, James Strong, and Sandford Brownler. In 1973, the land that is now the subdivision was purchased by Thomas Sottile. Mr. Sottile and his wife formed the Niagara Falls USA Campsite Corporation in that same year. The subdivision plans were approved by the Niagara Falls City Engineer in October, 1975. Shortly after, the property was leveled and divided into mobile home lots. It is thought that waste materials landfilled in low-lying areas were redistributed throughout the northern portion of the subdivision during development of the Forest Glen subdivision. A fire reportedly has destroyed all City file information regarding the development of the subdivision.

Installation of subdivision roads and utilities began in the mid-1970s. During these installation activities, ash, packets of white solid material, and small pieces of black plastic were noted in the utility excavations by construction workers. In 1979, the Niagara Falls USA Campsite Corporation began the sale of individual lots for mobile homes. Fifty-three families were living in the subdivision by the mid-1980s.

According to the Niagara County Health Department (NCHD), in June, 1980 a resident of 31 Lisa Lane, located in the southeastern portion of the subdivision, reported the presence of a yellow resin-like substance and 55-gallon drum tops in the surface soil surrounding her home. NCHD subsequently collected soil and water samples from the Lisa Lane property. The solid waste material was analyzed and determined to be a phenolic material.

In August, 1981, local gas company personnel encountered 55-gallon steel drums and a white solid material during excavation activities along Carrie Drive. The substance was later identified as non-hazardous polyvinyl chloride.

In December, 1982, a resident reported a resin-like substance in the surface soil at 43 Lisa Lane. A sample of the substance was collected and analyzed by NCHD. Infra-red spectral analysis, often considered inconclusive, identified the material as carbon methyl cellulose. At that time approximately ten truckloads of this material were reportedly excavated by the owners of the Niagara Falls USA Campsite Corporation and disposed of at the CECOS landfill.

Resident complaints of waste material migrating to the subdivision surface soil were commonly noted after periods of heavy rain or during construction activities. Drums also were discovered by residents at the ground surface east of Carrie Drive in an area where "odorous and sticky brown" deposits had been noted.

In 1987, EPA Region II was contacted by NCHD and NYSDEC in regard to the Forest Glen site. In August, 1987, the EPA Region II Field Investigation Team (FIT) contractor, NUS, collected four soil samples in the northern portion of the subdivision during an initial site inspection. The four soil samples were submitted to a Contract Laboratory Program (CLP) laboratory for Hazardous Substance List (HSL) parameters. Analytical results of the samples indicated the presence of volatile organics and semivolatile organic polyaromatic hydrocarbons (PAHs) and heavy metals at varying concentrations in the soil. Several tentatively identified compounds (TICs) were also found at elevated concentrations in the soil.

Based on the 1987 analytical results, EPA determined that additional investigatory activities were necessary at the site. At EPA's direction, FIT conducted a series of follow-up sampling programs from September, 1988 to April of 1989 to determine the extent of soil contamination. All samples were submitted to CLP laboratories for Target Compound List/Target Analyte List (TCL/TAL) parameters. Analytical results from the FIT sampling events indicated that the areas of highest contamination were located in the northern portion of the subdivision. Soil samples collected from the northern portion of the subdivision and from the wooded lots north and south of Edgewood Drive, and sediment samples collected from East Gill Creek contained elevated concentrations of semivolatile PAHs, semivolatile TICs, and inorganics. Solid waste material, present in the shallow subsurface soil, was also found to contain elevated levels of the semivolatile TICs. Figure 1-3 indicates the extent of contamination as delineated by the FIT investigations. Table 1-1 summarizes the analytical results of the previous EPA investigations.

In March, 1989, the Agency for Toxic Substances and Disease Registry (ATSDR), after reviewing the FIT sampling data, issued a Health Consultation for the Forest Glen site indicating that site conditions posed a potential health risk to residents. The ATSDR also recommended that the TICs in the soil be positively identified so potential health effects could be determined.

On March 25, 1989, EPA issued an Administrative Order, pursuant to Section 106 (a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), requiring

that the potentially responsible parties (PRPs) carry out actions to reduce the immediate threat posed by site conditions. EPA, at the time of the Administrative Order, identified three PRPs, including the Niagara Falls USA Campsite Corporation, Thomas Sottile, and Ernest Booth, who were determined to be viable and responsible for the contamination in the subdivision. EPA ordered the three PRPs to secure leaking or potentially leaking drums and containers, and to submit a Work Plan that would detail (1) construction of cover to seal off contaminated soil, (2) offsite disposal of drums, and (3) fencing of undeveloped areas east of the subdivision on either side of Edgewood Drive. The three PRPs did not comply with the Administrative Order.

In April, 1989, FIT, upon ATSDR's recommendation and at EPA's request, resampled 14 subdivision locations that previously exhibited high concentrations of TIC contamination. These samples were reanalyzed to confirm the presence of those compounds that previously had only been tentatively identified. Reanalysis positively identified the presence of aniline, benzothiazole, 2(3H)benzothiazole, 2(3H)benzothiazolethione, molecular sulfur, phenothiazine, and perylene in the subdivision soils. These compounds then became known as site-specific targeted organic compounds.

In the summer and fall of 1989, due to the non-responsiveness of the PRPs, EPA ultimately conducted interim measures to stabilize site conditions and to protect subdivision residents. Interim actions included collection, sampling, and offsite disposal of 100 drums, drum remnants, and small hazardous waste containers found in the areas north and east of the subdivision, installation of temporary fencing around the undeveloped areas of Edgewood Drive, and placement of geotextile covers over "hot spots" where solid waste material was visually observed in subdivision surface soils.

In July, 1989, ATSDR issued a Preliminary Health Assessment for the Forest Glen site. The assessment, which was based on the April, 1989 confirmatory sampling results, concluded that a significant health risk could occur from direct ingestion of and dermal contact with site soils and wastes contaminated with aniline, benzothiazole, mercaptobenzothiazole, and semivolatile PAHs. Potential health effects included allergic contact dermatitis, phototoxic skin reactions and cancer. ATSDR recommended that individuals be removed from the site due to this significant health risk. On July 31, 1989, ATSDR issued a Public Health Advisory in which it recommended relocating the residents of the subdivision. Based upon the ATSDR Public Health Assessment and Public Health Advisory, the USEPA, through its removal program and in conjunction with the Federal Emergency Management Agency (FEMA), implemented a temporary relocation program for the Forest Glen residents. Temporary Relocation activities began immediately after the Public Health Advisory was issued.

On November 15, 1989, the Forest Glen site was placed on the Superfund National Priority List (NPL). Once the site was listed on the NPL, EPA released a Focused Feasibility Study (FFS) for the Forest Glen subdivision that evaluated the effectiveness of the available alternatives in responding to the potential onsite health threat. EPA then released a Proposed Remedial Action Plan (PRAP) stating that permanent resident relocation was the preferred remedial alternative.

A Record of Decision (ROD) issued in December, 1989 mandated permanent resident relocation as the remedial action for the Forest Glen site. FEMA, on behalf of EPA, implemented all site-related remedial activities, which included the permanent relocation of all residents and the purchase of personal property. The resident relocation program was designated by the ROD as the first operable unit. The ROD also mandated that an RI/FS be conducted for the site as the second operable unit.

In December, 1992, the last family was relocated, leaving the subdivision deserted. The mobile homes have yet to be removed from the site and are currently boarded up. In 1994, a fence was installed around the subdivision's perimeter to limit potential access to the site.

CDM Federal initiated RI field activities for the second operable unit in November, 1994. It was noted at the time that the subdivision mobile homes were in poor condition as a result of vandalism and lack of maintenance. Flooding in the central portion of the subdivision, caused by leaking water pipes, was also observed. Segments of the site perimeter fence in both the subdivision and northern aspect had been removed, and the pedestrian gate in the northern aspect had been dislodged from its hinges.

1.4 PREVIOUS INVESTIGATIONS

1.4.1 PRE-REMEDIAL INVESTIGATIONS

1.4.1.1 Initial Site Inspection (August 1987)

In August, 1987, the EPA Region II FIT contractor, NUS, performed an initial site inspection at the Forest Glen site. Based on visual observations, FIT selected four soil sample locations in the northern portion of the subdivision. Samples were collected by hand auger from 1 to 3 feet below ground surface (BGS). Figure 1-4 shows the Initial Site Inspection sample locations.

Analytical results of the samples indicated the elevated concentrations of volatile organic compounds (VOCs), including 1,1,1-trichloroethane, 1,1-dichloroethane, and trichloroethane, and several heavy metals, including arsenic, mercury, and lead, in the soil samples. Significantly elevated levels of several semivolatile organic PAHs, including benzo(a)pyrene, anthracene, fluoranthene, and chrysene, were also detected in the soil samples. PAH concentrations ranged from 390 parts per billion (ppb) to 160,000 ppb. Several TICs were also detected, at elevated concentrations, in the soil samples. These compounds, which were tentatively identified as aniline, benzothiazole, 2-mercaptobenzothiazole, and phenothiazine, ranged in concentrations from 280,000 ppb (aniline) to 9,500,000 ppb (benzothiazole).

1.4.1.2 Site Inspection Follow-Up (September 1988)

Based on the 1987 analytical results, EPA determined that an expanded and more comprehensive investigation at Forest Glen was necessary. At EPA's direction, FIT conducted a site-inspection follow-up in September of 1988 to determine the extent of soil contamination. Thirty-six surface

soil samples, from zero to 3 inches BGS, and two sediment samples from East Gill Creek were collected during the sampling event. Twenty-three samples of waste material mixed with soil were also collected, from 12 to 36 inches BGS, at those surface soil locations where waste material was observed. The sampling effort was concentrated primarily in the subdivision's northern end. Figure 1-5 shows the site inspection follow-up sample locations.

Analytical results served to confirm the findings of the initial site inspection. Semivolatile PAHs, including benzo(a)pyrene, chrysene, and pyrene, with detected concentrations ranging from 830 ppb to 87,000 ppb (pyrene), were detected in the surface soil samples. The highest PAH concentrations were consistently observed in samples collected from the wooded lot south of Edgewood Drive. Heavy metals including arsenic, cadmium, mercury, and lead were also detected in the surface soils. As with the PAHs, the highest metals concentrations were detected in samples from the wooded lot south of Edgewood Drive. Benzothiazole was tentatively identified in five of the surface soil samples, with detected concentrations ranging from 690 ppb to 210,000 ppb. Benzothiazole was detected primarily in surface soil samples collected immediately south of Carrie Drive. Analysis of the East Gill Creek sediment sample collected downstream of the subdivision also revealed elevated concentrations of arsenic, cadmium, mercury, and lead.

VOCs, semivolatile PAHs, arsenic, chromium, and lead, as well as tentatively identified concentrations of aniline, benzothiazole, and 2-mercaptobenzothiazole, were detected in several of the solid waste samples. Detected concentrations of the TICs ranged from 3.2 ppb to 64,000 ppb (2-mercaptobenzothiazole). The highest contaminant concentrations were detected in samples collected between the Lisa Lane and Carrie Drive cul-de-sacs and from rusted drum debris in the northern aspect.

1.4.1.3 Resampling Event (April 1989)

In April, 1989, FIT, upon ATSDR's recommendation and at EPA's request, resampled 14 solid waste and surface soil locations, which had previously exhibited elevated concentrations of TICs, to confirm the presence of compounds that had only been tentatively identified. The sample locations chosen by FIT were primarily situated in the northern end of the subdivision between the Lisa Lane and Carrie Drive cul-de-sacs (Figure 1-6). Analytical results from the resampling activity positively identified the presence of aniline, benzothiazole, 2(3H)benzothiazole, 2(3H)benzothiazolethione, molecular sulfur, phenothiazine, and perylene in the subdivision soils. These compounds then became collectively known as the site-specific targeted organic compounds.

1.4.1.4 Sitewide Sampling Event (May 1989)

FIT, under the direction of EPA, conducted a sitewide sampling program in May, 1989 designed to characterize surface soil quality in the southern part of the subdivision and to confirm contaminant concentrations detected in the subdivision's northern end. FIT collected 75 additional soil and solid waste samples from locations throughout the site (Figure 1-7).

Analytical results did not indicate the presence of soil contamination in the subdivision's southern area. Several targeted organic compounds including aniline, 2-mercaptobenzothiazole, phenothiazine, and benzothiazole, however, were again detected in soil and solid waste samples collected in the northern portion of the subdivision. Detected concentrations ranged from 10 ppb to 35,000,000 ppb (2-mercaptobenzothiazole), with the highest noted in the surface soil and solid waste samples collected immediately south of Carrie Drive.

1.4.1.5 New York State Department of Health Exposure Survey (June 1989)

In June, 1989, the New York State Department of Health (NYSDOH) conducted an exposure survey of 115 residents of the Forest Glen subdivision. A total of 45 of the 51 occupied households (88 percent) participated in the survey. The survey found that 39 people from 23 households reported having contact with the chemical waste present in the subdivision. Forty-five people reported health problems that they believed were attributable to site contamination.

NYSDOH also collected three drinking water samples, five surface water samples, and one basement sump water sample. The samples were analyzed for pesticides, polychlorinated biphenyls (PCBs), priority pollutant semivolatiles, metals, and TICs. Analytical results indicated the presence of pesticides at low levels in the surface water and sump samples. No detectable levels of other organics were present in the drinking water samples.

1.4.1.6 Residential Sampling (August 1989)

FIT conducted a residential sampling investigation on August 1, 1989. The program was designed to determine whether site contamination had been transported into the Forest Glen homes and to determine whether personal property needed to be cleaned or required replacement. Composite wipe samples, loose dust ball samples, and composite vacuum samples were collected from locations likely to be contaminated such as high traffic areas and high dust areas. Benzothiazole was detected at low levels in several of the dust ball samples and at fractional microgram per square foot levels in several of the wipe samples. No other compounds were detected in the samples.

1.4.1.7 Expressway Village Target Compound Special Study (November 1989)

FIT, under direction from EPA, conducted a Preliminary Assessment and a Site Inspection at Expressway Village, the trailer park located approximately 500 feet south of the Forest Glen subdivision, from July 19 to July 20, 1989. The objective was to determine if the Forest Glen targeted organic compounds were also present on Expressway Village property. FIT collected 12 surface soil samples and 2 sediment samples from throughout the trailer park and submitted them for TCL/TAL analysis. One sample, which was collected from underneath oily machine parts, exhibited elevated levels of PAHs and metals. Elevated contaminant levels were not detected in any of the other samples.

EPA, in response to concerned residents and local officials, directed FIT to conduct an expanded investigation at Expressway Village. In November, 1989, a total of 74 samples were collected at varying depths from 25 locations throughout the trailer park. Samples were analyzed for the Forest Glen targeted organics using a portable gas chromatograph/mass spectrometer (GS/MS), and for mercury, lead, arsenic, copper, manganese, nickel, zinc, and chromium using a portable x-ray fluorescence system. No targeted organics were detected in the soil samples, and inorganics observed were at or below background levels.

ATSDR, based on the Expressway Village analytical results, issued an Addendum to the Preliminary Health Assessment for Forest Glen. The Addendum stated that the concentrations detected at Expressway Village posed no significant health risks and that there was no apparent contaminant migration from Forest Glen to Expressway Village. In conclusion, ATSDR stated that no further sampling was required at Expressway Village.

1.4.2 REMOVAL ACTIONS

Because the PRPs did not comply with the Administrative Order, in the spring of 1989 EPA initiated interim measures to stabilize site conditions and to protect subdivision residents. EPA's Technical Assistance Team (TAT) was responsible for the execution of these interim measures.

1.4.2.1 Drum Sampling and Removal (May 1989 - January 1990)

Beginning in May, 1989, drums, drum remnants, and small hazardous waste containers were collected from the along the berm in the northern aspect and from the wooded lots north and south of Edgewood Drive. Waste material from each of the containers was sampled to determine disposal options. After sample collection, the drums and drum remnants were overpacked and moved to the Service Road staging area. The smaller waste containers were stored in a 20-cubic-yard roll-off that was also located at the Service Road staging area.

On receipt of analytical data, the drums and waste containers were segregated by waste type for disposal. By January, 1990, approximately 100 drums and drum remnants and the contents of the roll-off container had been sent to the ChemWaste facility in Model City, New York for disposal.

1.4.2.2 Containment Activities

In May, 1989, a clean fill and gravel mixture was applied over the subdivision's lawns and undeveloped lots in an effort to minimize potential contact with the waste material present in the surface soil. To further minimize the potential for dermal contact, TAT also supervised the placement of geotextile covers over "hot spots" along Carrie Drive where solid waste material was visually observed in subdivision surface soils. In response to residents' concerns, one of the larger "hot spots", a 15-foot by 75-foot area at 13 Carrie Drive, was subsequently covered with 25 cubic yards of cement.

Temporary snow fencing was installed parallel to East Gill Creek, along the subdivision's northern boundary, and around the wooded lots north and south of Edgewood Drive in an effort to limit access to these areas.

1.5 REPORT ORGANIZATION

This RI report is organized in the following manner with tables and figures presented at the end of each Chapter.

Chapter 1 — INTRODUCTION, presents an overview of the Forest Glen site and summarizes the site history and previous site investigations.

Chapter 2 — STUDY AREA INVESTIGATIONS, describes the areas of concern and describes the methodology and sampling rationale for the various investigations conducted for the RI.

Chapter 3 — PHYSICAL CHARACTERISTICS OF THE STUDY AREA, briefly describes the physical attributes of the study area, including surface topography, meteorology, surface water hydrology, geology, hydrogeology, and soil types. Sections on demography, land use, and ecology describe the potential populations and habitats of human and ecological receptors.

Chapter 4 — NATURE AND EXTENT OF CONTAMINATION, lists the soil and groundwater action levels against which site data were screened to determine the extent of contamination, discusses the quality and useability of analytical data obtained during the investigation, and describes the type and extent of contamination determined to be present in each of the areas of concern.

Chapter 5 — CONTAMINANT FATE AND TRANSPORT, evaluates the persistence and mobility in the environment of the various types of contamination identified, and summarizes the fate and transport mechanisms that will apply within each area of concern based on each area's physical characteristics.

Chapter 6 — SUMMARY AND CONCLUSIONS, summarizes the significant determinations of the remedial investigation.

Chapter 7 — REFERENCES.

TABLE 1-1

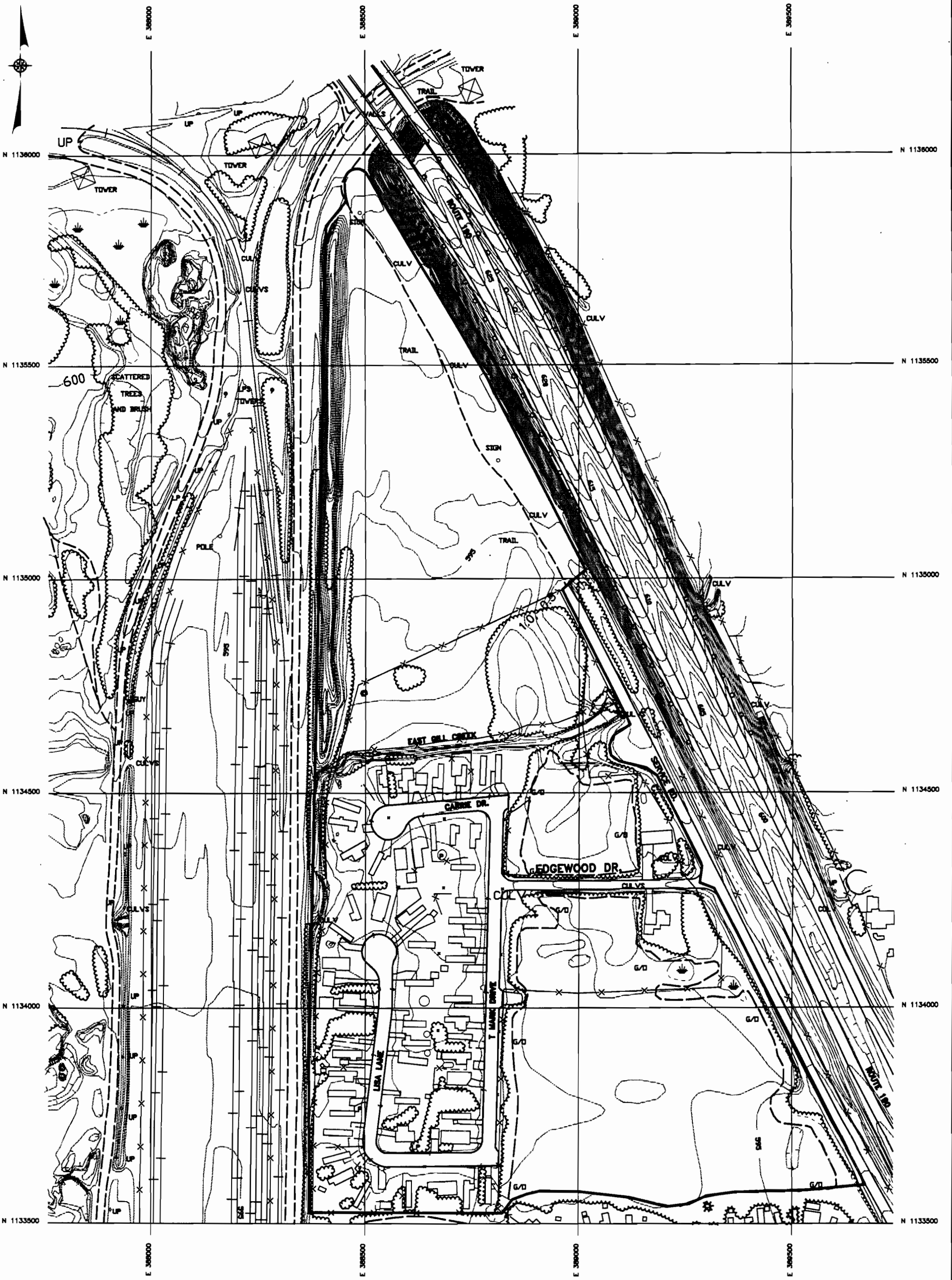
SUMMARY OF PREVIOUS EPA ANALYTICAL RESULTS

SEMIVOLATILE ORGANIC COMPOUNDS

FOREST GLEN SITE

NIAGARA FALLS, NEW YORK

Compound	Range of Detection (ug/kg)	Location of Highest Detection
Benzothiazole	8 - 44,000,000	Solid waste sample collected from south of Carrie Drive, (SW1 collected 5/89).
2(3H) Benzothiazole	20 - 2,600,000	Surface soil sample collected Carrie Drive, (S2 collected 8/87).
2(3H)Benzothiazolethione	4600000	Surface soil sample collected from Carrie Drive, (S2 collected 8/87).
Aniline	3.2 - 11,000,000	Solid waste sample collected from south of Carrie Drive, (SW1 collected 5/89).
Phenothiazine	700 - 5,500,000	Solid waste sample collected from drum remnants found in Northern Aspect, (DR1 collected 4/89)
Perylene	30 - 1,770	Surface soil sample collected from eastern end of Carrie Drive, (S90 collected 5/89).
Diphenylamine	5 - 8,3000,000	Solid waste sample collected from south of Carrie Drive, (SW1 collected 5/89).
2-Mercaptobenzothiazole	24 - 35,000,000	Solid waste sample collected from south of Carrie Drive, (SW1 collected 5/89).
Benzo(a)pyrene	30 - 88,000	Surface soil sample collected from wooded lot south of Edgewood Drive, (S4 collected 8/87).
Chrysene	30 - 110,000	Surface soil sample collected from wooded lot south of Edgewood Drive, (S4 collected 8/87).
Benzo(a)anthracene	28 - 110,000	Surface soil sample collected from wooded lot south of Edgewood Drive, (S4 collected 8/87).
Benzo(b)fluoranthene	55 - 160,000	Surface soil sample collected from wooded lot south of Edgewood Drive, (S4 collected 8/87).
Benzo(k)fluoranthene	42 - 60,000	Surface soil sample collected from wooded lot south of Edgewood Drive, (S31 collected 9/88).
Dibenzo(a,h)anthracene	608 - 21,000	Surface soil sample collected from wooded lot south of Edgewood Drive, (S4 collected 8/87).
Indeno(1,2,3-CD)pyrene	28 - 54,000	Surface soil sample collected from wooded lot south of Edgewood Drive, (S4 collected 8/87).
Phenol	610 - 34,742	Surface soil sample collected north of the Lisa Lane cul-de-sac, (S20 collected 4/89).
2-methylphenol	84 - 3,026	Surface soil sample collected from north of the Lisa Lane cul-de-sac, (S20 collected 4/89).



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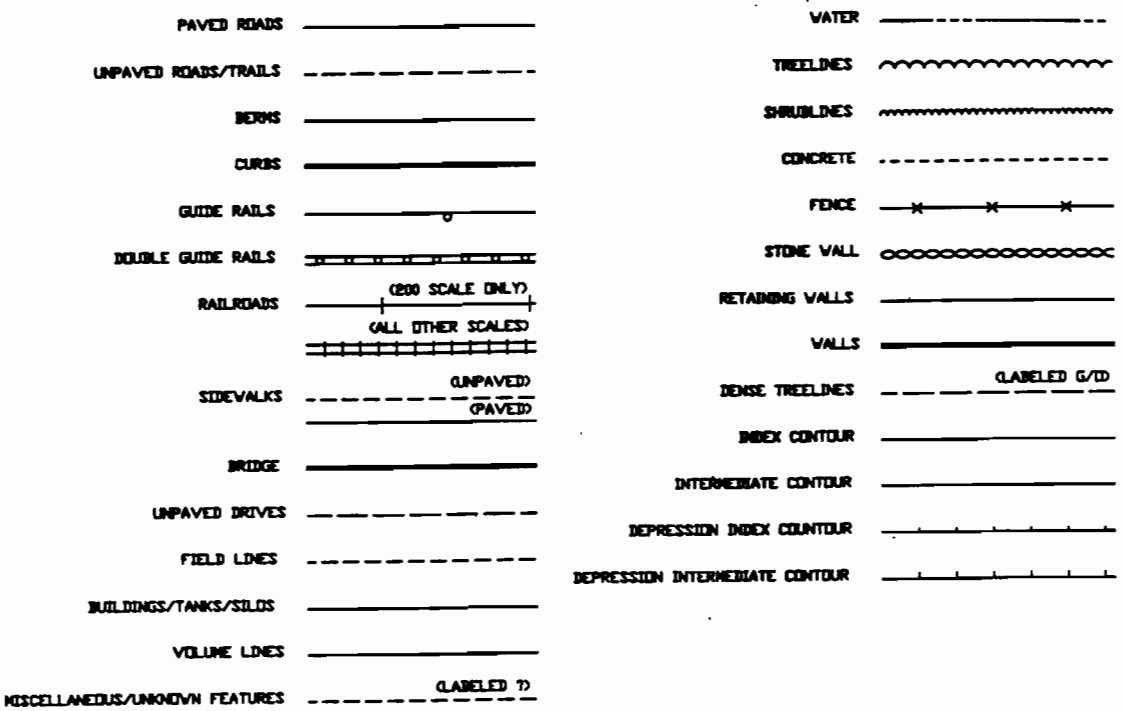
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

FIGURE 1-2

SITE MAP



[redacted]

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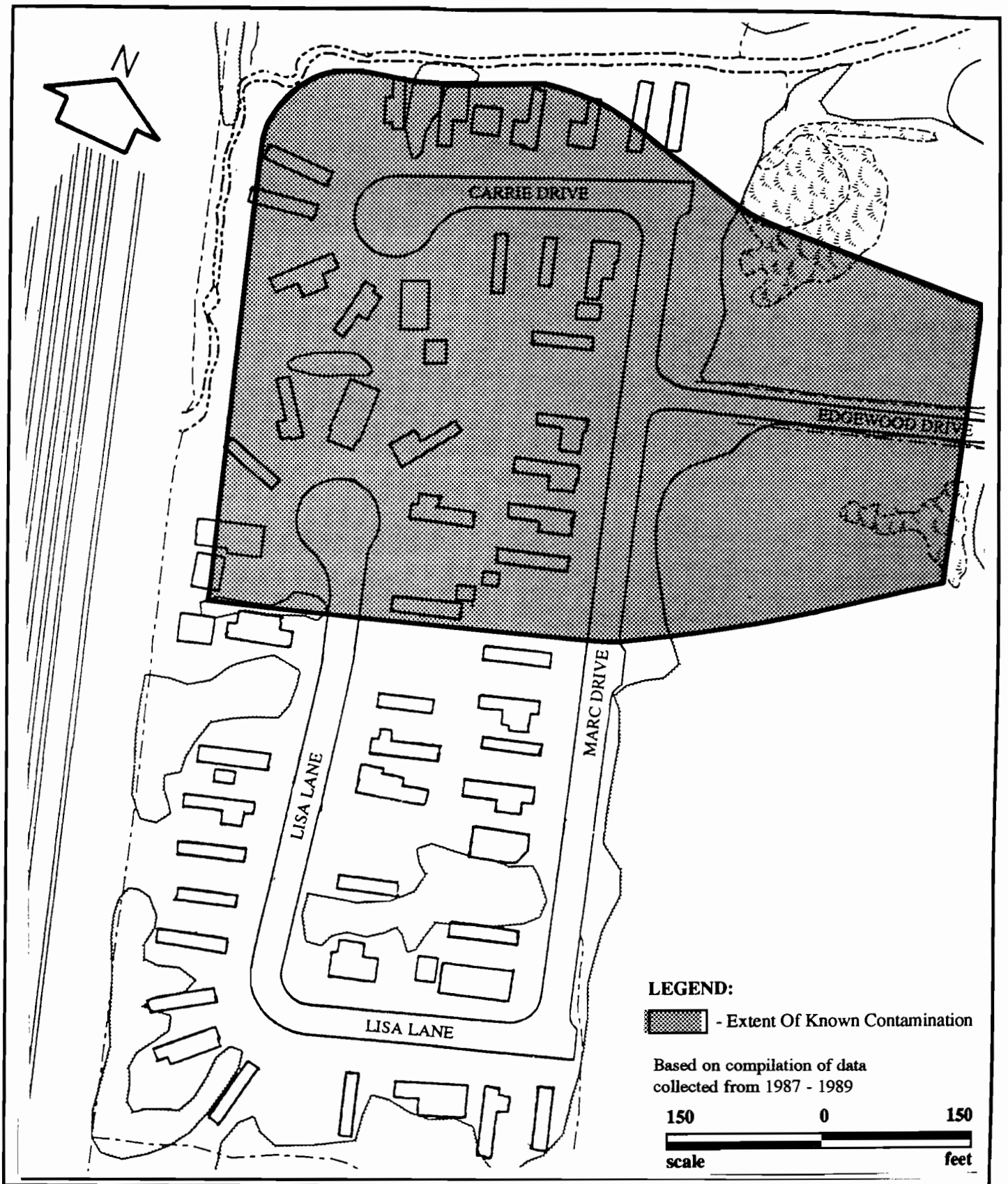
WORK ASSIGNMENT 053-2L3U

FIGURE 1- 2A
STANDARD LEGEND



[redacted]
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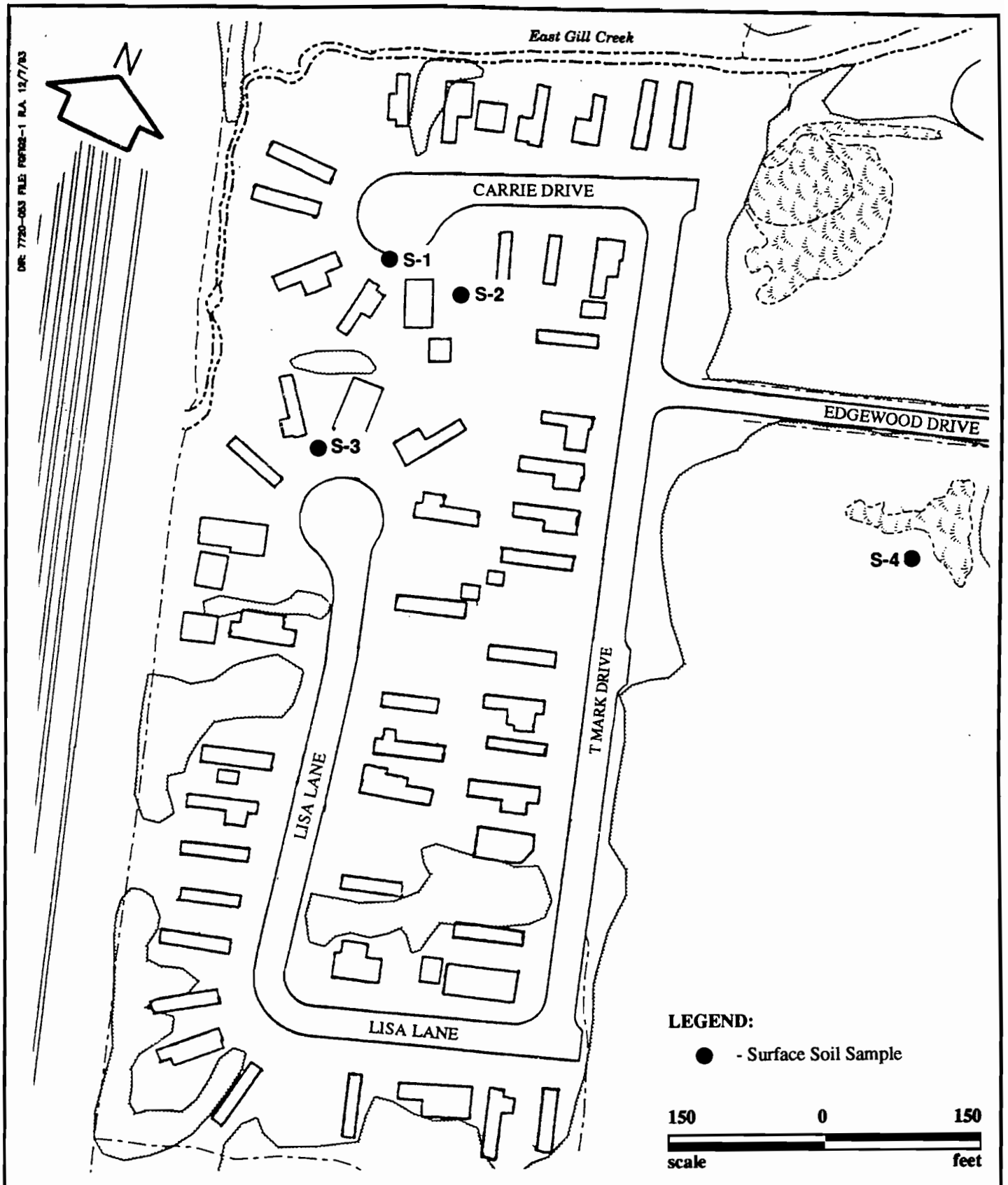
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U
Source: NUS Corporation

Figure 1-3
EXTENT OF CONTAMINATION DELINATED BY PREVIOUS EPA INVESTIGATIONS (THROUGH 1989)



FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

FIGURE 1-4
SITE INSPECTION
SAMPLE LOCATION MAP
(AUGUST 1987)

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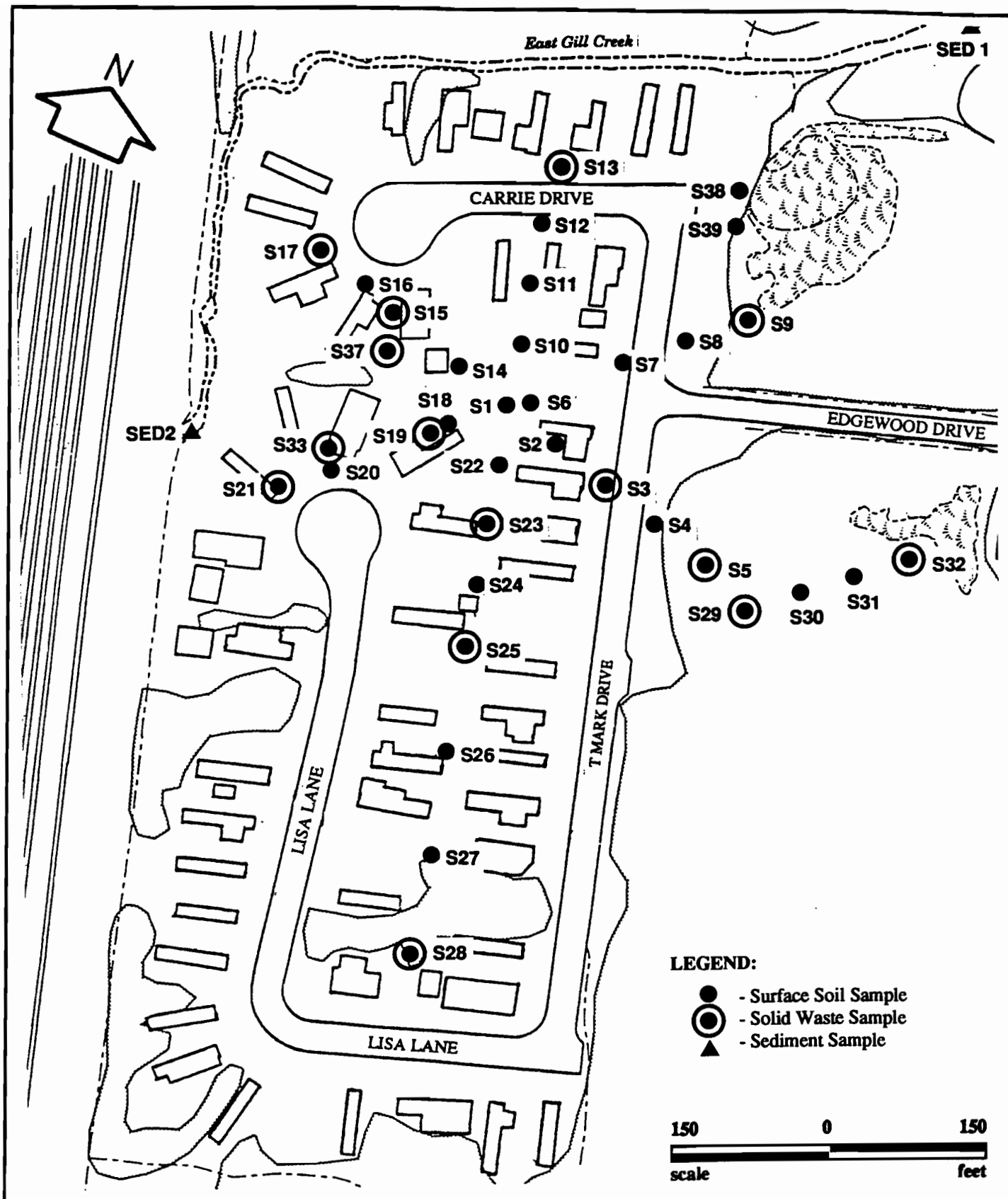

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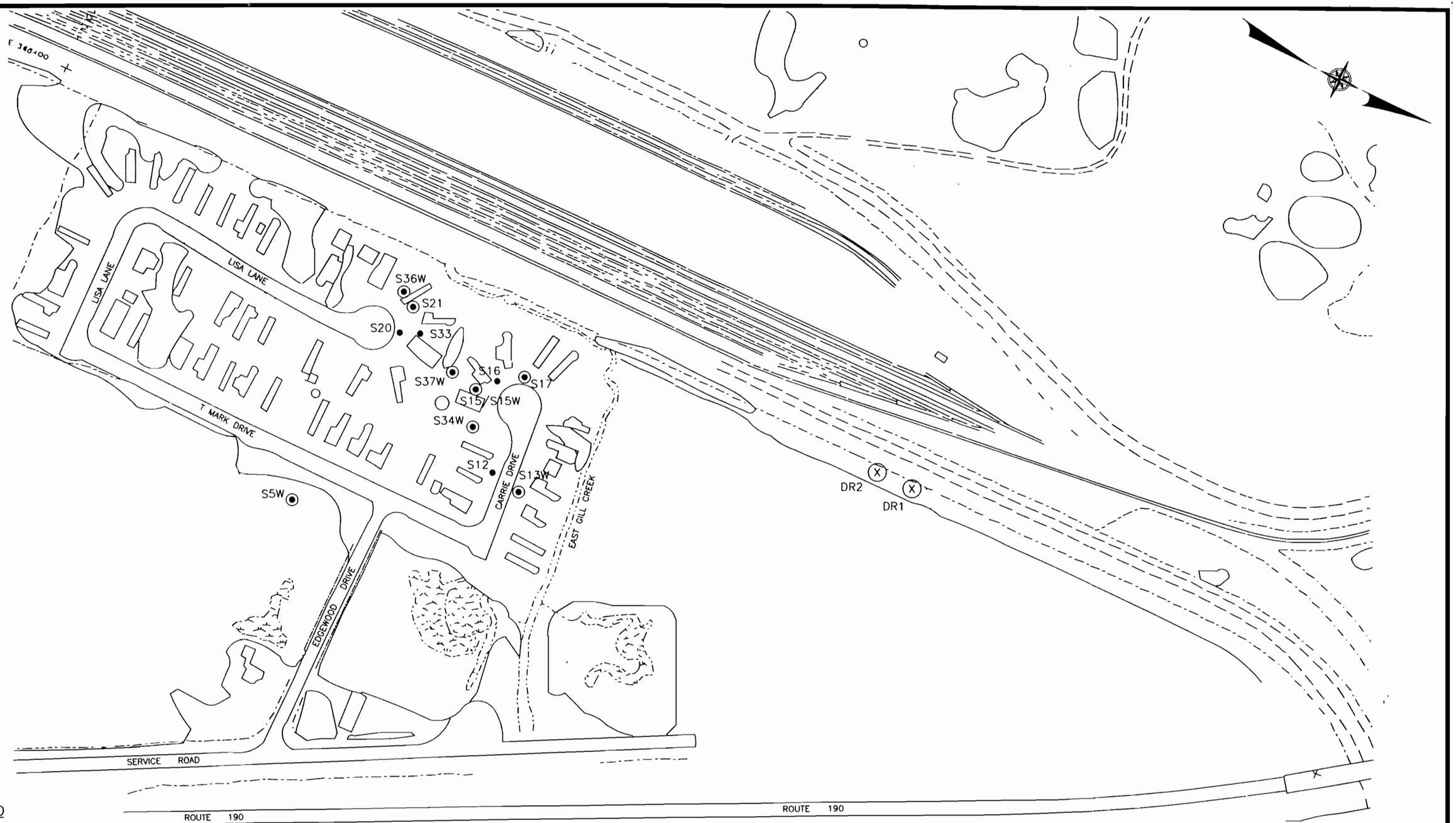
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

Source: HUS Corporation

FIGURE 1-5
FOLLOW-UP SITE INSPECTION SAMPLE LOCATION MAP (SEPTEMBER 1988)

DIR: 7720-053 FILE: FGFIG1-6 R.A. 12/7/93



LEGEND

- ◉ SOLID WASTE SAMPLE
- • SOIL SAMPLE
- (X) SAMPLES COLLECTED ADJACENT TO DRUM REMAINS

MAP COMPILED FROM AERIAL PHOTOGRAPHS TAKEN MAY, 1992

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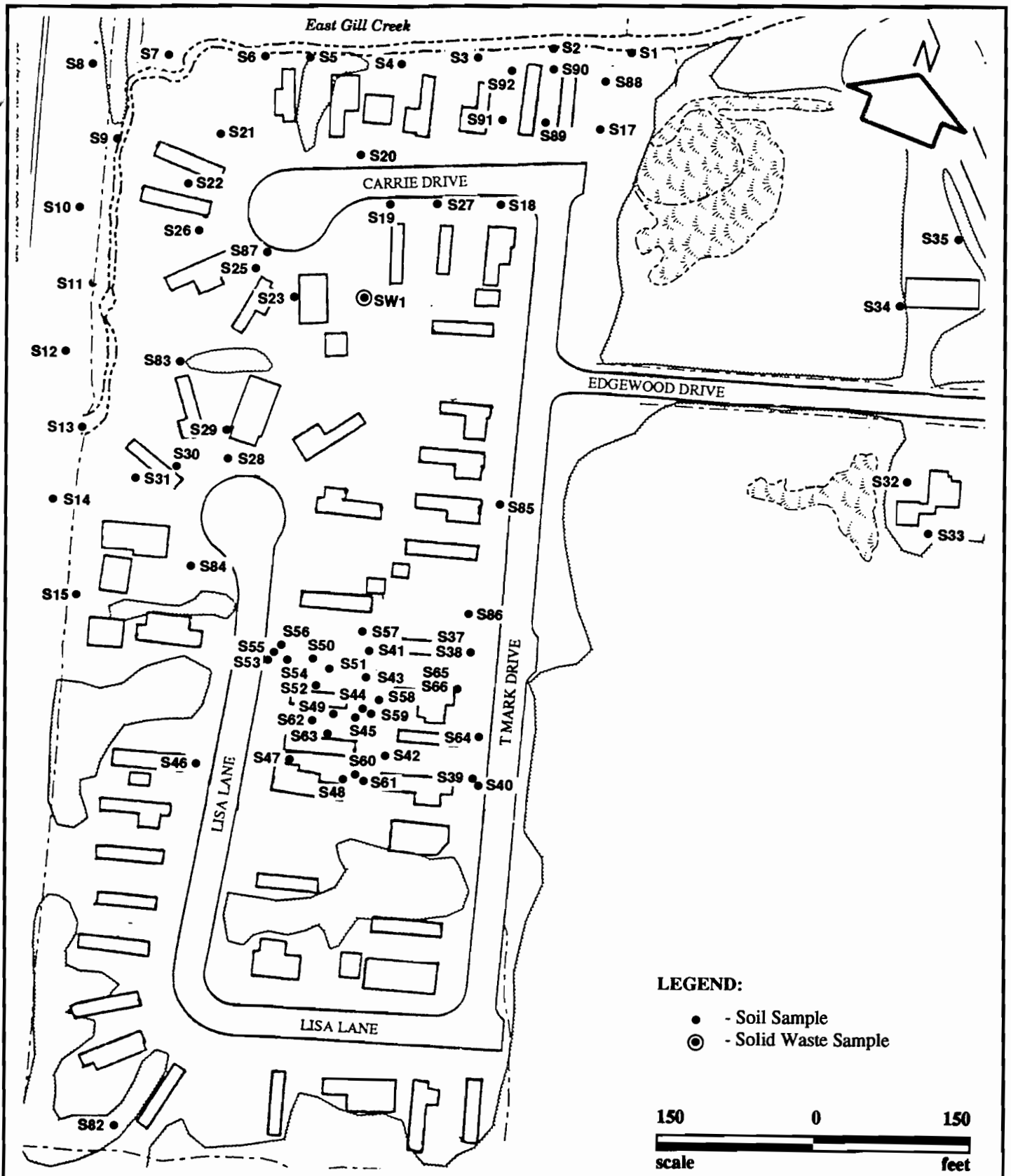
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U
Source: NUS Corporation

FIGURE 1-6
RESAMPLING LOCATIONS
(MARCH/APRIL 1989)



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FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

Source: NUS Corporation

FIGURE 1-7
SITE-WIDE SAMPLING
SAMPLE LOCATION MAP
(MAY 1989)

2.0 STUDY AREA INVESTIGATIONS

CDM Federal conducted a two-phase field investigation at the Forest Glen site to acquire data for the RI. The first phase was the initial site characterization, the second was the field data collection activities. The RI was conducted in accordance with the following EPA-approved project plans:

- The Final RI/FS Work Plan dated December, 1993. This plan was developed by EPA and modified by CDM Federal.
- The Revised Final Project Operations Plan (POP) dated June, 1994, prepared by CDM Federal.
- The POP Addendum No. 1, dated March, 1994, which was the Statement of Work (SOW) for the procurement of a laboratory to perform special analytical services (SAS) analyses.
- The Initial Site Characterization Technical Memorandum, dated February, 1995, which served to update the Final Work Plan.
- The POP Addendum No.2, dated April, 1995, which included test pit excavation and sampling procedures.

Appendix A provides the quality assurance (QA) requirements used to assure the useability of the data in order to meet RI objectives.

Based on the sampling results of previous EPA investigations and discussions with EPA technical staff, CDM Federal developed an analytical list of site-specific compounds that are not included on the TCL/TAL list. These site-specific compounds are collectively referred to as the targeted organic compounds. The targeted organic compound list consists of the following compounds: benzothiazole; 2-mercaptobenzothiazole; anilinobenzothiazole; diphenylamine; N,N'-diphenyl-1,4-benzenediamine; phenyl isothiocyanate; aniline; phenothiazine; and perylene. All samples collected during the RI field investigation were analyzed for the Forest Glen targeted organic compounds.

Initial site characterization, conducted in November and December, 1994, was designed to screen geologic, hydrogeologic, and hydrologic conditions at the site and to refine the soil sampling locations and monitoring well network proposed in the Final Work Plan. The following activities were conducted during the initial site characterization: a topographic survey, a geophysical survey, a drive-point soil boring program, and a Phase I ecological assessment.

Based on the conclusions of the initial site characterization study, CDM Federal reevaluated and redesigned the subsequent field data collection phase to more clearly define site conditions and to investigate newly identified potential areas of concern. CDM Federal's recommendations for

revisions to the field data collection activities were presented to EPA in the Initial Site Characterization Technical Memorandum (February, 1995). The Technical Memorandum served to revise the sampling program described in the Final Work Plan and Revised Final POP. EPA verbally approved the Technical Memorandum on June 5, 1995.

Field data collection activities, conducted from June to November, 1995, included test pit trenching, surface and subsurface soil sampling, wetland sediment sampling, two rounds of surface water and sediment sampling in East Gill Creek, monitoring well installation, continuous and synoptic water level measurements, and two rounds of groundwater sampling.

Table 2-1 summarizes the field activities conducted during CDM Federal's RI. Table 2-2 presents a summary of samples collected by CDM Federal during both investigation phases.

2.1 SURFACE FEATURE INVESTIGATION

A topographical survey of the site was performed, prior to initial site characterization activities, by a licensed New York surveyor, TVGA Engineering Surveyors (TVGA), under subcontract to CDM Federal. TVGA used a combination of Global Positioning System (GPS) and conventional surveying techniques. An aerial survey of the site was also conducted to complement the site survey activities.

The initial field survey activities were conducted from June 1 through June 6, 1994. Information obtained during the first round of survey activities was used to create a site map (Figure 2-1). The site map identifies physical features including buildings, mobile homes, driveways, potential wetland areas, roads, railroads, woodlands, and creeks.

The surveyor also established the geophysical survey and sampling grids for the initial site characterization activities. Two grids were established, one in the northern aspect (North Grid) and one in the subdivision (South Grid), to ensure that the geophysical survey and drive-point sampling activities systematically characterized the site. The grid nodes were staked in the field by the surveyor. Approximate sampling grid dimensions are 150 feet by 150 feet. The North Grid dimensions were modified to approximately 75 feet by 75 feet for the geophysical survey.

For nomenclature purposes, a Cartesian coordinate system was developed for the two grids. The coordinates for these systems are located at the southeastern corner of each grid. Each grid node is referenced by the associated coordinates. For example, the grid node located in the northwest corner of the southeastern-most block of the South Grid is referred to as 1.0, 1.0 (Figure 2-2).

On completion of the RI field activities, the locations and elevations of all newly installed monitoring wells and soil boring, test pit, surface soil, surface water, and sediment sampling points were surveyed by TVGA. The second phase of surveying activities was conducted from August 23 through August 25, 1995.

2.2 CONTAMINANT SOURCE INVESTIGATIONS

CDM Federal reviewed historical information from Federal, State, and local agencies regarding the Forest Glen site and other sites in the area regulated under CERCLA and the Resource Conservation and Recovery Act (RCRA). This historical information, along with aerial photographs and anecdotal reports from local residents, depicts the past disposal practices at the site and identifies potential contaminant source areas. Based on this information and CDM Federal's field investigation, six areas of concern (AOCs) were designated as discrete units because of their unique physical characteristics, waste disposal practices, and/or presence of visual contamination. These areas of concern are shown on Figure 2-3 and are described below.

2.2.1 BERM (AOC 1)

The berm is located in the northern aspect (AOC 2). Approximately 1,300 feet long, 50 feet wide, and 11 feet high, it is bordered on the west and north by the Conrail Foote Railroad yard and to the east and south by the northern aspect. The berm, constructed of fill material and native soil excavated from the ground surface of the northern aspect, was reportedly built to act as a sound barrier for the residential area that had been planned. Drums of waste material were discovered along the berm and were subsequently removed during previous EPA investigations.

CDM Federal's geophysical survey identified a series of anomalies associated with the berm. Soil boring activities later confirmed the presence of waste and fill materials within the central portion of the berm.

2.2.2 NORTHERN ASPECT (AOC 2)

This area consists of the 18-acre open field located north of the subdivision. A review of city tax and zoning maps revealed that the northern aspect was once targeted for residential development. According to the developer, Thomas Sottile, the field was leveled and top soil from the area was used to form the earthen berm that acts as much of the northern aspect's western boundary. The area is bounded to the south by East Gill Creek and the Service Road, to the north by the Conrail Foote Railroad yard, and to the east by Interstate 190.

Maps and aerial photographs indicate that a subdivision or trailer park, thought to be temporary housing for Power Authority workers, was located in the northern aspect. It is suspected the housing area was later removed to allow for construction of Interstate 190. Anecdotal reports from area residents also suggest that illegal landfilling occurred in the northern aspect throughout the years. These reports were later confirmed when drums containing chemical wastes were discovered and removed from the area during EPA removal actions in 1989.

CDM Federal's field investigation also confirmed these reports. The initial site characterization's geophysical survey detected several subsurface anomalies in the northern aspect. Test pits, later excavated during field data collection activities to confirm the anomalies, unearthed isolated

pockets of buried trash, construction debris, and scrap metal. CDM Federal also collected subsurface and surface soil samples from the northern aspect.

2.2.3 WOODED WETLAND (AOC 3)

This is a 1.5-acre low-lying wooded wetland area located in the southeastern part of the northern aspect. The area is characterized as a palustrine forest broad leaved deciduous wetland. It is bounded on the north and west by the northern aspect, on the south by East Gill Creek, and on the east by Service Road. At the time of CDM Federal's field data collection activities, black, graphite-like material, commonly associated with the fill found in the subdivision, discarded tires, and miscellaneous household trash were observed in the wooded wetland area. An intermittent streambed, a potential contaminant migration pathway, was also noted in the area. CDM Federal collected ten sediment samples from the intermittent streambed in the wooded wetland area.

2.2.4 EAST GILL CREEK (AOC 4)

East Gill Creek is a narrow, shallow, low flowing creek that serves as the subdivision's northern boundary. Subdivision runoff is directed into the creek via two outfalls. Aerial photographs indicate that a section of the creek was rerouted from its original location, the area now between Lisa Lane and Carrie Drive, 400 feet north to its current location sometime in the late 1960s. The creek flows onto the site from the east, after being directed under Interstate-190 by a series of culverts. It then flows westward across the northern portion of the subdivision and is directed off the site through a culvert under the Conrail Foote Railroad yard. The creek emerges through another culvert located west of the railroad yard, before it is directed underground through another westward-flowing culvert.

Samples collected from the creek during the previous EPA investigations indicated elevated levels of semivolatile organic compounds and heavy metals in the sediments. During RI field activities, CDM Federal noted that some creek bed sediments were black stained, viscous, and oily in texture at times of no or minimal flow. Sediment collected during higher streamflow was still black-stained although less viscous. An oily sheen was detected on standing water in the creek at times of low flow. CDM Federal collected two rounds of surface water and sediment samples from the creek.

2.2.5 EDGEWOOD DRIVE WOODED LOTS (AOC 5)

This area of concern consists of the two wooded, undeveloped lots located to the north and south of Edgewood Drive. The lots are bisected by Edgewood Drive and are both bounded by T Mark drive to the west and the Service Road to the east. The north lot is approximately 3 acres in size and is bounded to the north by East Gill Creek. The south lot is approximately 3.3 acres in size and extends approximately 250 feet to the south of Edgewood Drive.

Aerial photographs and anecdotal reports from residents suggest illegal landfilling occurred in the wooded areas over the years. Surface soil samples collected from the western end of both lots

during the EPA site investigations indicated elevated levels of semivolatile organic compounds and heavy metals.

Stressed vegetation and topographical depressions noted in these areas during CDM Federal's initial site characterization further suggested that illegal landfilling activities could have occurred in both lots. CDM Federal subsequently collected surface and subsurface soil samples from both lots during field data collection. Black-stained fill and elevated concentrations of semivolatile organic compounds were noted in numerous samples. CDM Federal findings appear to confirm the historical reports and the earlier analytical results.

2.2.6 FOREST GLEN SUBDIVISION (AOC 6)

This area includes the abandoned residential subdivision located in the southwest corner of the site; it consists of 51 mobile homes situated on 10 acres. The subdivision is bounded by T Mark Drive to the east, the Conrail Foote Railroad yard to the west, Lisa Lane to the south, and East Gill Creek to the north, and is accessed via Edgewood Drive. The majority of the subdivision's acreage is characterized by residential development including paved roads and driveways, sod lawns, and ornamental trees and shrubs. The mobile homes have been heavily vandalized; however, their individual base frames and chassis remain intact.

Historical reports of illegal landfilling and resident complaints of waste materials in the surface soils were later confirmed by EPA site investigations conducted in the late 1980s. Analytical results from the EPA studies indicated extensive soil contamination extending from the northern portion of Lisa Lane to the subdivision's northern boundary at East Gill Creek. Several hot spots, areas where chemical wastes were observed in the subdivision surface soils, were delineated along Carrie Drive during previous EPA investigations.

CDM Federal's field investigation, which included collection of subsurface soil samples from throughout the subdivision and a concentration of surface soil samples in the subdivision's northern end, confirmed EPA's earlier investigations. Black-stained fill and elevated contaminant concentrations were detected in numerous samples collected from the northern end of the subdivision.

2.3 METEOROLOGICAL INVESTIGATIONS

CDM Federal obtained monthly and yearly data on average temperature and precipitation for the Niagara Falls area from local U.S. Weather Bureau monitoring stations. The results of CDM Federal's meteorological investigation are presented in Section 3.2 of this report.

2.4 SURFACE WATER AND SEDIMENT INVESTIGATIONS

2.4.1 EAST GILL CREEK

In September 1988, FIT, under direction of EPA, conducted a Site Inspection Follow-up at the site. As part of the sitewide investigation, FIT collected an upstream and a downstream sediment sample from East Gill Creek. Both samples contained elevated levels of semivolatile organics and heavy metals. No other samples were collected from East Gill Creek in subsequent EPA FIT investigations.

CDM Federal conducted two rounds of surface water and sediment sampling in East Gill Creek. The objective of the sampling program was to determine the impact of site contamination on the creek and to define the nature and extent of any contamination potentially migrating off site via the surface water body. A second sampling round was conducted to confirm the Round 1 analytical results. Figure 2-4 shows CDM Federal's surface water and sediment sample locations. The sample locations are described below:

- Sampling location SW1/SD1 was selected to monitor upstream and background sample conditions since it represented conditions unimpacted by site-specific activities. Samples were collected east of the three storm culverts that carry East Gill Creek under I-190. Samples SW2/SD2 and SW3/SD3 were collected from two onsite locations that were parallel to the suspected fill areas on Carrie Drive.

- Sampling location SW4/SD4 was selected to collect samples from the creek before it enters the concrete culvert under the Conrail Foote Railroad yard. It is suspected that this location is immediately downstream of the two storm sewer outfalls that discharge subdivision runoff into East Gill Creek.

- Sampling location SW6/SD6 was selected to collect offsite samples west of the concrete culvert that directs East Gill Creek under the Conrail Foote Railroad yard. This offsite location was only sampled during Round 2 since it was added to the East Gill Creek investigation after Round 1 data indicated site-specific contamination in SD4, the onsite, downgradient sediment sample location.

Surface water samples were collected before sediment samples at each location. The most downstream surface water sample was collected first, with subsequent sampling progressing in an upstream direction to the final sampling point. Sample bottles were filled by immersing the entire container into the water just below the water surface with the sample container in an upstream direction. An effort was made to avoid disturbing the underlying sediments.

The volatile organic analysis sample was collected first. The first filled vial was used to determine the minimum amount of hydrochloric acid (HCl) required to bring the sample pH to less than 2. After the required amount of HCl was determined, it was then added to the actual sample containers. After the containers were filled, the vials were checked to ensure that zero

headspace was achieved. Once the volatile organic sample was collected, the remaining sample parameters were then collected.

Phthalate-free sampling gloves were worn and were changed at each sampling location. A sample of the surface water was collected so pH, temperature, specific conductance, and dissolved oxygen of the surface water at each sample location could be measured. All readings were recorded in the field logbook.

Sediment samples were collected from downstream locations first and then from upstream locations, in an upstream direction. At each location, the required sample depth (zero to 6 inches) was excavated using a decontaminated stainless steel trowel. The volatile organic sample was collected first, directly from the sampling trowel. Sediment for the remaining parameters was first placed in a decontaminated stainless steel mixing bowl and thoroughly homogenized prior to filling sampling containers. Sample-dedicated surgical, phthalate-free gloves were worn at each location.

Surface water samples were analyzed for TCL organics, TAL inorganics, targeted organic compounds, total dissolved solids (TDS), alkalinity, and hardness. Sediment samples were analyzed for TCL organics, TAL inorganics, targeted organic compounds, pH, total organic carbon (TOC), particle size, and total sulfides. Samples collected for TCL organics and TAL inorganics were submitted to a CLP laboratory for routine analysis. Samples for the remaining parameters were submitted to CDM Federal's laboratory subcontractor, H2M Laboratories.

Upon completion of sampling, each location was marked with a wooden stake and flagging, an indelible marker was used to mark sample number on both the stake and flagging. The following information was recorded in the field logbook: sample location, identification number, sample date and time, water temperature at the point and time of sampling, pH, specific conductance and dissolved oxygen content of water sample, depth of water, flow rate (when applicable), and other observable physical characteristics. Table 2-3 summarizes the surface water and sediment sampling information for both rounds. Section 4.2.5 presents the analytical results of CDM Federal's East Gill Creek investigation. All modifications to the POP necessitated by field conditions are discussed in Appendix A.

2.4.1.1 Sampling Round One

Round 1 surface water and sediment sampling was conducted on August 24 and 25, 1995. At the time of the Round 1 sampling, flow conditions in East Gill Creek were noted to be low to stagnant. CDM Federal collected four surface and four sediment samples from the locations specified in the Final Work Plan and POP. A duplicate surface water and sediment sample, SW5/SD5, was collected from location SW3/SD3.

At the time of the first round of sampling, miscellaneous trash was noted at SW1/SD1, the background location. Surface water at the upstream location, which was present in intermittent

ponds of standing water, was grayish-black and cloudy. Sediment at this location was grayish-black in color and contained organic matter, leaves and twigs, and some small gravel.

At locations SW2/SD2 and SW3/SD3, the standing water was approximately 4 inches deep, stagnant, and greenish-grey in color. Sediment at both locations was black-stained, oily, and tar-like in texture. Sediment at SD3, however, was noted to contain more clay than the SD2 sediment.

At location SW4/SD4, the surface water was approximately 4 inches deep, stagnant, and grayish in color. The sediment was black, contained decaying organic matter, and had a slight decayed odor associated with it. Analytical data from the first round sampling indicated sediment contamination at this location. CDM Federal, in response to this data, subsequently added SW6/SD6 to the Round 2 investigation. This location, downstream of SW4/SD4, was selected to provide data regarding the offsite migration of contaminants.

2.4.1.2 Sampling Round Two

Round 2 sampling was conducted on November 9 and 10, 1995. At the time of Round 2 sampling, the stream stage in East Gill had risen in comparison to the Round 1 level, however, the flow was still stagnant. Confirmational samples were collected from locations SW1/SD1 through SW4/SD4. Upon review of the Round 1 data, which indicated site-specific contamination in SD4, the downstream sediment sample, the Round 2 investigation was expanded to include offsite location SW6/SD6. CDM Federal collected five surface water and five sediment samples. A duplicate surface water and sediment sample, SW5/SD5, was collected from location SW3/SD3.

As in Round 1, miscellaneous trash was again noted at background location SW1/SD1. The surface water, approximately 1-foot deep, was brown in color and cloudy. Sediment at this location was noted to be a clayey silt, grayish-black in color, and to contain decaying organic matter including leaves and twigs, and some small gravel.

At locations SW2/SD2 and SW3/SD3, the standing water was approximately 9 to 12 inches deep and greenish grey in color, with no measurable flow observed at either location. Both sediment samples had a clayey-silt texture and contained decaying organic matter. Clumps of black-stained material were noted in both samples. This is significant since sediment during Round 1 was noted to be uniformly stained.

At location SW4/SD4, the surface water was approximately 10 inches deep and greyish in color. A moderate flow was observed at this location during the second round. The sediment was grey in color, contained some small cobbles and decaying organic matter, and had a slight decayed odor.

At location SW6/SD6, the surface water was low flowing, approximately 10 inches deep, and greyish-green in color. The sediment was grey in color, contained some small cobbles and decaying organic matter, and had a slight decayed odor.

2.4.1.3 Flow Measurements

The extremely low flow at the time of the Round 1 sampling prevented collection of flow rate measurements in East Gill Creek. The depth of the stream, however, was measured at each of the sampling locations and recorded in the field logbook. The surface water level at the staff gauges was read directly from the scale on the gauge. The vertical distance between the surveyor's mark on the gauge was used to calculate the elevation of the water surface.

During the second sampling round, the water level in the East Gill Creek was noticeably higher than in Round 1; however, the creek still appeared stagnant, with only minimal flow. The flow rate of the creek was measured at five locations using a portable water current meter that, when submerged in a flowing stream, rotates at a speed proportional to the water flow velocity. An effort was made not to disturb the stream flow while the measurements were taken.

The POP had required that East Gill Creek's horizontal extent be partitioned into stations. Measurements were then to be collected at each station. However, because of the narrowness of the creek and the minimal flow conditions, only one measurement was collected per sampling location.

Estimates of stream width, stream depth, and stream flow were made at locations SW1/SD1, SW2/SD2, SW3/SD3 (SW5/SD5 was a duplicate), SW4/SD4, and SW6/SD6. No flow velocity was measurable at any of the five locations sampled by the portable water current meter.

2.4.2 WOODED WETLAND

CDM Federal collected ten sediment samples from the wooded wetland (AOC 3) area located in the southeastern corner of the northern aspect, north of East Gill Creek (Figure 2-5). Because the intermittent streambed in this area is a potential contaminant migration pathway, samples were collected to delineate the nature and extent of wetland soil contamination resulting from past illegal disposal activities. At the time of sample collection, black graphite-like material, commonly associated with the fill found in the subdivision, discarded tires, and miscellaneous household trash were observed in the wooded wetland area.

Background wetland samples were collected from an area immediately south of the site on the Forest Glen property and north of Expressway Village. The background locations represented soil conditions similar to the site and were reportedly unimpacted by site activities. CDM Federal had proposed in the Technical Memorandum that two background sediment samples be collected from a wetland located to the east of the site; however, because of access difficulties, alternate locations were chosen. Sediment samples were collected and marked in the same manner as discussed in Section 2.4.1.

All soil sampling procedures adhered to the protocols stated in the POP. Samples were analyzed for TCL organics, TAL inorganics, targeted organic compounds, TOC, pH, total sulfides, and particle size. Samples collected for TCL organics and TAL inorganics were submitted to a CLP laboratory for routine analytical services. Samples for the remaining parameters were submitted to CDM Federal's laboratory subcontractor, H2M Laboratories. Sections 3.8 and 4.2.4 of this report present the results of CDM Federal's wooded wetland investigation.

2.5 GEOLOGICAL AND HYDROGEOLOGICAL INVESTIGATIONS

The objectives of these investigations were to characterize subsurface geological and hydrogeological conditions at the site. The investigations included: a geophysical survey, monitoring well installation, and continuous and synoptic water level measurements. The results of CDM Federal geological and hydrogeological investigations are presented in Sections 3.5 and 3.6 of this report.

2.5.1 GEOPHYSICAL SURVEY

CDM Federal conducted geophysical survey activities at the site from June 6 through June 22, 1994 and from November 14 through November 18, 1994. The purpose of the geophysical investigation was to gain initial information on the subsurface geology and to detect and identify buried drums and waste, if any. The procedures, results, and limitations of geophysical surveys were fully detailed in the Technical Memorandum and are provided as Appendix B. The surveys are also summarized below.

Electromagnetic and seismic refraction surveys were used to achieve the objectives of the geophysical survey. Electromagnetic surveys were conducted over the northern aspect where minimal interference was anticipated. Seismic refraction was used in the subdivision because of the presence of the mobile homes, fences, and utilities, which create excessive anomalous interference for the electromagnetic surveys. The surveyed grid nodes (Figure 2-2) served as reference starting points for all the geophysical surveys.

2.5.1.1 Electromagnetic Surveys

Two types of electromagnetic surveys were applied: EM31-D (shallow) and EM34-3 (deep). Generally, the procedures described in the POP, were implemented for both the EM31-D and the EM34-3 methods. Modifications to the POP are discussed in Appendix A.

Because of the limited depth of the penetration of the EM31-D instrument, readings were primarily of the overburden in the northern aspect. Terrain conductivity values measured by the EM31-D survey in the field are presented in Figures 2-6 (horizontal dipole) and 2-7 (vertical dipole).

The EM34-3 instrument was used in the horizontal dipole mode to map lateral changes in near-surface material conductivity and thickness, and in the vertical dipole mode to detect and map

potential fracture patterns and zones in the Lockport Dolomite within the northern aspect. The site contains a relatively conductive (clay-rich) overburden overlying a resistive (low-porosity) dolomite. Vertical fractures in the dolomite that are filled with water (and/or clay) behave and appear as sheet-like, vertical conductors. Figures 2-8 through 2-11 show contour diagrams of terrain conductivity for measurements of both horizontal and vertical dipole modes.

The electromagnetic surveys indicated the presence of three anomalous subsurface areas in the northern aspect:

1. A higher conductive area was noted in the overburden in the northwestern portion of the northern aspect. The area is approximately 600 feet by 150 feet and runs parallel with the berm. Test pits 1 through 8, EXP, and EXP2 were trenched in the vicinity of these anomalies during the field data collection activities. The source of the higher conductivity was buried waste including fill material, scrap metal, and cardboard boxes.

2. A lower conductivity area near the southwest corner of the northern aspect was identified. Shallow bedrock (approximately 5ft. BGS) was encountered in this area during the trenching of Test Pits 9 and 10.

3. A distinct high-conductivity anomaly exists north of the chainlink fence near grid node 1.0,1.5. Since this anomaly was limited in extent, SB-1 was drilled to a depth of 12.00' BGS investigate the source. No debris or fill was encountered in the boring. The source of this anomaly is unknown.

2.5.1.2 Seismic Refraction Survey

Due to background interference associated with the subdivision, the seismic refraction survey was used in this area to obtain subsurface information. The locations of the seismic survey lines are presented in Figure 2-2. The seismic refraction field procedures generally used during this survey are fully detailed in the POP. Appendix A lists modifications to the POP necessitated by field conditions.

The seismic refraction survey identified three seismic layers beneath the subdivision, based on known regional geology and observed seismic velocities. These layers are identified in the following table.

Seismic Velocity (ft/sec)	Approx. Depth (ft)	Description
<1000-2000	0-10	shallow, dry lacustrine clay
3000-9000	5-30	dense till, partially to fully saturated
7000-18000	15-40	bedrock (dolomite)

The overlap of depths to the various geologic layers shown in the table is due to varying depths to the different contacts across the subdivision. The information from the survey was used during the monitoring well and soil boring installation program to predict subsurface conditions.

2.5.2 MONITORING WELL INSTALLATION

Previous EPA investigations at Forest Glen did not characterize subsurface conditions at the site. The subsurface investigation was, therefore, designed to evaluate the impact of the known soil contamination on the underlying aquifer system. The monitoring well program focused on the groundwater which may have been impacted by the subdivision source areas identified in the previous studies. CDM Federal initially proposed that seven monitoring well clusters be installed to evaluate the potential horizontal and vertical extent of groundwater contamination beneath the subdivision. Each cluster was to consist of an overburden (zero to 20 feet BGS), a shallow bedrock (20 to 35 feet BGS), and a deep bedrock monitoring well (greater than 35 feet BGS).

Upon completion of the drive point soil borings during the initial site characterization, CDM Federal noted the site lithology generally consisted of 10 to 12 feet of thick, dry, and stiff red-brown clay overlying 2 to 3 feet of a moist, red-brown clay till, overlying weathered gray Lockport dolomite. With the exception of limited areas of perched groundwater located in subdivision fill areas, groundwater was encountered only in the thin clay till layer and in the fractured bedrock. Additionally, no subsurface fill or visual contamination was encountered in the northern aspect during the initial site characterization soil boring activities. Based on the information obtained during the initial site characterization, a total of nine monitoring well clusters were installed with respect to the west trending regional groundwater flow. The locations of the nine monitoring well clusters are shown on Figure 2-12.

CDM Federal's rationale for each monitoring well cluster is as follows:

- Monitoring well cluster MW-1(S/D) is located on the east side of the Service Road across from the intersection with Edgewood Drive. This cluster provides data on upgradient, background groundwater quality.

- Monitoring well clusters MW-9(S/D) and MW-2(S/D) are source area wells located in the wooded lot north and south of Edgewood Drive, respectively. Extensive areas of black stained fill material, encountered in both lots during soil boring activities, confirmed anecdotal reports of illegal landfilling in these areas.

- Monitoring well cluster MW-3 is a source area well located in the fill area, west of T Mark Drive, that was delineated during drive-point sampling activities. Perched water (PW), located in the fill, was also encountered during these activities. Following discussions with the EPA Work Assignment Manager (WAM), perched water and overburden (OB) monitoring wells were installed in addition to the shallow and deep bedrock wells for a total of four wells at cluster MW-3.

- Monitoring well clusters MW-4(S/D), MW-5(S/D), and MW-6(S/D), are located along the site's western fence line. These wells are downgradient of the delineated fill area and serve to intercept the groundwater flow from the potential source areas.

- Monitoring well clusters MW-7(S/D) and MW-8(S/D) are located off site and downgradient of the delineated fill area. These wells intercept offsite flow from the site's potential source areas.

Monitoring wells were installed in accordance with the methods specified in the POP with slight modifications necessitated by field conditions (refer to Appendix A). Table 2-4 summarizes monitoring well construction information. The monitoring well construction diagrams are in Appendix C.

CDM Federal has defined the groundwater zones monitored by the Forest Glen well network as follows:

Perched Water. The perched water zone at MW-3 was defined as the water encountered locally in the fill material that was encountered above the clay layer .

Overburden Groundwater. The overburden groundwater zone at MW-3 was defined as the groundwater encountered locally in the fill present above the bedrock.

Shallow Groundwater. Shallow groundwater was defined as the first groundwater encountered in a zone of highly fractured and broken bedrock, as determined from coring and water loss during coring operations.

Deep Groundwater. Deep groundwater was defined as the second highly fractured and broken bedrock zone encountered, as determined from coring and water loss during coring operations.

Initial placement of the monitoring well clusters was based on a regional groundwater flow direction to the west-southwest as described in Miller and Kappel (1987). In an effort to

determine local groundwater flow direction and finalize proposed well locations, monitoring well clusters MW-1, MW-4, and MW-6 were installed first and immediately surveyed so groundwater elevations could be determined. Local groundwater flow was then ascertained by triangulating groundwater elevations collected from the newly installed deep and shallow monitoring wells. The remaining monitoring well clusters were subsequently installed with respect to a regional groundwater flow direction to the west.

2.5.2.1 Deep Bedrock Monitoring Well Installation

The purpose of the deep bedrock monitoring program was to monitor groundwater quality and water levels in the second fractured zone of the Lockport dolomite aquifer. It was determined during coring operations that the deep bedrock zone occurred at depths greater than 26 feet BGS.

It was expected that both the overburden clay layer and the competent bedrock beneath the shallow bedrock aquifer zone act as confining or semiconfining layers. The deep bedrock monitoring wells were installed to maintain the potential confining qualities of both units. A double cased well design was used to prevent cross-contamination between the overburden, shallow, and deep bedrock aquifer zones.

Hollow stem augering was used to place the 8-inch inside diameter (ID) stainless steel overburden casing. Air-rotary drilling was then used to place the 4-inch ID stainless steel casing in the shallow groundwater zone. Four-inch diameter HQ coring was then used to complete the deep bedrock open borehole monitoring well. The deep bedrock well construction diagram is presented in Figure 2-13.

The overburden borehole was advanced with 10.25 inch ID hollow stem augers to refusal on the top of bedrock. The use of the hollow stem augers eliminated the need for 12-inch ID temporary steel casing that was specified in the POP. The overburden encountered was 10 to 12 feet of stiff, dry, and silty clay, overlying 1 to 2 feet of wet clay, sand, and gravel glacial till. The glacial till encountered on site was observed to be more permeable than the hard pan, low permeability, lodgement till that was expected at the time of project planning.

Eight-inch ID Schedule 5 stainless steel surface casing was then seated in the bedrock to prevent potential contaminant migration from the clay layer to the bedrock. The annular space was backfilled with cement bentonite grout and allowed to set for a minimum of 12 hours before drilling proceeded. CDM Federal did not use a bentonite seal, as specified in the POP, since the casing was seated directly into the bedrock.

The bedrock section of the borehole was then logged through the eight-inch casing via the acquisition of HQ (4-inch nominal diameter) gauge cores. CDM Federal had proposed the use of NQ (2-inch nominal diameter) gauge cores. However, the use of HQ gauge cores allowed for the creation a 4-inch open borehole and thereby eliminated the need to redrill the proposed two-inch, NQ gauge hole with 4-inch diameter air rotary. In an effort to expedite the drilling process, the cores were retrieved in up to 10-foot sections. All information regarding fracture frequency

and fracture characteristics was recorded by the site geologist and presented on the core logs in Appendix D.

The shallow bedrock section was cored first and was noted to extend downwards from the top of the bedrock to approximately 35 feet BGS. CDM Federal defined the bottom of this zone as the end of the first continuous 10-foot interval of relatively unfractured core or a maximum depth of 35 feet BGS, or whichever was less. The drilling water loss that generally occurred within this interval was indicative of a potential water-bearing zone.

Once the shallow bedrock section had been cored, the boring was reamed using air rotary methods to a diameter of 8-inches. A four-inch ID stainless steel Schedule 5 casing was then seated through the 8-inch casing. Bentonite pellets were used to seal the lower 2-feet of the borehole. The remaining annular space between the 8-inch and 4-inch casings was tremie grouted to the ground surface.

Coring operations in the deep bedrock aquifer zone then continued through the 4-inch casing until the first water-bearing fracture zone was encountered. This zone generally occurred at approximately 30 feet to 45 feet BGS and was exhibited by drilling water loss and a highly fractured core. As previously stated, the POP had proposed using two-inch NQ coring and then reaming the open hole section with 4-inch air rotary. Since the borehole was cored using a 4-inch diameter HQ core, the need to ream the open hole using air rotary was eliminated.

Deep bedrock monitoring wells were generally completed, depending on the deep zone depth, with a 20- to 30-foot, 4-inch-diameter open borehole. The well was finished so that the inner-most riser casing was truncated approximately 2 feet above the existing grade (Figure 2-13). Riser casing caps were provided for each well. A protective steel surface casing was installed to fit around the outer-most riser casing and extended at least 6-inches above the top of the inner-most riser casing. The surface cement was sloped away from the protective surface casing during final placement so as to create a drainage apron. The well number was painted on the outside of the protective casing. All excess soil cuttings and water generated during the drilling activities were drummed and moved to a secure area.

The wells were developed by the drilling subcontractor using a submersible pump. Development was considered complete when a relatively sediment-free discharge was achieved and the pH, temperature, and specific conductivity remained consistent within a +/- 10 percent range. Development water was contained in 55-gallon drums.

2.5.2.2 Shallow Bedrock Monitoring Wells

Shallow bedrock wells were installed to monitor the first groundwater zone encountered within the bedrock. The monitoring interval for the shallow bedrock wells was determined during the coring of the deep bedrock wells. This interval, generally noted to be 18 feet to 28 feet BGS, determined the placement of the well screen. The hollow stem auger method was used to drill through the overburden and the air rotary drilling method to drill through to the bottom of the

shallow bedrock zone. The shallow bedrock monitoring well construction diagram is shown in Figure 2-14.

The overburden borehole was advanced with 10.25-inch ID hollow stem augers to refusal on the top of bedrock. The use of the hollow stem augers eliminated the need for 12-inch ID temporary steel casing that was specified in the POP. The overburden encountered was 10 to 12 feet of stiff, dry, and silty clay overlying 1 to 2 feet of wet clay, sand, and gravel glacial till. The glacial till encountered on site was observed to be more permeable than the hard pan, low permeability, lodgement till that was expected at the time of project planning.

Eight-inch ID Schedule 5 stainless steel surface casing was then seated in the bedrock to prevent potential contaminant migration from the clay layer to the bedrock. The annular space was backfilled with cement bentonite grout and allowed to set for a minimum of 12 hours before drilling proceeded. A bentonite seal was not used since the casing was seated directly in the bedrock.

Air rotary, through the 8-inch casing, was used to drill the remainder of the borehole. The borehole was extended to the bottom of the monitoring interval that had been previously determined during the deep bedrock coring activity (not greater than 35 feet BGS). Since the upper fractured zone of the dolomite bedrock was highly weathered, a significant amount of silt and clay sized particles were in this zone. Therefore, these wells were equipped with a stainless steel screen and sand filter pack to filter out these particles. Four-inch diameter Schedule 5 stainless steel casing and 10 feet of stainless steel 0.010-inch slot well screen were installed.

The base of the well was secured a minimum of 1 foot above the bottom of the borehole. Graded, washed Morie No. 1 sand was added to the annulus until a continuous sand filter pack extended from 1 foot below the well screen's base to two feet above its top. A 2- to 3-foot bentonite seal was then installed above the top of the sand filter pack. The bentonite seal was overlain with a cement-bentonite grout that extended to the ground surface.

The well was finished so the inner-most riser casing was truncated approximately 2 feet above the existing grade (Figure 2-14). Riser casing caps were provided for each well. Protective steel surface casing was installed to fit around the outer-most riser casing and to extend at least 6-inches above the top of the inner-most riser casing. The surface cement was sloped away from the protective surface casing during final placement to create a drainage apron. The well number was painted on the outside of the protective casing. All excess soil cuttings and water generated during the drilling activities were drummed and moved to a secure area.

The wells were developed by the drilling subcontractor using a submersible pump to improve the hydraulic connection with the aquifer. Development was considered complete when a relatively sediment-free discharge was achieved and the pH, temperature, and specific conductivity remained consistent within a +/- 10 percent range. Development water was contained in 55-gallon drums.

2.5.2.3 Perched Water and Overburden Monitoring Wells

CDM Federal encountered perched water conditions in an area of fill material during installation of drive point soil borings. The MW-3 monitoring well cluster was installed in this fill area since the area represented a potential source area. In addition to the shallow and deep bedrock wells, CDM Federal also installed a perched water and an overburden well at this location.

The perched water condition in this fill area exists because the downward movement of the water through the fill is inhibited and trapped by the underlying clay layer. The perched water well was installed to monitor the quality of the water present in the fill.

The overburden encountered in the vicinity of cluster MW-3 was 6 to 8-feet of a black-stained and partially saturated layer of fill material overlying 4 feet of stiff, dry, and silty clay, overlying a 1 to 2 foot layer of wet clay, sand, and gravel glacial till. CDM Federal observed that the clay layer in the vicinity of MW-3 was not as thick as the clay layers encountered in areas where no fill was detected. It was determined that this thinner clay layer could potentially allow the migration of contaminants from the perched water to the bedrock groundwater. CDM Federal, with respect to this data, installed the overburden well to monitor for any potential seepage from the perched water zone.

The perched water and overburden monitoring wells were drilled by the hollow-stem auger method and constructed of 4-inch-diameter stainless steel casing and screen. The overburden and perched water monitoring well diagrams are presented in Figure 2-15.

For each well, a 12-inch-diameter borehole was advanced with a hollow-stem auger drilling rig. Four-inch-diameter Schedule 5 stainless steel casing and 10 feet of stainless steel 0.010-inch slot well screen (5-feet of screen for the perched water well) were then inserted into the borehole. The perched well was screened in the saturated fill above the natural clay layer. The overburden well was screened from the top of bedrock up through the clay till and into the clay layer. The screened intervals for the two wells were determined from observations made during the previously conducted drive-point sampling and during the installation of the MW-3 deep bedrock monitoring well.

Both wells were constructed in a similar manner. The base of the well was secured a minimum of 1 foot above the bottom of the borehole. Graded, washed Morie No. 1 sand was then added to the annulus until a continuous sand filter pack extended from one foot below the well screen's base to 2 feet above its top. A 2- to 3-foot bentonite seal was then installed above the top of the sand filter pack. The bentonite seal was then overlain with a cement-bentonite grout that extended to the ground surface.

Each well was finished so that the inner-most riser casing was truncated approximately 2 feet above the existing grade (Figure 2-15). Riser casing caps were provided for each well. The protective steel surface casing was installed to fit around the outer-most riser casing and to extend at least 6 inches above the top of the inner-most riser casing. The surface cement was sloped

away from the protective surface casing during final placement to create a drainage apron. The well number was painted on the outside of the protective casing. All excess soil cuttings and water generated during the drilling activities were drummed and moved to a secure area.

The wells were developed by the drilling subcontractor using a submersible pump to improve the hydraulic connection with the aquifer. Development was considered complete when a relatively sediment-free discharge was achieved and the pH, temperature and specific conductivity remained consistent within a +/- 10 percent range. Development water was contained in 55-gallon drums.

2.5.3 CONTINUOUS WATER LEVEL MEASUREMENTS

Before the first groundwater sampling event, continuous water level measurements were collected from three well clusters to monitor for cyclical head fluctuations in the perched water, overburden water, shallow bedrock, and deep bedrock aquifer zones. The water level monitoring was conducted from August 24 through September 1, 1995 using pressure transducers connected to a field electronic data logger. Modifications to the POP that were necessitated by field conditions are discussed in Appendix A.

Three stream gauges were installed in East Gill Creek to supplement groundwater elevation data collected during the continuous water level measurement event. Due to the low stream stage level of East Gill Creek at the time of the continuous water level measurement investigation, CDM Federal decided against collecting water level data from the creek as had been proposed in the POP. The data logger which had been designated for the creek was instead installed in a third monitoring well cluster so additional data on groundwater levels and flow regimes could be obtained. Therefore, a total of three well clusters were monitored.

Prior to installation of the pressure transducers, water levels were measured in the three well clusters monitored. Upon installation, the monitoring well transducers were positioned a minimum of 3 to 5 feet, and no more than 10 feet, below the water surface. Pressure transducers of 20 pounds per square inch (psi) were installed in monitoring wells MW-2S, MW-2D, MW-5S, MW-5D, and of 10 psi in MW-3S, MW-3D, and MW-3PW. The more sensitive 10- psi transducers were put in the MW-3 cluster since less change was expected in MW-3PW, which was suspected to lack connection with the bedrock aquifer.

After the installation of the transducers and testing of the datalogger units, the dataloggers were programmed to record at 1-minute intervals. Continuous water level monitoring was initiated on August 24, 1995. On September 1, 1995, the water level information stored in the dataloggers was downloaded to a spreadsheet and graphed for analysis.

An additional round of continuous water levels were taken in MW-7S, MW-7D, MW-8S, and MW-8D for a 24-hour period from December 27 to December 28, 1995, to evaluate any impacts of the PASNY projects on the water levels in these wells. Except for the time period and use of the only 20-psi pressure transducers in the 24-hour round, the procedures for both continuous water level rounds were the same.

2.5.4 SYNOPTIC WATER LEVEL MEASUREMENTS

Before each of the two groundwater sampling rounds, synoptic water level measurements were collected from each site monitoring well. Four additional rounds of synoptic water level measurements were collected during the morning and afternoon on November 16 and December 28, 1995. These data were collected in an effort to identify any regional fluctuations in water levels that might occur throughout the day. Table 2-5 summarizes the water level elevation data.

The synoptic water level measurements were collected with an electronic water level indicator to develop equipotential maps for the shallow bedrock and deep bedrock aquifer zones. The data was used to determine horizontal and vertical flow gradients and was evaluated in light of other surface and subsurface hydrogeologic information to develop a comprehensive hydrogeologic conceptual model for the site.

Static water levels in the monitoring wells were measured to the nearest 0.01 foot from the surveyors mark, a groove filed into the top of inner riser casing. All measurements, including depth to water and total depth of well, were recorded in the field logbook and on synoptic water level measurement data sheets.

2.6 SOIL AND VADOSE ZONE INVESTIGATIONS

Previous EPA soil investigations at Forest Glen extensively characterized subdivision surface soil quality. Subsurface soil quality, however, was only cursorily addressed since samples were collected from a maximum depth of 3 feet BGS. Based on previous investigations, historical information and aerial photographs, CDM Federal designed a sampling program to characterize both the horizontal and vertical extent of soil contamination. The results of CDM Federal's soil and vadose zone investigations are presented in Section 3.5.

2.6.1 DRIVE POINT SOIL BORING ACTIVITIES

Drive-point soil boring activities were conducted from November 14 through December 2, 1994. The drive-point program was designed to gather preliminary data on shallow groundwater quality, to characterize subsurface soil contamination, and to gather additional geologic information to supplement the geophysical survey data. CDM Federal was unable to collect groundwater samples by the drive-point method because the tight clay layers encountered in every soil boring did not allow adequate overburden groundwater flow for sample collection.

Drive-point soil borings were installed at 34 grid node locations along the sampling grid in the subdivision and northern aspect as shown in Figure 2-16. The sampling grid did not extent to the wooded area east of the southern portion of the subdivision, since there was no previous evidence of dumping in this area. Drive-point soil borings were advanced using a truck-mounted, hollow stem auger drill rig by CDM Federal's drilling subcontractor SJB Services, Inc. (SJB). Continuous split-spoon samples were collected by driving a 3-inch-diameter split-spoon through the 2-foot interval in advance of the augers.

Each split-spoon was scanned with an HNu photoionization detector immediately on being opened. All readings above background were noted in the field logbook and are presented in the boring logs. The soil sample was then characterized and described, using the Burmister Soil Classification System, by the CDM Federal hydrogeologist. Sample descriptions were recorded on to a boring log record and in the field logbook. The drive-point boring logs are presented in Appendix E. At most locations, continuous split-spoon samples were advanced to the top of the till.

Analytical samples were generally collected from the first split-spoon interval that indicated the presence of the clay till. This procedure was modified several times as a result of the field conditions. Additional analytical samples were also collected from those boring locations where visual contamination and fill material were noted.

Generally, one subsurface soil sample was collected from each drive-point soil boring location. Surface soil samples were also collected at each of the 12 locations in the northern aspect. CDM Federal collected four additional subsurface samples (DP-013B, DP-014B, DP-018B, DP-034B) and two additional surface soil samples (DP-013SS, DP-017SS) from subdivision locations where visual contamination was noted.

All soil sampling procedures adhered to the protocols stated in the POP. Samples were analyzed for TCL organics, TAL inorganics, targeted organic compounds, TOC, pH, and grain size. Samples collected for TCL organics and TAL inorganics were submitted to a Contract Laboratory Program (CLP) laboratory for routine analytical services. Samples for the remaining parameters were submitted to CDM Federal's laboratory subcontractor, H2M laboratories. The analytical results of the drive-point sampling activities are presented in Section 4.2.

2.6.2 SUBSURFACE SOIL BORING ACTIVITIES

Soil boring activities were conducted from June 19 through June 26, 1995. The soil boring program, as proposed in the Technical Memorandum, was designed to characterize subsurface soil contamination and to gather additional geologic information in those areas of potential concern identified during the initial site characterization. Figure 2-16 shows the soil boring locations.

Samples were collected from the following boring locations:

- Five locations on the berm in the northern aspect where borings were installed to define the vertical extent of the fill and to characterize the nature of any contamination associated with it. Because of the thickness of the fill material in the berm and the limitations of the all-terrain drill rig that was used during the soil boring program, the borings were advanced 2 feet into the naturally occurring clay layer. At each boring location, one subsurface soil sample was collected from the first split-spoon interval that indicated local clay, for laboratory analysis. CDM Federal also collected one additional subsurface soil sample from boring locations BERM 2 and BERM 3, where visual contamination and fill material were noted in the soil column.

- Four locations in the northern aspect. One boring was completed in the area where distinct high conductivity electromagnetic anomalies were noted during the geophysical survey (SB-01). Two borings (SB-02, SB-03) originally proposed to delineate the electromagnetic anomalies were relocated to delineate the horizontal and vertical extent of fill material encountered during test pit activities. One additional boring (SB-018) was added to assist in the fill delineation efforts. Northern aspect borings were advanced to the top of the till. One surface and subsurface soil sample was collected from each soil boring location. The subsurface analytical samples were collected from the first split-spoon interval that indicated the presence of the clay till.

- The areas of stressed vegetation and topographical depressions noted in the wooded areas north and south of Edgewood Drive during the initial site characterization. Based on these observations and historical reports of illegal landfilling, CDM Federal planned the installation of 14 soil borings in these areas. An additional boring was completed in both the north and south areas (SB-EXP and SB-Center, respectively) to assist in the delineation effort. A total of eight borings were completed in each area to define the vertical extent of contamination and to characterize the presence, integrity, and thickness of the local clay layer. However, due to low split spoon recovery, no subsurface soil samples were collected from locations SB07 and SBEXP1. At most locations, continuous split-spoon samples were advanced to the top of the till. One surface and subsurface soil sample was collected from each soil boring location. Subsurface analytical samples were generally collected from the first split-spoon interval that indicated the presence of the clay till. CDM Federal also collected one additional subsurface soil sample (SB14A) from boring location SB-14, where heavily stained fill material was noted in the soil column.

All soil borings were installed by SJB using an all-terrain, truck-mounted, hollow stem auger drill rig. Continuous split-spoon samples were collected by driving a 3-inch diameter split-spoon through the 2-foot interval in advance of the augers.

Each split-spoon was scanned with an HNu photoionization detector immediately upon being opened. All readings above background were noted in the field logbook and are presented in the boring logs in Appendix F. The soil sample was then characterized and described, using the Burmister Soil Classification System, by the CDM Federal hydrogeologist. Sample descriptions were recorded onto a boring log record and in the field logbook.

All soil sampling procedures adhered to the protocols stated in the POP. Samples were analyzed for TCL organics, TAL inorganics, the target organic compounds, TOC, pH, and grain size. Samples collected for TCL organics and TAL inorganics were submitted to a CLP laboratory for routine analytical services. Samples for the remaining parameters were submitted to CDM Federal's laboratory subcontractor. The analytical results of the subsurface soil sampling activities are presented in Section 4.2.

In addition to the subsurface soil collected for chemical analysis, CDM Federal collected two undisturbed clay samples using a Shelby tube sampler. The clay samples were analyzed for vertical hydraulic conductivity, particles size, Atterberg limits and density. One sample was taken from the southern end of the subdivision and the other was taken from the southeastern portion of the northern aspect to characterize the physical qualities of the local clay layer. The results of the Shelby tube samples are discussed in Section 3.5.2.2. The test results are presented in Appendix G.

2.6.3 SURFACE SOIL SAMPLING

Extensive surface soil sampling was by performed by FIT during the previous EPA investigations at the site. Surface soil samples were collected from throughout the subdivision; however, analytical results indicated that the contamination was heavily concentrated in its northern end. CDM Federal's surface soil investigation was developed with regard to the FIT analytical findings and was designed to address data gaps related to the nature and extent of soil contamination. Figure 2-17 presents CDM Federal's surface soil sample locations.

CDM Federal collected surface soil samples from each of the 12 drive-point boring locations in the northern aspect (DP-021 through DP-32) and from two subdivision drive-point locations (DP-033 and DP-034) during initial site characterization activities. Drive-point boring activities were conducted from November 14 through December 2, 1994. Surface soil samples were collected from zero to 2 feet with a decontaminated split-spoon, in accordance with the procedures discussed in Section 2.6.1, and were collected from subsurface boring locations.

CDM Federal collected two additional surface soil samples (DP-013SS, DP-017SS) during the initial site characterization. These samples, collected from zero to 6 inches in depth, were from locations in the subdivision where visual contamination was observed during drive-point soil boring activities.

During field data collection, CDM Federal collected 16 surface soil samples, from zero to 6-inches in depth, from areas of potential concern identified during the initial site characterization. Samples were collected to define the nature and extent of surficial soil contamination in the areas of potential concern. Samples were collected from the following locations:

- An elevated soil pile, noted in the central section of the northern aspect, which appeared to be composed of fill containing black graphite-like material that was similar in composition to material encountered in several initial site characterization subdivision soil borings. Similar fill material was also sporadically distributed on the ground surface in several areas of the northern aspect. These conditions suggested that illegal dumping or landfilling may have occurred in this area. Two surface soil samples (SS01, SS02) were collected from the soil mound.

- Ten surface soils (SS03, SS10-SS18) samples from previously sampled EPA FIT sample locations in the northern area of the subdivision. These locations represented areas where elevated levels of contamination had been previously detected.

- Along the Carrie Drive cul-de-sac in the subdivision where soil and waste piles, covered with geotextile material during site removal activities, were identified as potential areas of concern since the chemical composition of these piles was unknown. CDM Federal collected four of the six proposed surface soil samples from the two covered waste piles. Two soil samples located in the northern-most soil pile were not collected since its cover was intact and CDM Federal did not want to compromise the material's integrity. The remaining samples were collected from locations where the cover material had been torn and damaged.

CDM Federal also collected surface soil samples during the soil boring programs. Surface soil samples at the boring locations were collected from zero to 2 feet with a decontaminated split-spoon, in accordance with the procedures discussed in Section 2.6.2. Surface soil samples were collected from the following boring locations:

- The areas of stressed vegetation and topographical depressions noted in the wooded lots north and south of Edgewood Drive during the initial site characterization. Based on these observations and historical reports of illegal landfilling , CDM Federal planned the installation of 14 soil borings in the wooded lots north and south of Edgewood Drive. An additional boring was completed in both the north and south lot (SB-EXP1 and SB-Center, respectively) to assist in the delineation effort. A total of eight borings were completed in each lot. A total of 16 surface soil samples were collected from these borings.

- The four borings installed in the northern aspect. One boring was installed in the area where distinct high conductivity electromagnetic anomalies were noted during the geophysical survey. The other three borings were installed to delineate the horizontal and vertical extent of fill material encountered during test pit activities. A total of four surface soil samples were collected from soil borings located in the northern aspect (SB01-SS, SB02-SS, SB03-SS, SB018-SS).

- An area immediately south of the site on the Forest Glen property and north of Expressway Village, where two background soil samples were collected from zero to 6-inches depth. The background locations represented soil conditions similar to the site and were reportedly unimpacted by site activities. CDM Federal had proposed that the background soil samples be collected from Expressway Village; however, because of access difficulties, alternate locations were chosen. An additional background surface soil sample (from zero to 2 feet depth) was collected during installation of the background monitoring well, MW-1.

At each location, the required sample depth, zero to 6 inches or zero to 2 feet, was excavated using a decontaminated stainless steel trowel or split spoon, respectively. The volatile organic sample was collected first, directly from the sampling implement. Soil collected for the remaining parameters was first placed in a decontaminated stainless steel mixing bowl and thoroughly homogenized prior to filling sampling containers. Sample-dedicated surgical, phthalate-free gloves were worn at each location.

Upon completion of sampling, each location was marked with a wooden stake and flagging, with an indelible marker used to mark sample numbers on both the stake and flagging. CDM Federal recorded the following information for each location in the field logbook: sample location, CLP identification number, date, time, physical description of the sample, and location, time, and frame number of any photographs.

All soil sampling procedures adhered to the protocols stated in the POP. Samples were analyzed for TCL organics, TAL inorganics, targeted organic compounds, TOC, pH, and grain size. Samples collected for TCL organics and TAL inorganics were submitted to a CLP laboratory for routine analytical services. Samples for the remaining parameters were submitted to CDM Federal's laboratory subcontractor, H2M Laboratories. The analytical results of the surface soil sampling activities are presented in Section 4.2.

2.6.4 TEST PIT SAMPLING

CDM Federal performed test pit excavation sampling from June 12 through June 15, 1995. The test pit sampling, recommended in the Technical Memorandum, characterized anomalous areas in the northern aspect that were identified during the electromagnetic surveys. Based on this information, eight test pits were trenched in the northern extent of the northern aspect where higher conductivity readings were noted, while two test pits were trenched in the southwestern extent of the northern aspect where lower conductivity readings were found. CDM Federal also excavated two additional test pits, TP-EXP and TP-EXP2, to further delineate the nature and extent of the detected fill material. Figure 2-18 shows the test pit locations.

CDM Federal's subcontractor, SJB Drilling, was responsible for the operation of the backhoe used for the test pit excavation. Each test pit was 50 feet in length and was excavated down to a minimum depth of 6 feet into the native clay soils. All test pit excavation and sampling procedures adhered to the EPA-approved Revised Final POP Addendum No. 2 (April, 1995). Test pit logs are in Appendix H.

It should be noted that the procedures in the POP Addendum No. 2 stated that test pits would be excavated to the top of the clay till. However, based on field observations, CDM Federal determined that the native clay encountered was competent and undisturbed. It was, therefore, unnecessary to excavate to the top of the clay till. At those locations where visual contamination or waste material was noted, the test pit was excavated only 2 feet into the native clay soil to minimize the potential for vertical migration of contamination.

One disturbed soil sample was collected from each test pit. These samples were defined as "disturbed" because excavation could volatilize any organic compounds present in the soil sample and because it was not possible to decontaminate the backhoe bucket according to standard protocols.

At locations where no waste or fill material was detected, a sample was collected directly from the backhoe bucket using a decontaminated stainless steel trowel, following procedures in the Revised POP Addendum No. 2. However, at locations where waste or fill material was encountered, CDM Federal collected the required sample volume from both the backhoe bucket and excavated soil pile in an effort to collect a more representative sample.

In all cases, the volatile organic sample was collected first, directly from the sampling trowel. Soil collected for the remaining parameters was first placed in a decontaminated stainless steel mixing bowl and thoroughly homogenized prior to filling sampling containers. Sample-dedicated surgical, phthalate-free gloves were worn at each location.

Upon completion of the trenching activity, each end of the test pit location was marked with a wooden stake and flagging, with an indelible marker used to mark sample number on both the stake and flagging.

All soil sampling procedures adhered to the protocols stated in the POP. Samples were analyzed for TCL organics, TAL inorganics, targeted organic compounds, TOC, pH, and grain size. Samples collected for TCL organics and TAL inorganics were submitted to a CLP laboratory for routine analytical services. Samples for the remaining parameters were submitted to CDM Federal's laboratory subcontractor, H2M Laboratories. The results of the test pit sampling activities are presented in Section 4.2.

2.7 GROUNDWATER INVESTIGATIONS

Because groundwater quality was not characterized during the previous EPA investigations at the site, the CDM Federal groundwater sampling program sought to define the nature and extent of site-related contamination in the two local aquifer zones. Two rounds of groundwater samples were collected from the nine newly installed well clusters. All well clusters consist of two wells, one in the shallow zone and one in the deep, except cluster MW-3. Overburden and perched wells were installed at location MW-3, along with the shallow and deep bedrock monitoring wells. All sampling procedures adhered to the protocols stated in the Revised Final POP. The results of CDM Federal's groundwater investigation are presented in Sections 3.6.2 and 4.2.8 of this report.

2.7.1 GROUNDWATER SAMPLING

The first round of groundwater sampling was conducted from September 11 through September 14, 1995, approximately one month after well installation and development. A confirmatory

sampling round was conducted from November 13 through November 17, 1995. Figure 2-12 illustrates the monitoring well cluster locations.

Three to five well volumes were purged from each well prior to sampling using a 2-inch submersible pump equipped with dedicated tubing. To determine the required purge volume, the static water level from the top of the inner casing was measured and the total depth of the well remeasured. The appropriate purge volume then was calculated based on casing radius, total casing and screen length, depth to water and height of water column. The equation used to calculate a single well volume was as follows: $V=\pi r^2 h$, where V equals Volume, πr equals the cross-section of the well and h equals the height of the water column.

Once the maximum yield of the well was determined, a minimum of three casing volumes was evacuated from the well. The temperature, pH, and specific conductivity of the pump discharge were monitored after each well volume was purged and these data were recorded in the well sampling data sheet and the field logbook. After three casing volumes had been purged, evacuation ceased if the measurements stabilized to within ten percent between two successive readings. If measurements had not stabilized, the well was purged until readings stabilized or a maximum of five well volumes had been removed. A final set of field measurements was collected from sampled purge water upon completion of well evacuation activities. All well purge water was contained in 55-gallon drums and stored for disposal.

Samples were collected using a decontaminated polyvinyl chloride (PVC) bailer that was repeatedly lowered to the water level, allowed to fill, and carefully removed from the well so as to avoid agitation of the contents. The volatile organic analysis (VOA) sample was then collected. The first filled VOA vial was used to determine the minimum amount of HCl required to bring the sample pH to < 2. HCl was then added to the remaining two vials that were submitted for analysis. The vials were checked to ensure that zero headspace was achieved. Once the volatile organic sample vials were filled, the remaining sample parameters were then collected. Phthalate-free sampling gloves were worn and were changed at each sampling location.

Groundwater samples were analyzed for TCL organics, TAL inorganics, targeted organic compounds, TOC, nitrate-nitrite, chemical oxygen demand (COD), total Kjeldahl nitrogen (TKN), ammonia, biochemical oxygen demand (BOD), and TDS. Samples collected for TCL organics and TAL inorganics were submitted to a CLP laboratory for routine analytical services. Samples for the remaining parameters were submitted to CDM Federal's laboratory subcontractor, H2M Laboratories.

The following information was recorded in the field logbook and the well sampling data sheets: monitoring well location, sample identification number, sample date and time, weather conditions, physical description of sample (color, smell), well purging activities including volume removed and pumping rate, and field measurements (pH, specific conductance, temperature). Table 2-6 summarizes the well data for both sampling rounds. Well sampling data sheets are presented in Appendix 1.

Because of low water levels in wells MW-3OB and MW-3PW at the time of Round 1 sampling, CDM Federal was unable to purge the wells of the required three well volumes. In an effort to obtain analytical information, the wells were purged to dryness with decontaminated Teflon bailers with the evacuated water from each well collected in sample bottles. Samples were collected for targeted organic compounds, TAL metals, and TCL volatile organic compounds (VOCs). The sampled purged water was then stored on ice and the wells were allowed to recover.

Water levels in both wells were checked within 3 and 24 hours from the initial purge time, and it was determined that neither well had adequately recovered. The recovery at monitoring well MW-3OB was minimal and only allowed for the collection of a VOC sample. The VOC sample and the MW-3OB purge water, which had been collected the previous day for targeted organic compounds and TAL metals, were then submitted for laboratory analysis.

Monitoring well MW-3PW only recovered enough to permit collection of a volatile organics, targeted organics, and TAL metals sample. Round 1 data obtained from these wells was qualified and evaluated accordingly with respect to this deviation from established sampling protocol.

During Round 2 sampling, monitoring well MW-3PW was purged and sampled according to established sampling protocols. Monitoring well MW-3OB, however, was purged dry and the excavation water, as in the previous round, was collected in sample bottles. The sampled purged water was then stored on ice and the wells were allowed to recover. Water levels were checked within 3 and 24 hours from the initial purge time. After 24 hours, the well had only recovered enough to allow for the collection of the TCL organics and TAL metals sample. The previously sampled purge water was submitted to the laboratory for the remaining parameters. Data obtained from these wells was qualified and evaluated accordingly with respect to this deviation from established sampling protocol.

2.8 HUMAN POPULATION SURVEYS

In an effort to gain a comprehensive understanding of the study area demographics, CDM Federal obtained updated population and land use data from the City of Niagara Falls. EPA's geographical information system, Landview II, was also consulted for additional U.S. Census and land use data. CDM Federal conducted a well search within a 3-mile radius of the site in an effort to define groundwater usage in the study area. The results of CDM Federal human population surveys are presented in Section 3.7.

2.9 ECOLOGICAL INVESTIGATIONS

CDM Federal conducted Phase I ecological assessment activities at the site from November 21 through 23, 1994 and on April 24 and 25, 1995. The ecological assessment included a field investigation, a wetlands delineation, and establishment of reference conditions. The results of CDM Federal's ecological investigation are presented in Section 3.8 of this report.

Specific objectives for the Phase I ecological assessment were to:

- Identify the general drainage features and other related topographical characteristics of the site;
- Characterize onsite wildlife habitat;
- Identify land use patterns and potential wildlife habitat in the proximity of the site;
- Identify areas of environmental degradation and potential biotic stress;
- Establish a potential reference location within a one-half-mile radius of the site;
- Identify and develop list of potential ecological receptors; and
- Determine wetland boundaries at the site.

2.9.1 ECOLOGICAL FIELD INVESTIGATION

CDM Federal conducted the ecological field investigation according to the procedures and methods specified in the POP. Prior to field characterization of the site, CDM Federal reviewed the following background information:

- Endangered/threatened species and sensitive habitats on and near the site supplied by the NYSDEC Natural Heritage Program (NHP, 1994)
- Soil survey information for Niagara County, New York, from the United States Department of Agricultural Soil Conservation Service (Higgins et al., 1972)
- Topographic depiction of the site and surrounding environment from the United States Geological Survey (USGS, 1980)
- Wetland Inventory map designations of the United States Fish and Wildlife Service (USFWS, 1994)

Field characterization was accomplished by walking informal north-south and east-west transects through the undeveloped portions of site. As the transects were walked, attention was focused on potential habitats within and immediately adjacent to the site. Onsite vegetative cover types, habitat types, animal occurrences, and visual signs of environmental degradation and stress were identified and recorded. A vegetative cover-type map was developed and is presented and discussed in Section 3.8.1.

Identities of observed vegetation and evidence of vertebrate animals were recorded, where possible, to the species level using various field guides and identification texts.

On-site waterways were described in terms of occurrence, direction, flow, and depth. Water temperature and conductivity were measured at three onsite and two offsite locations. Sediment composition was visually observed. Sweep net sampling and visual observation were used to determine the presence of aquatic life.

2.9.2 WETLAND DELINEATION

A wetland delineation was performed on April 24 and 25, 1995, in accordance with the POP, with the following exception. As of January 1993, it has been the policy of EPA Region II to use the methodology of the 1987 *U.S. Army Corps of Engineers (ACOE) Wetland Delineation Manual* (Environmental Laboratory, 1987) rather than the *1989 Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (Federal Interagency Committee for Wetland Delineation, 1989). Therefore, the 1987 ACOE manual was followed rather that the 1989 Federal manual specified in the POP.

A routine wetland determination was performed for the natural areas of the site (non-residential areas where natural vegetation was present). The wetland boundaries were field determined by walking transect lines along the soil wetness continuum in an effort to locate wetland boundaries and document these locations. Potential wetland boundary locations were searched for using visual cues of wetland hydrology (such as standing water, drainage depressions, stained leaf litter, surficial roots), hydrophytic vegetation, and hydric soil conditions. Three transect lines were located perpendicular to the East Gill Creek stream corridor with slight modification of the locations due to site topography. Several locations along the transect lines were assessed for wetland indicators and the assessment documented. Photographic documentation was taken of these locations.

Dominant plant species were determined by greatest basal area (for trees), greatest height (for shrubs including saplings), and greatest percent areal cover (for herbs). Dominant trees were determined in a 30-foot radius of the soil characterization location and dominant shrubs and herbs were determined in a 5-foot radius of the soil characterization location.

The indicator status for the dominant plant species was determined from the *National List of Plant Species that Occur in Wetlands: Northeast (Region 1)* (Reed, Jr., 1988). For any species not included in this list, the indicator status was designated using *The New Britton and Brown Illustrated Flora* (Gleason, 1952) and Manual of the Trees of North America (Sargent, 1965).

Surface/subsurface soil was characterized to a depth of 18 inches. Soil types were as described by the *Soil Survey of Niagara County, New York* (Higgins et al., 1972).

Wetland locations were determined by the presence of at least one positive wetland indicator for each of these three parameters: vegetation, soil, and hydrology. Wetland areas were classified according to the terminology presented in *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979). A wetlands map was created to depict the extent and

types of wetlands at the site. A detailed discussion of the wetland delineation findings is presented in Section 3.8.1.

2.9.3 REFERENCE CONDITION ESTABLISHMENT

Potential offsite reference conditions were selected within a half-mile radius of the site. The following documents were used as guidance for establishing the reference condition:

- Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference, EPA/600/3-89/013, March 1989 (EPA, 1989)

- Biological Criteria, National Program Guidance for Surface Waters, EPA-440/5-90-004, April 1990 (EPA, 1990)

Potential reference locations in the proximity of the site were examined for soil conditions, topography, hydrology, habitat characteristics (including vegetative composition) and evidence of wildlife usage. After several potential reference conditions were examined, the locations that most closely resembled site conditions were selected as reference conditions.

TABLE 2-1
SUMMARY OF RI FIELD ACTIVITIES
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

ACTIVITY	DATES
INITIAL SITE CHARACTERIZATION	
Phase I Topographic Survey	June 1-6, 1994
Geophysical Survey	June 6-22, 1994 Nov. 14-18, 1995
Drive-Point Soil Boring Sampling	Nov. 14 - Dec. 2, 1994
Phase I Ecological Survey	Nov. 21-23, 1994
FIELD DATA COLLECTION	
Wetland Delineation	April 24-25, 1995
Surface Soil Sampling	June 8, 1995
Test Pit Sampling	June 12-15, 1995
Soil Boring Sampling	June 19-25, 1995
Wooded Wetland Sediment Sampling	June 20-21, 1995
Monitoring Well Installation	July 10 - Aug. 16, 1995
Continuous Water Level Measurements	Aug. 24 - Sept. 1, 1995
Round One Surface Water/Sediment Sampling	Aug. 24-25, 1995
Phase Two Survey Activities	Aug. 23-25, 1995
Round One Synoptic Water Level Measurements	Sept. 11, 1995
Round One Groundwater Sampling	Sept. 11-14, 1995
Round Two Surface Water/Sediment Sampling	Nov. 9-10, 1995
Round Two Synoptic Water Level Measurements	Nov. 13, 1995
Round Two Groundwater Sampling	Nov. 13-17, 1995
Round Three Synoptic Water Level Measurements	Nov. 16, 1995
Round Two Continuous Water Level Measurements	Dec. 27-28, 1995
Round Four Synoptic Water Level Measurements	Dec. 28, 1995

TABLE 2-2
ANALYTICAL SAMPLE SUMMARY
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	AREA OF CONCERN	SAMPLE DEPTH (ft. bgs)	DATE COLLECTED	INVESTIGATION PHASE
SURFACE SOIL SAMPLES				
DP013-SS	Subdivision	0.0-0.5'	12/02/94	Initial Site Characterization
DP017-SS	Subdivision	0.0-0.5'	12/02/94	Initial Site Characterization
DP021-SS	Northern Aspect	0.0-2.0'	11/29/94	Initial Site Characterization
DP022-SS	Northern Aspect	0.0-2.0'	11/29/94	Initial Site Characterization
DP023-SS	Northern Aspect	0.0-2.0'	11/30/94	Initial Site Characterization
DP024-SS	Northern Aspect	0.0-2.0'	12/01/94	Initial Site Characterization
DP025-SS	Northern Aspect	0.0-2.0'	11/30/94	Initial Site Characterization
DP026-SS	Northern Aspect	0.0-2.0'	11/30/94	Initial Site Characterization
DP027-SS	Northern Aspect	0.0-2.0'	12/01/94	Initial Site Characterization
DP028-SS	Northern Aspect	0.0-2.0'	12/01/94	Initial Site Characterization
DP029-SS	Northern Aspect	0.0-2.0'	12/01/94	Initial Site Characterization
DP030-SS	Northern Aspect	0.0-2.0'	12/02/94	Initial Site Characterization
DP031-SS	Northern Aspect	0.0-2.0'	12/01/94	Initial Site Characterization
DP032-SS	Northern Aspect	0.0-2.0'	12/02/94	Initial Site Characterization
DP033-SS	Subdivision	0.0-2.0'	11/29/94	Initial Site Characterization
DP034-SS	Subdivision	0.0-2.0'	11/29/94	Initial Site Characterization
SS01	Northern Aspect	0.0-0.5'	06/08/95	Field Data Collection
SS02	Northern Aspect	0.0-0.5'	06/08/95	Field Data Collection
SS03	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SS04	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SS05	Subdivision	0.0-0.5'	06/08/95	Field Data Collection

TABLE 2-2
ANALYTICAL SAMPLE SUMMARY
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	AREA OF CONCERN	SAMPLE DEPTH (ft. bgs)	DATE COLLECTED	INVESTIGATION PHASE
SS06	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SS09	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SS10	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SS11	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SS12	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SS13	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SS14	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SS15	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SS16	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SS17	Subdivision	0.0-0.5	06/08/95	Field Data Collection
SS18	Subdivision	0.0-0.5'	06/08/95	Field Data Collection
SB01-SS	Northern Aspect	0.0-2.0'	06/20/95	Field Data Collection
SB02-SS	Northern Aspect	0.0-2.0'	06/20/95	Field Data Collection
SB03-SS	Northern Aspect	0.0-2.0'	06/21/95	Field Data Collection
SB04-SS	Lot North of Edgewood Drive	0.0-2.0'	06/21/95	Field Data Collection
SB05-SS	Lot North of Edgewood Drive	0.0-2.0'	06/22/95	Field Data Collection
SB06-SS	Lot North of Edgewood Drive	0.0-2.0'	06/22/95	Field Data Collection
SB07-SS	Lot North of Edgewood Drive	0.0-2.0'	06/22/95	Field Data Collection
SB08-SS	Lot North of Edgewood Drive	0.0-2.0'	06/22/95	Field Data Collection
SB09-SS	Lot North of Edgewood Drive	0.0-2.0'	06/22/95	Field Data Collection
SBEXP-1-SS	Lot North of Edgewood Drive	0.0-2.0'	06/22/95	Field Data Collection
SB10-SS	Lot South of Edgewood Drive	0.0-2.0'	06/26/95	Field Data Collection

TABLE 2-2
ANALYTICAL SAMPLE SUMMARY
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	AREA OF CONCERN	SAMPLE DEPTH (ft. bgs)	DATE COLLECTED	INVESTIGATION PHASE
SB11-SS	Lot South of Edgewood Drive	0.0-2.0'	06/26/95	Field Data Collection
SB12-SS	Lot South of Edgewood Drive	0.0-2.0'	06/27/95	Field Data Collection
SB13-SS	Lot South of Edgewood Drive	0.0-2.0'	06/26/95	Field Data Collection
SB14-SS	Lot South of Edgewood Drive	0.0-2.0'	06/26/95	Field Data Collection
SB15-SS	Lot South of Edgewood Drive	0.0-2.0'	06/27/95	Field Data Collection
SB16-SS	Lot South of Edgewood Drive	0.0-2.0'	06/23/95	Field Data Collection
SB17-SS	Lot South of Edgewood Drive	0.0-2.0'	06/23/95	Field Data Collection
SBCENTER-SS	Lot South of Edgewood Drive	0.0-2.0'	06/26/95	Field Data Collection
SB18-SS	Northern Aspect	0.0-2.0'	06/21/95	Field Data Collection
DP035*	Duplicate of DP033SS	0.0-2.0'	11/29/95	Initial Site Characterization
DP036*	Duplicate of DP026-SS	0.0-2.0'	11/30/95	Initial Site Characterization
DP037*	Duplicate of DP032-SS	0.0-2.0'	12/02/95	Initial Site Characterization
SB20*	Duplicate of SB07-SS	0.0-2.0'	06/22/95	Field Data Collection
SB23*	Duplicate of SB15-SS	0.0-2.0'	06/27/95	Field Data Collection
SURFACE SOIL BACKGROUND SAMPLES				
MW1-SS	Background	0.0-2.0'	07/13/95	Field Data Collection
SSBK01	Background	0.0-0.5'	07/10/95	Field Data Collection
SSBK02	Background	0.0-0.5'	07/10/95	Field Data Collection
SSBK03	Background	0.0-0.5'	07/10/95	Field Data Collection
SUBSURFACE SOIL SAMPLES				
BERM1	Berm	14.0-16.0'	06/19/95	Field Data Collection
BERM2	Berm	8.0-10.0'	06/19/95	Field Data Collection

TABLE 2-2
ANALYTICAL SAMPLE SUMMARY
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	AREA OF CONCERN	SAMPLE DEPTH (ft. bgs)	DATE COLLECTED	INVESTIGATION PHASE
BERM2A	Berm	4.0-6.0'	06/19/95	Field Data Collection
BERM3	Berm	16.0-18.0'	06/20/95	Field Data Collection
BERM3A	Berm	10.0-12.0'	06/20/95	Field Data Collection
BERM4	Berm	12.0-14.0'	06/20/95	Field Data Collection
BERM5	Berm	6.0-8.0'	06/20/95	Field Data Collection
DP01	Subdivision	10.0-12.0'	11/15/94	Initial Site Characterization
DP02	Subdivision	10.0-12.0'	11/15/94	Initial Site Characterization
DP03	Subdivision	8.0-10.0'	11/16/94	Initial Site Characterization
DP04	Subdivision	10.0-12.0'	11/16/94	Initial Site Characterization
DP05	Subdivision	9.0-11.0'	11/18/94	Initial Site Characterization
DP06	Subdivision	12.0-14.0'	11/18/94	Initial Site Characterization
DP07	Subdivision	8.0-10.0'	11/17/94	Initial Site Characterization
DP08	Subdivision	8.0-10.0'	11/17/94	Initial Site Characterization
DP09	Subdivision	8.0-10.0'	11/18/94	Initial Site Characterization
DP010	Subdivision	11.0-13.0'	11/21/94	Initial Site Characterization
DP011	Subdivision	10.0-12.0'	11/21/94	Initial Site Characterization
DP012	Subdivision	6.0-8.0'	11/22/94	Initial Site Characterization
DP013	Subdivision	11.0-13.0'	11/22/94	Initial Site Characterization
DP013B	Subdivision	2.0-4.0'	11/22/94	Initial Site Characterization
DP014	Subdivision	10.0-12.0'	11/22/94	Initial Site Characterization
DP015	Subdivision	9.0-11.0'	11/23/94	Initial Site Characterization
DP016	Subdivision	6.0-8.0'	11/23/94	Initial Site Characterization

TABLE 2-2
ANALYTICAL SAMPLE SUMMARY
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	AREA OF CONCERN	SAMPLE DEPTH (ft. bgs)	DATE COLLECTED	INVESTIGATION PHASE
DP017	Subdivision	9.0-11.0'	11/28/94	Initial Site Characterization
DP017B	Subdivision	2.0-4.0'	11/28/94	Initial Site Characterization
DP018	Subdivision	10.0-12.0'	11/28/94	Initial Site Characterization
DP018B	Subdivision	2.0-4.0'	11/28/94	Initial Site Characterization
DP019	Subdivision	10.0-12.0'	11/28/94	Initial Site Characterization
DP020	Subdivision	8.0-10.0'	11/23/94	Initial Site Characterization
DP021	Northern Aspect	10.0-12.0'	11/29/94	Initial Site Characterization
DP022	Northern Aspect	8.0-10.0'	11/30/94	Initial Site Characterization
DP023	Northern Aspect	10.0-12.0'	11/30/94	Initial Site Characterization
DP024	Northern Aspect	6.0-8.0'	12/1/94	Initial Site Characterization
DP025	Northern Aspect	6.0-8.0'	11/30/94	Initial Site Characterization
DP026	Northern Aspect	9.0-11.0'	11/30/94	Initial Site Characterization
DP027	Northern Aspect	6.0-8.0'	12/1/94	Initial Site Characterization
DP028	Northern Aspect	6.0-8.0'	12/1/94	Initial Site Characterization
DP029	Northern Aspect	6.0-8.0'	12/2/94	Initial Site Characterization
DP030	Northern Aspect	6.0-8.0'	12/2/94	Initial Site Characterization
DP031	Northern Aspect	10.0-12.0'	12/01/94	Initial Site Characterization
DP032	Northern Aspect	8.0-10.0'	12/02/94	Initial Site Characterization
DP033	Subdivision	10.0-12.0'	11/29/94	Initial Site Characterization
DP034	Subdivision	8.0-10.0'	11/29/94	Initial Site Characterization
DP034B	Subdivision	4.0-6.0'	11/29/94	Initial Site Characterization
SB01	Northern Aspect	8.0-10.0'	06/21/95	Field Data Collection

TABLE 2-2
ANALYTICAL SAMPLE SUMMARY
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	AREA OF CONCERN	SAMPLE DEPTH (ft. bgs)	DATE COLLECTED	INVESTIGATION PHASE
SB03	Northern Aspect	12.0-14.0'	06/21/95	Field Data Collection
SB04	Lot North of Edgewood Drive	10.0-12.0'	06/21/95	Field Data Collection
SB05	Lot North of Edgewood Drive	6.0-8.0'	06/22/95	Field Data Collection
SB06	Lot North of Edgewood Drive	8.0-10.0'	06/22/95	Field Data Collection
SB08	Lot North of Edgewood Drive	8.0-10.0'	06/22/95	Field Data Collection
SB09	Lot North of Edgewood Drive	8.0-10.0'	06/22/95	Field Data Collection
SB10	Lot South of Edgewood Drive	6.0-8.0'	06/26/95	Field Data Collection
SB12	Lot South of Edgewood Drive	6.0-7.0'	06/27/95	Field Data Collection
SB13	Lot South of Edgewood Drive	6.0-8.0	6/26/96	Field Data Collection
SB14	Lot South of Edgewood Drive	6.0-8.0'	06/26/95	Field Data Collection
SB14A	Lot South of Edgewood Drive	4.0-6.0'	06/26/95	Field Data Collection
SB15	Lot South of Edgewood Drive	6.0-8.0'	06/27/95	Field Data Collection
SB16	Lot South of Edgewood Drive	8.0-10.0'	06/23/95	Field Data Collection
SB17	Lot South of Edgewood Drive	10.0-12.0'	06/23/95	Field Data Collection
SBCENTER	Lot South of Edgewood Drive	4.0-6.0'	06/26/95	Field Data Collection
SB18	Northern Aspect	12.0-14.0'	06/21/95	Field Data Collection
SUBSURFACE SOIL BACKGROUND SAMPLES				
MW1	Background	12.0-14.0'	07/13/95	Field Data Collection
MW11*	Duplicate of MW1	12.0-14.0'	07/13/95	Field Data Collection
TEST PIT SAMPLES				
TP01	Northern Aspect	0.0-4.0'	06/12/95	Field Data Collection
TP02	Northern Aspect	0.0-5.0'	06/12/95	Field Data Collection

TABLE 2-2
ANALYTICAL SAMPLE SUMMARY
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	AREA OF CONCERN	SAMPLE DEPTH (ft. bgs)	DATE COLLECTED	INVESTIGATION PHASE
TP03	Northern Aspect	5.5-6.0'	06/13/95	Field Data Collection
TP04	Northern Aspect	4.0-6.0'	06/13/95	Field Data Collection
TP05	Northern Aspect	0.0-6.0'	06/13/95	Field Data Collection
TP06	Northern Aspect	0.0-6.0'	06/14/95	Field Data Collection
TP07	Northern Aspect	0.0-6.0'	06/14/95	Field Data Collection
TP08	Northern Aspect	0.0-6.0'	06/14/95	Field Data Collection
TP09	Northern Aspect	0.0-2.0'	06/15/95	Field Data Collection
TP10	Northern Aspect	0.0-4.0'	06/15/95	Field Data Collection
TPEXP	Northern Aspect	0.0-6.0'	06/14/95	Field Data Collection
TP11*	Duplicate of TP06	0.0-6.0	06/14/95	Field Data Collection
TP12*	Duplicate of TP08	0.0-6.0	06/14/95	Field Data Collection
EAST GILL CREEK SURFACE WATER SAMPLES-ROUND ONE				
GCSW1	East Gill Creek	NA	8/25/95	Field Data Collection
GCSW2	East Gill Creek	NA	8/24/95	Field Data Collection
GCSW3	East Gill Creek	NA	8/24/95	Field Data Collection
GCSW4	East Gill Creek	NA	8/24/95	Field Data Collection
GCSW5*	Duplicate of GCSW3	NA	8/24/95	Field Data Collection

TABLE 2-2
ANALYTICAL SAMPLE SUMMARY
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	AREA OF CONCERN	SAMPLE DEPTH (ft. bgs)	DATE COLLECTED	INVESTIGATION PHASE
EAST GILL CREEK SURFACE WATER SAMPLES-ROUND TWO				
GCSW1	East Gill Creek	NA	11/10/95	Field Data Collection
GCSW2	East Gill Creek	NA	11/10/95	Field Data Collection
GCSW3	East Gill Creek	NA	11/09/95	Field Data Collection
GCSW4	East Gill Creek	NA	11/09/95	Field Data Collection
GCSW5*	Duplicate of GCSW3	NA	11/09/95	Field Data Collection
GCSW6	East Gill Creek	NA	11/09/95	Field Data Collection
EAST GILL CREEK SEDIMENT SAMPLES - ROUND ONE				
GCSD1	East Gill Creek	0.0-0.5'	8/25/95	Field Data Collection
GCSD2	East Gill Creek	0.0-0.5'	8/24/95	Field Data Collection
GCSD3	East Gill Creek	0.0-0.5'	8/24/95	Field Data Collection
GCSD4	East Gill Creek	0.0-0.5'	8/24/95	Field Data Collection
GCSD5*	Duplicate of GCSD3	0.0-0.5'	8/24/95	Field Data Collection
EAST GILL CREEK SEDIMENT SAMPLES - ROUND TWO				
GCSD1	East Gill Creek	0.0-0.5'	11/10/95	Field Data Collection
GCSD2	East Gill Creek	0.0-0.5'	11/10/95	Field Data Collection
GCSD3	East Gill Creek	0.0-0.5'	11/09/95	Field Data Collection
GCSD4	East Gill Creek	0.0-0.5'	11/09/95	Field Data Collection
GCSD5*	Duplicate of GCSD3	0.0-0.5'	11/09/95	Field Data Collection
GCSD6	East Gill Creek	0.0-0.5'	11/09/95	Field Data Collection
SEDIMENT SAMPLES				
WTSD01	Wooded Wetland	0.0-0.5'	06/20/95	Field Data Collection

TABLE 2-2
ANALYTICAL SAMPLE SUMMARY
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	AREA OF CONCERN	SAMPLE DEPTH (ft. bgs)	DATE COLLECTED	INVESTIGATION PHASE
WTSD02	Wooded Wetland	0.0-0.5'	06/20/95	Field Data Collection
WTSD03	Wooded Wetland	0.0-0.5'	06/20/95	Field Data Collection
WTSD04	Wooded Wetland	0.0-0.5'	06/20/95	Field Data Collection
WTSD05	Wooded Wetland	0.0-0.5'	06/21/95	Field Data Collection
WTSD06	Wooded Wetland	0.0-0.5'	06/21/95	Field Data Collection
WTSD07	Wooded Wetland	0.0-0.5'	06/21/95	Field Data Collection
WTSD08	Wooded Wetland	0.0-0.5'	06/21/95	Field Data Collection
WTSD09	Wooded Wetland	0.0-0.5'	06/21/95	Field Data Collection
WTSD10	Wooded Wetland	0.0-0.5'	06/21/95	Field Data Collection
WTSD11*	Duplicate of WTSD10	0.0-0.5'	06/21/95	Field Data Collection
WETLAND BACKGROUND SEDIMENT SAMPLES				
WTSDBK1	Background	0.0-0.5'	7/10/95	Field Data Collection
WTSDBK2	Background	0.0-0.5'	7/10/95	Field Data Collection
GROUNDWATER SAMPLES - ROUND ONE				
MW1S	Sitewide	NA	09/11/95	Field Data Collection
MW1D	Sitewide	NA	09/11/95	Field Data Collection
MW2S	Sitewide	NA	09/11/95	Field Data Collection
MW2D	Sitewide	NA	09/12/95	Field Data Collection
MW30B	Sitewide	NA	09/14/95	Field Data Collection
MW3PW	Sitewide	NA	09/13/95	Field Data Collection
MW3S	Sitewide	NA	09/13/95	Field Data Collection
MW3D	Sitewide	NA	09/13/95	Field Data Collection

TABLE 2-2
ANALYTICAL SAMPLE SUMMARY
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	AREA OF CONCERN	SAMPLE DEPTH (ft. bgs)	DATE COLLECTED	INVESTIGATION PHASE
MW4S	Sitewide	NA	09/12/95	Field Data Collection
MW4D	Sitewide	NA	09/12/95	Field Data Collection
MW5S	Sitewide	NA	09/12/95	Field Data Collection
MW5D	Sitewide	NA	09/13/95	Field Data Collection
MW6S	Sitewide	NA	09/12/95	Field Data Collection
MW6D	Sitewide	NA	09/13/95	Field Data Collection
MW7S	Sitewide	NA	09/12/95	Field Data Collection
MW7D	Sitewide	NA	09/12/95	Field Data Collection
MW8S	Sitewide	NA	09/13/95	Field Data Collection
MW8D	Sitewide	NA	09/13/95	Field Data Collection
MW9S	Sitewide	NA	09/11/95	Field Data Collection
MW9D	Sitewide	NA	09/11/95	Field Data Collection
MW10S	Duplicate of MW6D	NA	09/13/95	Field Data Collection
GROUNDWATER SAMPLES - ROUND TWO				
MW1S	Sitewide	NA	11/13/95	Field Data Collection
MW1D	Sitewide	NA	11/13/95	Field Data Collection
MW2S	Sitewide	NA	11/15/95	Field Data Collection
MW2D	Sitewide	NA	11/15/95	Field Data Collection
MW30B	Sitewide	NA	11/16/95	Field Data Collection
MW3PW	Sitewide	NA	11/16/95	Field Data Collection
MW3S	Sitewide	NA	11/16/95	Field Data Collection
MW3D	Sitewide	NA	11/16/95	Field Data Collection

TABLE 2-2
ANALYTICAL SAMPLE SUMMARY
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	AREA OF CONCERN	SAMPLE DEPTH (ft. bgs)	DATE COLLECTED	INVESTIGATION PHASE
MW4S	Sitewide	NA	11/13/95	Field Data Collection
MW4D	Sitewide	NA	11/13/95	Field Data Collection
MW5S	Sitewide	NA	11/14/95	Field Data Collection
MW5D	Sitewide	NA	11/14/95	Field Data Collection
MW6S	Sitewide	NA	11/14/95	Field Data Collection
MW6D	Sitewide	NA	11/14/95	Field Data Collection
MW7S	Sitewide	NA	11/13/95	Field Data Collection
MW7D	Sitewide	NA	11/14/95	Field Data Collection
MW8S	Sitewide	NA	11/14/95	Field Data Collection
MW8D	Sitewide	NA	11/14/95	Field Data Collection
MW9S	Sitewide	NA	11/15/95	Field Data Collection
MW9D	Sitewide	NA	11/15/95	Field Data Collection
MW10S*	Duplicate of MW3S	NA	11/16/95	Field Data Collection

* Denotes duplicate sample.

TABLE 2-3
SURFACE WATER/SEDIMENT SAMPLING DATA
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Surface Water/ Sediment Location	Surface Water pH	Surface water Dissolved Oxygen Content (mg/l)	Surface Water Conductivity (umhos)	Surface Water Description	Sediment Description
ROUND ONE - AUGUST 24 - 24, 1995					
SW/SD1	2.57*	0.5	3800	Dark, Cloudy	Gray in color with decaying organic matter
SW/SD2	7.48	0.6	1800	Gray, Stagnant	Black and tar-like in consistency
SW/SD3	7.91	0.1	2850	Greenish-gray, Stagnant	Black and tar-like in consistency
SW/SD4	8.10	0.5	1500	Cloudy, Gray	Black with decaying organics
ROUND TWO - NOVEMBER 9 - 10, 1995					
SW/SD1	7.73	7.3	780	Brown, Cloudy	Gray with decaying organics
SW/SD2	7.75	7.2	850	Brownish-Green, Cloudy	Gray with black staining
SW/SD3	7.70	7.8	800	Brownish-green, Cloudy	Brown with black staining
SW/SD4	7.81	8.5	600	Brown, Cloudy	Charcoal gray intermixed with black clumps
SW/SD6	8.68	7.8	625	Brown, Cloudy	Charcoal gray intermixed with black clumps

* Suspected instrument error

TABLE 2-4
MONITORING WELL CONSTRUCTION INFORMATION
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Monitoring Well	Date Installed	Ground Surface Elevation (ft MSL)	Top Of Casing (TOC) Elevation (Ft MSL)	Total Depth (ft TOC*)	Screen Interval (ft BGS)	Well Diameter (in.)	Casing Material	Screen Material
MW-1S	07/24/95	594.80	597.15	29.1	17.3-27.3	4	Stainless Steel	Stainless Steel
MW-1D	07/24/95	594.90	597.05	51.2	28.4-49.17	4	Stainless Steel	Stainless Steel
MW-2S	08/01/95	594.10	595.95	30.0	18.0-28.0	4	Stainless Steel	Stainless Steel
MW-2D	08/02/95	594.00	595.98	61.6	35.2-59.6	4	Stainless Steel	Stainless Steel
MW-3S	08/02/95	594.30	596.43	30.0	18.0-28.0	4	Stainless Steel	Stainless Steel
MW-3D	08/03/95	594.10	596.10	51.7	31.0-50.0	4	Stainless Steel	Stainless Steel
MW-3O	08/03/95	593.80	595.91	17.8	10.8-15.8	4	Stainless Steel	Stainless Steel
MW-3P	08/01/95	594.20	595.99	10.5	3.50-8.50	4	Stainless Steel	Stainless Steel
MW-4S	07/12/95	592.60	594.34	22.0	10.0-20.0	4	Stainless Steel	Stainless Steel
MW-4D	07/17/95	592.40	594.44	61.3	30.0-59.3	4	Stainless Steel	Stainless Steel
MW-5S	07/25/95	591.20	593.25	28.0	16.0-26.0	4	Stainless Steel	Stainless Steel
MW-5D	07/26/95	591.40	593.34	51.7	27.0-49.7	4	Stainless Steel	Stainless Steel
MW-6S	07/20/95	594.20	596.11	29.0	17.0-27.0	4	Stainless Steel	Stainless Steel
MW-6D	07/21/95	593.80	595.73	56.5	27.0-54.5	4	Stainless Steel	Stainless Steel
MW-7S	08/08/95	593.30	595.28	30.0	18.0-28.0	4	Stainless Steel	Stainless Steel
MW-7D	08/09/95	593.20	595.28	53.0	31.0-51.0	4	Stainless Steel	Stainless Steel
MW-8S	08/09/95	593.80	595.67	32.9	20.4-30.4	4	Stainless Steel	Stainless Steel
MW-8D	08/10/95	593.80	595.86	52.0	32.9-52.0	4	Stainless Steel	Stainless Steel
MW-9S	07/28/95	592.20	594.22	27.0	15.0-25.0	4	Stainless Steel	Stainless Steel
MW-9D	07/31/95	592.50	594.31	56.3	26.0-55.0	4	Stainless Steel	Stainless Steel

*Top of Inner Casing

TABLE 2-5
SYNOPTIC WATER LEVELS
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

MONITORING WELL	Top of Casing Elevation(TOC) (ft MSL)	Depth to Groundwater 09/11/95 (ft BGS)	Elevation of Groundwater 09/11/95 (ft MSL)	Depth to Groundwater 11/13 AM (ft BGS)	Elevation of Groundwater 11/13 AM (ft MSL)	Depth to Groundwater 11/16 AM (ft BGS)	Elevation of Groundwater 11/16 AM (ft MSL)	Depth to Groundwater 11/16 PM (ft BGS)	Elevation of Groundwater 11/16 PM (ft MSL)	Depth to Groundwater 12/28 AM (ft BGS)	Elevation of Groundwater 12/28 AM (ft MSL)	Depth to Groundwater 12/28 PM (ft BGS)	Elevation of Groundwater 12/28 PM (ft MSL)
MW-1D	597.05	19.15	577.9	13.2	583.85	12.8	584.25	13	584.05	16.92	580.13	16.95	580.1
MW-2D	595.98	19	576.98	13.25	582.73	13.1	582.88	13	582.98	16.75	579.23	16.73	579.25
MW-3D	596.1	18.95	577.15	13.12	582.98	12.83	583.27	13	583.1	16.39	579.71	16.38	579.72
MW-4D	594.44	17.45	576.99	11.9	582.54	11.7	582.74	11.4	583.04	15.17	579.27	15.07	579.37
MW-5D	593.34	16.43	576.91	10.79	582.55	10.7	582.64	10.5	582.84	14.15	579.19	14.13	579.21
MW-6D	595.73	18.81	576.92	13.15	582.58	13	582.73	12.9	582.83	16.5	579.23	16.48	579.25
MW-7D	595.28	18.5	576.78	12.6	582.6801	13.4	581.88	12.6	582.6801	16.18	579.1	16.15	579.13
MW-8D	595.86	18.3	577.56	14.5	581.36	14.5	581.36	14.8	581.06	18.46	577.4	18.45	577.41
MW-9D	594.31	17.08	577.23	10.8	583.51	11.2	583.11	11.2	583.11	14.7	579.61	14.63	579.68
MW-1S	597.15	19.2	577.95	17.2	579.95	12.9	584.25	13.2	583.95	16.85	580.3	16.82	580.33
MW-2S	595.95	18.55	577.4	12.78	583.17	12.8	583.15	12.9	583.05	16	579.95	16	579.95
MW-3S	596.43	19	577.43	13.2	583.23	12.95	583.48	13.1	583.33	16.5	579.93	16.5	579.93
MW-30	595.91	16.75	579.16	10.02	585.89	*15.92	579.16	10.4	568.76	NR	NR	14.15	581.76
MW-3P	595.99	7.95	588.04	7.0	588.99	8.81	579.23	7.3	580.74	7.53	588.46	7.5	588.49
MW-4S	594.34	16.63	577.71	11.2	583.14	10.9	583.44	10.9	583.44	13.92	569.22	14.03	580.31
MW-5S	593.25	16.13	577.12	10.4	582.85	10.2	583.05	10.3	582.95	13.85	579.4	13.82	579.43
MW-6S	596.11	18.75	577.36	12.17	583.94	12.1	584.01	12	584.11	15.63	580.48	15.55	580.56
MW-7S	595.28	12.3	582.98	6.7	588.58	7.4	587.88	7.4	587.88	9.7	585.58	9.8	585.48
MW-8S	595.67	15.7	579.97	12.2	583.47	12.8	582.87	12.9	582.77	15.48	580.19	15.5	580.17
MW-9S	594.22	10.25	583.97	10.6	583.62	10.8	583.42	10.7	583.52	14.05	580.17	13.95	580.27

*Potential measuring error
NR No reading due to problems with water level indicators

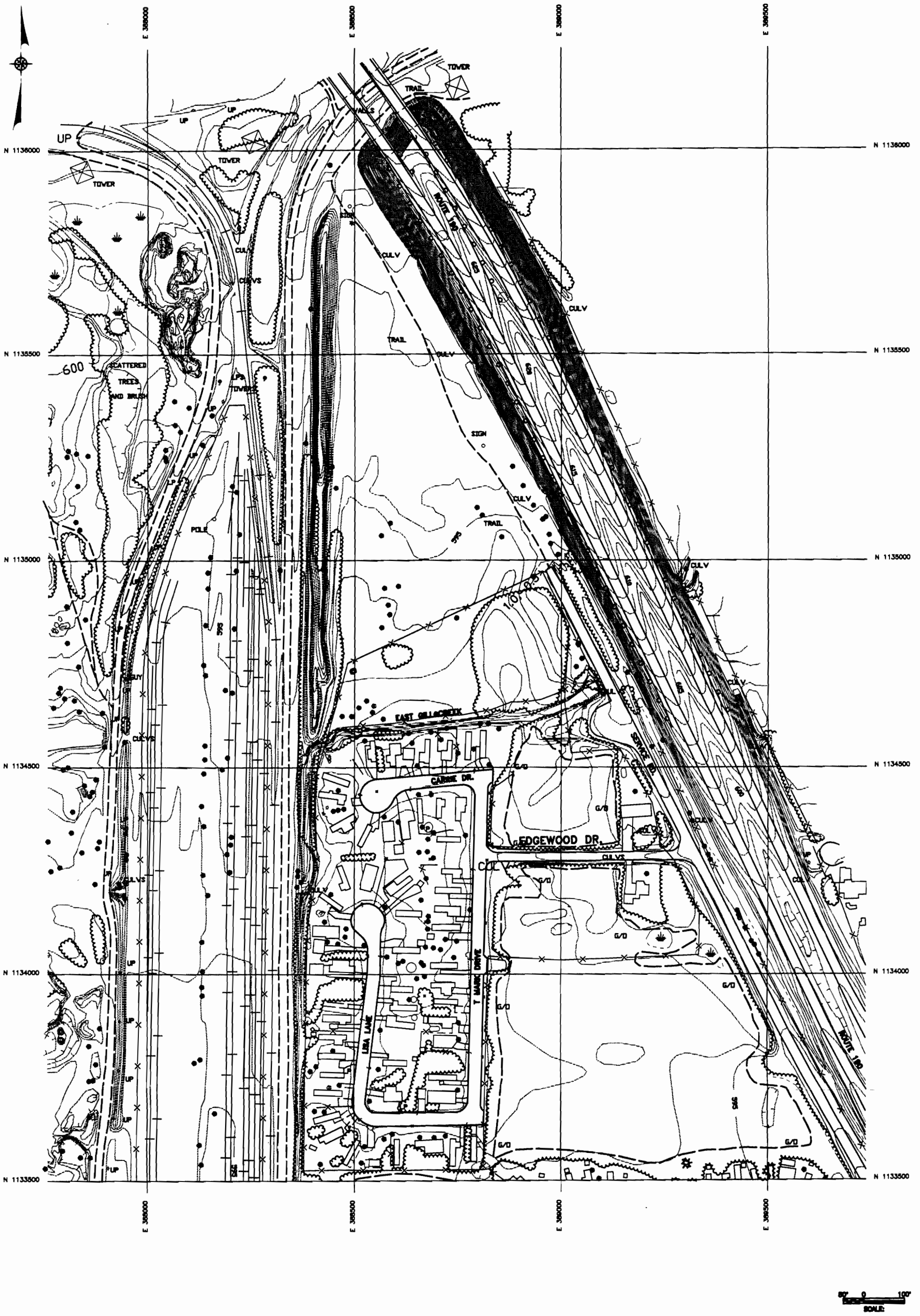
TABLE 2-6
GROUNDWATER PURGE DATA
ROUND ONE
SEPTEMBER 11 - SEPTEMBER 14, 1995
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Monitoring Well	Total Volume Purged (Gallons)	Final pH Reading	Final Conductivity Reading (umhos)	Final Temperature Reading (Degrees Celcius)	Final Purge Water Description	Comments
MW01S	40	6.72	3200	11.0	Clear	
MW01D	72	7.02	1400	11.5	Clear	
MW02S	22	6.59	1000	10.5	Clear	
MW02D	85	6.30	1250	10.5	Slightly Cloudy	Purge water has a phenolic odor
MW03S	27	5.70	1150	12.75	Clear	
MW03D	75	5.70	1100	12.0	Clear	Well Bailed Dry at 1 gallon
MW030	1	8.43	2420	14.6	Slightly Silty	1 gallon was purged for sample
MW03P	3.5	7.97	1450	15.8	Silty Gray	Well Bailed Dry at 3.5 gallons
MW04S	10.05	7.27	1210	11.8	Very Turbid/Brown	
MW04D	90	6.54	1100	12.0	Clear	
MW05S	24	7.19	1180	12.8	Slightly Silty and Gray	
MW05D	70	8.87	1220	11.8	Clear	
MW06S	21	9.76	600	11.7	Clear	
MW06D	75	8.96	1100	11.9	Clear	
MW07S	36	6.32	650	14.0	Clear/Slightly Cloudy	
MWO7D	75	6.61	1200	12.0	Slightly Cloudy	
MW08S	36	5.95	550	12.5	Slightly Cloudy	
MW08D	75	5.56	1200	12.0	Slightly Cloudy	
MW09S	33	6.34	800	11.5	Clear	
MW09D	90	7.63	1150	10.0	Clear/Slightly Cloudy	

TABLE 2-6 (Continued)
GROUNDWATER PURGE DATA
ROUND TWO
NOVEMBER 11 - NOVEMBER 16, 1995
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Monitoring Well	Total Volume Purged (Gallons)	Final pH Reading	Final Conductivity Reading (umhos)	Final Temperature Reading (Degrees Celcius)	Final Purge Water Description	Comments
MW01S	0.2	*	1600	13.5	Clear/Light Sediment	pH meter not functioning*
MW01D	35.2	*	1200	12.0	Clear/Light Sediment	pH meter not functioning*
MW02S	85 58.6	7.16	970	9.4	Clear	
MW02D	96.7	6.95*	1000	8.8	Cloudy	Purge water has sulfur odor
MW03S	33.8	7.3	610	9.9	Clear	
MW03D	76	7.02	700	10.2	Cloudy	
MW03P	No Readings taken just purged 3 volumes & sampled since this is a perched water well.					
MW030	8.3	Not taken	Not taken	Not taken	Clear	
MW030B	Did not purge, collected recharge					
MW04S	21.4	6.82	1500	10.3	Brown/turbid	
MW04D	96	6.78	990	9.5	Clear	Purge water has sulfur odor
MW05S	34.8	6.51	820	10.4	Clear	
MW05D	81	6.62	940	10.2	Clear	
MW06S	43.7	7.1	500	9.9	Clear	
MW06D	85.9	6.7	870	9.8	Cloudy	
MW07S	45.6	*	300	13.0	Clear/Light Sediment	pH meter not functioning*
MW07D	83	*	1000	11.0	Clear	pH meter not functioning*
MW08S	43.5	8.05	450	11.1	Slightly cloudy	
MW08D	82.5	7.87	1050	11.0	Clear	
MW09S	90	6.43	820	11.0	Clear	
MW09D	48	6.43	800	9.0	Clear	

*Due to cold temperatures, pH meter was not functioning properly



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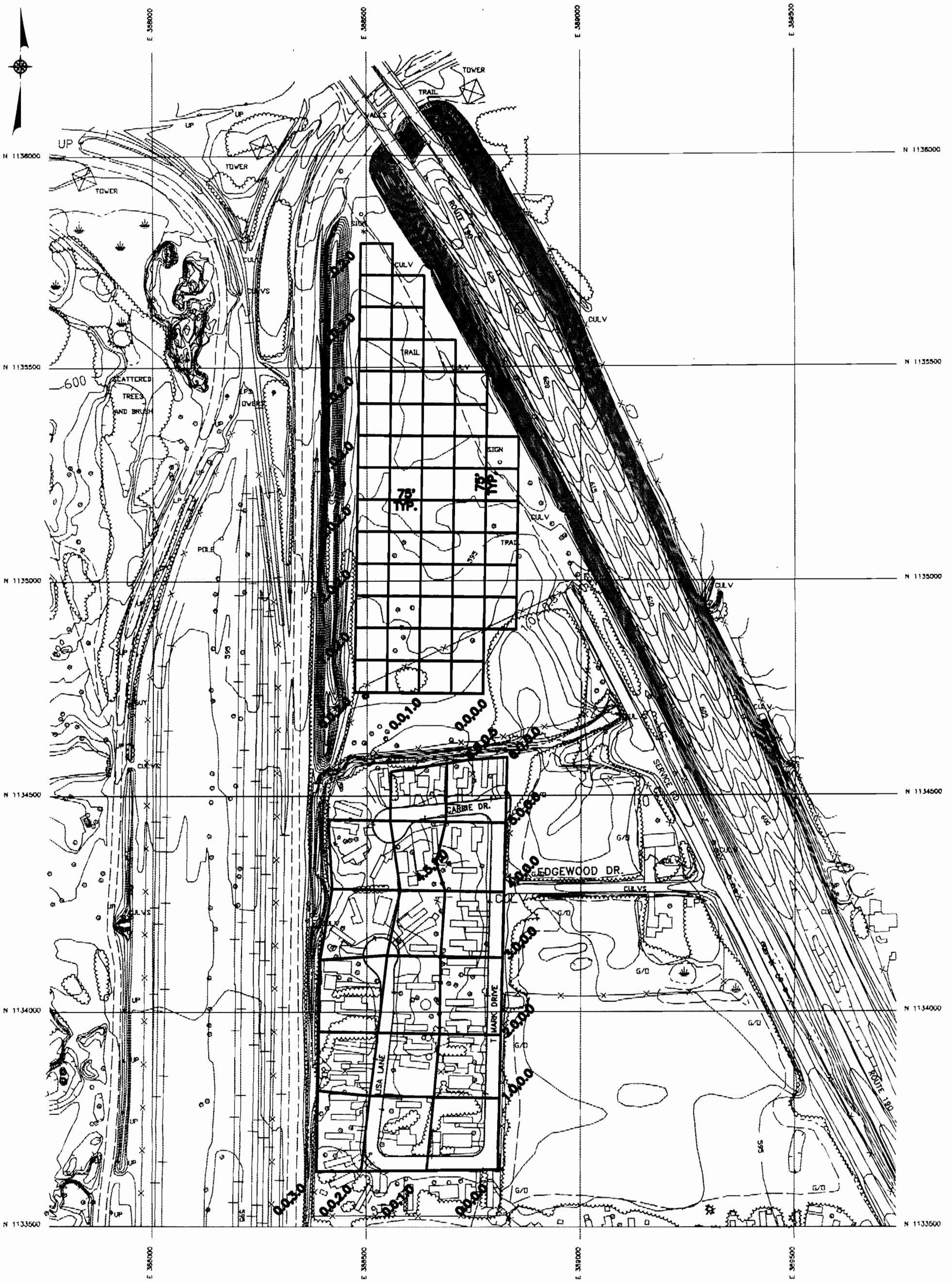
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

FIGURE 2-1
SITE BASE MAP



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FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

FIGURE 2-2
GRID MAP

FILE: C:\FOREST_G\SW.DWG J.J. 1/12/96

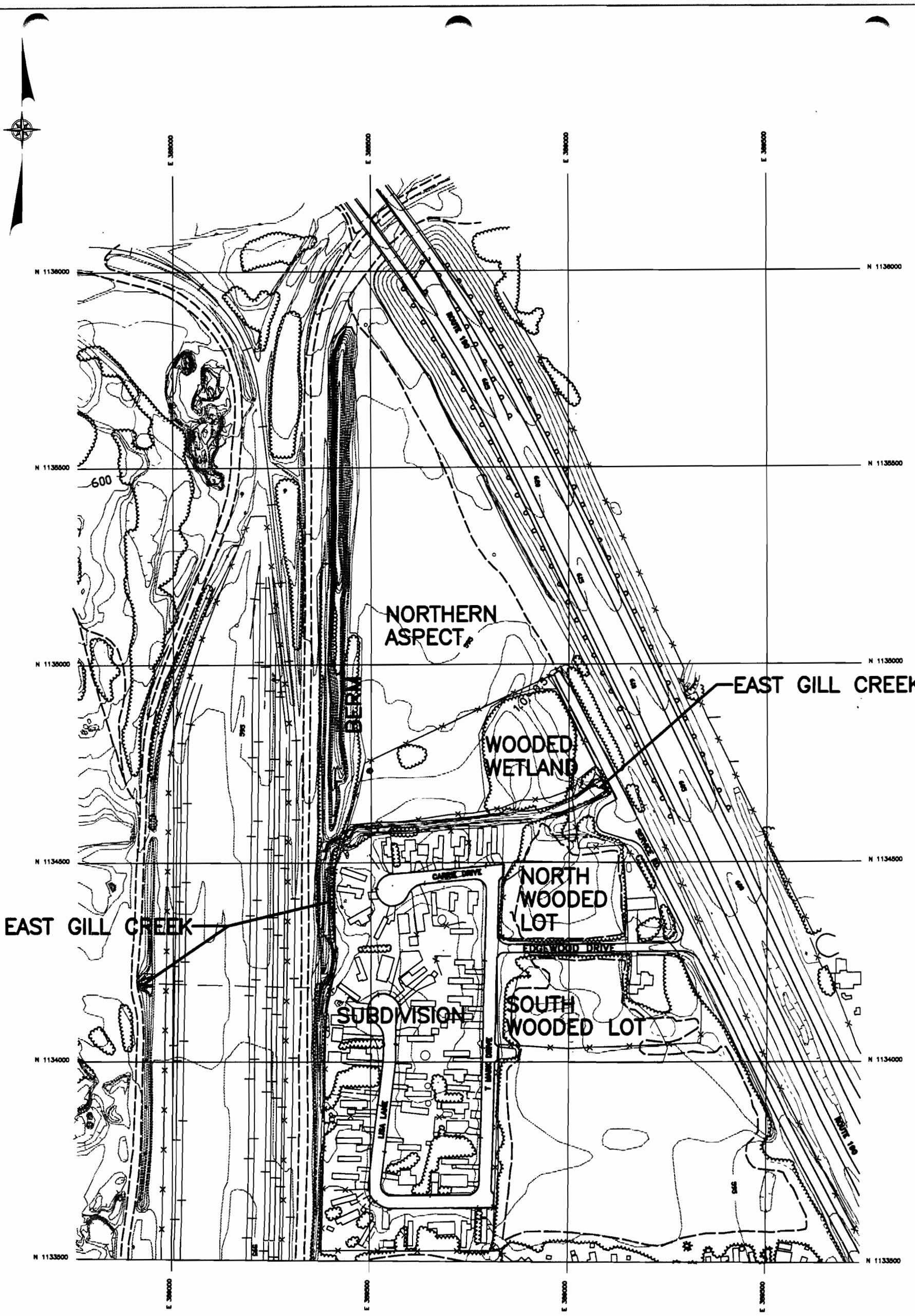

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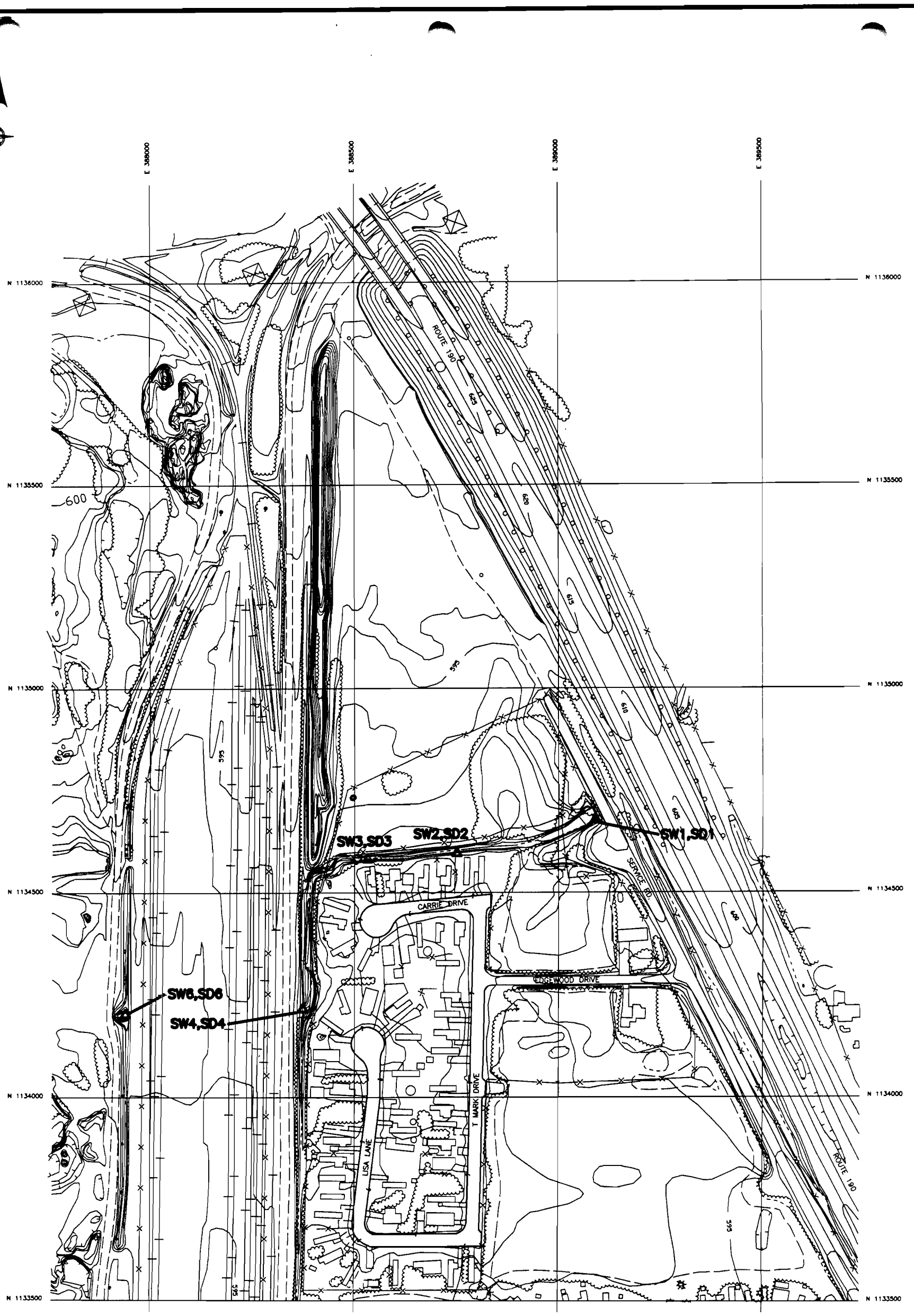
FIGURE 2-3
AREAS OF CONCERN MAP

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

FILE: C:\FOREST_G\SW5.DWG R.A. 1/18/96



LEGEND

- TRAIL
- TREELINE
- FENCE
- RAILROAD
- BUILDING (RESIDENTIAL)
- ▲ WETLAND SEDIMENT SAMPLE LOCATION
- △ SURFACE WATER/SEDIMENT SAMPLE LOCATION

125' 0 250'

SCALE:

CDM FEDERAL PROGRAMS CORPORATION
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FIGURE 2-4

EAST GILL CREEK SURFACE WATER/SEDIMENT LOCATIONS

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

FILE: C:\FOREST_G\SW5.DWG R.A. 1/18/96

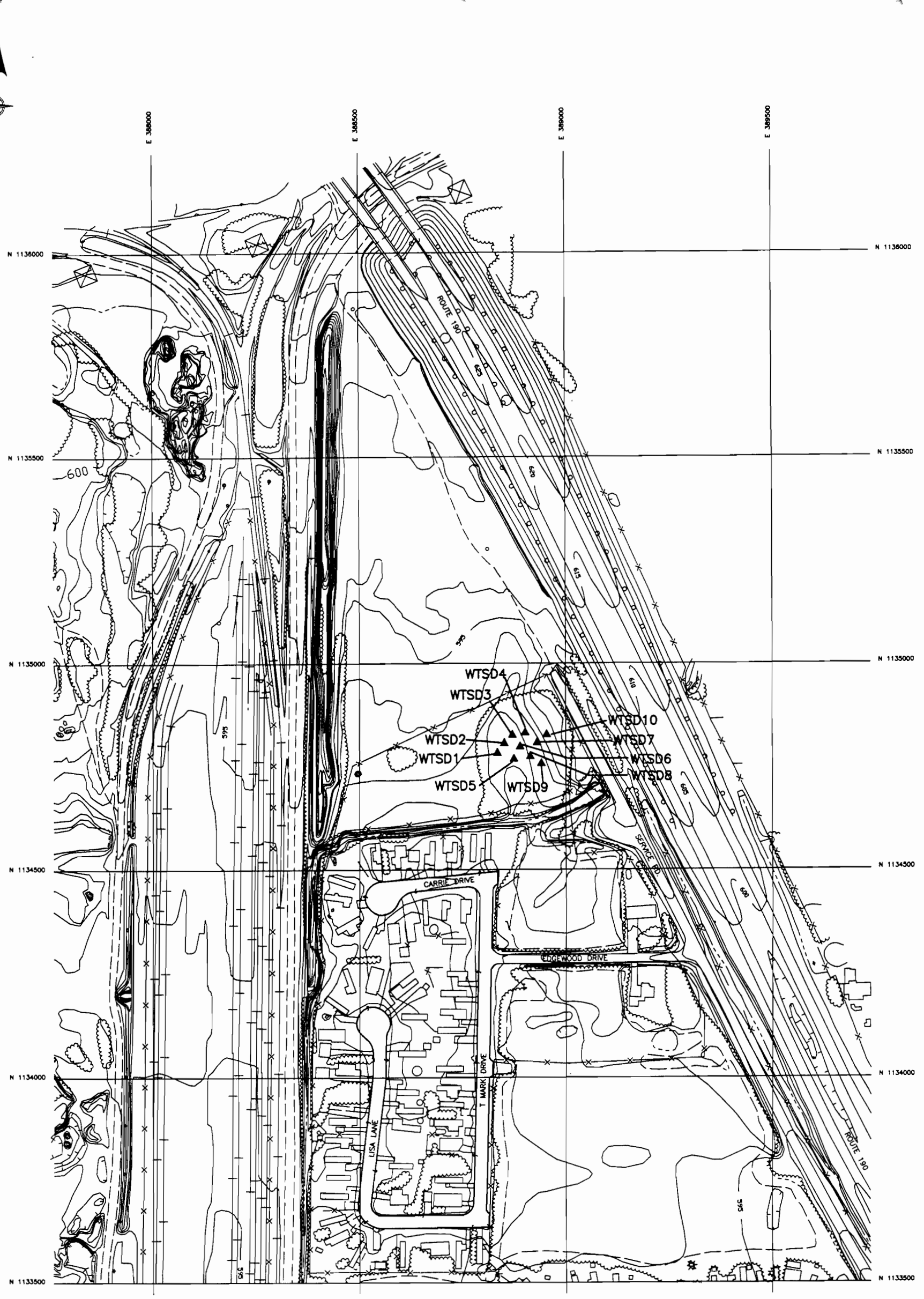

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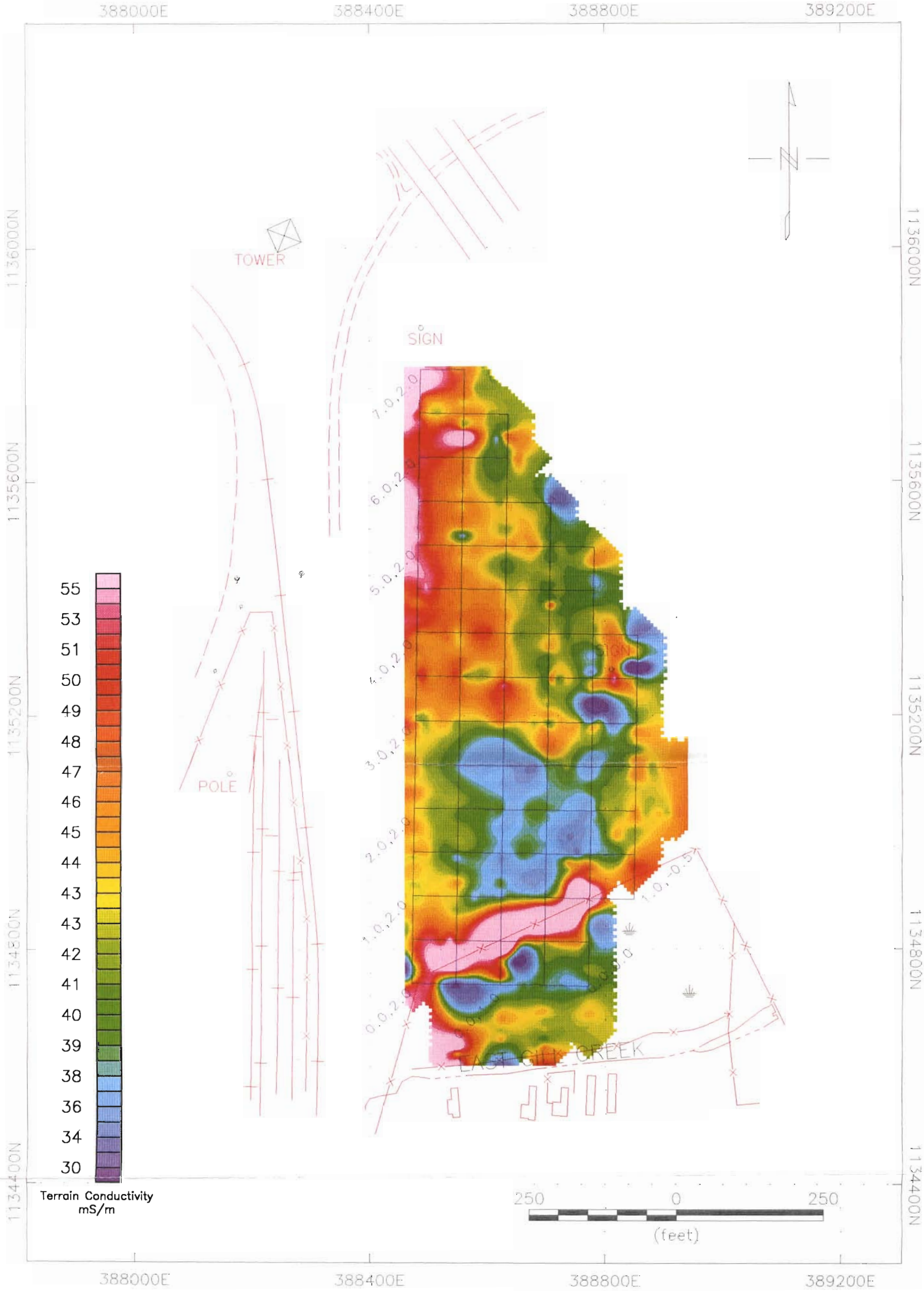
FIGURE 2-5

WOODED WETLAND SEDIMENT SAMPLE LOCATIONS

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

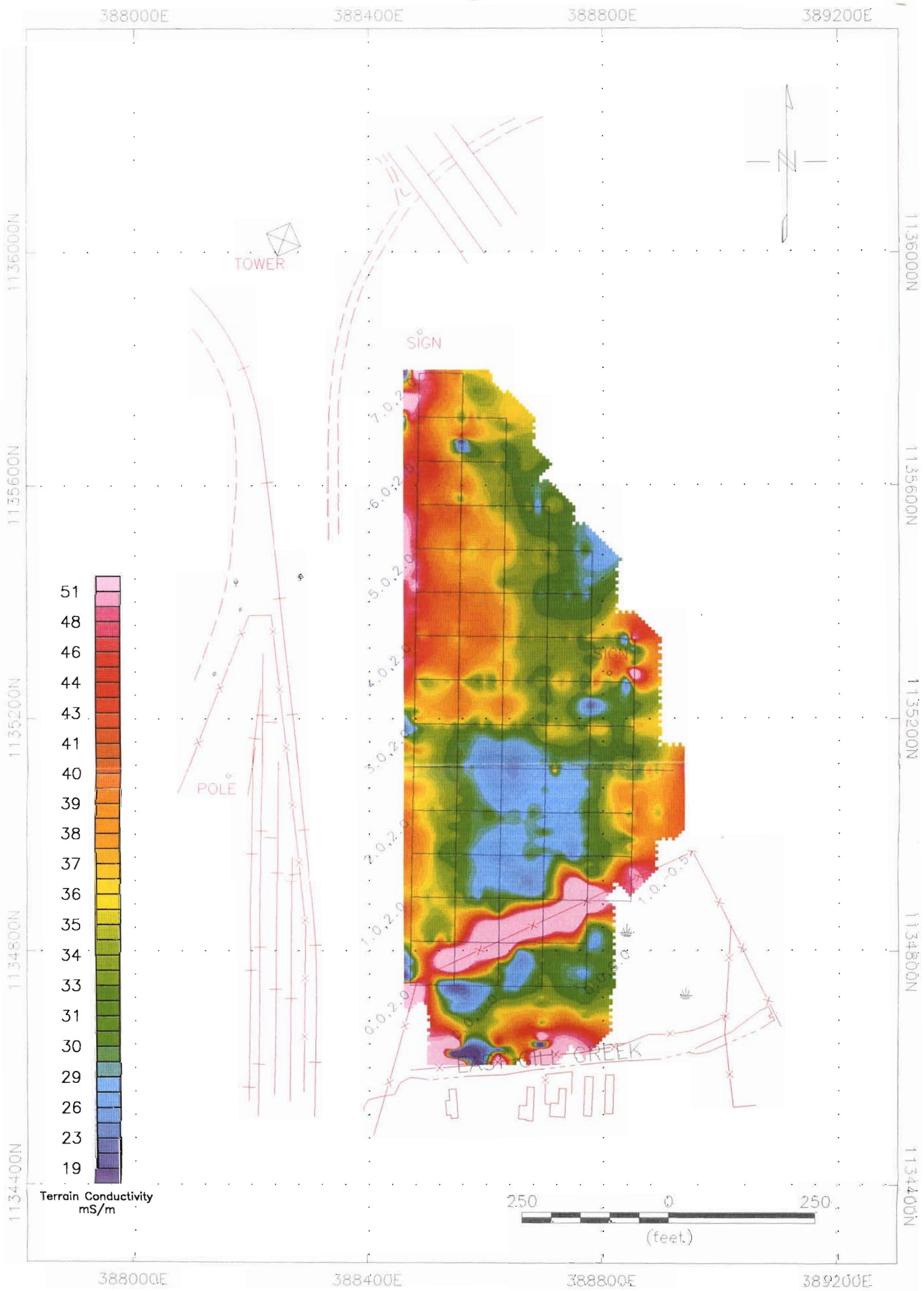


FOREST GLEN

Electromagnetic Survey

EM31-D Horizontal Dipole

FIGURE 2-6

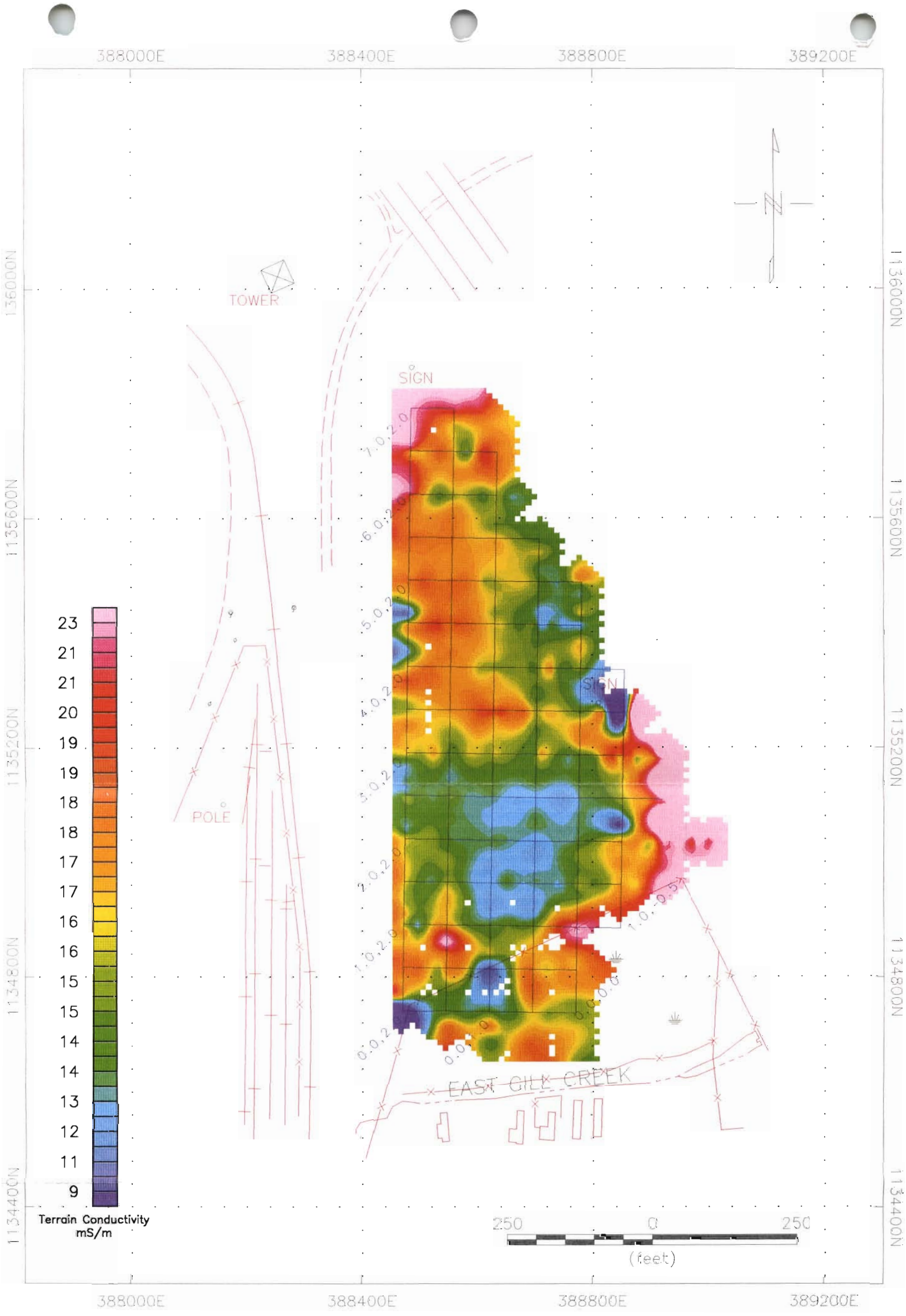


FOREST GLEN

Electromagnetic Survey

EM31-D Vertical Dipole

FIGURE 2-7

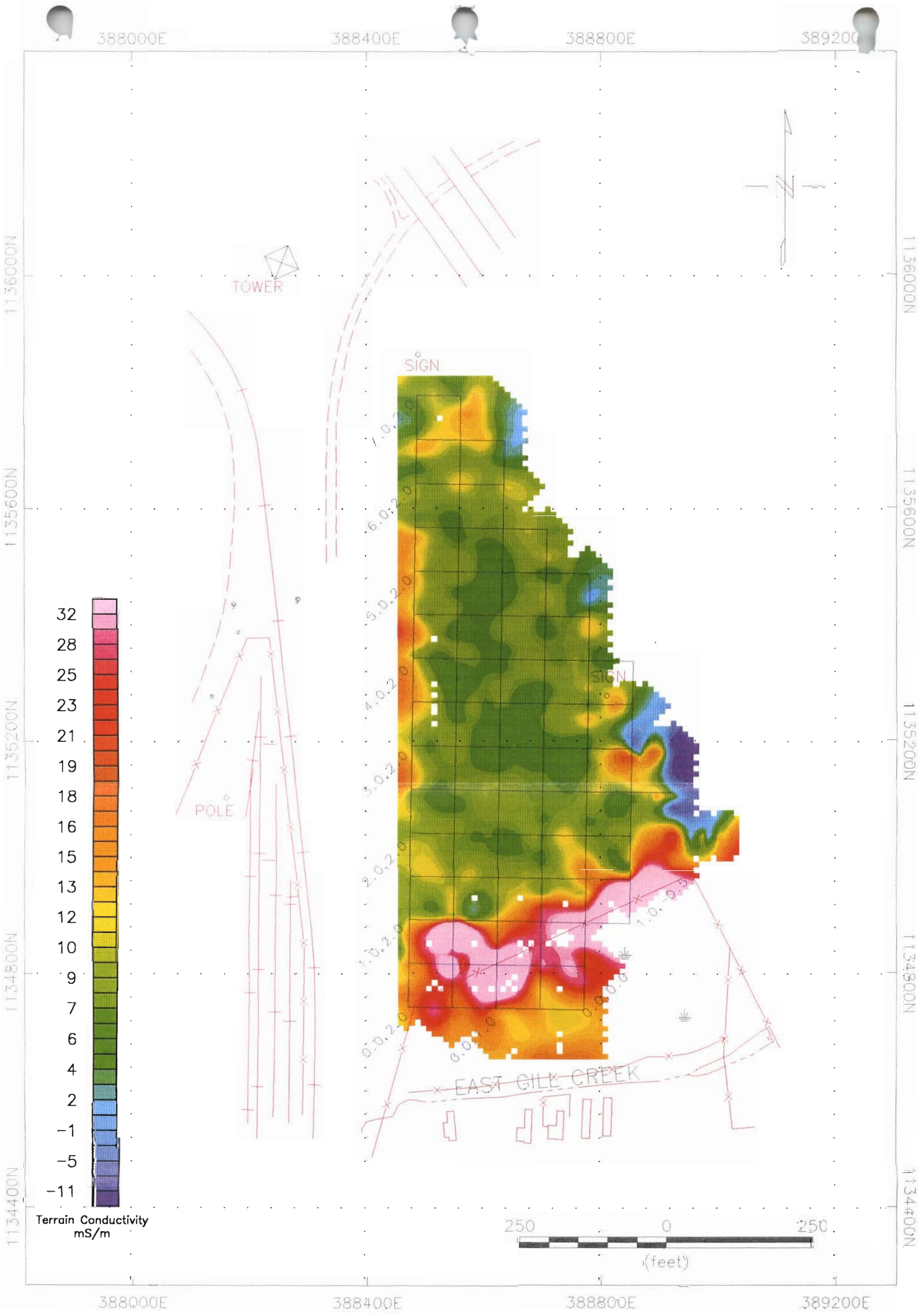


FOREST GLEN

Electromagnetic Survey

EM34-3 20 Meter Horizontal Dipole

FIGURE 2-8

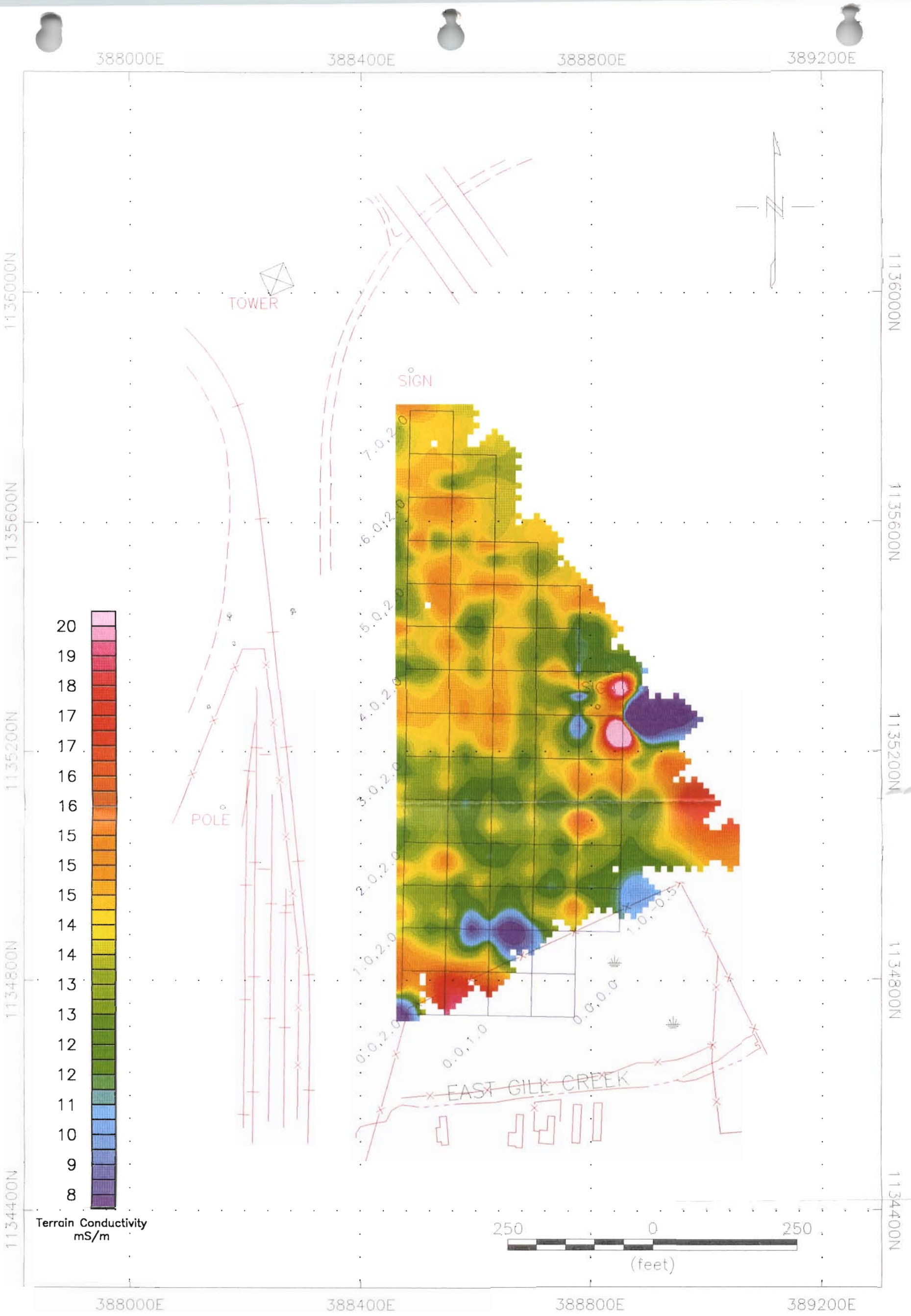


FOREST GLEN

Electromagnetic Survey

EM34-3 20 Meter Vertical Dipole

FIGURE 2-9

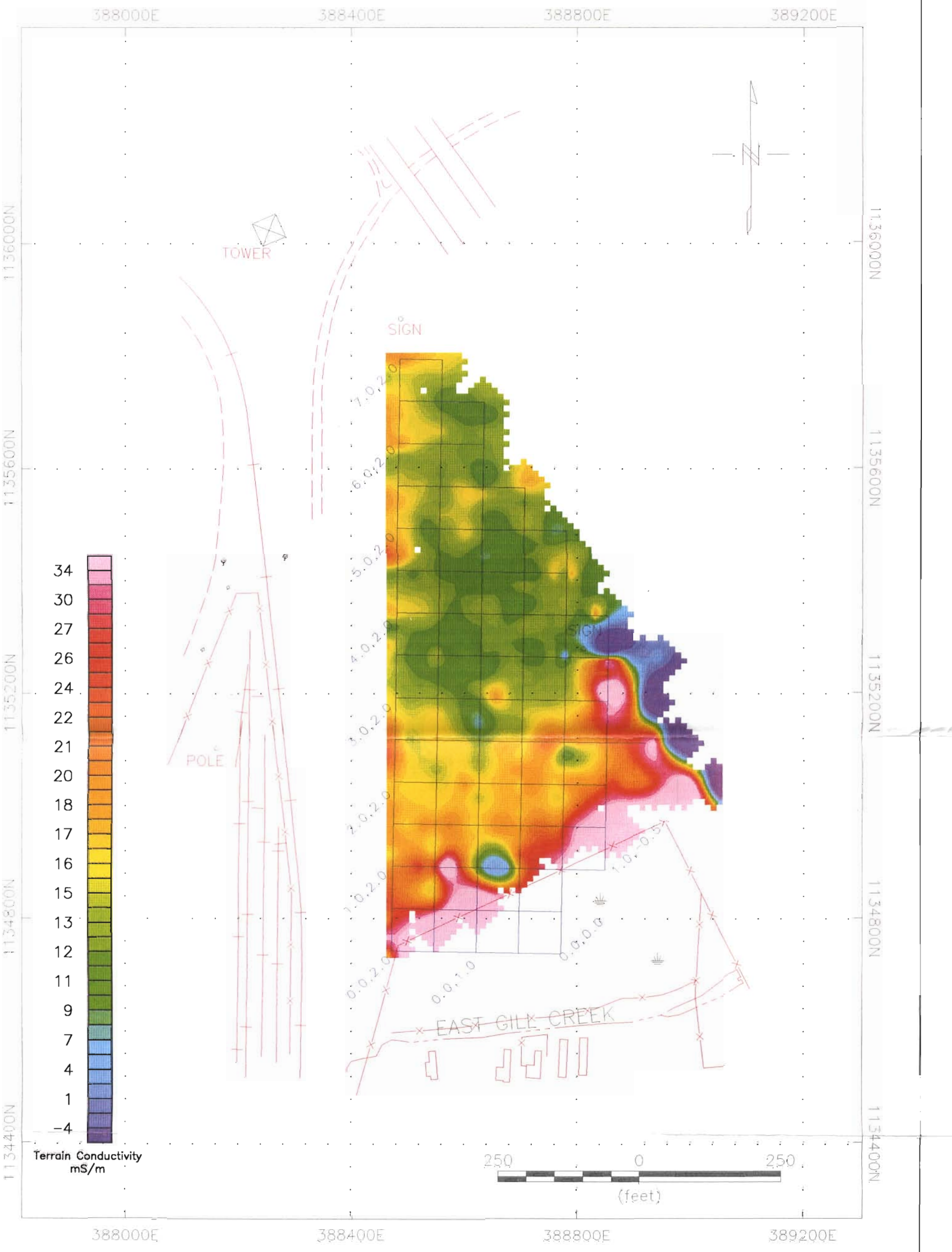


FOREST GLEN

Electromagnetic Survey

EM34-3 40 Meter Horizontal Dipole

FIGURE 2-10



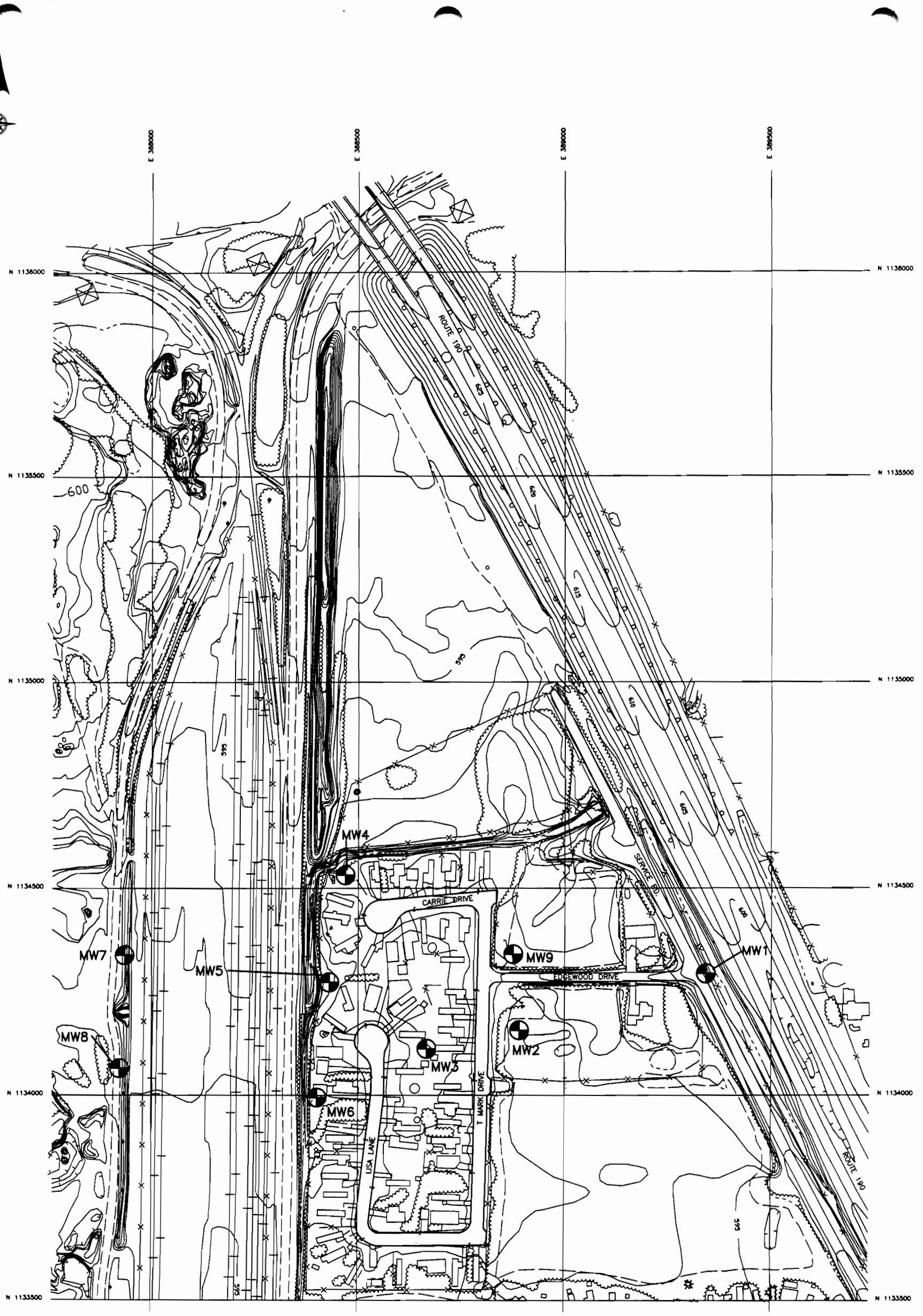
FOREST GLEN

Electromagnetic Survey

EM34-3 40 Meter Vertical Dipole

FIGURE 2-11

FILE: C:\FOREST_G\SW4.DWG RA. 1/18/96



125' 0 250'

SCALE:

LEGEND

- TREELINE
- FENCE
- RAILROAD
- BUILDING (RESIDENTIAL)
- MONITORING WELL LOCATION

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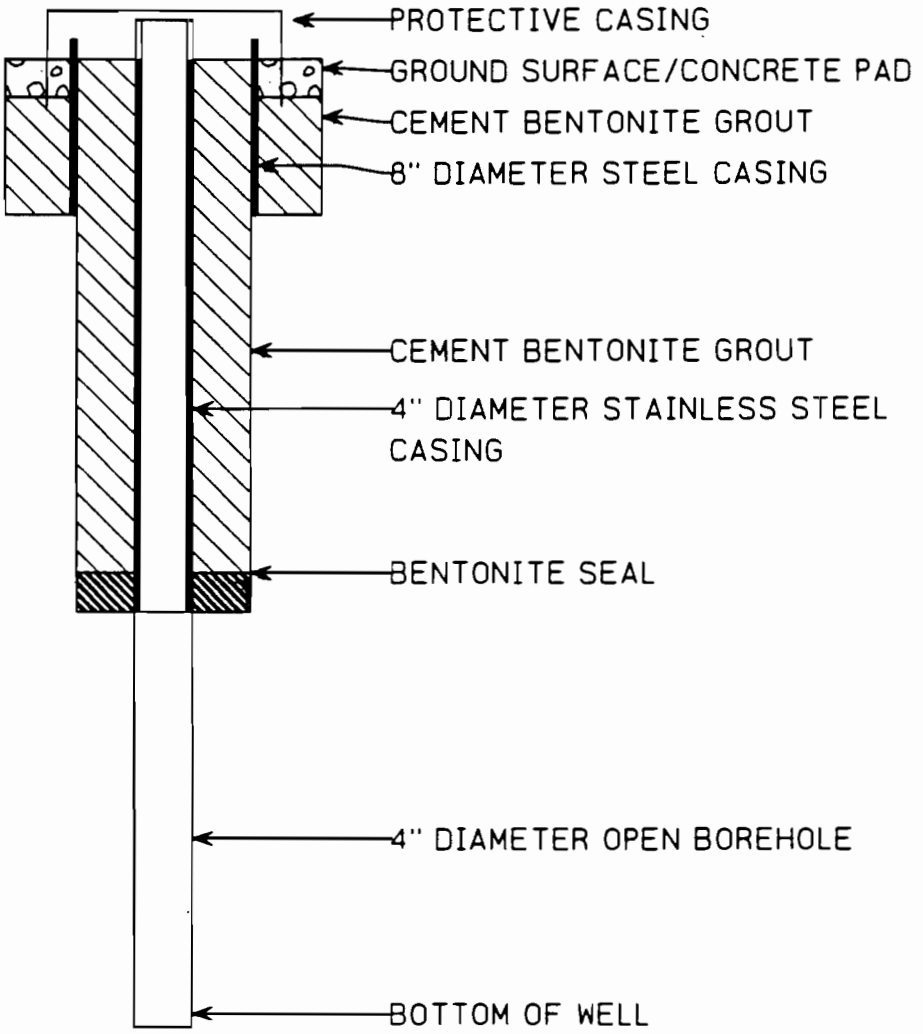
FIGURE 2-12

MONITORING WELL CLUSTER LOCATIONS

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

MONITORING WELL COMPONENTS



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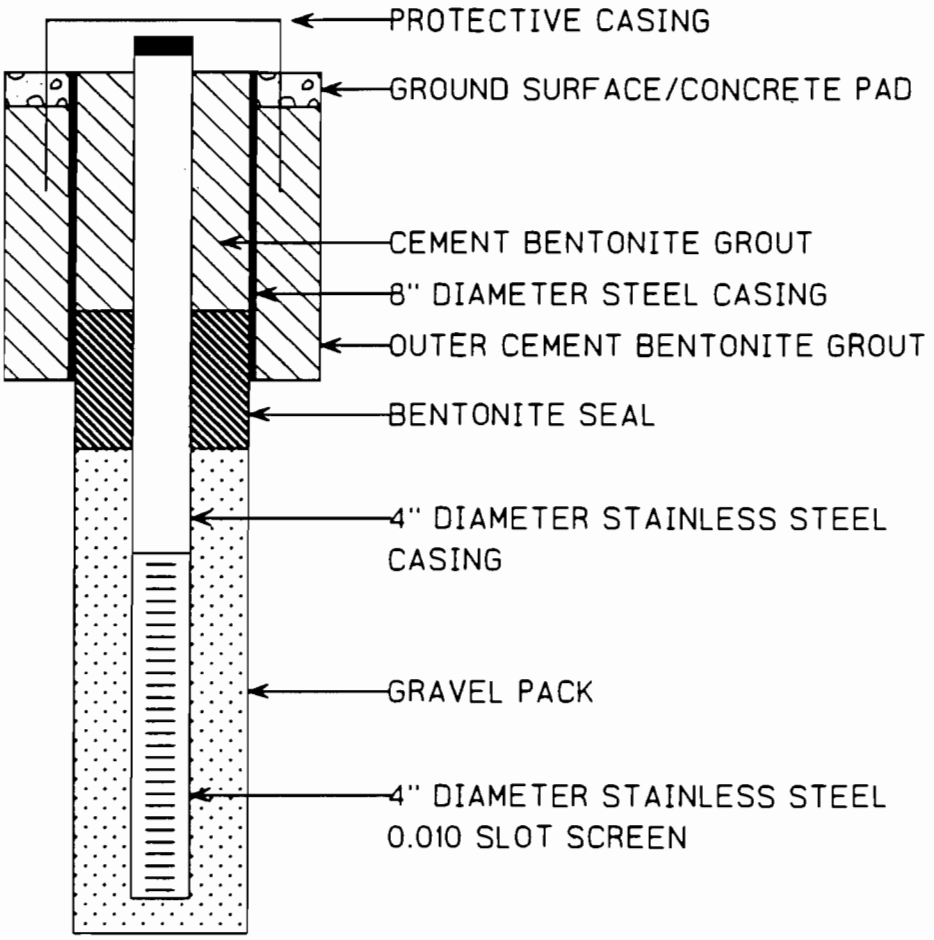
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

FIGURE 2-13
DEEP BEDROCK MONITORING WELL CONSTRUCTION DIAGRAM

MONITORING WELL COMPONENTS



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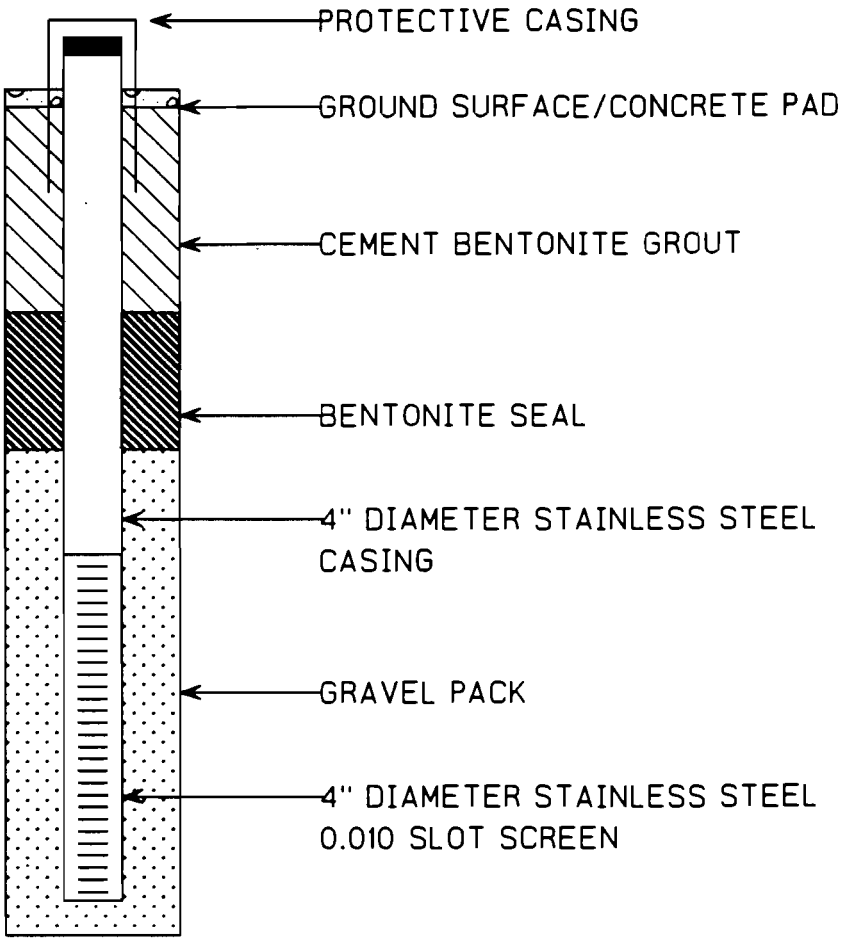
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

FIGURE 2-14
SHALLOW BEDROCK MONITORING WELL CONSTRUCTION DIAGRAM

DWR 7720-053 FILE FGFIG1-5.DN 4/1/96

MONITORING WELL COMPONENTS



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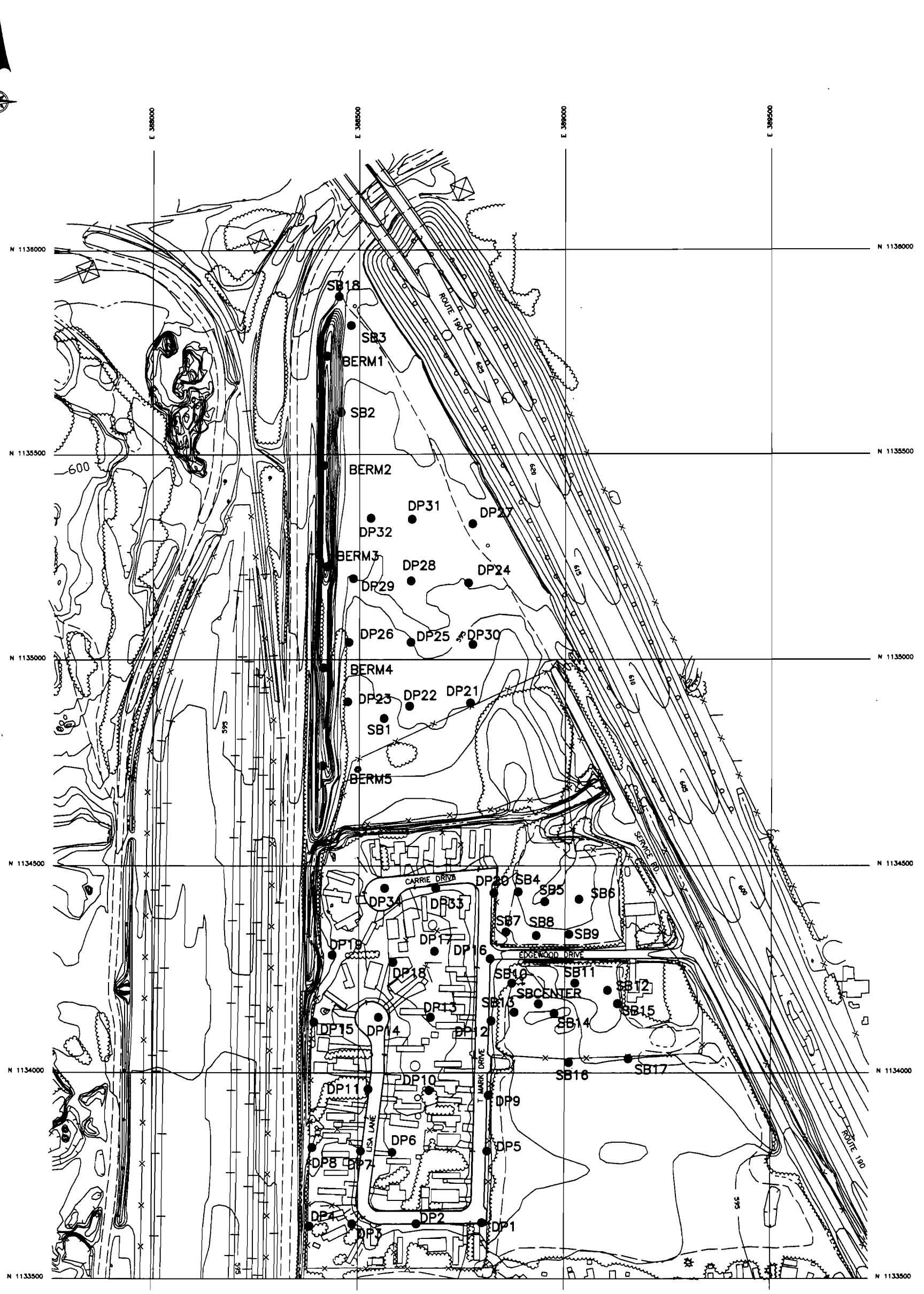
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

FIGURE 2-15
PERCHED WATER/ OVERBURDEN MONITORING WELL CONSTRUCTION DIAGRAM

FILE: C:\FOREST_G\SW3.DWG R.A. 1/18/96



125' 0 250'

SCALE:

LEGEND

- TRAIL
- TREELINE
- FENCE
- RAILROAD
- BUILDING (RESIDENTIAL)
- SUBSURFACE SAMPLE LOCATION

FIGURE 2-16

SOIL BORING LOCATIONS

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
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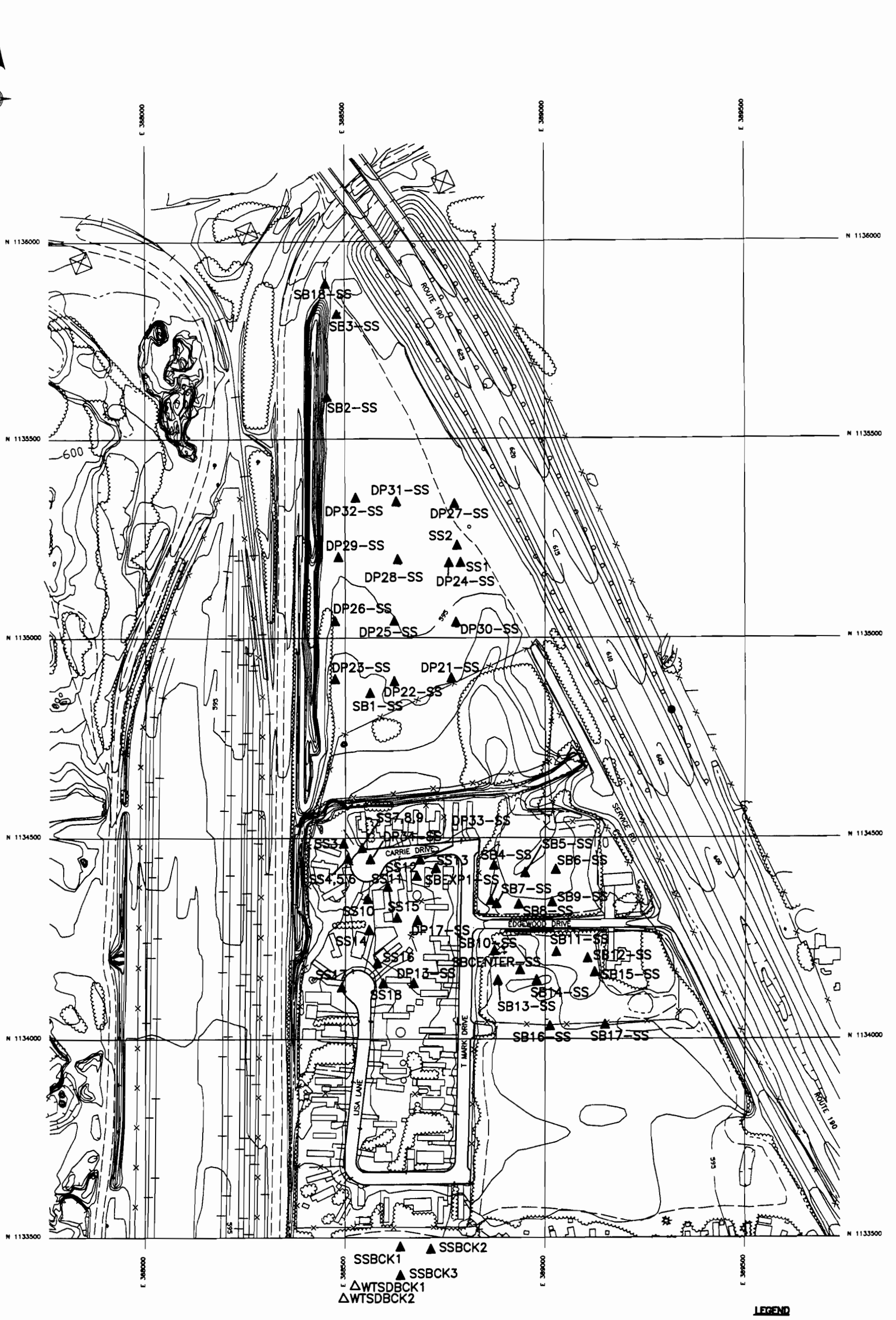
FILE: C:\FOREST_G\SW1.DWG R.A 1/18/96



NOTE: Background samples were collected from an area south of the subdivision on Forest Glen property that is not shown on this figure.

125' 0 250'

SCALE:

LEGEND

- TRAIL
- TREELINE
- FENCE
- RAILROAD
- BUILDING (RESIDENTIAL)
- ▲ SURFACE SOIL SAMPLE LOCATION
- △ SEDIMENT SAMPLE LOCATION

FIGURE 2-17

SURFACE SOIL AND BACKGROUND SAMPLE LOCATIONS

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
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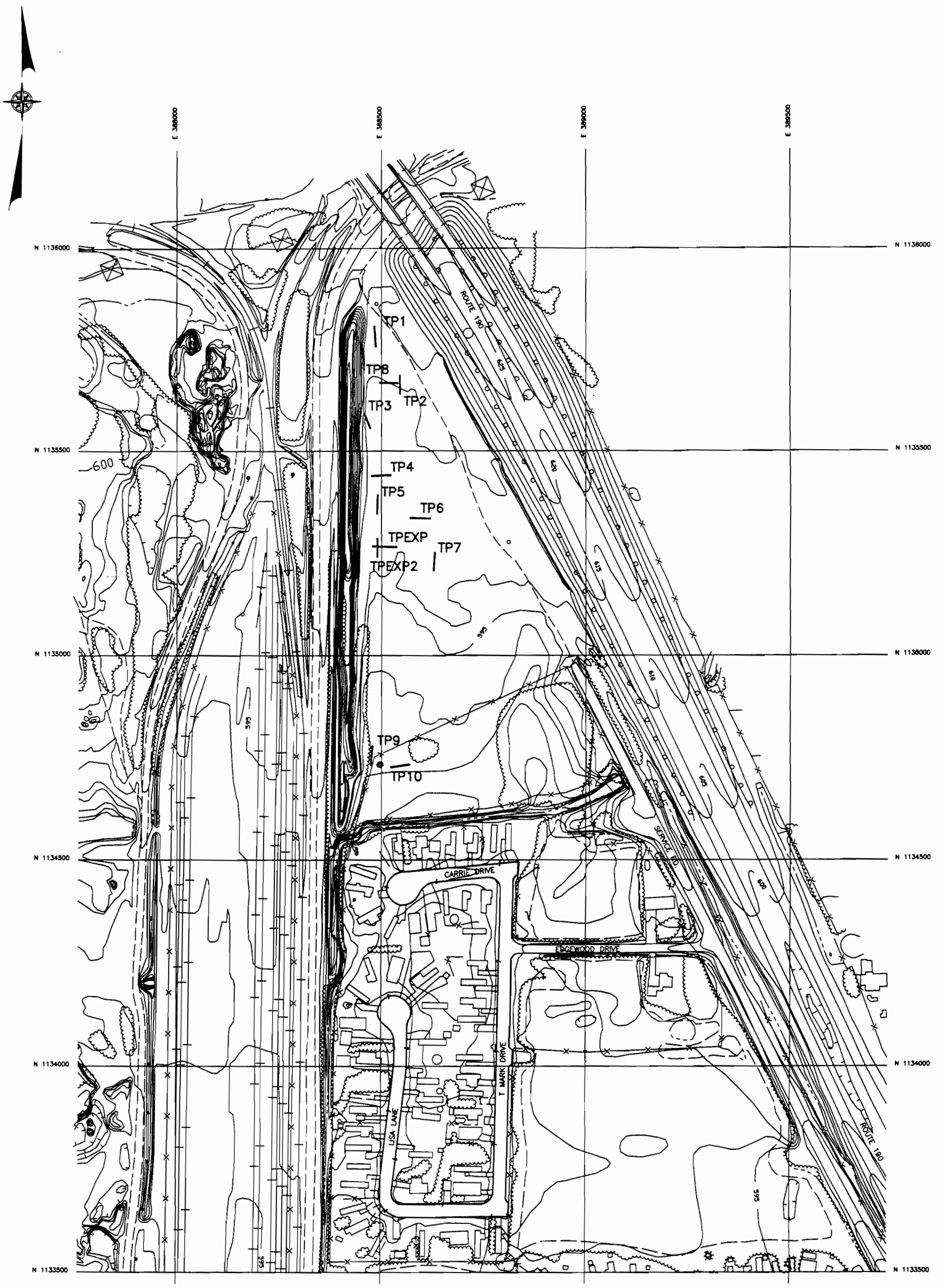

LEGEND

- TRAIL
- TREELINE
- FENCE
- RAILROAD
- BUILDING (RESIDENTIAL)
- TEST PIT

125' 0 250'

SCALE:

FIGURE 2-18

TEST PIT LOCATIONS

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3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

3.1 SURFACE FEATURES

The Forest Glen site is generally flat with the ground elevation increasing toward to the north. Local variations in topography occur along East Gill Creek, the berm in the northern aspect, surface drainage features, and several soil mounds. Surface elevations range from 591 feet above mean sea level (amsl) in the subdivision to 608 feet amsl in the northern aspect (including the approximately 11-foot-high berm).

The subdivision's two homes and 51 mobile homes have been badly vandalized but all remain standing. The two houses and the mobile homes are situated on the four paved roads: Edgewood Drive, T Mark Drive, Lisa Lane, and Carrie Drive. The entire subdivision is surrounded by a 15-foot-high chain link fence that is equipped with a vehicle gate, on Edgewood Drive, and three pedestrian gates, located throughout the subdivision. The integrity of the pedestrian gates and a portion of the fenceline along T Mark Drive have been compromised.

The entire site, excluding the paved subdivision and northern aspect berm, is classified as wetland. Ponded water is seasonally present throughout the undeveloped areas of the site. East Gill Creek flows onto the site from the east and flows westward across the northern portion of the subdivision forming its northern boundary.

3.2 METEOROLOGY

The City of Niagara Falls is located on the shores of the Niagara River, which flows northward from Lake Erie to Lake Ontario. The average annual daily temperature is 48° F, with the average summer temperature of 68° F and the average winter temperature of 27° F (NOAA, 1992). The prevailing wind direction is from the west and north with an average wind speed of 9 miles per hour (AWS, 1987). Summer is characterized by cool breezes originating from the Great Lakes. Gale force winds with snow occur in winter.

Because of the close proximity of the Great Lakes, the area receives an average of 35 inches of rain annually that is distributed at a fairly consistent rate of approximately 3 inches per month. In the winter months, precipitation comes in the form of snow, averaging 67 inches per year (AWS, 1987). Table 3-1 presents a summary of climatic data in the vicinity of the site.

3.3 SURFACE WATER HYDROLOGY

The site, excluding the berm in the northern aspect, is fairly flat with a gentle southern declination in the northern aspect. There is one low flowing creek, East Gill Creek, and two surface water pools onsite. In addition to these, minor depressions and drainageways exist on a microscale throughout the site. Local variations in topography occur along East Gill Creek and

several drainage ditches on and adjacent to the site. Figure 3-1 depicts the surface waterways and water bodies located at the site.

East Gill Creek (AOC4), a shallow and slow-flowing creek, runs east to west and is located between the northern aspect and Edgewood and Carrie Drives. It enters the site approximately 10 feet to the west of the Service Road through three adjacent culverts. At this point, the creek is an undistinguished drainage channel, approximately 8 feet wide and variable in depth to one foot, with small vegetated islands of mounded sediment. As the creek flows westerly adjacent to the subdivision, it is approximately 6 feet wide and 9 inches in depth. Farther west, at the northwest corner of the subdivision, the creek makes a turn and flows southerly. Here, the creek is approximately 4 feet wide and 10 inches deep. At this point and for approximately 30 feet, the creek narrows to approximately 12 to 18 inches wide, the streambed slopes at 5 to 10 percent, and the flow becomes more rapid. Approximately 300 feet downstream, where the creek exits the site through a culvert underneath the railroad yard at the eastern boundary of the site, small riffles exist due to the presence of cobbles. The water depth at this location varies from 3 to 10 inches and the creek forms a 10-foot by 5-foot pool.

East Gill Creek originates approximately one mile upstream of the site, draining residential and commercial areas before entering the site. Upon leaving the site, the creek flows through a culvert under the Conrail Foote Railroad yard to the west of the site. The creek reemerges adjacent to the western edge of the railroad yard, where it continues to flow approximately 20 feet to the west and into another culvert. East Gill Creek ultimately flows into Hyde Park Lake, joining the main channel of Gill Creek, at a location immediately south of New York State Route 182 (approximately 1 mile southwest of the site). East Gill Creek, as a tributary to Gill Creek, is classified by NYSDEC as a Class C fresh surface water (Beech, 1996). Class C fresh surface waters are suitable for fish propagation and survival as well as for primary and secondary contact recreation (including swimming and boating), although other factors may limit recreational use.

The onsite portion of East Gill Creek appears to be a permanent stream (i.e., with continual water presence) with no measurable flow, as observed during the November, 1995 sampling activities. The streambed material appears to be of a fine texture (clay with silt).

The pH of the water is neutral to basic and varies slightly from when it enters the site to its most basic, pH greater than 8, as it leaves the site (Table 2-3). The downstream value represents an exceedances of the NYSDEC water quality standard for pH, greater than 8.5, for the creek's designated surface water classification. The dissolved oxygen content of the onsite portion of the creek was demonstrated to vary widely between summer and late fall (Table 2-3). The dissolved oxygen content of the creek during the August, 1994 field activities was so low that it did not comply with the water quality standard (less than 40 mg/l) for minimum daily average dissolved oxygen.

Two other surface water bodies exist at the site. One, a shallow body of water located in a depression within the wooded wetland (AOC 3) has the appearance of a historical, winding streambed. It is estimated to be one-third acre in size. The surface water from this location

drains into the East Gill Creek. The other notable surface water body is 20 feet south of Edgewood Drive and 15 feet west of the permanent residence south of Edgewood Drive. This shallow pool was observed to be approximately one tenth acre in size during the May, 1995 field activities; however, is likely to vary seasonally.

As observed during the May and November, 1995 ecological field activities, other onsite areas have pockets of smaller, amorphous pools of standing water. One such area is in the woods between East Gill Creek and Edgewood Drive (north lot of AOC 5). Another is in the woods south of the permanent residence to the south of Edgewood Drive (south lot of AOC 5). All of these pools are shallow and may exist seasonally. The pools, located in the woods southeast of Edgewood Drive, are vegetated with wetland plants.

Much of the site surface water runoff is discharged into East Gill Creek. In the northern aspect, surface water runoff generally flows southward along minor drainage depressions into the wooded wetland (AOC3) and ultimately drains into East Gill Creek. The surface water runoff from the wooded lot north of Edgewood Drive drains into East Gill Creek and into the storm sewer at the corner of T Mark and Carrie Drives. Surface water runoff from the wooded lot south of Edgewood Drive flows either into the man-made, unlined earthen drainage ditch along Edgewood Drive and into the storm sewer inlet at T Mark Drive, or to the west, directly into the storm sewer inlets along T Mark Drive. According to subdivision plans, site storm sewers are constructed of 15-inch diameter reinforced concrete pipe.

Surface water runoff from the subdivision flows into the storm sewer inlets along Carrie and T Mark Drives and along Lisa Lane. Runoff that enters those storm sewer inlets located along Carrie and T Mark Drives and along the eastern-most portion of Lisa Lane is discharged to East Gill Creek via an outfall located approximately 75 feet north of where the creek exits the site. Runoff that enters storm sewer inlets located along the remainder of Lisa Lane is discharged to East Gill Creek via an outfall located approximately 45 feet north of where the creek exits the site. Figure 3-1 shows the location and flow direction of the onsite storm sewers.

3.4 SOILS

According to the United States Department of Agriculture's Soil Survey of Niagara County, New York (USDA, 1972), the only natural soil type that exists at the site is Odessa silty clay loam (Figure 3-2). The Odessa soil series is described as a deep, somewhat poorly drained, moderately fine textured soil and is formed in lacustrine deposits in which calcareous clay is dominant. The permeability of the upper 8 inches of soil is 0.2 to 2 inches per hour, while that of deeper soil is expected to be less than 0.2 inches per hour. The available moisture capacity of the soil is in the range of 0.15 to 0.2 inch per inch of depth (USDA, 1972).

Many areas of the site have been reworked and/or filled in with non-native soils. These areas are located in the vicinity of the berm in the northern aspect, the central area of the subdivision, and north and south of Edgewood Drive. Most of the Odessa silty clay loam has been removed from these areas or mixed with the non-native soils.

3.5 GEOLOGY

3.5.1 REGIONAL GEOLOGY

The city of Niagara Falls is located within the Erie-Ontario Lowlands Physiographic Province. The geomorphology of this area is the product of the advance and subsequent retreat of the Laurentide continental glacier between 20,000 and 30,000 years ago. One of the most significant topographic features in the region is the east-northeast trending Niagara Escarpment. This feature is interpreted to be the result of post-glacial uplift related to unloading caused by the removal of the ice sheets (Tepper, et al., 1990). Relief along the north face of this escarpment is on the order of 200 feet. Post-glacial uplift is also thought to be the cause of the other main topographic feature in the area: the Niagara River Gorge. As the terrain rebounded following the retreat of the continental glacier, the Niagara River cut back into the escarpment, creating a gorge approximately 160 feet deep.

The area to the south of the escarpment and to the east of the Niagara River Gorge was shaped primarily by the action of the advancing and retreating glacier. As the ice sheet advanced, the underlying rock units were scoured and eroded. Much of the material picked up by the glacier was deposited as terminal moraine material. The remainder was deposited as ground moraine along the base of the glacier. This material, commonly known as lodgment till, is compact and generally very impermeable. The resulting topography is generally flat due to the scouring effect of the glacier, and poorly drained due to the impermeability of the glacial lacustrine clay and glacial till.

The region surrounding the site exhibits glacial geomorphology, although evidence of manmade modification is apparent. The open areas to the northeast and southwest of the site display a slightly hummocky terrain. The land surface slopes gently to the south and the total local relief is on the order of about 10 to 15 feet. The regional overburden thickens to the southeast and thins to the west toward the Niagara Gorge and to the north toward the Niagara Escarpment (NUS, 1989).

The underlying bedrock consists of approximately 150 feet of upper Silurian Lockport Dolomite overlying approximately 120 feet of middle Silurian limestones and shales (Clinton Group) including the impermeable Rochester Shale (Johnston, 1964). Below the Clinton Group is approximately 130 feet of lower Silurian interbedded limestone and sandstone. Underlying the interbedded limestone and sandstone is the upper Ordovician Queenstone Shale (Johnston, 1964) (Figure 3-3). This stratigraphic sequence is well exposed at Niagara Falls where the Lockport dolomite forms the lip of the Falls (Figure 3-4). The bedrock beneath the site and throughout the region dips gently to the south at 29 feet per mile (Zenger, 1962).

3.5.2 SITE-SPECIFIC GEOLOGY

To characterize the overburden and bedrock lithology, continuous split-spoon samples were collected at boring locations, geophysical surveys were performed, and nine bedrock monitoring

well locations were cored during initial site characterization and field data collection activities. Sampling activities were also performed to locate potentially contaminated soils within the subdivision and in the northern aspect (Figure 3-5). Twelve test pits were excavated in the northern aspect to investigate electromagnetic anomalies revealed during the geophysical survey. The boring logs, core logs, geophysical survey information, and the test pit logs are presented in Appendices B, D, E, F, and H. The information from the logs and surveys was used to interpret and define the site geology. In addition, geological information from borings, test pits, and monitoring wells were projected perpendicularly onto cross-section lines in locations where conditions were not documented.

The overburden at the site is relatively thin, ranging from 5 to 17.2 feet in thickness. It consists of fill, glaciolacustrine deposits (clay), and clay till deposits overlying the Lockport dolomite. The site overburden is thickest in the center of the subdivision and thins toward the north (Figure 3-6).

The thinnest overburden (9 feet) was encountered in the area between MW-4 cluster and test pits 9 and 10 (5 feet) (Figure 3-6 and Table 3-2). This area also coincides with a large negative electromagnetic anomaly (blue region) near north grid nodal points 0.0, 2.0 and 0.0, 1.5 as seen in the EM31 and EM34 survey maps Figures 2-6 to 2-12. A negative electromagnetic anomaly may indicate thin overburden or shallow bedrock since less high conductive clay and more low conductive dolomite is encountered by the electromagnetic field generated by the survey instrument.

Figure 3-7 shows the overburden cross-section locations, while Figures 3-8 and 3-9 show cross-sections of the overburden through the areas that contain fill. The glaciolacustrine deposits are made up of compacted clays with fine silt laminations or varves. The clay till below the glaciolacustrine sediments is a very poorly sorted mixture of clay, silt, sand, and gravel.

The upper portion of the Lockport dolomite bedrock was characterized during the monitoring well installation and coring. The depth to bedrock at the site ranged from 5 feet in TP-10 to 17.2 feet at the MW-6 cluster and averaged 13.5 feet BGS. The subsurface conditions encountered during the field investigation are described below.

3.5.2.1 Stained Fill Material

Fill was encountered in borings and test pits in the northwest section of the northern aspect, in all berm samples, in some of the borings north and south of Edgewood Drive, and in the northern and central section of the subdivision (Figure 3-3). Soil boring and test pit logs are located in Appendices E, F, and H, respectively.

The fill was thickest in the northwest section of the northern aspect, where it was as thick as 11.5 feet at SB-3, and in the berm, where it is as thick as 14.5 feet at locations BERM-2 and BERM-3 (Figure 3-10). The geophysical anomalies, investigated during test pit investigations, were correlated to a fill composed of clay, wet burnt cardboard, metal pipe, and some black-stained

material. Similar fill material was also observed beneath the berm. The berm, however, also contained white and yellow powder granules and more black stained material than test pit fill.

The fill north and south of Edgewood Drive consisted of a black-stained silt and fine sand that contained black, coal-like material and white and yellow powder granules. This fill material was encountered in borings SB-04, SB-07, SB-EXP1, SB-10, SB-13, SB-14, and SB-Center. White powder granules were also present in SB-14. North of Edgewood Drive the fill was 2 to 4 feet thick, while south of Edgewood Drive it was 6 to 7.5 feet thick (Figure 3-10). Table 3-3 shows the grain size distributions for fill samples.

The fill below the subdivision was similar to that found in the vicinity of Edgewood Drive and was encountered in borings DP-012, DP-013, DP-014, DP-017, DP-018, DP-019, DP-020, DP-033, and DP-034. White and yellow powder granules were also present in DP-014, DP-018, DP-033, and DP-034. The fill was encountered from the ground surface to depths of 9.3 feet. The greatest thickness of fill was observed in borings DP-013 and DP-017, with thicknesses of 9.3 feet and 7.5 feet, respectively (Figure 3-10). The fill encountered in these two borings (DP-013, DP-017) appeared to have been artificially placed over the native clay layer. In all other borings, where fill was encountered, it appears to be mixed with the native clay. Two to 3 feet of black-stained silty clay was observed beneath the fill in several of these borings.

3.5.2.2 Clay

The clay layer, overlain by approximately 6 inches of topsoil, was found in every boring. The clay consists of a 2-foot yellow-brown to brown silty clay layer underlain by a 4 to 8-foot red-brown to brown clay layer. The clay is laminated, dry, and stiff, with numerous breaks along silt partings. Moist seams of less than 1-centimeter width, usually associated with very fine sand partings, were noted in some split-spoon samples collected from the bottom of the clay layer. These seams are too thin to produce any noticeable amounts of groundwater. No groundwater was encountered in the overburden clay layer.

The thickness of the clay ranged from 0.5 feet in boring SB-01 to 13.0 feet in boring DP-006. The thickness of the clay is generally between 6 and 10 feet beneath most sections of the subdivision and the northern aspect. The clay is thin in the northwest section of the subdivision and thicker in the south central portion of the subdivision, and in the southern section of the northern aspect (Figure 3-11). It is possible that during illegal landfilling activities that the clay layer was breached which would have allowed fill material to come in contact with the more permeable clay till.

Shelby tube samples of clay taken from the subdivision and the northern aspect (Appendix G) indicate the samples are composed of 60 percent clay, 35 percent silt and 5 percent fine sand. The coefficient of permeability for the two samples was approximately 1.0×10^{-8} cm/sec. The plasticity indices and liquid limits of both samples reveal clay of moderate plasticity with a moisture content of 26 percent. Grain size analyses of 34 split-spoon samples of clay collected

during soil boring activities showed similar grain size distributions when clay and collid sizes were combined (Table 3-4).

3.5.2.3 Clay Till

The transition downward from the clay layer into clay till is indicated by the presence of soft silty clay mixed with pebbles, gravel, and sand, (Table 3-5) and by moist to wet conditions. This poorly sorted material is typical of glacial sediments found in the site vicinity (Maslia and Johnston, 1982). The clay till is encountered throughout the site and at approximately 8 to 10 feet BGS. The clay till directly overlies the Lockport Group bedrock at the site. The full thickness of the clay till was observed in eight borings: DP-001, DP-002, DP-004, DP-005, DP-006, DP-008, SB-07, and DP-031. These borings were drilled in order to characterize the thickness of the clay till and the depth to bedrock. The thickness of the clay till ranged from 1.1 feet in boring DP-006 to 7.1 feet in DP-002 and averaged 2 to 3 feet thick.

3.5.2.4 Lockport Dolomite

Dark gray dolomite fragments, indicating the top of bedrock, were encountered in seven borings and two test pits advanced to bedrock contact. The top of bedrock (Lockport Dolomite) was determined by auger or split-spoon refusal and by visual inspection of the sample. The bedrock elevation map in the vicinity of the monitoring wells reveals areas of differential erosion. A bedrock surface elevation high is located at MW-7, while a bedrock surface elevation low is present at MW-5 (Figure 3-12). Bedrock is unusually shallow (5 feet BGS) in the area between the subdivision (near MW-4) and the northern aspect, (near test pits TP-09 and TP-10). As discussed in Section 3.5.2 this area also coincides with a large negative electromagnetic anomaly (blue region) near north grid nodal points 0.0, 2.0 and 0.0 1.5 (Figures 2-6 to 2-11). Shallow bedrock may be indicated by a negative electromagnetic anomaly since less highly conductive clay and more low conductive dolomite is encountered by the electromagnetic field generated by the survey instrument.

Nine monitoring well locations were cored into the bedrock beneath the site. The Lockport dolomite encountered is similar among the cores. The first 10 to 15 feet of rock is moderately fractured and highly vuggy. Most fractures are horizontal, paralleling bedding, with some vertical fractures present (Appendix D). The vugs are sometimes filled with recrystallized gypsum. The next 7 to 10 feet consist of fine grained, fairly competent dolomite, with few, if any, vugs. This competent zone is considered to define the division between the shallow and deep bedrock zones beneath the site. The competent zone is then followed by an increase in vugginess and horizontal fractures. A few vertical fractures were noticed in this zone. This zone was approximately 25 feet thick and was terminated as the openhole monitoring interval of the deep bedrock zone well (Figures 3-13 through 3-15).

3.6 HYDROGEOLOGY

3.6.1 REGIONAL HYDROGEOLOGY

3.6.1.1 Overburden

The overburden consists of the glacial lacustrine clay deposits, fill, where encountered, and the the basal clay till and extends approximately from zero to 20 feet BGS. The overburden is generally a very low permeability formation; hydraulic conductivity values ranging from 1×10^{-4} to 1×10^{-6} cm/sec have been estimated by Woodward-Clyde (1988). The low permeability of these deposits commonly results in either perched water conditions below surface or standing water conditions at the surface. The static water table is often found in the sand lenses directly above the clay till. These sand lenses are not considered to be a significant aquifer in the area and were not encountered during the RI field activities. According to Johnston (1964), well yields from the overburden zone in the Niagara Falls area are on the order of 1 to 3 gallons per minute (gpm).

3.6.1.2 Lockport Dolomite

The Lockport Dolomite is the major water-producing formation of the area. The regional strike of the Lockport Dolonite bedding planes is near east-west and the dip, toward the south, is at approximately 29 feet per mile (Zenger, 1965). Bedding plane fractures that parallel the formation bedding are believed to transmit the majority of the groundwater flow (Johnston, 1964; Miller and Kappel, 1987; Yaeger and Kappel, 1987). High angle to vertical joints related to regional stress patterns are common in the Lockport Dolomite and also contribute groundwater production from this formation. These joints are best developed in the upper part of the Lockport Dolomite, where a relatively high degree of weathering has occurred (Johnston, 1964). Where dissolution has occurred, these joints may serve as conduits for vertical and horizontal movement of groundwater between bedding plane fractures. The prominent sets of vertical joints in the Niagara Falls area are oriented N65°E and N30°W (Johnston, 1964). Near the bedrock surface, joints tend to be open and well developed; however, they become relatively tight and poorly developed at depth (Miller and Kappel, 1987).

Johnston (1964), Yaegar and Kappel (1987) and Tepper, et al. (1990) all provide evidence for a regional structural lineament (fracture zone) that passes southeast of the site and may have a dramatic influence on the regional groundwater flow pattern. The original evidence for this feature was provided by Johnston (1964), who made direct observations of fractures at the intersection of the Falls Street Tunnel and the buried conduits. Johnston correlated these fractures to an alignment of highly productive wells. A dewatering well installed along this alignment was pumped at 950 gallons per minute for one month before the surrounding bedrock was dewatered. Although structural, seismic, and hydrogeologic evidence support the existence of this feature (Tepper, et al., 1990), the details of its shape, size, and subcrop pattern are not well defined. Information provided in Tepper, et al., (1990) was used to plot the approximate location of the

lineament (Figure 3-17). The lineament appears to pass approximately 4,000 feet southeast of the site.

Johnston (1964) reported that a significant amount of groundwater flow occurs through horizontal water-bearing bedding plane fracture zones in the bedrock underlying the site, based on observations of the exposed walls of the buried conduits which cut through the Lockport Dolomite west of the site area. Johnston (1964) identified seven water-bearing zones, each consisting of either a single open bedding plane or an interval of rock layers containing several open bedding planes. These water bearing zones are isolated from each other by impermeable bedrock, and are therefore considered to be semiconfined aquifers.

3.6.1.3 Effects of Power Authority of the State of New York (PASNY) Hydroelectric Power Projects on Hydrogeology

The regional topography makes the Niagara Falls area well suited for the development of hydroelectric power. Figure 3-17 shows the main features of the PASNY hydroelectric power operations in the Niagara Falls vicinity. The Niagara River Gorge provides for a head differential of approximately 160 feet between two large manmade reservoirs located on either side of the gorge and the river base. The Niagara River above the falls is a groundwater recharge boundary. At the falls, the surface water elevation drops below the surrounding groundwater level and the river forms a regional groundwater discharge boundary. The numerous seeps found in the walls of the gorge provide ample evidence of this relationship.

The Forebay Canal is a discharge boundary and Robert Moses Power Plant Reservoir is a recharge area. A groundwater convergence lies along the buried conduits. According to Miller and Kappel (1987), the convergence is related to a subsurface drainage system that serves the buried conduits. Daily head fluctuations in the Forebay Canal are on the order of 15 feet. This head fluctuation is carried along the buried conduits' drainage system and has been detected as far south as the CECOS Landfill (Yaeger, personal communication) just south of the site, and affects groundwater levels within 0.5 mile of the buried conduits (Miller and Kappel, 1987). Groundwater flowed to the southwest in the vicinity of the site before the PASNY construction (Figure 3-18) but changed to the west, toward the buried conduits, after construction (Figure 3-19).

3.6.2 SITE-SPECIFIC HYDROGEOLOGY

The site hydrogeology is defined by three hydrostratigraphic zones: perched overburden water, shallow bedrock, and deep bedrock.

As discussed above, groundwater was not encountered in the overburden zone beneath the site. However, because of the low permeability of the overburden materials, perched groundwater conditions were encountered in two drive-point soil borings (DP-013 and DP-017), and within the fill material in the berm and the test pits. Since perched conditions were not aerially extensive, this report focuses on the shallow and deep bedrock groundwater zones.

Groundwater was encountered at all monitoring well clusters and in several borings where split spoons were advanced to the top of bedrock. During well drilling, dry conditions were encountered through the clay, but were noted to become moist to wet when the clay till was reached. Groundwater rose in the monitoring wells to the level of the dry clay. This indicates that confined conditions exist in bedrock groundwater zones.

3.6.2.1 Shallow Bedrock Zone

The shallow bedrock zone, which lies directly beneath the clay till at depths from 16 to 28 feet BGS, is the first zone of highly fractured bedrock where significant core drilling water loss occurred. Cross sections (Figures 3-15 and 3-16) show the shallow and deep bedrock zones encountered beneath the site. The dolomite in the shallow zone was highly vuggy with numerous horizontal fractures and some vertical fractures. According to Maslia and Johnson (1982), this is the most productive, aerially extensive aquifer in the region. Groundwater in this zone flows both vertically and horizontally through an interconnecting system of closely spaced joints and bedding plane fractures. Maslia and Johnson estimate the bulk hydraulic conductivity of this zone to be approximately 3.53×10^{-5} cm/sec. Direct slug test measurements made at the Necco Park site (Woodward-Clyde, 1988), near the Forest Glen site generally yielded higher values ranging from 1×10^{-4} to 1×10^{-2} cm/sec. Over large areas where the density of the vertical joints is high, this zone has been modeled as a confined heterogeneous isotropic aquifer. However, given the relatively small size of the site, this aquifer should be considered as a confined, discretely fractured, heterogeneous, anisotropic aquifer with respect to groundwater flow.

3.6.2.2 Deep Bedrock Zone

Below the shallow zone, the vugginess and fractures decrease and a 5- to 10-foot section of fine-grained structurally competent dolomite is encountered (Appendix D). Below this competent zone, the deep bedrock zone is evident by an increase in vugginess, fractures, and core water loss during drilling. In the Lockport dolomite beneath the site, this zone begins at 25 to 30 feet below the top of the bedrock (40 to 45 feet BGS). Although literature states that each fracture can be treated as a discrete, confined, homogeneous anisotropic aquifer at this depth, some vertically oriented closed and open fractures containing mineralization were observed while coring this zone. It is probable that hydraulic communication occurs between the shallow and deep bedrock zones beneath the site. Woodward-Clyde (1988) reported hydraulic conductivities measured from discrete fractures within this zone ranging from 1×10^{-4} to 1×10^{1} cm/sec.

3.6.2.3 Groundwater Flow

Shallow Bedrock Zone. Groundwater flow in the shallow bedrock zone was evaluated from synoptic water level measurements taken in November and December, 1995. Groundwater flow in this zone closely follows the top of bedrock elevation contours toward a bedrock surface low beneath the MW-5 cluster (Figures 3-12, 3-20, and 3-21). Groundwater elevations in wells adjacent to MW-5S are between 0.5 to 1 foot higher than in MW-5S.

The groundwater elevation of MW-7S is anomalously high (on the order of five feet) compared to surrounding wells and can be explained by the locally high bedrock surface encountered beneath MW-7S. This groundwater high results in a local flow to the east and south, deviating from the expected regional flow to the west (Figures 3-20 and 3-21).

Assessing which shallow bedrock groundwater zone wells are downgradient from the site is difficult due to these local anomalies. It was expected that MW-7 and MW-8 would be considered downgradient of the site. The groundwater elevation data reveals that MW-8S may be downgradient of the site and that much of the site's shallow bedrock zone groundwater flow is toward MW-5S. Some of the flow at MW-5S may be directed vertically downward as indicated in the vertical head differences at the MW-5 cluster (Table 3-6). The horizontal component of flow from MW-5S is not obvious from the data collected during the RI. The area between and south of MW-5S, MW-6S and MW-8S needs further investigation in order to evaluate the shallow bedrock groundwater flow from the site. It is also important to characterize groundwater flow in the vicinity of MW-7S.

Deep Bedrock Zone. Groundwater flow in the deep bedrock zone was also evaluated from synoptic water level data taken in November and December, 1995. Groundwater in this zone generally flows to the west/southwest (Figures 3-22 and 3-23). Groundwater elevations at MW-2D are slightly lower than expected low and MW-3D groundwater elevations slightly higher in relation to the regional flow to the west. These anomalies may be due to slight variations in fracture permeabilities. These permeability variations may affect the reaction time to changes that affect groundwater levels, like barometric pressure, when compared to water levels in adjacent monitoring wells.

Deep bedrock zone groundwater flow follows a more expected pattern with MW-7D and MW-8D being downgradient of the site and MW-1D upgradient of the site.

Vertical Gradients. Vertical groundwater flow at each monitoring well cluster was downward as evidenced by the higher groundwater elevations of the shallow versus those of the deep wells, indicating that the site is located in a groundwater recharge area (Table 3-6).

Groundwater Fluctuation. According to Miller and Kappel (1987) groundwater, within 0.5 mile from the buried conduits, is affected by water level fluctuations in the conduits that are induced by level changes in the Forebay Canal. They also state that groundwater levels up to 3.5 miles south of the Forebay Canal are affected by water level fluctuations in the canal. The Forest Glen site is approximately 0.5 miles east of the buried conduits and 2.4 miles southeast of the Forebay Canal.

Continuous water level measurements were performed over a 7-day period in August, 1995 in MW-5S, MW-5D, MW-2S, MW-2D, MW-3S, MW-3D, and MW-3P and over a 24-hour period in December 1995 in MW-7S, MW-7D, MW-8S and MW-8D to monitor any significant water level changes in the wells.

Groundwater levels in MW-5S, MW-2S, MW-2D, MW-3S, MW-3D, and MW-3P from the August event show only slight variations, on the order of 0.1 foot. (Figure 3-24). The groundwater levels in MW-7S, MW-7D, and MW-8D from the December event show a drop of 0.3 feet in water levels during this period (Figure 3-25). These slight changes are likely due to barometric pressure fluctuations.

Groundwater levels in MW-5D exhibited daily groundwater fluctuations on the order of 1 foot and may be affected by NYPA water use for the production of hydroelectric power to the north and west (Figure 3-24).

During the August, 1995 7-day continuous water level monitoring of well clusters MW-5, MW-3, and MW-2 only MW-5D appeared to be impacted by the NYPA daily fluctuations. This may be because MW-5D is closest to the buried conduits and intersects the same fracture system that is in contact with both the conduits and the Forebay Canal.

MW-7D and MW-8D monitored in December, 1995, are closer to the buried conduits but did not experience the same daily fluctuation as MW-5D. These wells may not intersect the connecting fracture system. Additionally, these wells may have been monitored in period when water level fluctuations caused the Forebay Canal are small. The Forebay Canal water level fluctuates as much as 25 feet during the summer and fall as little as 5 feet in the spring (Miller and Kappel, 1987).

The measurements for MW-8S, taken during the December event, show an erratic pattern of sharp water level drops probably caused by data logger malfunction rather than natural or manmade impacts on the water levels (Figure 3-25).

3.7 DEMOGRAPHY AND LAND USE

The Forest Glen subdivision lies on the outskirts of the City of Niagara Falls. According to the 1990 census, 61,840 people live within the city limits. Recent demographic and socioeconomic information in the vicinity of the site is provided in Table 3-7. According to EPA's LandView II Geographical Information System (GIS), 517 people live within a one-half-mile radius of the site. Approximately eight percent of this population are less than five years old, 63 percent are between 20 and 64 years old, and 13 percent are 65 or older. Within a one-mile radius of the site, 3032 people are reported to reside. Five percent of the population are less than five years old, approximately 62 percent are between 20 and 64 years old, and approximately 14 percent are 65 or older.

The average household size within a one-half-mile radius of the site is 2.24 people. The average household size within a one-mile radius is approximately 2.71 people. The ratio of the number of renter-occupied households to the total number of households ranged from 51.9 percent (within a one-half-mile radius of the site) to 18 percent (within a one-mile radius).

Land use within the City of Niagara Falls is heavily industrial. Several chemical plants and industrial facilities are located along the banks of the Niagara River. The PASNY has two power plants in the area, the Lewiston Power Plant and the Robert Moses Niagara Power Plant. Although agricultural land use existed in the past, the closest farms now are a few miles to the east in the towns of Wheatfield and Lewiston.

Within a one-mile radius of the Forest Glen site, there is a mixture of residential and commercial developments including two trailer parks, a golf course, a sanitary landfill, a chemical management facility, and a substation for PASNY. Immediately to the west of the subdivision is the Conrail Foote Railroad yard, which serves the chemical and industrial facilities of Niagara Falls.

Groundwater flows westward from the site to the vicinity of the Power Authority aqueducts. At that point, groundwater flow is diverted north under the influence of the aqueduct drainage system. Public water services in the vicinity of the site include the City of Niagara Falls and the Town of Niagara. The water departments of these municipalities were contacted for information on the possible existence of water supply wells in the vicinity of the site and CDM Federal conducted a groundwater well search for a 3-mile radius surround the site. No public water supply wells were reported to exist within a 3-mile radius of the site.

NCDH was contacted for information regarding the possible existence of private water supply wells in the area of the site. No private water supply wells are believed to exist within a two-mile radius of the site. A few non-potable use wells may exist in the farmland to the east of the two-mile radius.

According to EPA's LandView II GIS (EPA, 1995), four National Priority List Superfund sites exist within 4 miles of the site. One site is approximately 2.5 miles northwest of Forest Glen and another is 2.5 miles south of the site. The other two Superfund sites are approximately 3.5 and 4 miles to the southeast of Forest Glen.

3.8 ECOLOGY

3.8.1 ECOLOGICAL SITE CHARACTERIZATION

The site can be partitioned into four broad habitat categories: residential, wetland, aquatic, and disturbed upland successional habitat.

These categories are described in greater detail below.

3.8.1.1 Residential Habitat

The residential zones consist of 51 mobile home lots (the subdivision, AOC 6) and two permanent residential properties (to the east of AOC 5, the Edgewood Drive wooded lots). Standing mobile home and house structures exist in the residential zones and have been boarded

up. The residential lots contain some driveways and paved walkway/patio areas, but are primarily vegetated with grass, cultivated trees, and shrubs.

3.8.1.2 Wetland Habitat

Nearly all of the non-residential areas of the site were determined by the April 1995 wetland delineation to be wetland areas. The exception is the berm, AOC 1, at the northwestern border of the site and the area of disturbed vegetation (described in Section 3.8.2). Appendix J contains the routine onsite wetland delineation data forms and the wetland delineation location map. The following wetlands were found at the site:

- Palustrine, forested, broad-leaved, deciduous wetland approximately 10 acres in size, located in essentially three contiguous areas (the wooded wetland, AOC 3; the Edgewood Drive wooded lots, AOC 5; and the forested area to the south of AOC 5).

- Palustrine scrub-shrub, broad-leaved, deciduous wetland, approximately 8 acres in size, located north of East Gill Creek. This area corresponds to the northern aspect, AOC 2.

- Emergent wetland, a total of less than one-half acre in size, several areas located within the palustrine forested wetland (AOC 5 and the forested area to the south of AOC 5) and two areas at locations along East Gill Creek (AOC 4).

Figure 3-26 depicts the extent and types of wetlands at the site.

Palustrine Forested Broad-Leaved Deciduous Wetland. This wetland is distinguished by a mid- to late-stage successional vegetative community dominated by trees. These wooded wetlands appear to be temporarily flooded (flooded for brief periods during the growing season) in some areas and seasonally flooded (flooded for extended periods during the growing season) in other areas. Standing water in shallow depressions, water-stained leaf litter, watermarks on tree trunks, and trees (particularly red maples) with exposed roots and multiple trunks were observed as evidence of periodic flooding.

There are two categories of wooded wetlands at the site, distinguished by differences in vegetative composition. The two wooded wetland categories are: (1) ash and (2) maple/beech/oak. Figure 3-26 illustrates the locations of these wetlands.

The ash wooded wetland (AOC 3), approximately 1.5 acres in size, is located in the southeastern corner of the northern aspect, just above East Gill Creek. Black ash (*Fraxinus nigra*) is dominant at this location. Table 3-8 lists additional vegetation observed in this wooded wetland. This area displays a vegetative structure consisting of a closed canopy, a sparse subcanopy, a sparse shrub layer, and a sparse to moderate herb layer. Leaf litter is present.

The maple/beech wooded wetland occurs to the south of East Gill Creek and along the eastern half of the site (Figure 3-26). This area includes the Edgewood Drive wooded lots (AOC 5) and

the area to the south of AOC 5. This wetland is dominated by red maple (*Acer rubrum*) and American beech *(Fagus grandifolia),* in association with several other subdominant tree species, including green ash (*Fraxinus pennsylvanica),* black ash *(Fraxinus nigra*), white oak (*Quercus alba*), hop hornbeam (*Ostrya virginiana*), chestnut oak (*Quercus prinus*), and big shellbark hickory (*Carya laciniosa*). Table 3-8 lists additional plant species observed within the maple/beech wooded wetland. The vegetative structure of this wetland consists of a closed canopy, a sparse to moderate subcanopy, a moderate shrub layer, and a sparse herb layer. Leaf litter is present.

Palustrine, Scrub-Shrub Broad-Leaved Deciduous Wetland. This wetland is distinguished by an early successional vegetation community dominated by forbs. The canopy, subcanopy, and shrub layers of this wetlands vegetative structure are essentially absent, giving the area the look of a wet meadow. The herb layer covers or nearly covers the ground surface. Little to no leaf litter is present. Overall, because saplings and shrubs in this area were less than 3.2 feet in height, they were classified as herbs in accordance with the wetland delineation manual (Environmental Laboratory, 1987). Woody species comprise approximately 15 percent of this wetland plant community, consisting primarily of gray dogwood (*Cornus racemosa*). Forb species most frequently observed in this area include yellow avens (*Geum aleppicum*), Knappweed (*Centaurea* sp.), Goldenrod (*Solidago* sp), blue vervain (*Verbena hastata*), and wild strawberry (*Fragaria canadensis*). Table 3-9 is a more complete listing of species of this wetland area.

The berm, AOC 1, adjacent to this wetland, along the northwest side of the northern aspect, is moderately to densely vegetated by forbs and shrubs. Common to this area are gray dogwood, sumac (*Rhus* sp.), and common reed-grass (*Phragmites communis*). The berm appears to have disturbed soils due to its construction and is not considered part of the onsite wetlands. This area is categorized as a scrub-shrub nonwetland (Figure 3-26).

Emergent Wetland. This wetland is minor at the site, occupying less than one-half acre in several locations within the maple/beech/oak forested wetland and along the East Gill Creek (see Figure 3-26). The emergent wetland areas within the forested wetland contain narrow-leaved cattail (*Typha angustifolia*) and an unidentified grass species (Gramineae) as the dominant vegetation. The emergent wetland area at East Gill Creek's entrance to the site is dominated by purple loosestrife (*Lythrum salicaria*). The emergent wetland area at East Gill Creek along with western portion of the site is dominated by common reed-grass.

3.8.2 AQUATIC HABITAT

The aquatic habitat of East Gill Creek (AOC 4) at the site consists of relatively small, shallow areas with minimal water flow. A more complete description of East Gill Creek is provided in Section 3.3 (Surface Water Hydrology). East Gill Creek is shaded by trees along the eastern third of its length and by common reed-grass where it makes a turn to the south. Along the northern portion of the subdivision; the creek is essentially not shaded and its water is somewhat turbid. The sediment is clayey-silt in texture and contains decaying organic matter and often has a

decaying odor to it. The section of East Gill Creek adjacent to the subdivision contains considerable amounts of filamentous algae.

3.8.3 DISTURBED UPLAND SUCCESSIONAL HABITAT

An area of what may be termed "disturbed" or "stressed" vegetation was noted during the November 1994 and April 1995 field activities. This area extends from the corner of T Mark and Edgewood Drives southward approximately 200 feet and eastward approximately 150 feet (Figure 3-26). This area is located in the wooded lot south Edgewood Drive (AOC 5). At this location, there is a one-half- to 2-foot rise in soil elevation and an exposed edge, approximately 200 feet long, of dark gray rubber-like granular debris (apparently mixed with soil, concrete, and plastic debris). There is approximately six to seven feet of black-stained fill in this area. The vegetative community at this location is forested, but its composition is different than any of the wooded areas at the site. Common cottonwoods (*Populus deltoides*) dominate the canopy and subcanopy with wild red raspberry (*Rubus idaeus*) and staghorn sumac (*Rhus typhina*) comprising the shrub layer. Grape (*Vitis* sp.) vines and fleabane (*Erigeron* sp.) are also present. No where else on the site is this assemblage of vegetation present. Because of the cottonwood-dominated plant community and its early stage of secondary succession (neither of which was observed elsewhere), it was determined that a condition of disturbed or stressed vegetation may exist at this location. The cause of the apparent stress in vegetative condition is not known. It is conceivable that this condition is caused by a recent physical disturbance (such as the dumping of the debris/fill) thereby giving rise to this stage of succession, or by the physical presence of the solid debris, which prevents or retards the normal root growth of some plant species.

3.8.4 THREATENED, ENDANGERED SPECIES/SENSITIVE ENVIRONMENTS

The U.S. Fish and Wildlife Service (USFWS) was contacted for information regarding the presence of Federally-listed or proposed endangered or threatened species in the vicinity of the site. The USFWS reported that none of the Federally-listed or proposed endangered or threatened species under the USFWS jurisdiction are known to exist on or in the vicinity of the site (USFWS, 1996). The USFWS also reported that no habitat within the State of New York is currently designated as "critical habitat" in accordance with provisions of the Endangered Species Act.

Files of the New York Heritage Program were reviewed by NYSDEC's Wildlife Resources Center for information on threatened and endangered species as well as ecologically sensitive environments that may exist on and in the vicinity of the site (NHP, 1996). NYSDEC reported several State-listed threatened endangered and rare plant and animal species have been cited in the vicinity of the site (i.e., City of Niagara Falls, Grand Island, Tonawanda, Lewiston). The State-listed threatened plant species include white camas (*Zigadenus elegans* subspecies *glaucus*) and smooth cliff brake (*Pellaea glabella*). The State-listed endangered plant species is the lesser fringed gentian (*Gentianopsis procera*). The State-listed rare plant species include elk sedge (*Carex garberi*) and ninebark (*Physocarpus opulifolius* var. *intermedius*). The State-listed threatened animal species include: common tern (*Sterna hirundo*) and lake sturgeon (*Acipenser*

fulvenscens). None of these species were observed to occur on site during the November 1994 and April 1995 field activities. Habitats suitable for these State-listed threatened or endangered species are not found at the site, with the following exceptions. White camas may be found in wet calcareous soils and the lesser fringed gentian may be found in moist soils, in habitats possibly found at the site. Habitat conditions suitable for the elk sedge has not been identified thus the presence of elk sedge habitat at the site cannot be ruled.

Several ecologically sensitive communities and wildlife concentration areas were reported by NYSDEC to occur in the vicinity of the site. These include a calcarious cliff community, a calcarious talus slope woodland, a gull nesting colony, a waterfowl concentration area, and a warm water fish concentration area. These communities and wildlife concentration areas were not observed to be present at the site during the November 1994 and April 1995 field activities. Appropriate habitat to support these communities and wildlife concentration areas was not found at the site.

3.8.5 WILDLIFE OBSERVATIONS

Wildlife usage of the site was evidenced by diurnal observations made during field activities, particularly those observations made during the November 1994 and April 1995 site visits. Numerous onsite wildlife observations have been made. These include direct observations of birds, mammals, fish, amphibians, reptiles, insects, and arachnids, as well as evidence of wildlife usage such as tracks, nests, scat, runways, and browsed vegetation. Table 3-9 lists the wildlife species observed on-site. Table 3-10 lists additional onsite wildlife usage evidence.

A variety of passerines (perching birds and songbirds) have been observed on the site, including black-capped chickadees, red-winged blackbirds, and American robins. It is expected that these birds will migrate through and/or feed within the site. Because of the varied habitats, it is also expected that some bird species will also breed onsite.

At least one raptor (bird of prey) species has been observed onsite. An active red-tailed hawk nest complete with young was located in the forested area to the south of AOC 5. Raptors are expected to utilize the abundant onsite food source (such as small mammals, passerines) and to breed on the site.

Deer tracks have been observed onsite, particularly in the northern aspect. Deer typically inhabit forests, swamps, and open brushy areas. These animals adapt to a variety of conditions and are very tolerant of people. White-tailed deer (*Odocoileus virginianus*) are herbivores, browsing and grazing on tender shoots as well as consuming a wide assortment of grasses and herbaceous material, fungi, acorns, and nuts (Burt and Grossenheider, 1980). Gray dogwoods in the northern aspect were observed to have been browsed, presumably by white-tailed deer.

A cottontail rabbit (*Sylvilagus floridanus*) was observed in the wooded wetlands and rabbit pellets were observed in the northern aspect. The cottontail rabbit can inhabit numerous and diverse locations, often in transitional habitats and is active from early evening until late morning. This

species consumes a variety of plant species including such onsite vegetation as red maple, wild carrot, and red raspberry (Chapman and Feldhamer, 1982).

Raccoon (*Procyon lotor*) tracks have been observed near East Gill Creek in the northern aspect. Raccoons are found within their range nearly everywhere that water is available and are primarily nocturnal. Raccoons are omnivorous and opportunistic when feeding and vegetation is generally consumed more than animals during the winter months (Chapman and Feldhamer, 1982; Martin et al., 1951). Onsite vegetation that raccoons will consume include nuts (such as acorns, beech nuts, and hickory nuts) and berries (such as grape, raspberry, and strawberry).

An eastern gray squirrel (*Sciurus carolinensis*) and numerous squirrel nests have been observed in the forested locations of the site. The gray squirrel inhabits varied habitats, but prefers mature hardwood forests (which the forested areas of the site appear to be becoming (Chapman and Feldhamer, 1982). Squirrel forage such as acorns, hickory nuts, beech nuts, maple buds and bark, and insects are all present at the site.

Scat, believed to be left by red fox (*Vulpes vulpes*), was discovered in the southern portion of the northern aspect near East Gill Creek. Red fox prefer habitats with a diversity of fields and woods; however, they may also inhabit suburban locations such as cemeteries, golf courses, and parks. Red fox are often active during the day, but are primarily active at night. Diets of the red fox vary seasonally, depending on the availability of food sources (Chapman and Feldhamer, 1982). Besides the small mammals and birds that utilize the site, red foxes are also expected to consume grasses, nuts, fruits, and berries at the site.

Numerous small mammal runways were observed in the northern aspect of the site. These runways indicate the presence of a voles, mice, and/or shrews. Voles (*Microtus species*) inhabit areas such as grasslands and highway right-of-ways. Voles are active day or night. Voles forage on grains, grasses, tree bark, roots, and other food sources (all available in abundance at the site). The white-footed mouse (*Peromyscus leucopus*) prefers wooded or brushy areas, although open areas are sometimes inhabited. White-footed mice feed on seeds, fruits, nuts, roots, and insects (all occurring at the site). They are nocturnal. Shrews (shorttail shrew - *Blarina brevicauda*, masked shrew - *Sorex cinereus*, and pygmy shrew - *Microsorex hoyi*) inhabit grasslands, brushy areas, and forests, often where moist. Shrews are active day or night. Shrews feed on insects, worms, other invertebrates, and possibly small mammals (all available at the site).

The observation of fresh cattail root pieces in the water of East Gill Creek indicates possible muskrat (*Ondatra zibethica*) activity. Muskrats prefer to inhabit areas with slow-moving water such as the habitat of East Gill Creek. Muskrats are largely herbivores, consuming various parts of aquatic plants such as roots, shoots, tubers, stems, and leaves. Cattails are likely to be the primary muskrat forage at the site, but other onsite vegetation may be eaten (such as common reed-grass, maples, aquatic and upland grasses, and various forbs).

An eastern garter snake (*Thamnophis sirtalis sirtalis*) was observed in the northern aspect of the site. The eastern garter snake occupies a wide range of habitats, many of which are found at the

site (meadows, woodlands, hillsides, sides of streams, drainage ditches, and dumping areas). These snakes have a varied diet including earthworms, insects, birds' eggs, fish, and small mammals that can be found at the site.

Wood frogs (*Rana sylvatica*) have been heard on the vernal pool in the wooded wetland at the eastern border of the site. Wood frogs are known to inhabit moist wooded areas such as those found on the site. In general, the diet of frogs consists mainly of algae and decaying plant material when they are in the tadpole stage, and of insects, worms, and snails when they mature.

An unidentified fish species has been observed onsite in East Gill Creek. Because of the shallow, slow-flowing nature of East Gill Creek and the abundance of filamentous algae there, the creek is likely to be a habitat for minnows and shiners. These small fish feed primarily on algae.

Other than the wildlife species described above, additional species are expected to utilize the site. Although no direct evidence of their presence has been observed skunks, opossums, woodchucks, bats, jumping mice, and rats are expected to frequent and/or reside on the site because of their forage and habitat preferences. The following natural history information is provided for these species (Chapman and Feldhamer, 1982; Burt and Grossenheider, 1980; Martin et al., 1951):

Skunk. The striped skunk (*Mephitis mephitis*) inhabits a wide variety of habitats including mixed woods, brushland, semi-open country, and drainage ditches where water is available. The striped skunk is chiefly nocturnal. The striped skunk is omnivorous, consuming such foods as frogs, spiders, insects, earthworms, eggs, berries, rats, rabbits, snakes, and carrion. Onsite vegetation preferred by the striped skunk includes raspberries, grasses, and nuts.

Opossum. The Virginia opossum (*Diedelphis virginiana*) prefers to inhabit deciduous woodlands in association with streams. Opossums are omnivorous. Their diet includes numerous foods that can be found at the site such as grasses, earthworms, fruits, grains, insects, invertebrates, and flesh (such as birds and rabbits).

Woodchuck. The woodchuck (*Marmota monax*) is primarily diurnal and prefers to inhabit dry soils in open woodlands, thickets, and fields. As such, they may be expected to inhabit the berm at the site. The woodchuck's diet consists entirely of vegetation, primarily herbaceous materials.

Bat. The bat (including *Myotis*, *Lasiurus*, and *Eptesicus* species) is nocturnal and may be found inhabiting wooded areas. They consume insects.

Jumping Mouse. The meadow jumping mouse (*Zapus hudsonius*) prefers to feed in low meadows, but will inhabit various habitats. Jumping mice hibernate during the winter. The woodland jumping mouse (*Napaeozapus insignis*) prefers to inhabit stream borders and wooded or brushy areas near water. Jumping mice feed on seeds, insects, and fruits, all of which can be found at the site.

Rat. The Norway rat (*Rattus norvegicus*) inhabits a wide variety of habitats and has adapted extremely well to human activities. The rat is an omnivorous feeder, consuming grains, fruits, and meat (all expected to be available on the site).

3.8.6 REFERENCE CONDITIONS

Two offsite reference conditions were selected to be representative of the onsite forested wetlands in terms of vegetative composition, soil condition, topography, hydrology, and wildlife usage (both observed and potential usage). The two reference conditions were labeled Reference A and Reference B, with Reference A soils being slightly wetter.

Offsite reference conditions for the onsite scrub-shrub wetland and upland areas were not selected because of limited access; however, it is believed that reference condition for these areas are likely to exist in the west of the adjacent rail yard.

An offsite reference condition for the onsite aquatic habitat was not selected because of limited access; however, it is believed that a reference condition for this habitat exists just upstream of the site within East Gill Creek (to the east of I-190).

TABLE 3-1
CLIMATIC DATA FOR THE VICINITY OF THE SITE
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

	Mean Temperature[1] (°F)	Mean Wind Speed (Kts) and Mean Wind Direction[2]	Mean Precipitation[2] (Inches)	Mean Snowfall[2] (Inches)
January	23.5	11 W	2.5	18
February	24.9	10 WSW	2.3	14
March	34.1	10 SW	2.8	9
April	45.7	9 SW	2.9	3
May	57.0	8 SW	2.9	<0.05
June	65.9	8 SW	2.8	0
July	70.9	8 SW	2.6	0
August	68.9	7 SW	3.6	0
September	61.8	8 SW	3.1	<0.05
October	51.2	8 W	2.8	<0.05
November	40.4	10 W	3.2	6
December	29.0	10 W	3.2	17
Annual Mean	47.8	9 SW	-	-
Annual Total	-	-	34.7	67

1 Values from the Lockport 2NE Station (4311N latitude, 07839W longitude). Source of data: National Oceanic and Atmospheric Administration (NOAA). 1992. Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1961-90, New York. NOAA, National Climatic Data Center, Asheville, NC. January 1992.

2 Values from the Niagara Falls International Airport Station (4306N latitude, 07857W longitude). Source of data: Air Weather Service. 1987. Climatic Brief for the Niagara Falls, New York International Airport Station.

TABLE 3-2
THICKNESS OF CLAY, FILL, AND OVERBURDEN
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE LOCATION	GROUND SURFACE ELEVATION (ft.)	FILL THICKNESS (ft.)	CLAY THICKNESS (ft.)	OVERBURDEN THICKNESS (ft.)
BERM1	608.1	12.0	NA	NA
BERM2	608.4	14.5	NA	NA
BERM3	608.0	14.5	NA	NA
BERM4	607.1	12.5	NA	NA
BERM5	599.9	0.0	NA	NA
DP1	591.3	0.0	9.3	15.8
DP2	592.8	0.0	9.1	14.3
DP3	593.2	0.0	9.0	NA
DP4	593.6	0.0	11.9	16.4
DP5	590.4	0.0	10.2	13.0
DP6	592.4	0.0	13.0	14.3
DP7	591.6	0.0	9.6	NA
DP8	591.2	0.0	9.1	15.3
DP9	592.0	0.0	9.7	NA
DP10	593.2	0.0	11.9	NA
DP11	592.1	0.0	11.5	NA
DP12	592.0	0.5	5.6	NA
DP13	594.1	9.3	NA	NA
DP14	592.3	8.3	3.3	NA
DP15	592.3	0.0	10.7	NA
DP16	590.9	2.0	5.5	NA
DP17	594.3	6.9	NA	NA
DP18	594.4	4.6	NA	NA
DP19	590.8	6.0	3.4	NA
DP20	591.5	4.0	5.8	NA
DP21	594.3	0.0	11.5	NA
DP22	595.1	0.0	7.6	NA
DP23	594.5	0.0	10.0	NA
DP24	597.7	0.0	7.1	NA
DP25	595.7	0.0	6.0	NA
DP26	595.5	0.0	11.0	NA
DP27	597.7	0.0	7.7	NA
DP28	596.7	0.0	6.7	NA
DP29	595.8	0.0	7.6	NA
DP30	595.6	0.0	8.0	NA
DP31	597.4	0.0	10.0	NA
DP32	596.7	0.0	9.7	NA
DP33	593.2	3.0	8.1	NA
DP34	593.0	5.0	4.3	NA
SBCENTER	594.2	5.7	NA	NA
SBEXP	591.2	0.0	NA	NA
SBEXP1	592.2	1.7	NA	NA
SB1	594.4	0.0	NA	NA

TABLE 3-2
THICKNESS OF CLAY, FILL, AND OVERBURDEN
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE LOCATION	GROUND SURFACE ELEVATION (ft.)	FILL THICKNESS (ft.)	CLAY THICKNESS (ft.)	OVERBURDEN THICKNESS (ft.)
SB2	598.5	9.5	NA	NA
SB3	598.6	11.5	NA	NA
SB4	592.5	4.0	NA	NA
SB5	590.9	0.0	NA	NA
SB6	591.6	0.0	NA	NA
SB7	592.2	4.0	NA	NA
SB8	591.9	0.0	NA	NA
SB9	592.6	0.0	NA	NA
SB10	593.0	6.0	NA	NA
SB11	591.3	0.0	NA	NA
SB12	589.6	0.0	NA	NA
SB13	594.0	6.0	NA	NA
SB14	594.4	7.5	NA	NA
SB15	590.9	0.0	NA	NA
SB16	592.2	0.0	NA	NA
SB17	592.7	0.0	NA	NA
SB18	599.2	0.0	NA	NA
TPEXP	596.3	0.5	NA	NA
TPEXP2	596.3	1.0	NA	NA
TP1	598.7	5.0	NA	NA
TP10	593.6	0.0	NA	NA
TP2	597.9	0.0	NA	NA
TP3	598.0	6.5	NA	NA
TP4	597.1	0.0	NA	NA
TP5	596.6	0.0	NA	NA
TP6	597.1	0.0	NA	NA
TP7	597.0	0.0	NA	NA
TP8	597.8	4.0	NA	NA
TP9	593.7	0.0	NA	NA
MW-1	594.9	NA	NA	14.2
MW-2	594.0	NA	NA	15.7
MW-3	594.1	NA	NA	16.0
MW-4	592.4	NA	NA	12.5
MW-5	591.4	NA	NA	15.3
MW-6	593.8	NA	NA	17.2
MW-7	593.2	NA	NA	12.5
MW-8	593.8	NA	NA	16.2
MW-9	592.5	NA	NA	12.5

* NA - Not available due to environmental constraints

TABLE 3-3
GRAIN SIZE ANALYSES OF FILL SAMPLES
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE NO.	DEPTHS (ft bgs)	GRAVEL[1] % WEIGHT	SAND (A) COARSE[2] % WEIGHT	SAND (B) MEDIUM[2] % WEIGHT	SAND (C) FINE[2] % WEIGHT	SAND (D) FINE[2] % WEIGHT	SILT (A)[3] % WEIGHT	SILT (B)[3] % WEIGHT	CLAY* % WEIGHT	COLLOIDS* % WEIGHT	AOC LOCATION
Berm -2A	4.0 - 6.0	6.40	8.30	3.60	9.30	2.50	12.70	12.40	3.10	41.80	1
Berm -2	8.0 - 10.0	14.00	10.10	5.00	11.80	3.00	19.10	14.80	11.00	11.10	1
Berm- 3A	10.0 - 12.0	12.60	22.20	11.60	13.80	1.10	0.00	5.90	8.10	24.70	1
SB-10SS	0.0 - 2.0	16.20	7.60	10.40	32.40	5.70	18.30	9.50	0.00	0.00	5
SB-13SS	0.0 - 2.0	37.40	7.50	10.80	28.00	6.20	0.30	9.80	0.00	0.00	5
SB-14SS	0.0 - 2.0	10.80	4.80	8.30	19.70	4.10	3.70	18.40	11.50	18.80	5
SB-CENTER SS	0.0 - 2.0	12.30	6.10	8.10	22.30	4.50	0.00	17.10	9.00	22.00	5
SB-CENTER	4.0 - 6.0	4.80	3.10	5.60	15.10	2.40	2.40	13.90	15.50	37.20	5
DP-013B	2.0 - 4.0	17.60	11.60	12.00	18.00	3.60	18.20	14.40	2.00	0.70	2
DP-017B	2.0 - 4.0	12.20	15.90	6.00	21.00	4.60	25.50	13.50	0.00	1.20	2
DP-018B	2.0 - 4.0	9.50	11.80	4.50	12.10	2.50	18.90	12.60	9.40	15.30	2
DP-033SS	0.0 - 2.0	3.10	3.60	2.00	5.40	2.10	23.20	14.70	17.40	27.60	2
DP-034SS	0.0 - 2.0	11.40	6.30	2.40	6.50	2.00	19.30	8.70	13.30	28.40	2
AVERAGE		12.95	9.15	6.95	16.57	3.41	12.43	12.75	7.72	17.60	

(1) Gravel, (Passing 3 in. & retained on No. 4 sieve)

(2) Sand
- (a) Coarse Sand (Passing No. 4 sieve & retained on No. 20 sieve)
- (a) Medium Sand (Passing No. 20 sieve & retained on No. 40 sieve)
- (b) Fine Sand (Passing No. 40 sieve & retained on No. 140 sieve)
- (c) Fine Sand (Passing No. 140 sieve & retained on No. 200 sieve)

(3) Silt Size (,0.075 to-0.005 mm)
- (a) Silt (0.075 to 0.033 mm)
- (b) Silt (0.033 to 0.007 mm)

* Clay Size (0.007 to 0.001 mm)

Colloids (smaller than 0.001 mm)

NA Not available

TABLE 3-4
GRAIN SIZE ANALYSES OF CLAY SAMPLES
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE NO.	DEPTHS (ft.bgs)	GRAVEL[1] % WEIGHT	SAND (A) COARSE[2] % WEIGHT	SAND (B) MEDIUM[2] % WEIGHT	SAND (C) FINE[2] % WEIGHT	SAND (D) FINE[2] % WEIGHT	SILT (A)[3] % WEIGHT	SILT (B)[3] % WEIGHT	CLAY[4] % WEIGHT	COLLOIDS[4] % WEIGHT	AOC LOCATION
Berm -1	14.0 - 16.0	0	0.3	0.4	1.40	0.60	20.60	12.8	20.8	43.2	1
Berm-5	6.0 - 8.0	0	1.4	0.8	2.9	1.1	19.6	22	21.4	30.8	1
SB-01SS	0 - 2.0	0	2.3	0.6	2.8	0.8	19.8	19.9	14.4	39.4	2
SB-02SS	0 - 2.0	0.7	2.2	1.1	3.7	1.5	22.6	17.5	20.9	29.8	2
SB-04SS	0 - 2.0	1.9	2.3	1.6	4.8	1.4	16.9	17.4	22.2	31.7	5
SB-05SS	0 - 2.0	0	0.1	0.4	0.9	0.4	0	8.29	22	75.4	5
SB-06SS	0 - 2.0	0	0.3	1.1	3.3	1	18.4	16.4	22.7	36.9	5
SB-08SS	0 - 2.0	0	1	2.2	4	0.8	18.3	23.2	27.4	23.1	5
SB-09SS	0 - 2.0	1	0.2	0.6	2.4	0.8	12	18.9	21.6	42.5	5
SB-10	6.0 - 8.0	0.4	0.4	0.8	4	1	0	8.5	24.3	67.2	5
SB-11SS	0 - 2.0	1.1	0.4	0.9	3.2	1	0	1.4	26.2	65.8	5
SB-12SS	0 - 2.0	0	1.7	1.9	9	2.5	22.5	14.8	16.2	31.4	5
SB-13	NA	0.2	0.5	1.9	7.2	1.8	21	14.5	18.1	34.9	5
SB-15SS	0 - 2.0	0	0.3	0.8	4.7	1.5	6.1	22.4	21.2	43	5
SB-16SS	0.0 - 2.0	0	0.8	1.3	3.9	1.1	19.9	19.6	20	33.5	5
SB-17SS	0.0 - 12.0	0	0.1	0.1	0.9	0.3	0	15.4	25.2	59.4	5
DP-004	10 - 12.0	0	0.9	0.5	2.6	1.6	10.1	23.5	25.8	34.8	6
DP-013	11 - 13.0	0.2	0.4	0.2	0.5	0.4	6.9	19.4	30.6	40.4	6
DP-017	9 - 11.0	0	0.1	0.1	0.7	0	5.2	12.5	28.7	52.4	6
DP-018	10.0 - 12.0	0.9	0.9	0.5	2.1	1	9.4	18.7	27.6	37.8	6
DP-021SS	0 - 2.0	0	0.2	0.2	0.8	0.2	21	13.5	22	42.1	2
DP-022SS	0 - 2.0	0.7	0.6	0.5	2.5	0.6	28.3	18.4	17.5	30.9	2
DP-023SS	0 - 2.0	0	0.1	0.1	0.8	0.5	6	15.2	25.5	51.8	2
DP-025SS	0 - 2.0	0	0.6	0.7	2.5	1.1	30.1	15.1	16.4	32.4	2
DP-026SS	0 - 2.0	0	0.3	0.5	1.1	0.4	2.9	13.1	27.9	53.8	2
DP-027SS	0 - 2.0	0	0.1	0.2	0.9	0.3	24	13.7	21.3	39.4	2
DP-028SS	0 - 2.0	0	0.9	0.9	2.9	1.5	5.7	20.1	19.2	47.9	2
DP-030SS	0 - 2.0	0	0.5	0.3	2.5	1	10.9	20	20.3	43.9	2
DP-031SS	0 - 2.0	0	0.3	0.6	1.7	0.7	7.7	17.8	26.8	44.4	2
DP-032SS	0 - 2.0	0.5	0.5	0.3	2	0.9	12.1	18.2	22.8	42.7	2
Average		0.25	0.69	0.74	2.71	0.91	12.58	16.41	22.57	42.76	

(1) Gravel, (Passing 3 in. & retained on No. 4 sieve)

(2) Sand
- (a) Coarse Sand (Passing No. 4 sieve & retained on No. 20 sieve)
- (a) Medium Sand (Passing No. 20 sieve & retained on No. 40 sieve)
- (b) Fine Sand (Passing No. 40 sieve & retained on No. 140 sieve)
- (c) Fine Sand (Passing No. 140 sieve & retained on No. 200 sieve)

(3) Silt Size (,0.075 to-0.005 mm)
- (a) Silt (0.075 to 0.033 mm)
- (b) Silt (0.033 to 0.007 mm)

* Clay Size (0.007 to 0.001 mm)

Colloids (smaller than 0.001 mm)

NA Not available

TABLE 3-5
GRAIN SIZE ANALYSES OF CLAY TILL SAMPLES
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE NO.	DEPTHS (ft. bgs)	GRAVEL[1] % WEIGHT	SAND (A) COARSE[2] % WEIGHT	SAND (B) MEDIUM[2] % WEIGHT	SAND (C) FINE[2] % WEIGHT	SAND (D) FINE[2] % WEIGHT	SILT (A)[3] % WEIGHT	SILT (B)[3] % WEIGHT	CLAY* % WEIGHT	COLLOIDS* % WEIGHT	AOC LOCATION
SB-01	8.0 - 10.0	13.10	10.00	3.20	9.80	4.80	34.60	21.40	3.10	0.00	2
SB-06	8.0 - 10.0	9.50	9.50	3.50	10.70	4.60	20.40	17.10	8.60	16.20	5
SB-09	8.0 - 10.0	20.70	4.50	4.20	12.10	4.70	29.70	13.60	7.20	3.30	5
SB-12	6.0 - 7.0	9.90	1.40	1.40	4.70	2.70	25.80	19.50	17.20	17.50	5
SB-16	8.0 - 10.0	6.40	2.60	3.00	9.60	3.20	26.40	21.20	16.80	10.70	5
SB-18	12.0 - 14.0	10.00	12.70	4.30	14.40	5.40	28.20	18.70	6.20	0.00	2
DP-019	10.0 - 12.0	12.90	9.60	3.70	10.10	5.40	37.50	15.00	2.40	0.00	6
DP-022	8.0 - 10.0	12.70	9.40	3.30	11.60	2.10	35.10	15.60	3.90	4.50	2
DP-023	10.0 - 12.0	7.50	2.70	1.30	4.10	1.60	17.10	11.90	17.40	36.10	2
DP-025	6.0 - 8.0	9.60	11.20	4.00	14.20	6.40	29.00	14.50	5.20	4.40	2
DP-031	10.0 - 12.0	4.90	8.10	3.30	10.60	5.50	25.80	18.80	8.80	12.60	2
Average		10.65	7.43	3.20	10.17	4.22	28.15	17.03	8.80	9.57	

(1) Gravel, (Passing 3 in. & retained on No. 4 sieve)

(2) Sand
- (a) Coarse Sand (Passing No. 4 sieve & retained on No. 20 sieve)
- (a) Medium Sand (Passing No. 20 sieve & retained on No. 40 sieve)
- (b) Fine Sand (Passing No. 40 sieve & retained on No. 140 sieve)
- (c) Fine Sand (Passing No. 140 sieve & retained on No. 200 sieve)

(3) Silt Size (,0.075 to-0.005 mm)
- (a) Silt (0.075 to 0.033 mm)
- (b) Silt (0.033 to 0.007 mm)

* Clay Size (0.007 to 0.001 mm)

Colloids (smaller than 0.001 mm)

NA Not available

TABLE 3-6
VERTICAL HEAD
DIFFERENCES BETWEEN SHALLOW AND
DEEP MONITORING WELL GROUNDWATER ELEVATIONS
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

WELL CLUSTER	VERTICAL HEAD DIFFERENCE (ft.)* 11/16 AM	VERTICAL HEAD IFFERENCE (ft.) 12/28 AM
MW-1	0.00	0.17
MW-2	0.27	0.72
MW-3	0.21	0.22
MW-4	0.70	1.15
MW-5	0.41	0.21
MW-6	1.28	1.25
MW-7	6.00	6.48
MW-8	1.51	2.79
MW-9	0.31	0.56

*Positve value denotes a vertical head difference downward

TABLE 3-7

DEMOGRAPHIC AND SOCIOECONOMIC DATA
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

	Distance from Forest Glen Site	
	0.5 mile radius	1.0 mile radius
Total Population	517	3,032
Age Groupings:		
0-4 years	41	153
5-9 years	26	196
10-19 years	54	408
20-49 years	242	1,294
50-64 years	85	571
65 years & up	69	410
Number of Households	231	1,119
House Units:		
Owner-Occupied	48.1	82.0
Renter-Occupied	51.9	18.0

TABLE 3 - 8
VEGETATION COMMUNITY TYPES OF THE FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

COMMUNITY TYPE/DOMINANT SPECIES	ASSOCIATED VEGETATION	
Palustrine Forested Wetland/Black ash (*Fraxinus nigra*)	Trees:	American beech (*Fagus grandifolia*)
	Shrubs:	Buckthorn (*Rhamnus* sp.) Leatherwood (*Dirca palustris*)
	Herbs:	Fleabane (*Erigeron* sp.) Large-leaved avens (*Geum macrophyllum*) Moneywort (*Lysimachia nummularia*) Rush-garlic (*Allium sibiricum*) Wild red raspberry (*Rubus idaeus*)
Palustrine Forested Wetland/Red Maple (*Acer rubrum*) and American beech (*Fagus grandifolia*)	Trees:	Basswood (*Tilia americana*) Big shellbark hickory (*Carya laciniosa*) Black ash (*Fraxinus nigra*) Black oak (*Quercus velutina*) Chestnut oak (*Quercus prinus*) Cottonwood (*Populus deltoides*) Green ash (*Fraxinus pennsylvanica*) Hop hornbeam (*Ostrya virginiana*) Ironwood (*Carpinus caroliniana*) Sugar maple (*Acer saccharum*) White oak (*Quercus alba*)

TABLE 3-8
VEGETATION COMMUNITY TYPES OF THE FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

COMMUNITY TYPE/DOMINANT SPECIES	ASSOCIATED VEGETATION	
Palustrine Forested Wetland/Red Maple (*Acer rubrum*) and American beech (*Fagus grandifolia*) (Continued)	Shrubs:	Gray dogwood (*Cornus racemosa*) Leatherwood (*Dirca palustris*) Purple-fruited chokeberry (*Aronia atropurpurea*) Pussy willow (*Salix discolor*) Red-osier dogwood (*Cornus stolonifera*) Staghorn sumac (*Rhus typhina*)
	Herbs:	Common reed-grass (*Phragmites communis*) Fleabane (*Erigeron* sp.) Grasses (several unidentified species, one semi-aquatic) Meadow buttercup (*Ranunculus acris* Moneywort (*Lysimachia nummularia*) Narrow-leaved cattail (*Typha angustifolia*) Purple loosestrife (*Lythrum salicaria*) Running strawberry bush (*Euonymus obovatus*) Sensitive fern (*Onoclea sensibilis*) Trout lily (*Erythronium* sp.) Wild red raspberry (*Rubus idaeus*) Wild strawberry (*Fragaria canadensis*) Yellow avens (*Geum aleppicum*)
	Vines:	Grape (*Vitis* sp.)

TABLE 3 - 8
VEGETATION COMMUNITY TYPES OF THE FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

COMMUNITY TYPE/DOMINANT SPECIES	ASSOCIATED VEGETATION	
Palustrine Scrub-schrub Wetland/no dominant species	Trees:	None present
	Shrubs*:	Gray dogwood (*Cornus racemosa*) Hawthorn (*Crataegus* sp.) Red-osier dogwood (*Cornus stolonifera*)
	Herbs:	Bird's-foot trefoil (*Lotus corniculatus*) Bladder campion (*Silene cucubalus*) Blue vervain (*Verbena hastata*) Bristly dewberry (*Rubus hispidus*) Canadian St. Johnswort (*Hypericum canadense*) Dame's rocket (*Hesperis matronalis*) Fleabane (*Erigeron* sp.) Goldenrod (*Solidago gigantea, S. canadensis*, and others) Hawkweed (*Picris hieracioides*) Knapweed (*Centaurea nigra* or *jacea*) Moneywort (*Lysimachia nummularia*) Moss (several unidentified species) Oxeye daisy (*Chrysanthemum leucanthemum*) Queen Anne's lace (*Daucus carota*) Wild strawberry (*Fragaria canadensis*) Yellow avens (*Geum aleppicum*)

TABLE 3 - 8
VEGETATION COMMUNITY TYPES OF THE FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

COMMUNITY TYPE/DOMINANT SPECIES	ASSOCIATED VEGETATION	
Emergent Wetland/Dominant vegetation variable	Trees:	Intrusions from adjacent communities
	Shrubs:	Intrusions from adjacent communities
	Herbs:	Common reed-grass (*Phragmites communis*) Grasses (unidentified semi-aquatic species) Narrow-leaved cattail (*Typha angustifolia*) Purple loosestrife (*Lythrum salicaria*) Skunk cabbage (*Symplocarpus foetidus*)

* Woody species. Less than 3.2 foot high, thus classified as herbs for wetland delineation.

TABLE 3 - 9
WILDLIFE SPECIES OBSERVED ONSITE
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

CATEGORY COMMON NAME	SCIENTIFIC NAME	SIGHTING LOCATION	COMMENTS
AVIAN			
American robin	*Turdus migratorius*	Wooded wetland and at Edgewood Drive	Multiple sightings.
Black-capped chickadee	*Parus atricapillus*	Wooded wetland areas	Multiple sightings.
Blue jay	*Cyanocitta cristata*	Southeastern wooded wetland	
Eastern meadowlark	*Sturnella magna*	Northern aspect near berm	
European starling	*Sturnus vulgaris*	Wooded wetland	
Gray catbird	*Dumetella carolinensis*	Southeastern wooded wetland	Multiple sightings.
Hairy woodpecker	*Picoides villosus*	Southeastern wooded wetland	Sighting of a pair.
Herring gull	*Larus argentatus*	Northern aspect	
Killdeer	*Charadrius vociferus*	Northern aspect near berm	
Northern cardinal	*Cardinalis cardinalis*	Edgewood Drive	
Red-tailed hawk	*Buteo jamaicensis*	Northern aspect and southeastern wooded wetland	Multiple sightings. Active nest with young in southeastern wooded wetland.
Red-winged blackbird	*Agelaius phoeniceus*	Southeastern wooded wetland	Multiple sightings.
Tufted titmouse	*Parus bicolor*	Wooded wetland	

TABLE 3 - 9
WILDLIFE SPECIES OBSERVED ONSITE
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
(Continued)

CATEGORY COMMON NAME	SCIENTIFIC NAME	SIGHTING LOCATION	COMMENTS
MAMMALIAN			
Eastern cottontail rabbit	*Sylvilagus floridanus*	Wooded wetland	
Eastern gray squirrel	*Sciurus carolinensis*	Southeastern wooded wetland	
PISCES			
Unidentified fish species	class Osteichthyes	East Gill Creek	Likely to be a minnow (*Pimephales* sp.) or a shiner (*Notropis* sp.).
AMPHIBIAN			
Wood frog	*Rana sylvatica*	Vernal pool in southeastern wooded wetland	Identified by call.
REPTILE			
Garter snake	*Thamnophis sirtalis*	Northern aspect	
ARACHNID			
Ground spider	order Araneae	Northern aspect	
INSECT			
Ant	family Formicidae	Southeastern wooded wetland	Nest with larvae and adults
Centipede	class Chilopoda	Southeastern wooded wetland	
Pill bug	*Oniscus asellus*	Southeastern wooded wetland	
Swallowtail butterfly	family Papilionidae	Northern aspect	

TABLE 3 - 10
EVIDENCE OF ONSITE WILDLIFE USAGE
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

OBSERVATION	LOCATION AND DATE	COMMENTS
Browsed dogwoods	Northern Aspect, 4/95	White-tailed deer (*Odocoileus virginianus*) browsed this vegetation.
Fresh root pieces of cattail (*Typha*)	Floating in East Gill Creek as it enters the site, 11/95	Suspected muskrat (*Ondata zibethica*) activity.
Nests for eastern gray squirrel (*Sciurus carolinensis*)	Forested wetland areas, 11/94	
Nest for wren (family Troglodytidae)	Northern aspect (near berm), 4/95	
Scat of eastern cottontail rabbit (*Sylvilagus floridanis*)	Northern aspect, 11/94	
Scat with small mammal fur and teeth	Southern portion of the northern aspect near East Gill Creek, 4/95	Suspected red fox (*Vulpes fulva*) scat.
Runways of small mammals	Northern aspect, 4/95	Runways are likely produced by voles (*Microtus* spp) and/or shrews (*Sorex/Cryptotis* spp).
Tracks of raccoon (*Procyon lotor*)	Southern portion of the northern aspect, near East Gill Creek, 4/95	
Tracks of White-tailed deer	Northern aspect, 4/95	

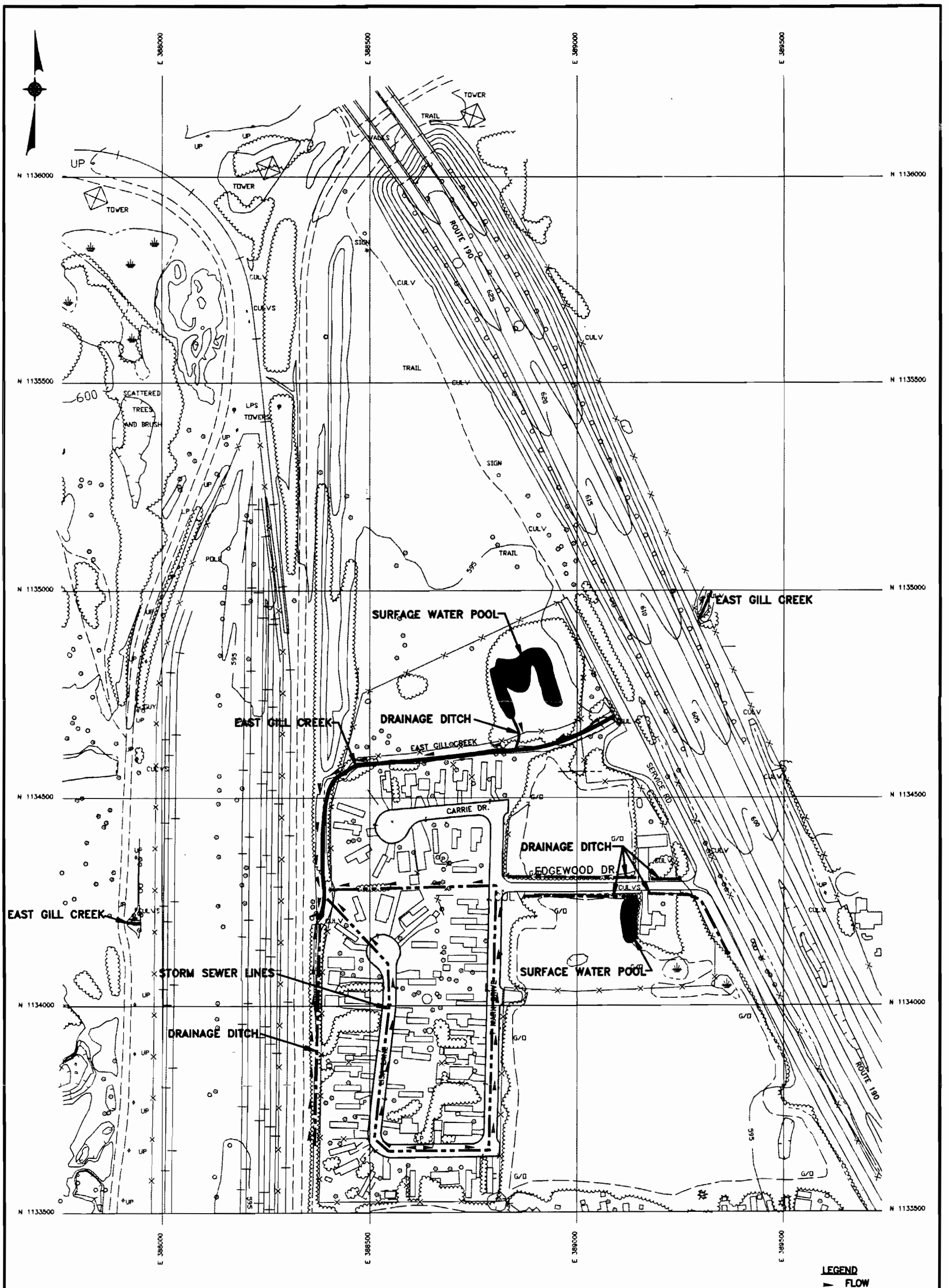

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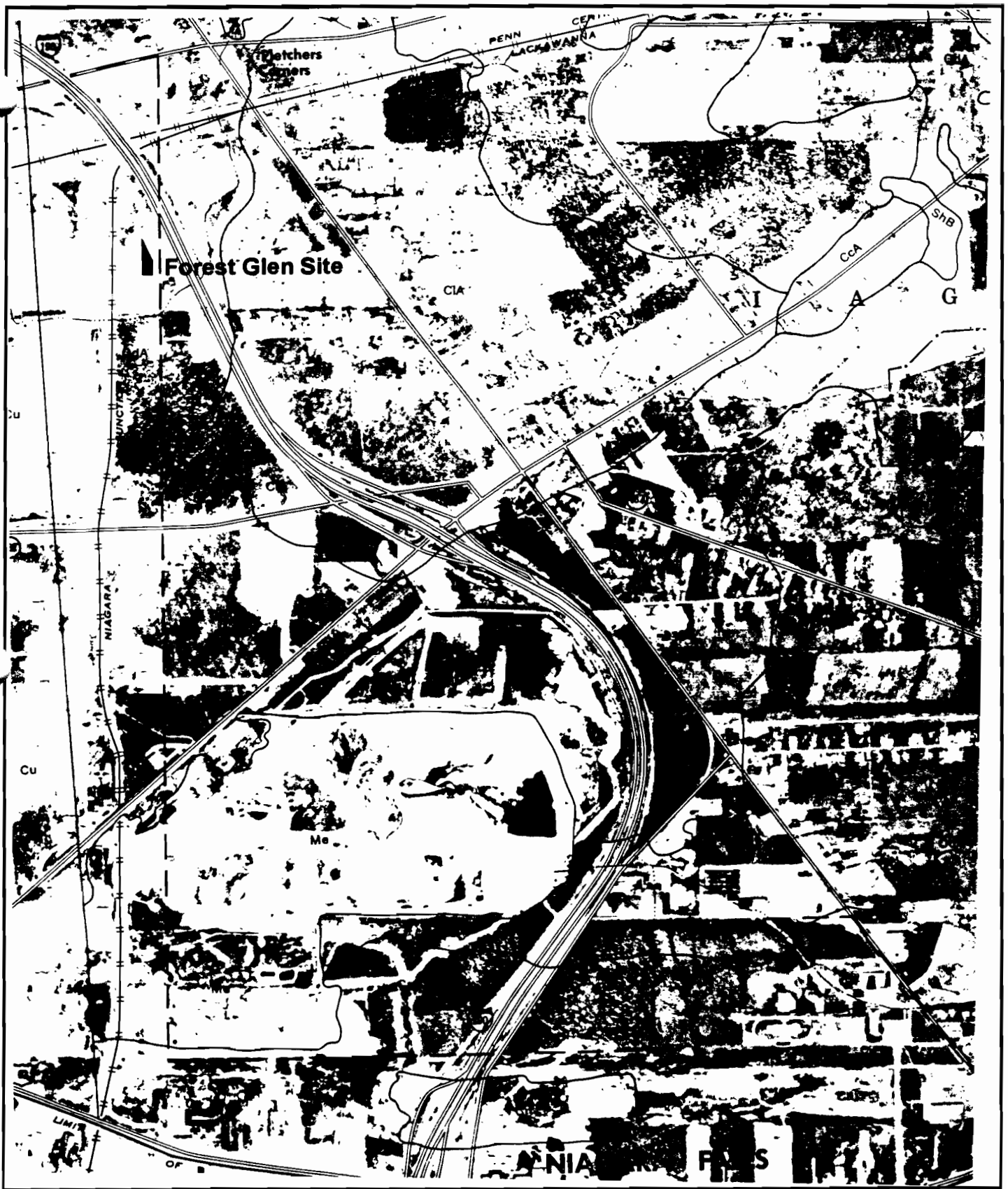
FIGURE 3-1
SURFACE WATER DRAINAGE AND WATER BODIES
Forest Glen Site, Niagara Falls, New York
WORK ASSIGNMENT 053-2L3U



FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

Source: USDA, 1972

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FIGURE 3-2
SOIL MAP OF THE FOREST GLEN SITE VICINITY

DIR 7720 053 FILE FGFIG1-5 D N 4/1/96

System and series		Group	Formation	Thickness (feet)	Description
Silurian	Middle	Lockport	Lockport Dolomite	158	Dark-gray to brown, massive to thin-bedded dolomite locally containing algal reefs and small, irregularly shaped masses of gypsum. Near the base are light-gray coarse-grained limestone (Gasport Limestone Member, dark-gray shaley dolomite)
		Clinton	Rochester Shale	60	Dark-gray calcareous shale weathering light-gray to olive.
			Irondequoit Limestone	12	Light-gray to pinkish-white coarse-grained limestone.
			Reynales Limestone	10	White to yellowish-gray shaly limestone and dolomite.
			Neahga Shale	5	Greenish-gray soft fissile shale.
	Lower	Medina	Thorold Sandstone	8	Greenish-gray shaly sandstone.
			Grimsby Sandstone	45	Reddish-brown to greenish-gray cross-bedded sandstone interbedded with red to greenish-gray shale.
			Power Glen Shale	40	Gray to greenish-gray shale interbedded with light-gray sandstone.
			Whirlpool Sandstone	20	White, quartzitic sandstone
Ordovician	Upper	Richmond	Queenston Shale	1,200	Brick-red sandy to argillaceous shale.

FIGURE 3-3
STRATIGRAPHY OF THE NIAGARA FALLS AREA

FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

Source: Miller and Kappel, 1987

[redacted]
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Figure 1-1
SITE LOCATION MAP

FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

Source: USGS Topographic Maps

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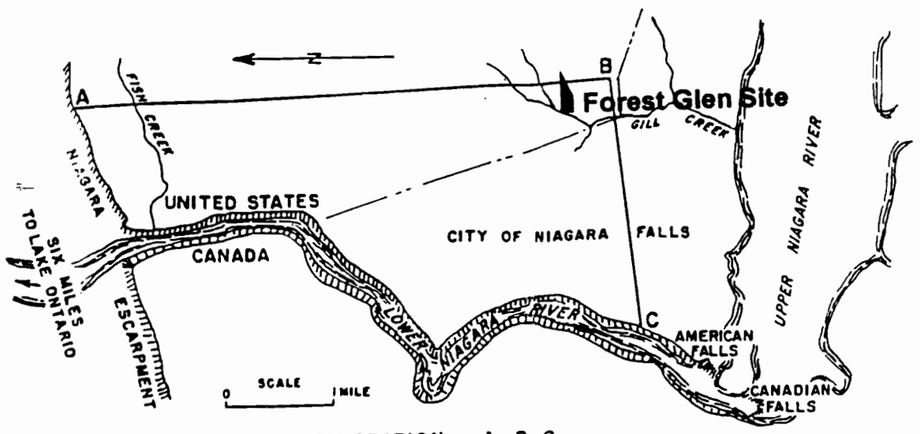


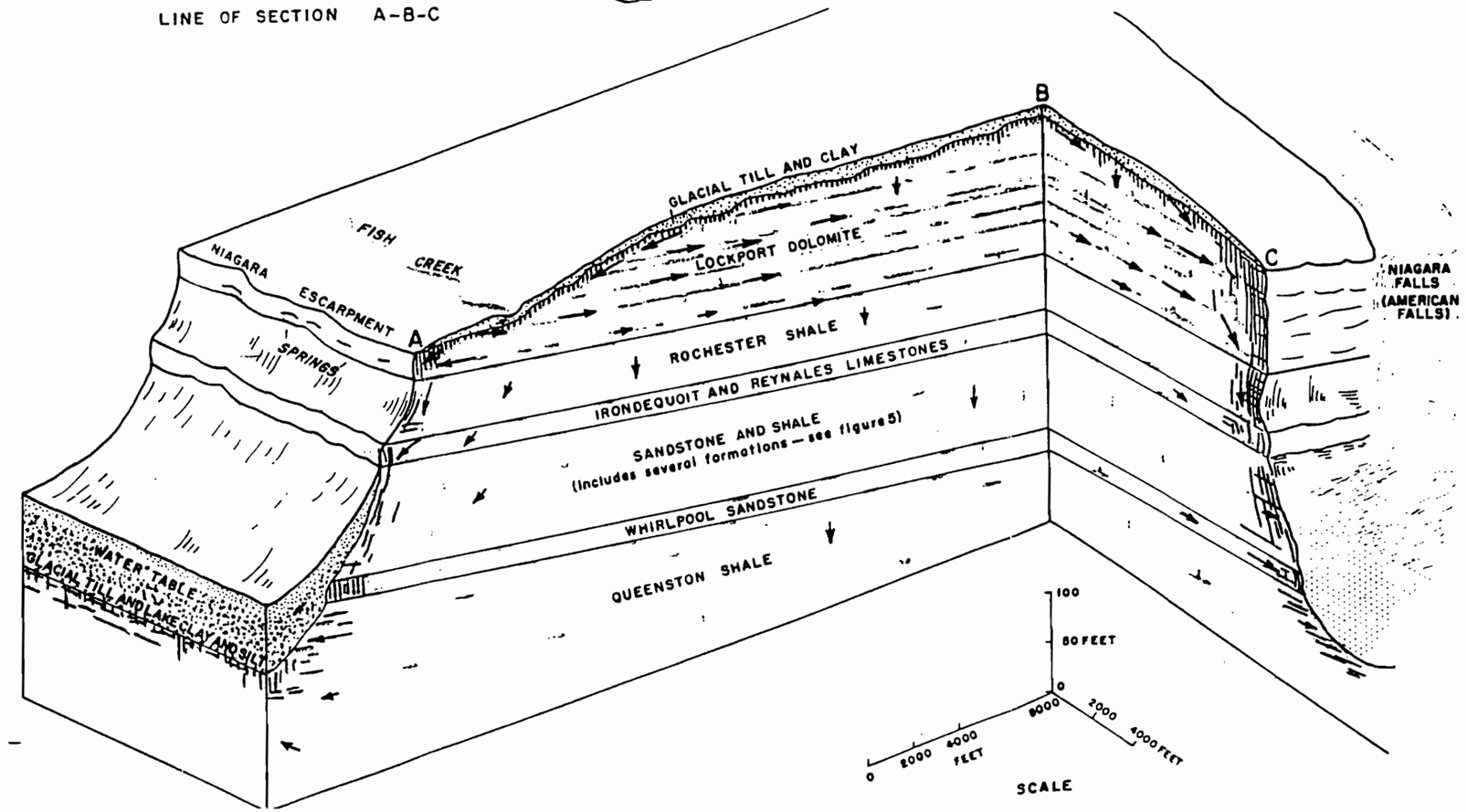
LINE OF SECTION A-B-C

EXPLANATION

WATER-BEARING ZONES AND OPENINGS IN BEDROCK

ZONE OF SATURATION IN THE UNCONSOLIDATED DEPOSITS

DIRECTION OF GROUND-WATER MOVEMENT IN PLANE OF SECTION



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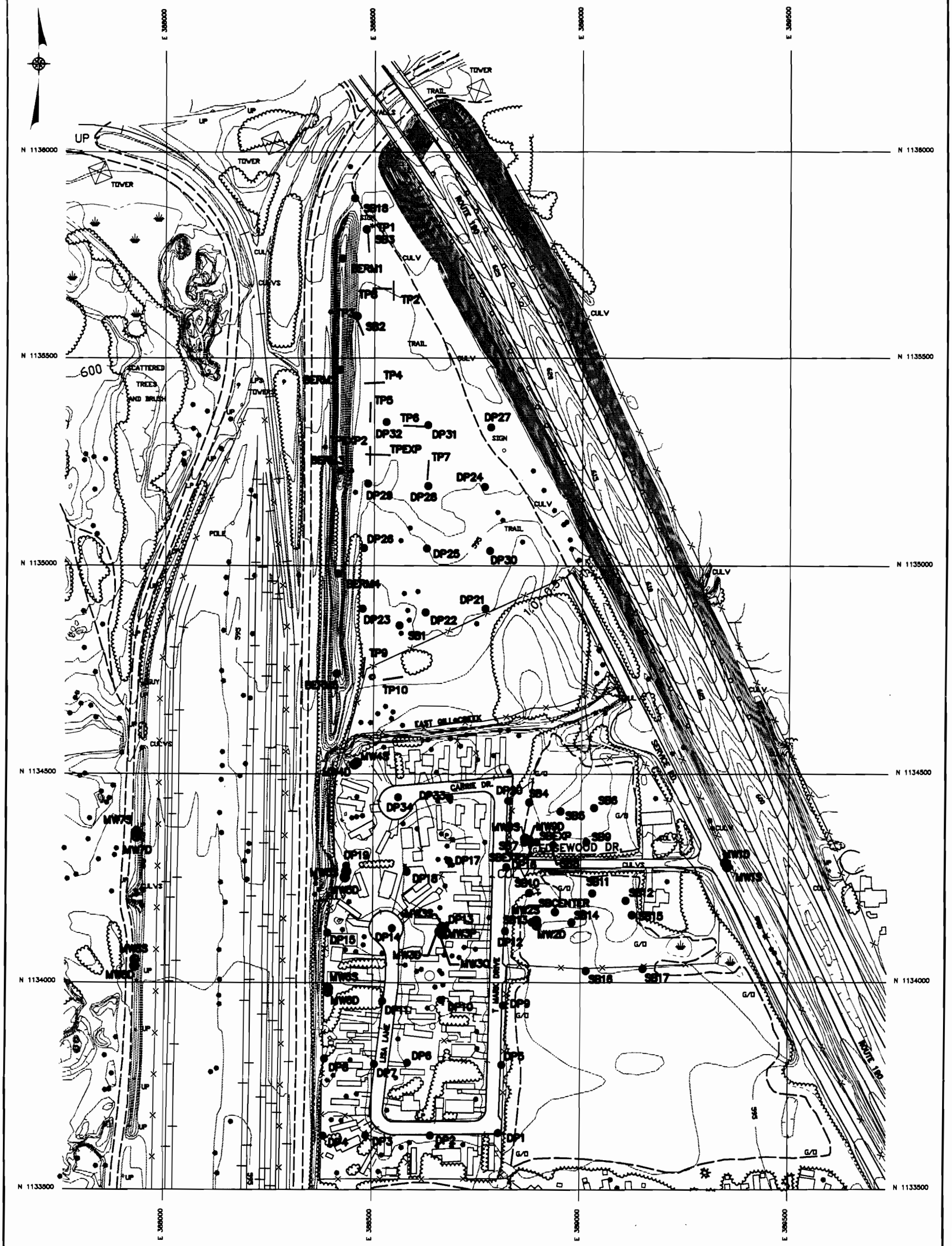
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

Source: Johnston, 1964

FIGURE 3-4
GEOLOGIC CROSS SECTION OF THE
NIAGARA FALLS AREA



CH2M FEDERAL PROGRAMS CORPORATION
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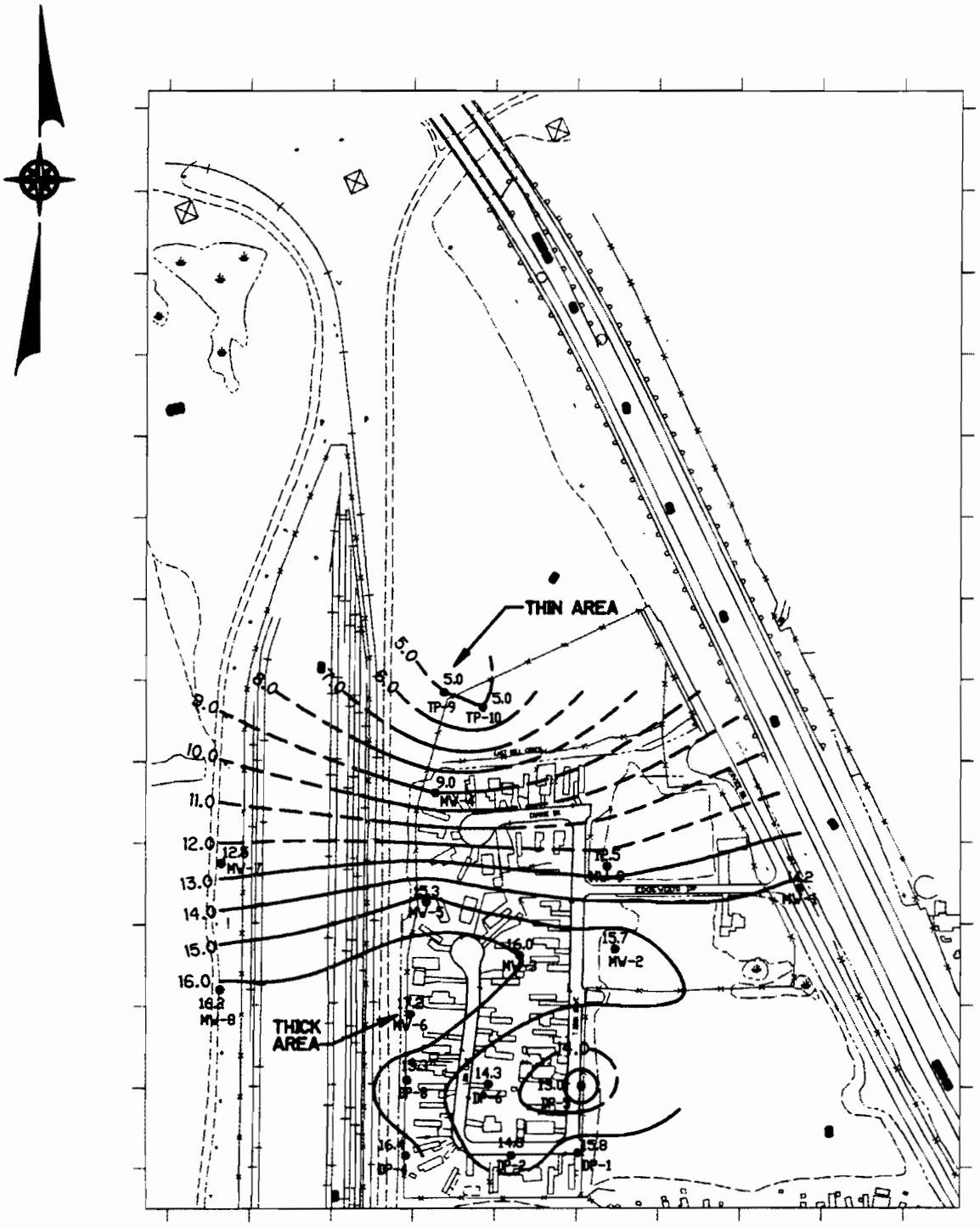
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

FIGURE 3-5

SOIL BORING, TEST PIT, AND MONITORING WELL LOCATIONS



LEGEND

1.0	ISOPACH CONTOUR (ft)
— —	ESTIMATED ISOPACH CONTOUR
6.4	OVERBURDEN THICKNESS (ft)
DP-4	SOIL BORING/MONITORING WELL LOCATION

1" = 400'

200 0 400

NOTE: CONTOUR INTERVAL = 1 FOOT

FIGURE 3-6

ISOPACH MAP OF OVERBURDEN THICKNESS

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
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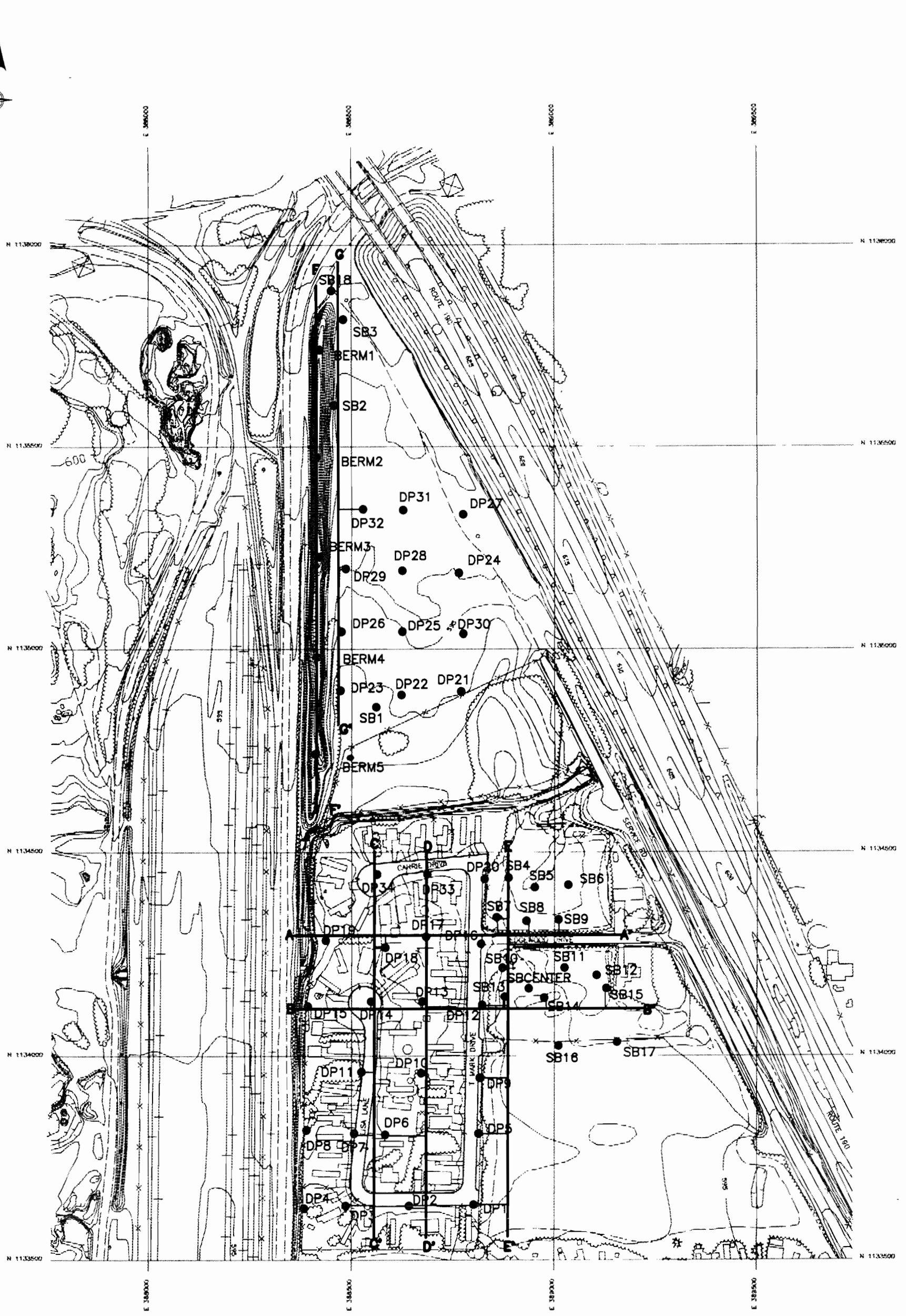
FILE: C:\FOREST_G\SW3.DWG R.A. 1/18/96



LEGEND

- TRAIL
- TREELINE
- FENCE
- RAILROAD
- BUILDING (RESIDENTIAL)
- SUBSURFACE SAMPLE LOCATION

125' 0 250'

SCALE:

FIGURE 3-7

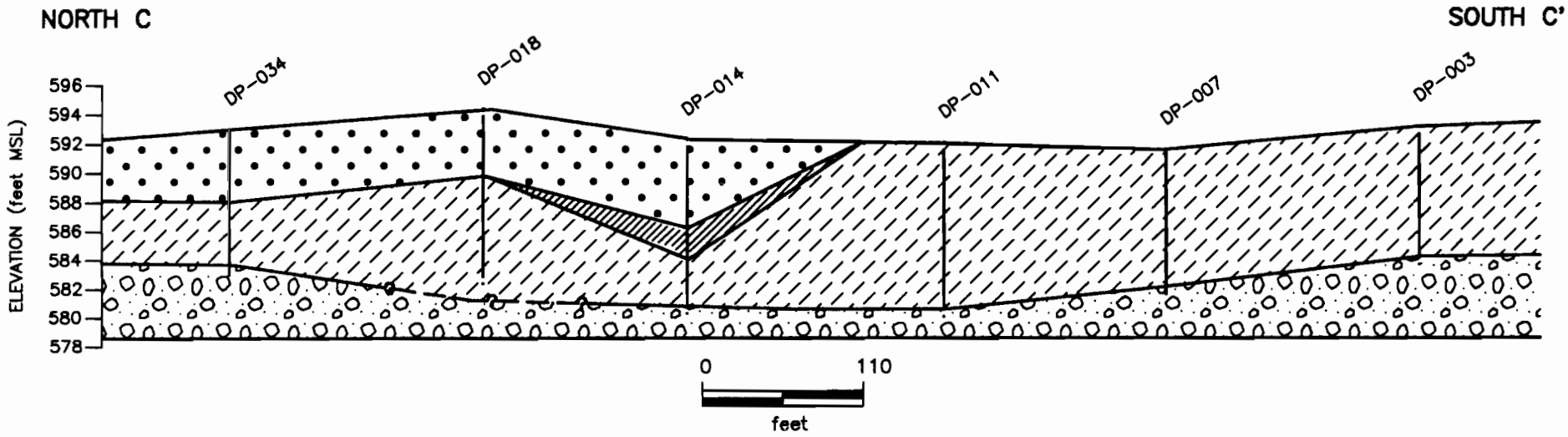
LOCATION OF OVERBURDEN CROSS SECTIONS

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

NORTH C

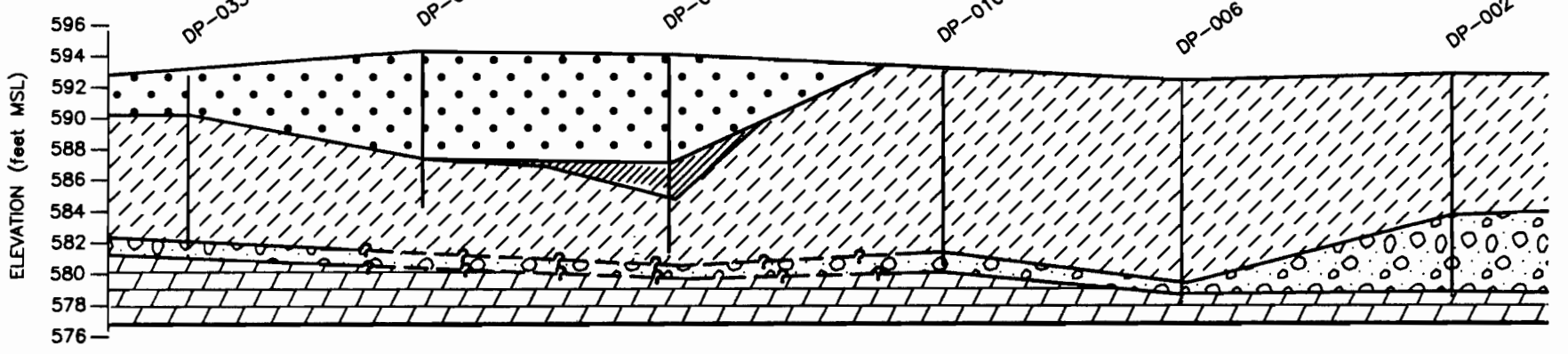
SOUTH C'



Vertical Exaggeration = 10.00

NORTH D

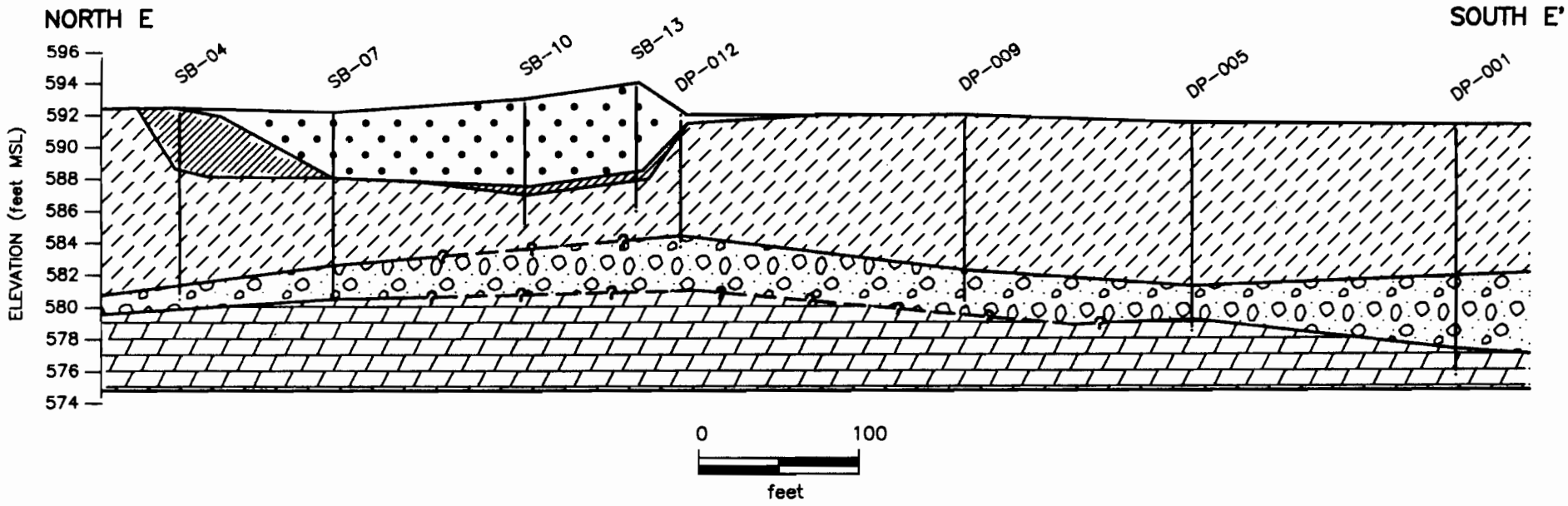
SOUTH D'



Vertical Exaggeration = 10.00

NORTH E

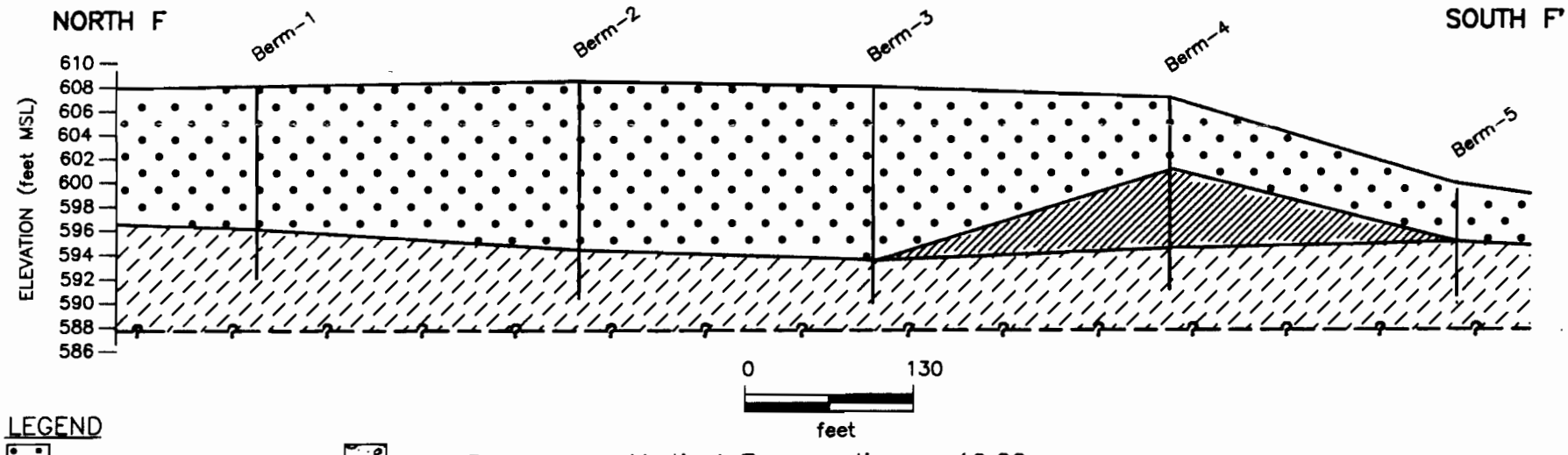
SOUTH E'



Vertical Exaggeration = 10.00

NORTH F

SOUTH F'



Vertical Exaggeration = 10.00

LEGEND

- FILL
- BLACK STAINED CLAY
- CLAY/SILTY CLAY
- CLAY TILL
- LOCKPORT DOLOMITE
- ESTIMATED CONTACT

FIGURE 3-8

NORTH-SOUTH CROSS SECTIONS OF OVERBURDEN WITHIN THE FOREST GLEN SUBDIVISION VICINITY

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
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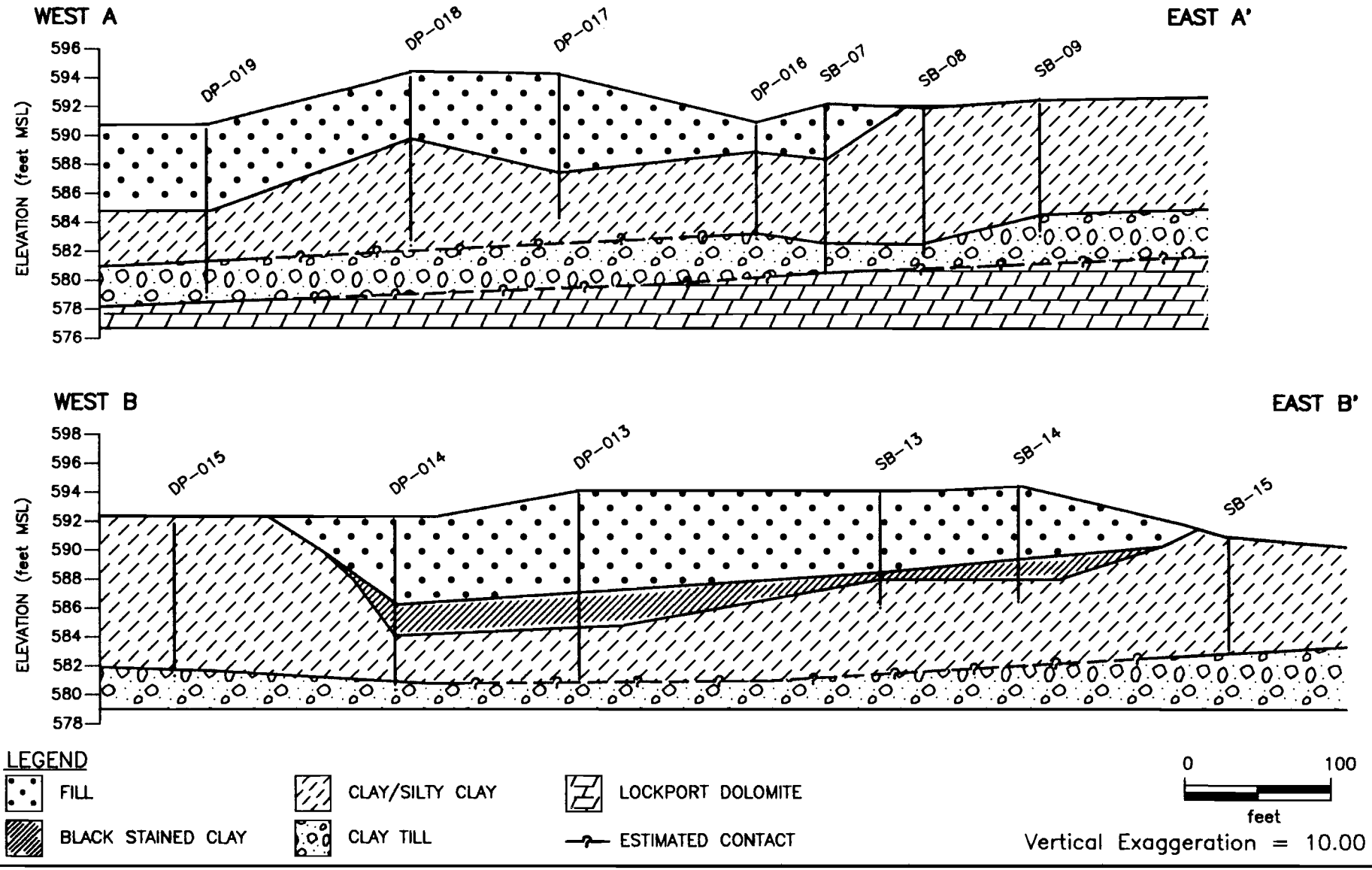

FIGURE 3-9

EAST-WEST CROSS SECTIONS OF OVERBURDEN WITHIN THE FOREST GLEN SUBDIVISION VICINITY

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
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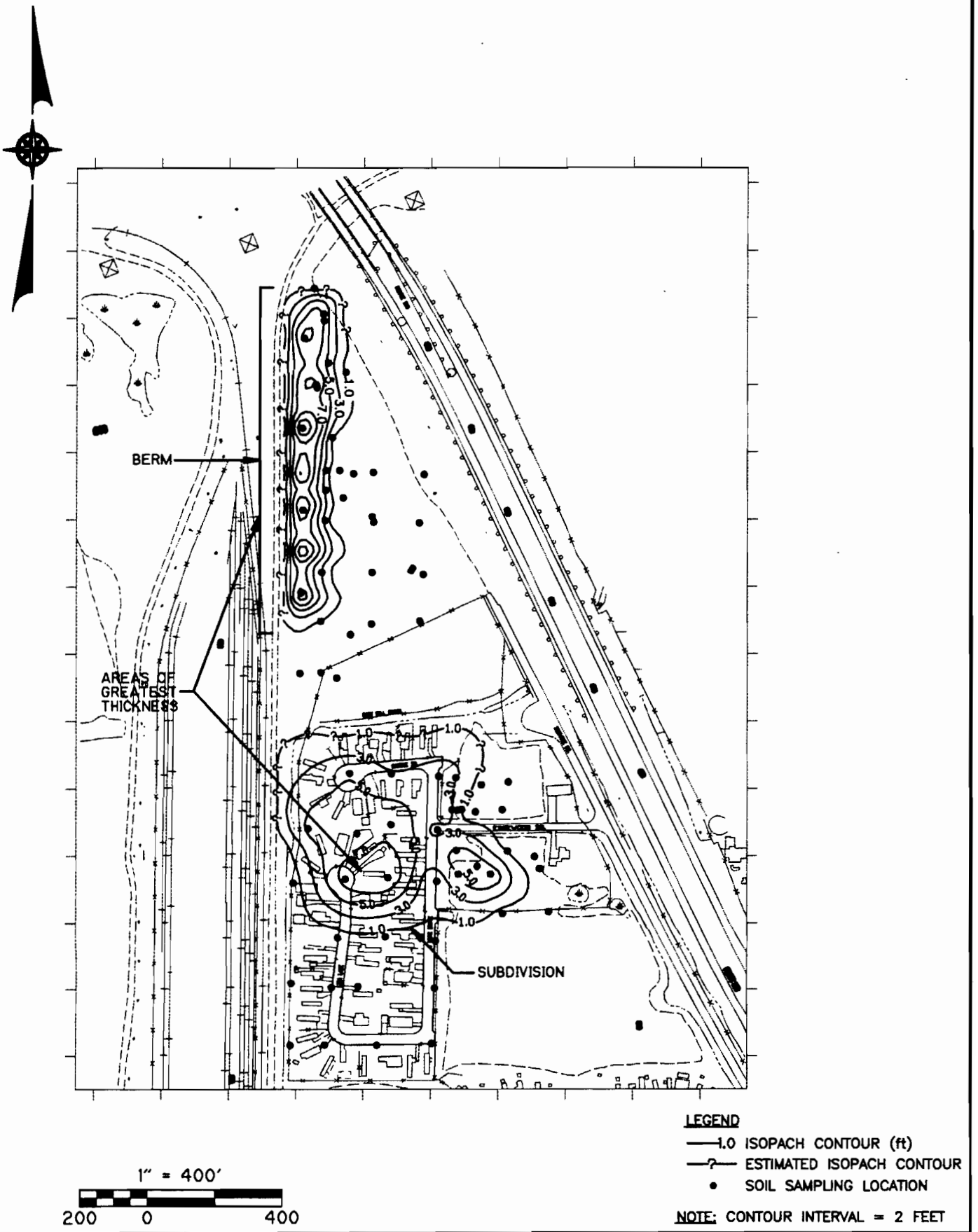

FIGURE 3-10

LOCATION OF FILL AREAS EXCEEDING 1FT. IN THICKNESS

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
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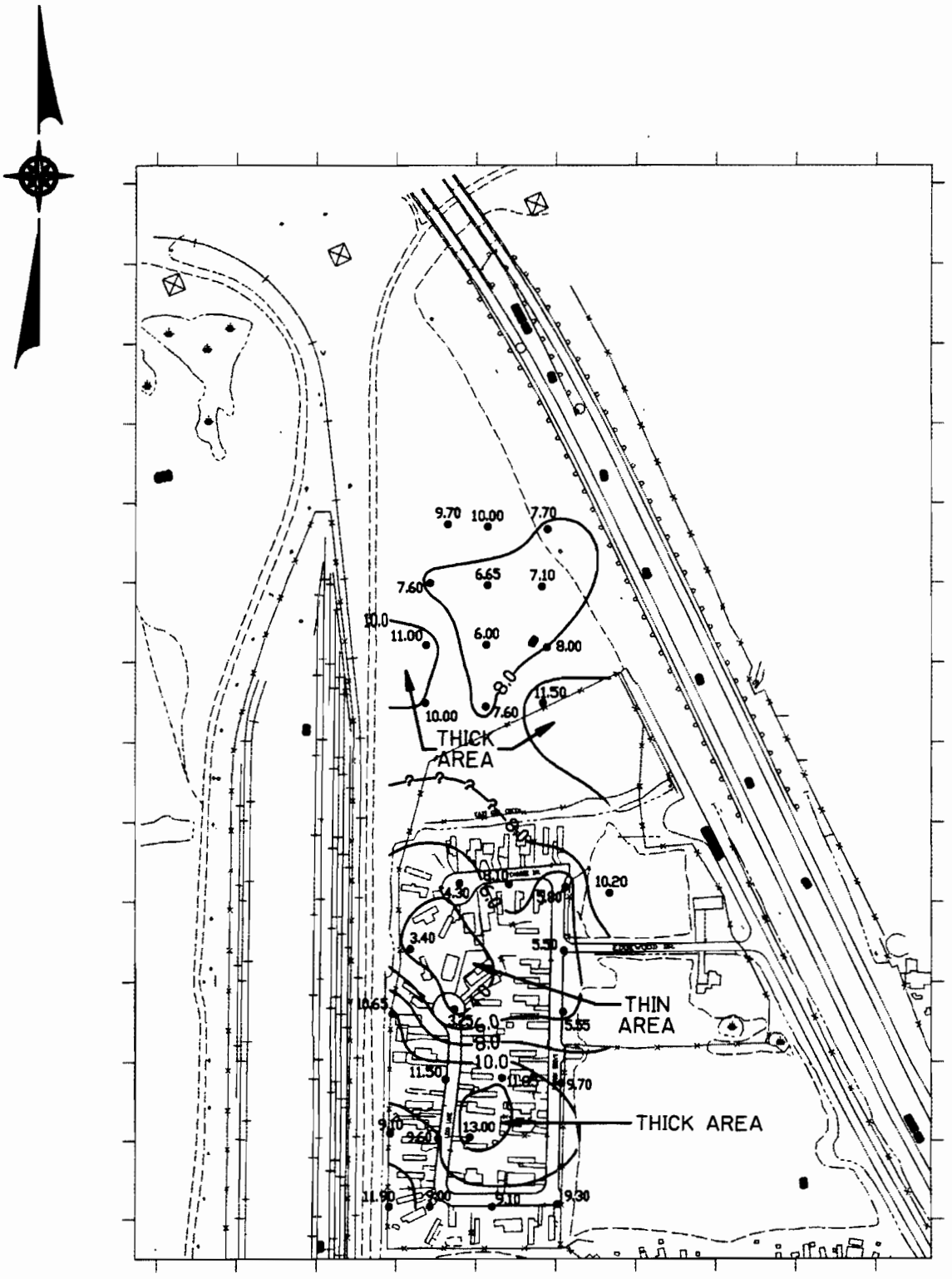
CDM FEDERAL PROGRAMS CORP. R.A. 04/09/96 14:26:06 7:31 FILL C:\FOREST



LEGEND

—1.0— ISOPACH CONTOUR (ft)

—?— ESTIMATED ISOPACH CONTOUR

• SOIL SAMPLING LOCATION

NOTE: CONTOUR INTERVAL = 2 FEET

1" = 400'

200 0 400

FIGURE 3-11

ISOPACH MAP OF CLAY LAYER

WORK ASSIGNMENT 053-2L3U

Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION

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CDM FEDERAL PROGRAMS CORP. R.A. 03/09/96 10:02:48 5:07 CLAY C:\FOREST

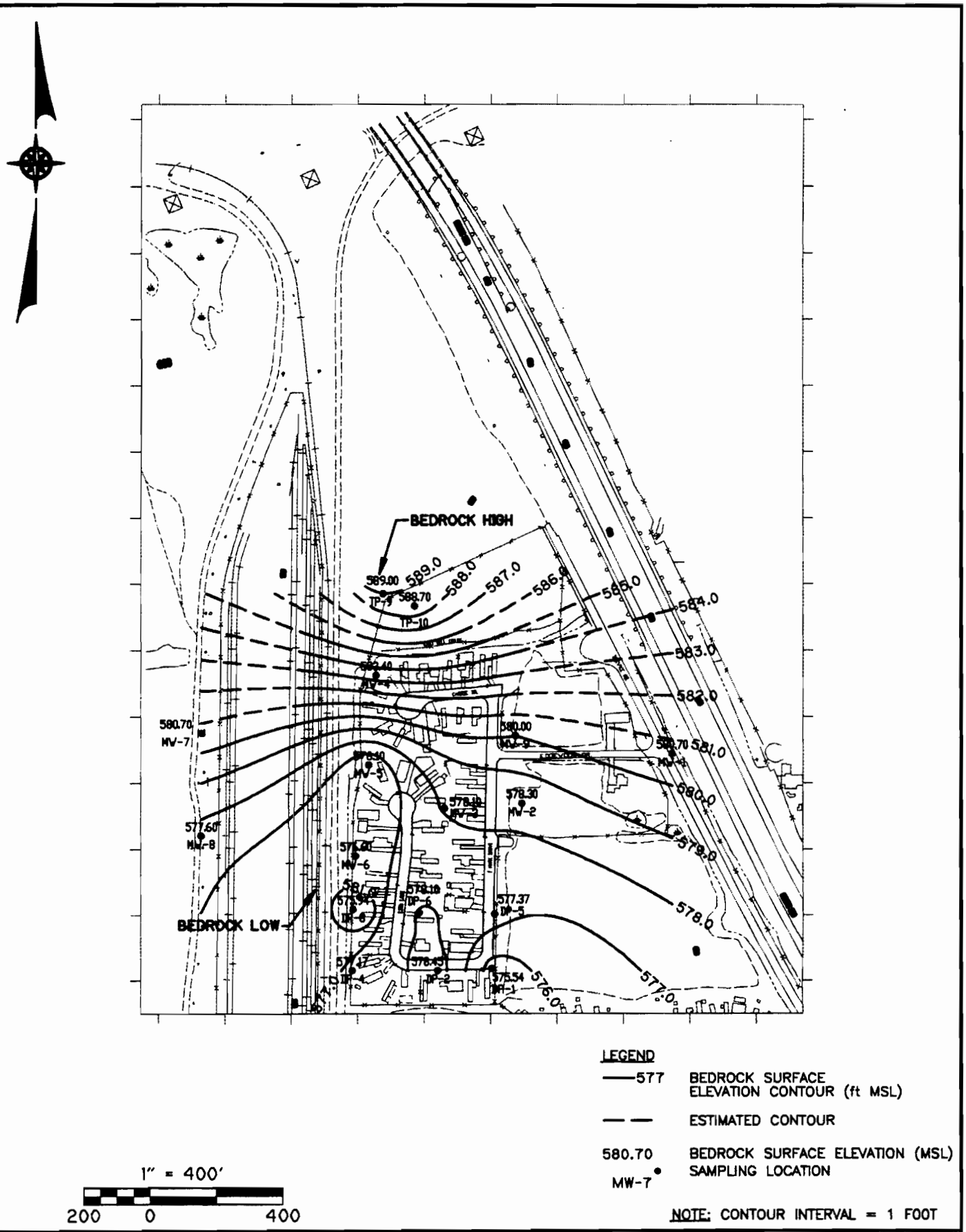

FIGURE 3-12

BEDROCK SURFACE ELEVATION

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
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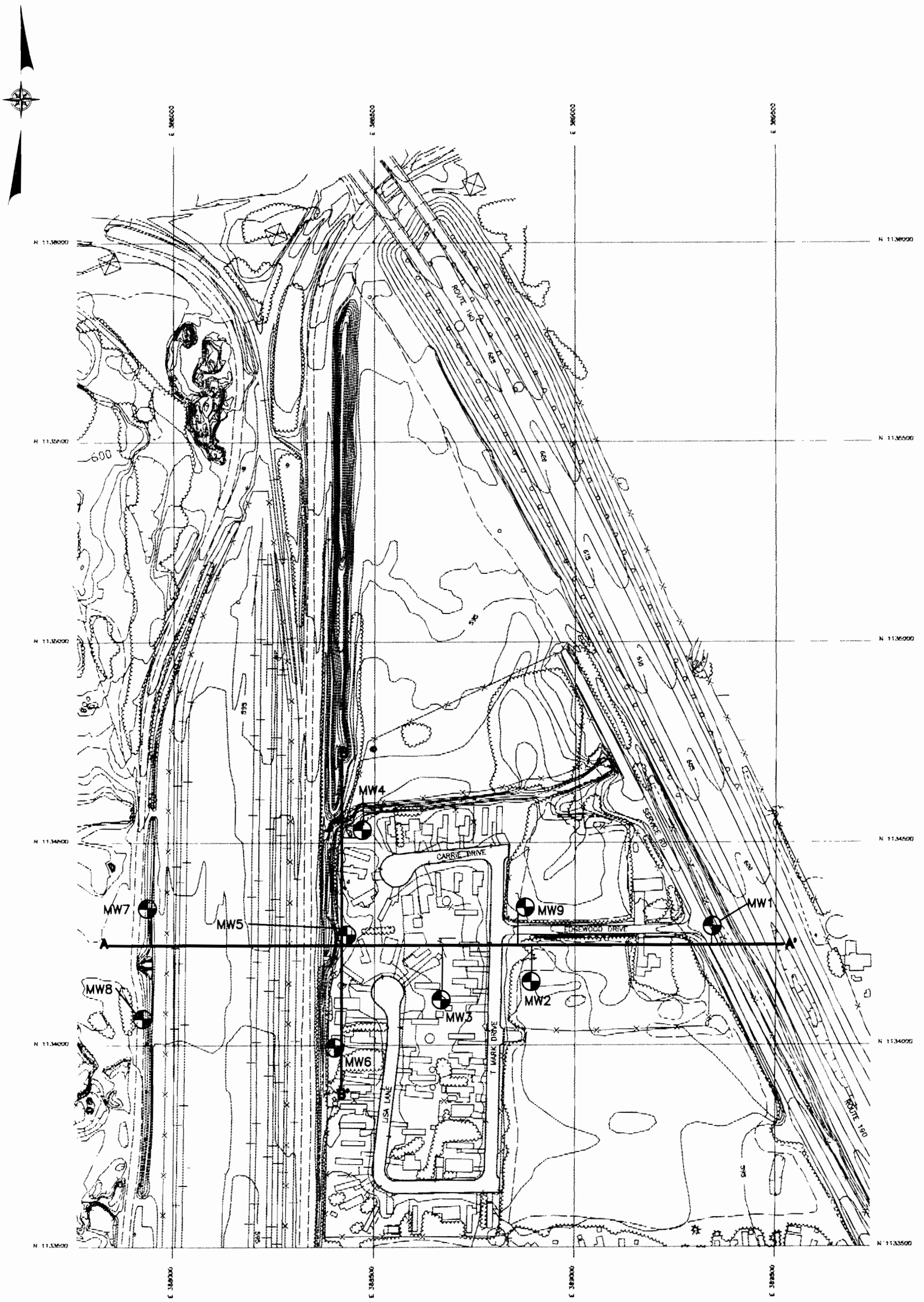
FILE: C:\ FGRN FG3-13.DWG D.N. 4/5/98



125' 0 250'

SCALE:

LEGEND

- TRAIL
- TREELINE
- FENCE
- RAILROAD
- BUILDING (RESIDENTIAL)
- MONITORING WELL LOCATION

FIGURE 3-13

LOCATION OF UPPER LOCKPORT DOLOMITE CROSS SECTIONS

WORK ASSIGNMENT 053-2L3U

Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION

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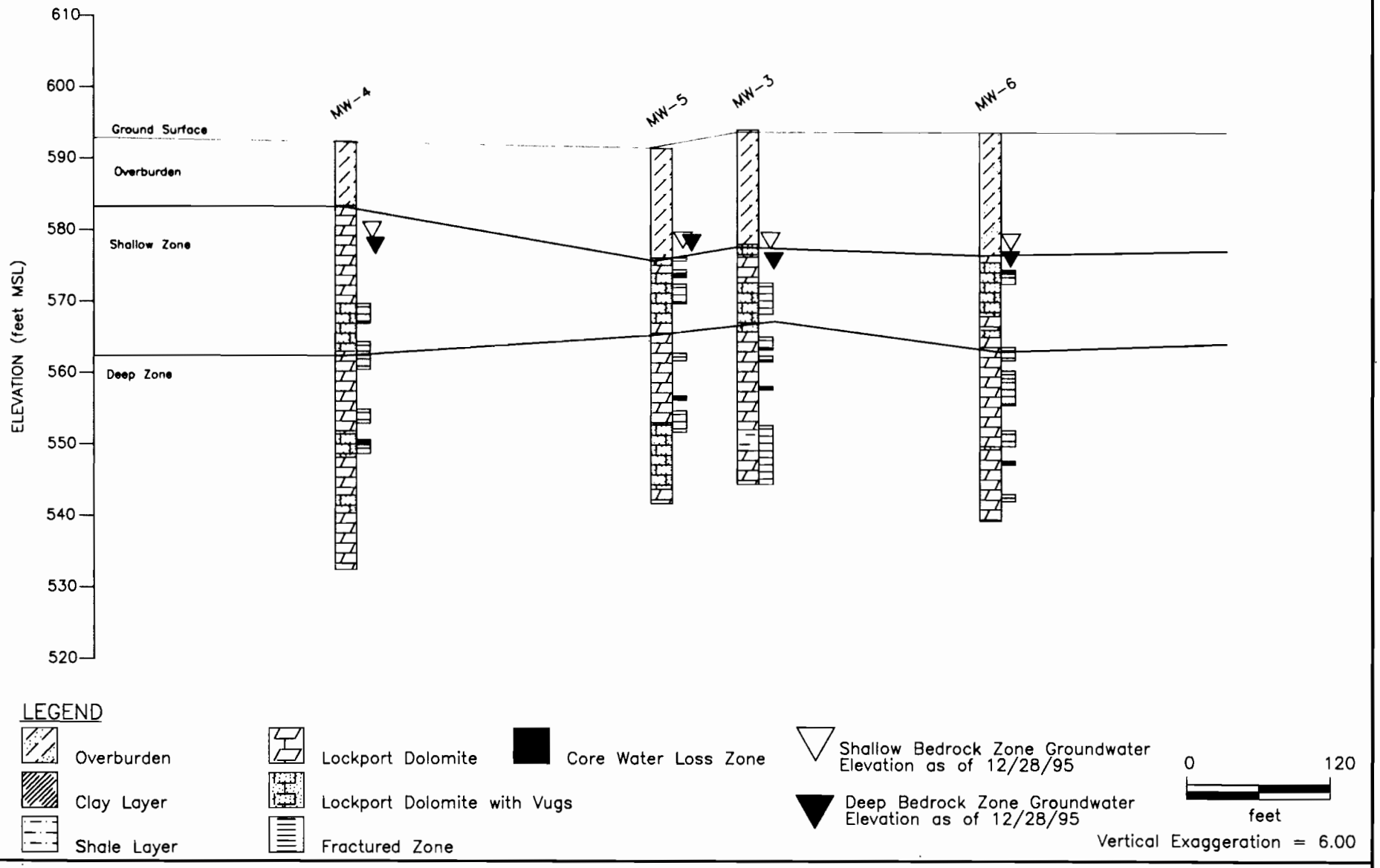

FIGURE 3-14

NORTH-SOUTH CROSS SECTION OF UPPER LOCKPORT DOLOMITE CORED AT THE FOREST GLEN SITE

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

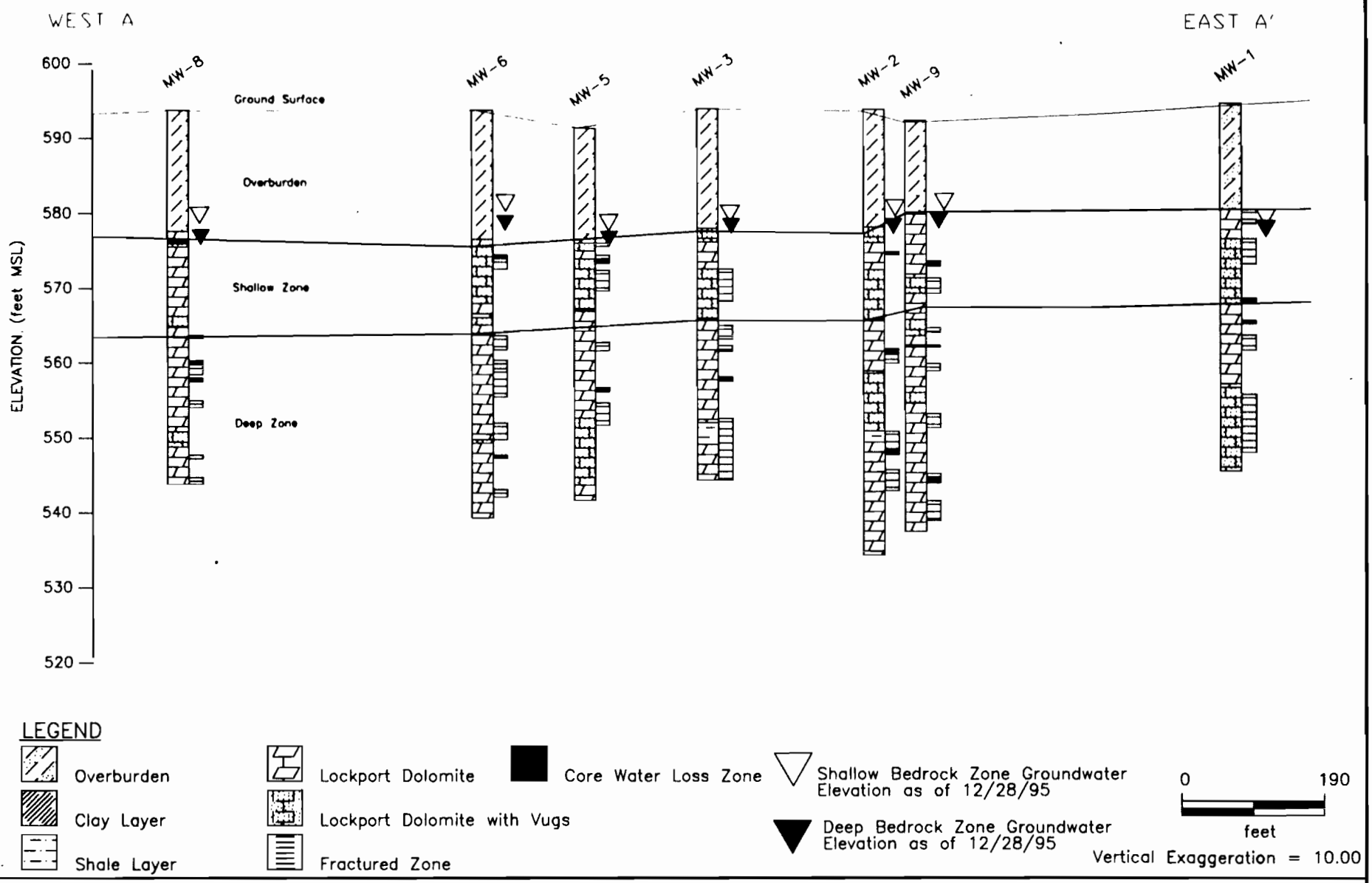

FIGURE 3-15

EAST-WEST CROSS SECTION OF UPPER LOCKPORT DOLOMITE CORED AT THE FOREST GLEN SITE

CDM FEDERAL PROGRAMS CORPORATION
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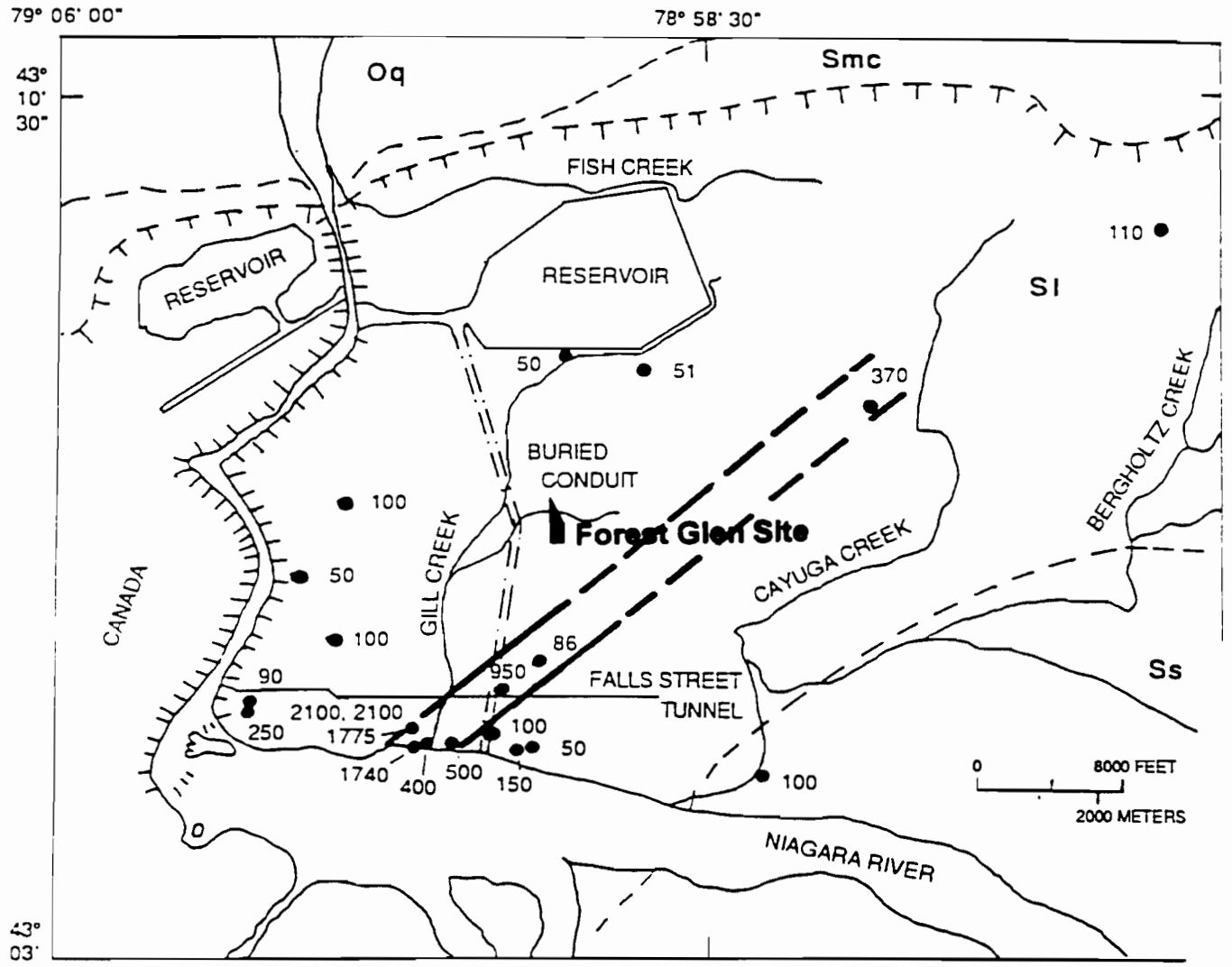
WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York



EXPLANATION

Zone of High Transmissivity identified by Johnson (1964) -- Dashed where extrapolated in this study

50 Production Well -- number is well yield, in gallons per minute

Niagara Escarpment

Niagara Gorge

Contact between Geologic Formation or Group

Ss	Silurian Salina Group
Sl	Silurian Lockport Group
Smc	Silurian Medina and Clinton Groups
Oq	Ordovician Queenston Formation

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FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

Source: Yager and Koppel, 1987

FIGURE 3-16
ZONE OF HIGH TRANSMISSIVITY IN THE NIAGARA FALLS AREA

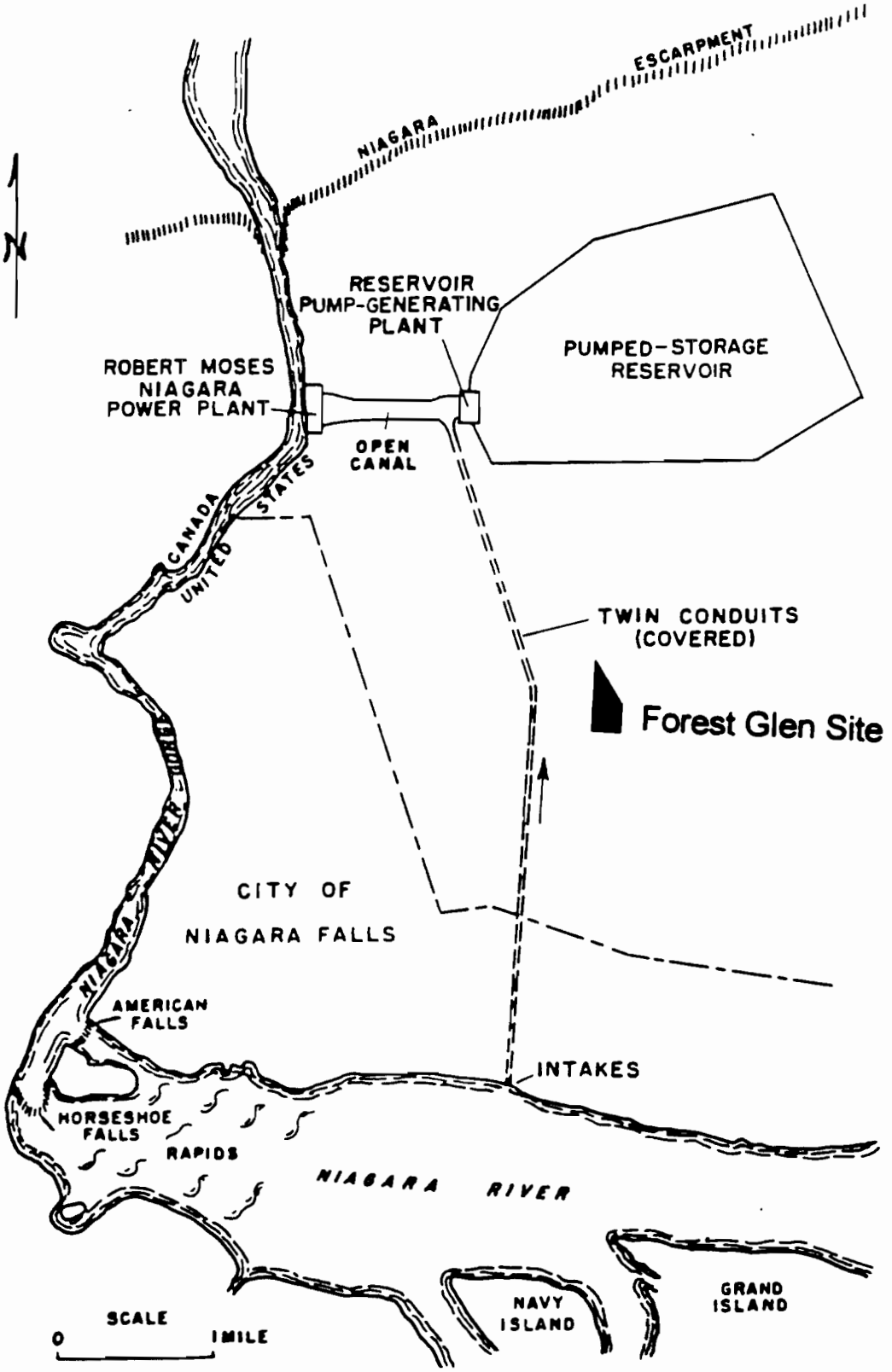

FIGURE 3-17

FEATURES OF PASNY HYDROELECTRIC POWER SYSTEM

FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

Source: Johnston, 1964.

[redacted]
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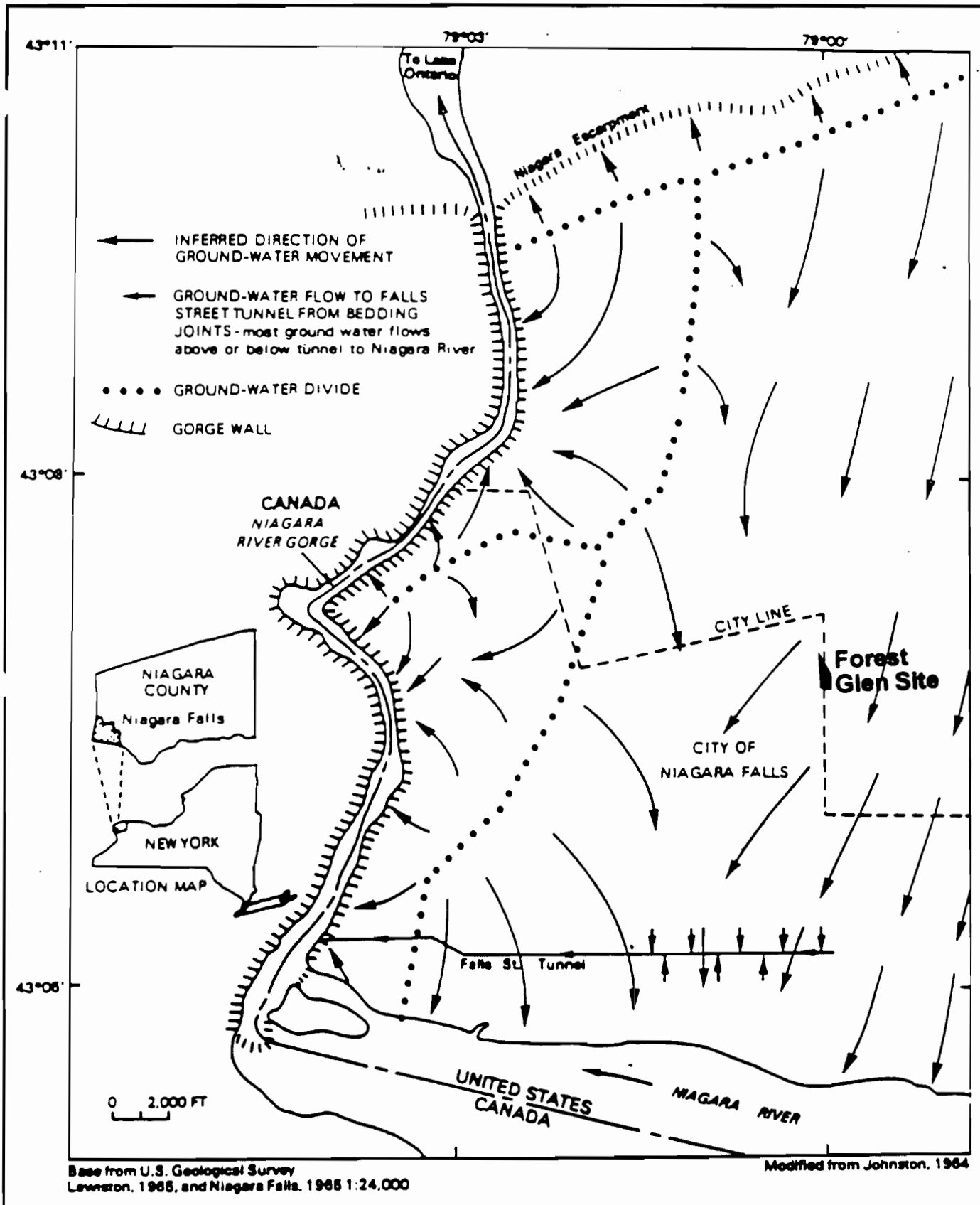

FIGURE 3–18
GROUNDWATER FLOW BEFORE PASNY CONSTRUCTION

FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053–2L3U

Source: Miller and Koppel, 1967

[redacted]
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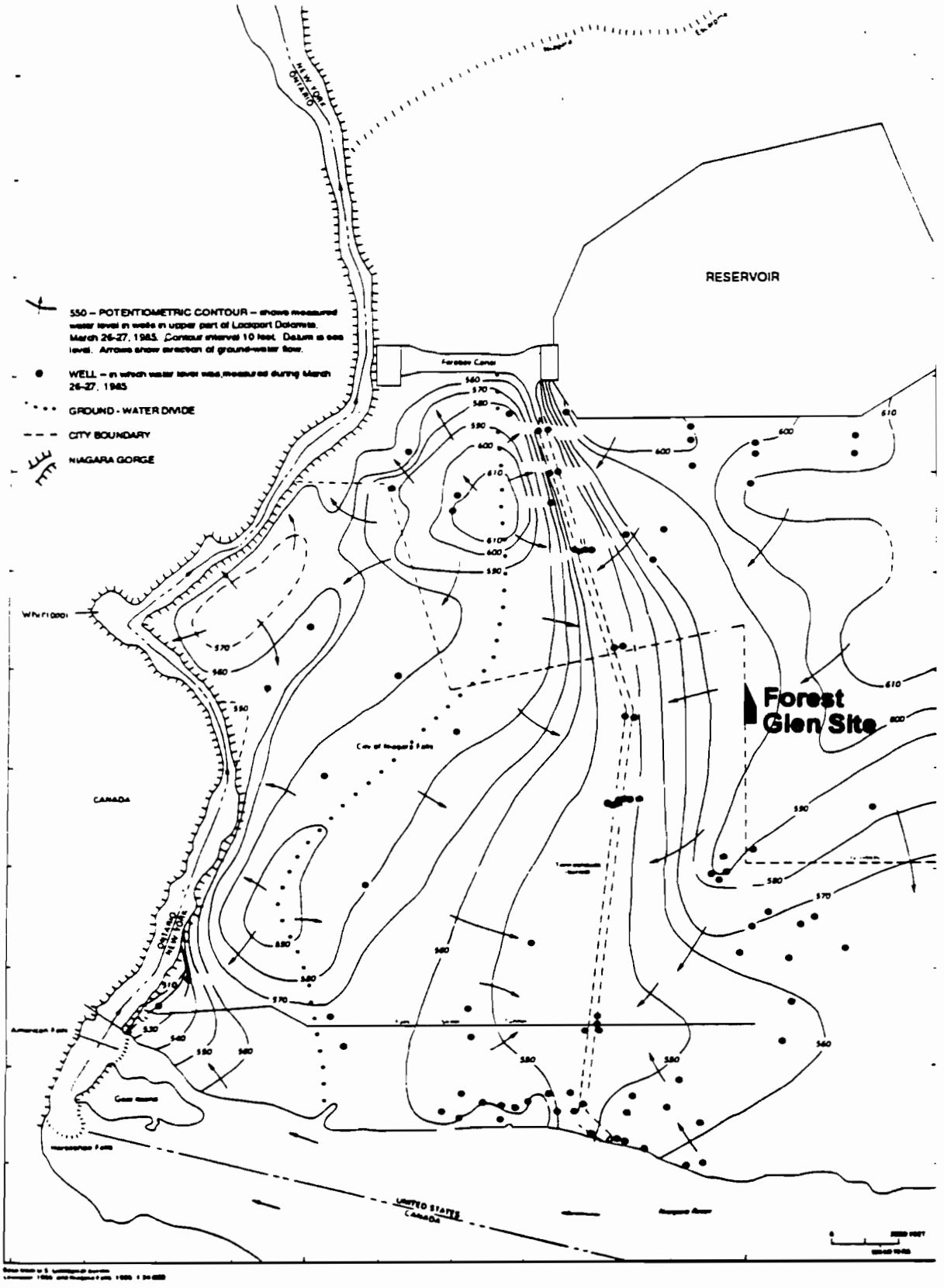

FIGURE 3-19
GROUNDWATER FLOW
AFTER PASNY
CONSTRUCTION

FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

Source: Yager and Kappel, 1987

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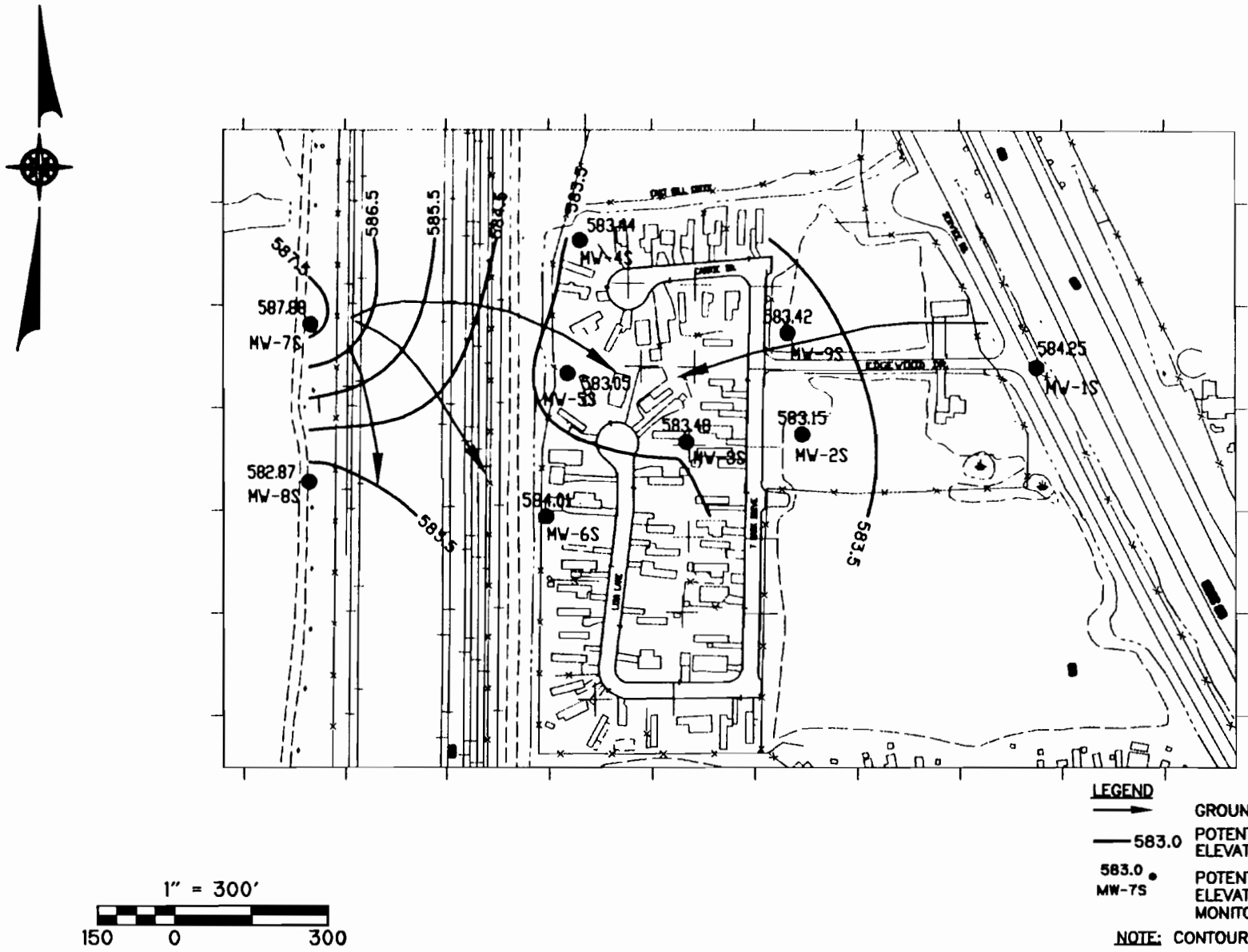

FIGURE 3-20

POTENTIOMETRIC SURFACE – SHALLOW BEDROCK WELLS, NOVEMBER 16, 1995

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
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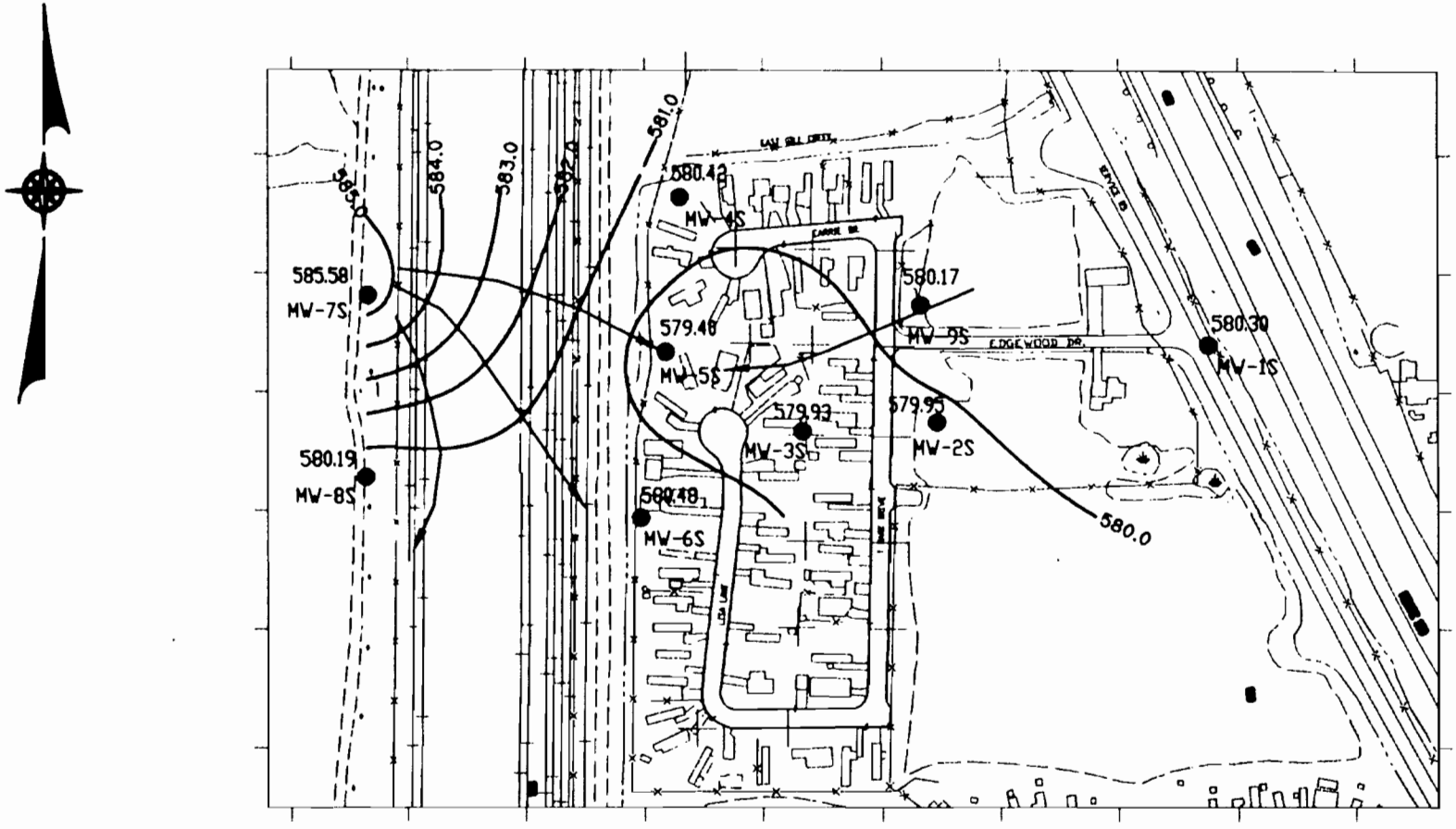


LEGEND

- GROUNDWATER FLOW DIRECTION
- 583.0 — POTENTIOMETRIC SURFACE ELEVATION CONTOUR (ft. MSL)
- 583.0 MW-7S • — POTENTIOMETRIC SURFACE ELEVATION (ft. MSL) AND MONITORING WELL LOCATION

NOTE: CONTOUR INTERVAL = 1 FOOT

1" = 300'

150 0 300

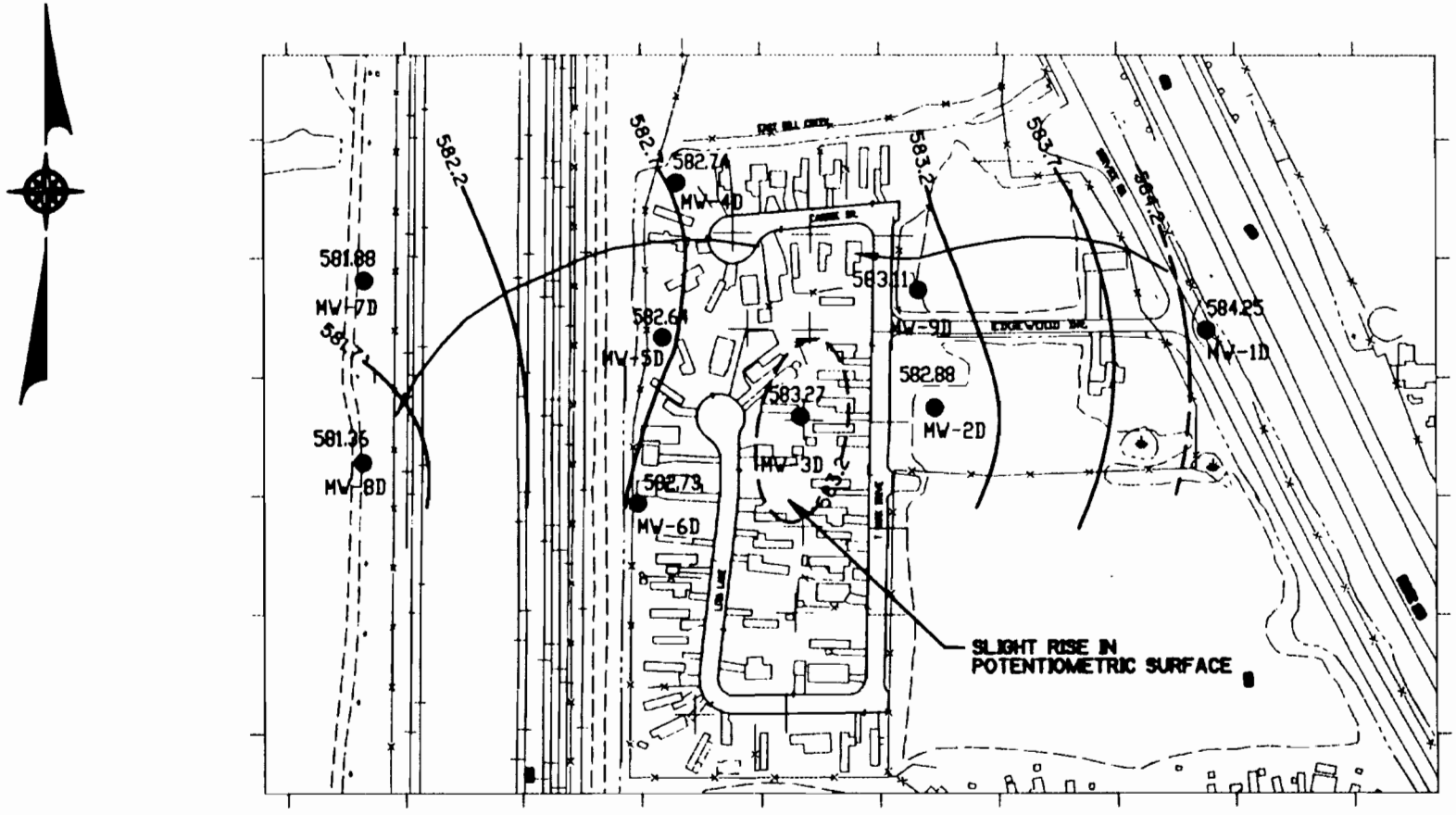
FIGURE 3-21

POTENTIOMETRIC SURFACE – SHALLOW BEDROCK WELLS, DECEMBER 28, 1995

WORK ASSIGNMENT 053-2L3U

Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.



LEGEND

- GROUNDWATER FLOW DIRECTION
- 583.0 — POTENTIOMETRIC SURFACE ELEVATION CONTOUR (ft. MSL)
- 583.0 MW-7D — POTENTIOMETRIC SURFACE ELEVATION (ft. MSL) AND MONITORING WELL LOCATION

NOTE: CONTOUR INTERVAL = 0.5 FOOT

1" = 300'

150 0 300

FIGURE 3-22

POTENTIOMETRIC SURFACE – DEEP BEDROCK WELLS, NOVEMBER 16, 1995

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

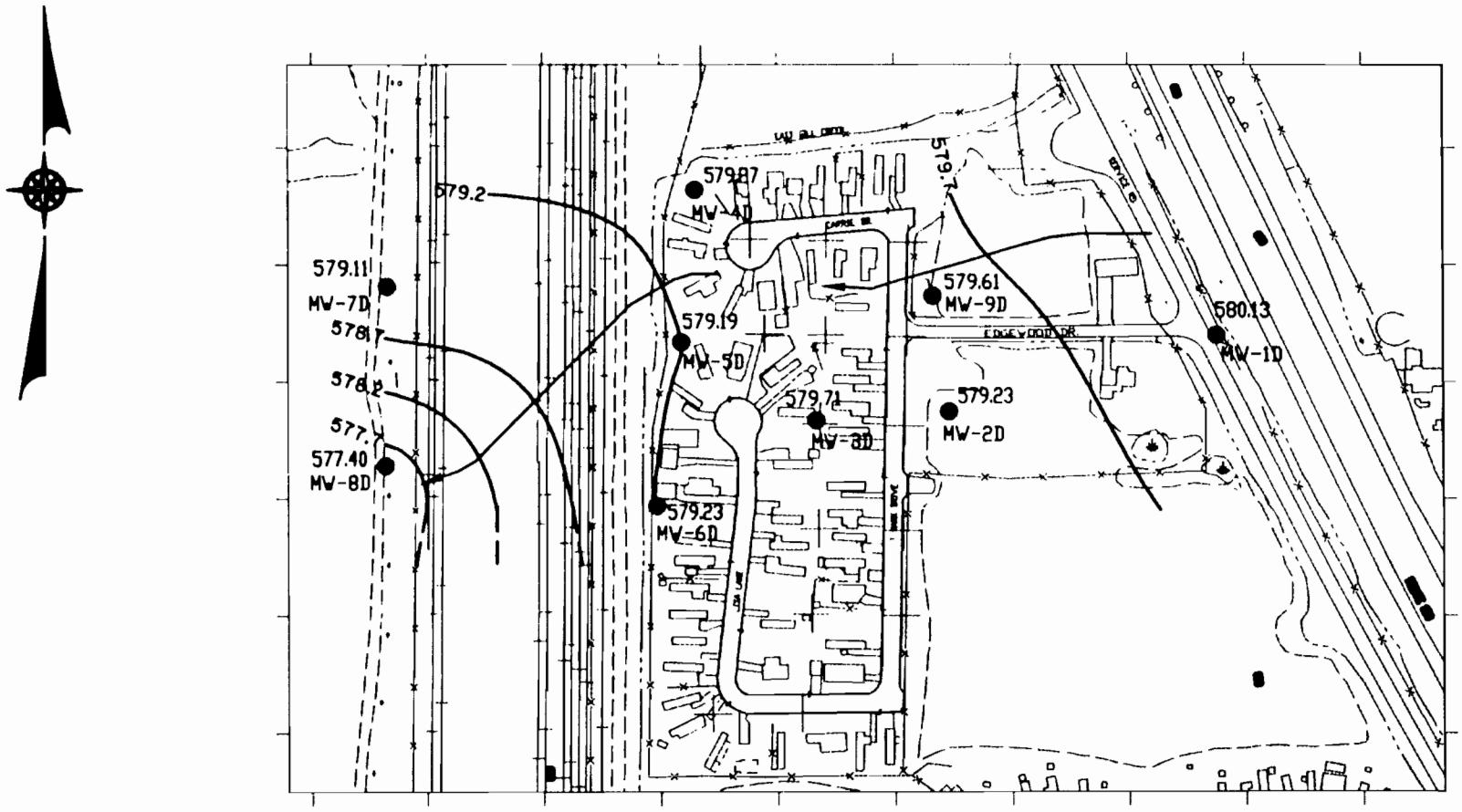
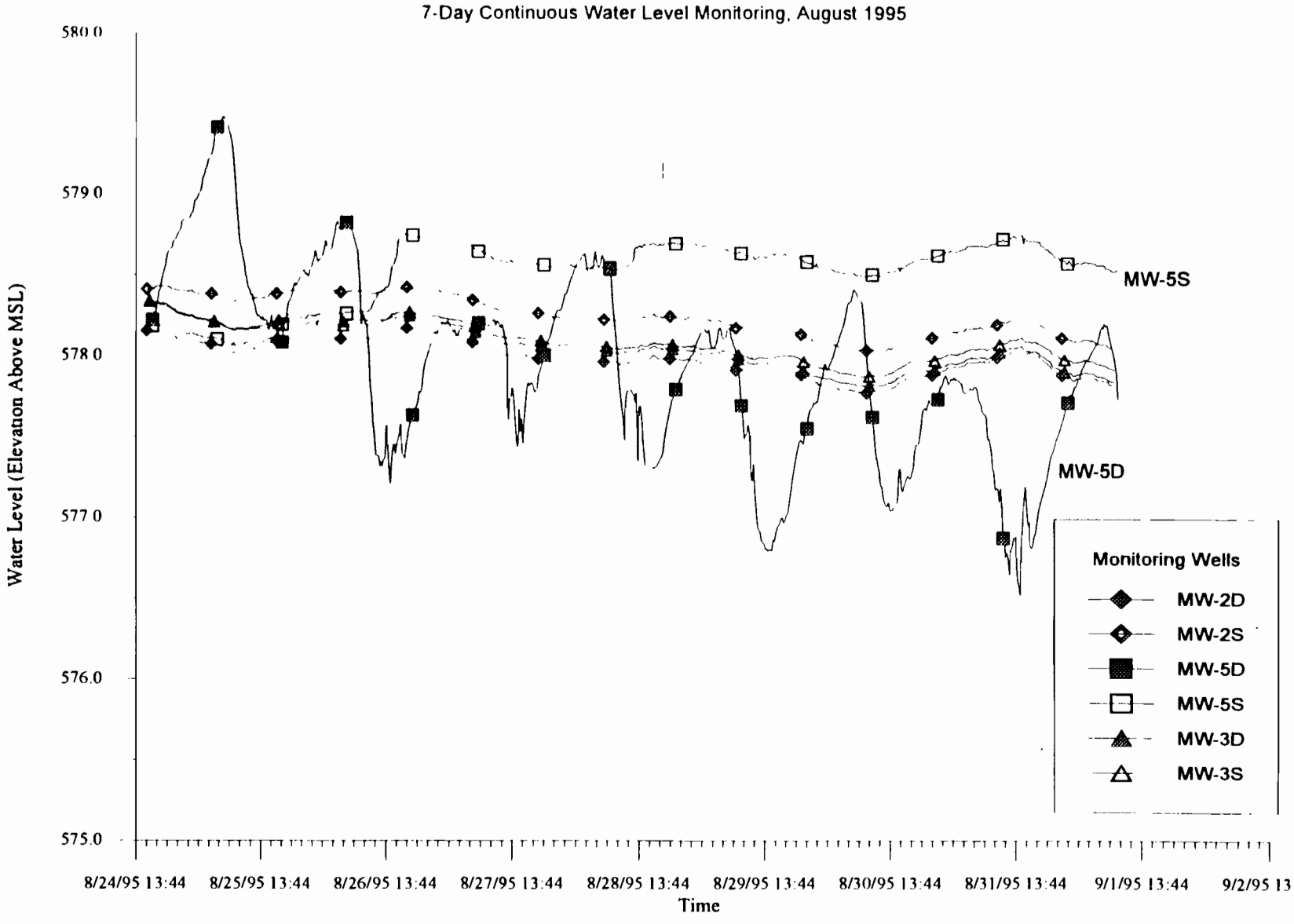


FIGURE 3-23

POTENTIOMETRIC SURFACE – DEEP BEDROCK WELLS, DECEMBER 28, 1995

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.



[redacted]
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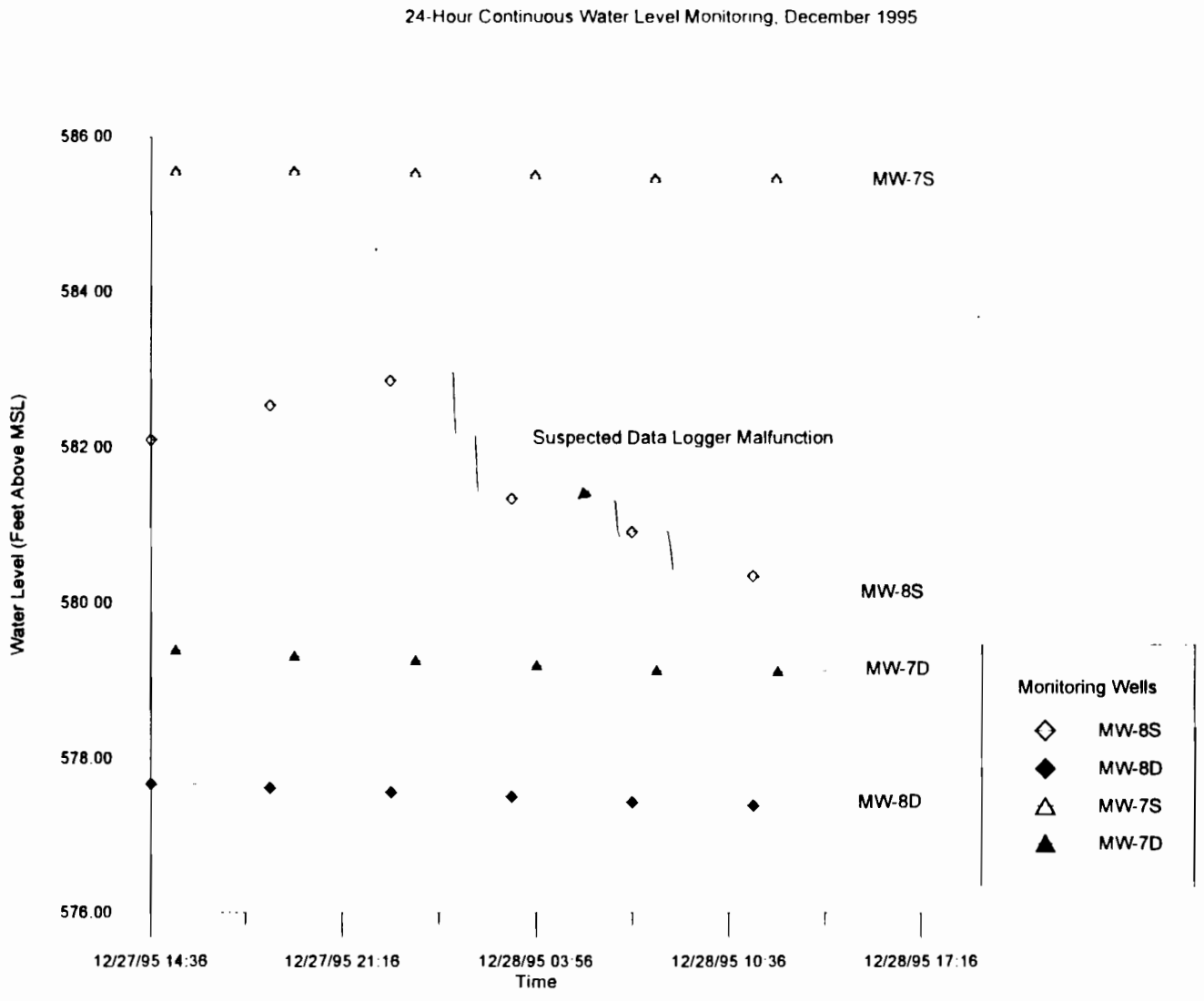
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

FIGURE 3-24
7-DAY CONTINUOUS
GROUNDWATER LEVELS,
AUGUST, 1995



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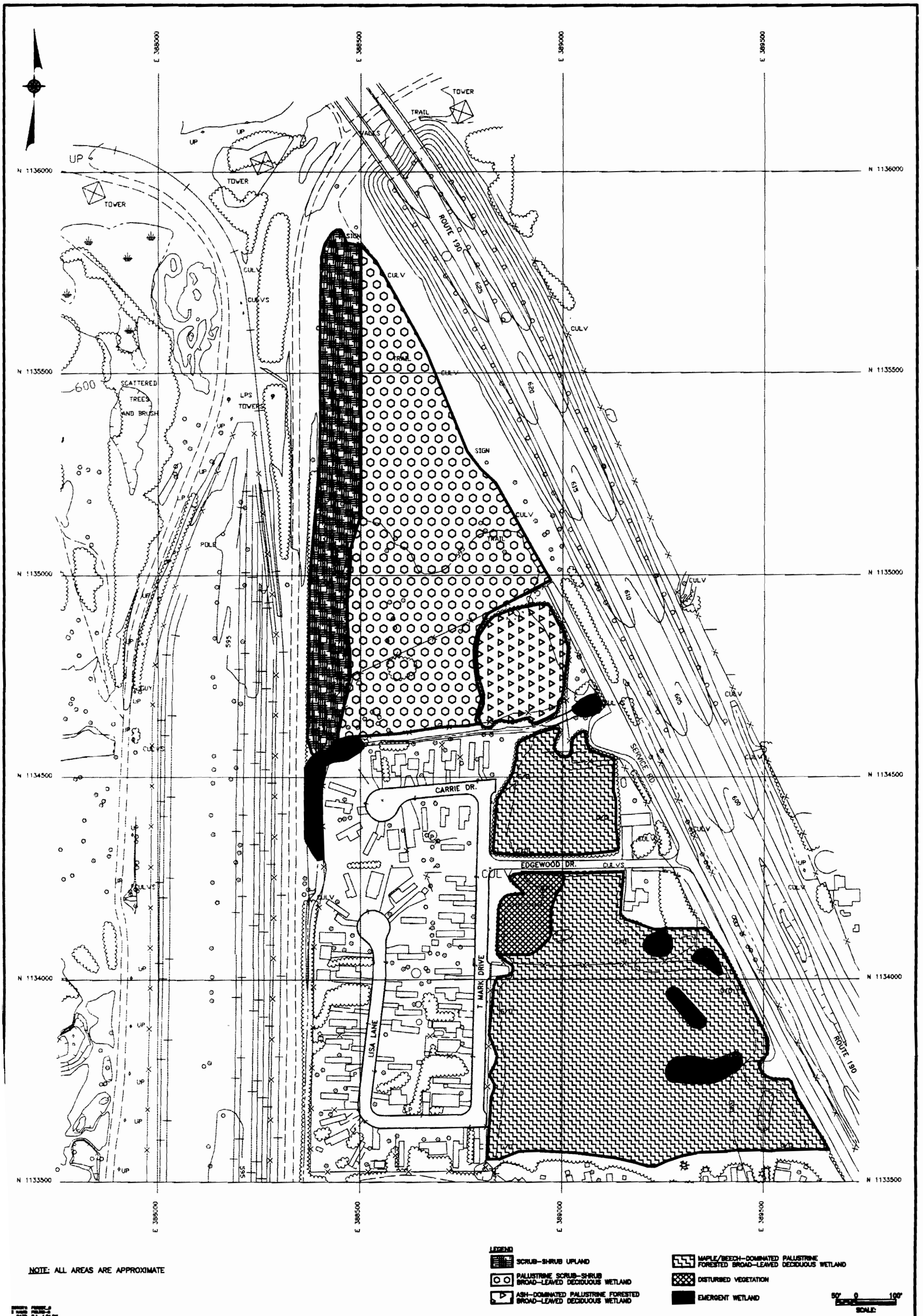
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
WORK ASSIGNMENT 053-2L3U

FIGURE 3-25
24-HOUR CONTINUOUS GROUNDWATER LEVELS, DECEMBER, 1995



NOTE: ALL AREAS ARE APPROXIMATE

[redacted]
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FIGURE 3-26
VEGETATION COVER TYPES AND WETLAND CLASSIFICATION
WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

4.0 NATURE AND EXTENT OF CONTAMINATION

This section discusses the type and distribution of organic and inorganic contamination at the Forest Glen site. Section 4.1 discusses CDM Federal's approach to the evaluation, with the use of applicable screening levels, and characterization of site contamination. Section 4.2 presents the nature and extent of contamination in the six site AOCs.

4.1 APPROACH TO THE EVALUATION OF CONTAMINATION

CDM Federal focused the characterization of the six AOCs on those constituents that were identified as contaminants of concern (COCs) in the site soil, sediment, surface water, and groundwater. COCs were determined by the following criteria: 1) exceedance of regulatory screening criteria or naturally occurring background levels; 2) frequency of exceedance; and 3) magnitude of exceedance.

A complete set of analytical data is provided in Appendix K. However, CDM Federal's characterization of site conditions emphasized the extent and spatial distribution of the COCs within each AOC. Therefore, non-COC contaminants are only briefly discussed in the AOC summaries. Non-COC contaminants that exceeded screening criteria are illustrated on AOC data presentation figures for informational purposes.

4.1.1 SELECTION OF SCREENING CRITERIA (ARARs, TBCs, BACKGROUND)

As a first step in the evaluation and determination of Forest Glen COCs, CDM Federal selected screening criteria for detected constituents in the various types of sampled media. Whenever possible, established regulatory criteria, known as chemical-specific applicable or relevant and appropriate requirements (ARARs), were used to screen data. This was the case for groundwater, where State and/or Federal drinking water standards exist for many contaminants. In the absence of ARARs, non-enforceable regulatory guidance values, known as "to be considered", or "TBCs", were used to screen the data. This was the case for soil and sediment which have no established State or Federal ARARs. Background values were also used to screen data in an attempt to supplement regulatory guidances.

The screening criteria used included:

Criteria	Status
National Primary Drinking Water Standards 40 CFR Part 141	ARAR
NYS Department of Health Drinking Water Standards 10 NYCRR Part 5, Subpart 5-1	ARAR

NYS Water Classifications and Quality Standards 6 NYCRR Parts 609; 700-704	ARAR
NYSDEC Technical and Administrative Guidance Memorandum (TAGM) Determination of Soil Cleanup Objectives and Cleanup Levels NYSDEC TAGM HWR-94-4046	TBC
NYSDEC Technical Guidance for Screening Contaminated Sediments (1994)	TBC
Ontario Ministry of Environment and Energy (Ontario MEE), Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (Persaud et al., 1993)	TBC

Background surface and subsurface soil samples were used to screen inorganic analytical results, as recommended in the NYSDEC TAGM 4046, Recommended Soil Cleanup Objectives.

The feasibility study will include a complete listing and evaluation of chemical-specific, location-specific, and action-specific ARARs.

4.1.2 BACKGROUND SAMPLES

Table 4-1 lists the background soil and sediment sample locations collected for the Forest Glen investigation. During the Forest Glen RI, four background surface soil samples (SSBK1, SSBK2, SSBK3, and MW1SS), two background wetland sediment samples (WTSDBK1, WTSDBK2), and one background subsurface soil sample (MW1 10 to 12 feet BGS) were collected in areas on the site which were thought to be unimpacted by illegal landfilling activities. Background samples were analyzed for the same parameters as the investigation samples. Background samples were collected south of the subdivision on the Forest Glen property abutting Expressway Village (Figure 2-17).

One background sample (GCSW1/SD1) was collected from East Gill Creek to monitor surface water and sediment quality upstream from where illegal landfilling activities were reported to have occurred.

Additionally, CDM Federal installed the upgradient monitoring well cluster, MW1, to monitor background water quality. Background groundwater samples were analyzed for the same parameters as the investigative samples.

In a developed area such as Niagara Falls it is difficult to obtain a background soil sample that is completely unimpacted by chemical contamination. Upon analytical review, it was determined that the RI background samples were generally unimpacted by site specific contamination. Therefore, CDM Federal believed the samples were appropriate for comparison purposes.

4.1.3 CHEMICAL SCREENING VALUES FOR SOILS

4.1.3.1 Organic Compounds in Soils

All environmental soil samples were analyzed for targeted organic compounds and TCL organics. TCL analytical sample results were compared to default NYSDEC TAGM 4046 Recommended Soil Cleanup Objectives. The TAGMs are TBC guidance values that were developed utilizing extremely conservative assumptions to assure maximum protection for human health. The default values issued by NYSDEC assume a soil organic carbon content of one percent (five percent for PCBs). The guidance recommends that soil cleanup objectives be adjusted for actual organic carbon values if known.. CDM Federal determined, based upon review of the analytical data, that total organic carbon (TOC) content of the soils is approximately one percent. Therefore, the NYSDEC default values were appropriate for screening the Forest Glen data.

The TAGM recommended soil cleanup objectives for VOCs, SVOCs, and pesticides/PCBs detected in the Forest Glen AOCs are presented in Table 4-2.

4.1.3.2 Inorganic Analytes in Soil

All surface and subsurface soil samples collected during the RI were analyzed for TAL metals and cyanide. Analytical results were compared to onsite background soil sample data, as well as the recommended cleanup objectives in the NYSDEC TAGM 4046 for soils. The TAGM cleanup objectives represent average background concentrations reported from a 1984 NYSDEC survey. With the exception of mercury, the TAGM recommends that site background be used as a cleanup objective when available. Based on the TAGM recommendation, CDM Federal calculated the site background values for both surface and subsurface soil.

Surface soil background values were derived by averaging the analytical results of the three surface soil samples collected from 0.0 to 0.5 feet BGS (SSBK1, SSBK2, SSBK3) and the MW1-SS (0.0 to 2.00') surface soil sample collected during the installation of the upgradient monitoring well, MW-1. If an individual analyte was not detected in any of the background samples, then the average of the analyte's method detection level from each sample was used for the background value. If an analyte was detected in some, but not all, of the background samples, then half of the nondetected analyte's method detection level was averaged into the calculation with the detected values from the other samples. Data that was rejected during validation activities was not used in the background calculation.

Subsurface soil background values were obtained, as discussed with the EPA Work Assignment Manager (WAM) and risk assessment specialist, from the average of inorganic analytical results from samples MW-1(12.00-14.00'), DP01(10.00-12.00'), DP02(10.00-12.00'), and DP03(8.00-10.00'). The subsurface soil background was calculated in the same manner as the surface soil background average.

Once an inorganic background average was calculated, CDM Federal screened, as discussed with the EPA WAM and risk assessment specialist, the detected analytes, including mercury, against two times the background number. This was done to obtain a conservative evaluation of the inorganic contamination onsite.

Inorganic background values for surface and subsurface soil samples are presented on Tables 4-3 and 4-4, respectively.

4.1.3.3 Targeted Organic Compounds

No screening criteria are available for the targeted organic compounds. Per EPA direction, all analytical detections of the Forest Glen targeted organic compounds are reported and evaluated in this section. Additionally, all targeted organic compounds are reported on AOC data tables and are illustrated on the AOC data presentation figures.

4.1.4 SEDIMENT SCREENING CRITERIA

CDM Federal collected 10 sediment samples from the wooded wetland area and seven downstream sediment samples, over two sampling events, from East Gill Creek. Inorganic and organic analytical results from both AOCs were compared against the NYSDEC's 1994 "Technical Guidance for Screening Contaminated Sediments". The New York State sediment criteria are tied to State water quality standards and guidance values and are intended to be protective of human or ecological health. An explanation on the derivation of the standards is presented in the NYSDEC guidance document.

The guidance provides sediment screening criteria for non-polar organic contaminants. Organic compounds detected in the sediment samples were compared against the sediment criteria for human health bioaccumulation. The NYSDEC guidance also provides sediment screening criteria for inorganic analytes. NYSDEC has established two levels of metals screening criteria. The Lowest Effect Level (LEL) indicates a level of sediment contamination that can be tolerated by the majority of benthic organisms, but will still cause toxicity to a few species. The Severe Effect Level (SEL) indicates a contaminant concentration capable of producing a profound disturbance to the sediment dwelling community. The sediment is considered contaminated when inorganic LELs are exceeded.

CDM Federal also compared the site sediment sample results to the Ontario MEE sediment quality guidelines (Persaud et al., 1993). These guidance values were developed to protect sediment-dwelling organisms; by protecting against food chain biomagnification of contaminants as well as other water quality concerns. The LEL, used for screening RI sediment chemical detections, indicates a level of contamination that can be tolerated by the majority of the sediment-dwelling organisms. The LEL values were derived using field-based data on the co-occurrence of sediment concentrations and benthic species.

Site sediment sample results were also compared to Federal screening criteria. The Federal sediment quality criteria were established by the EPA to protect benthic organisms from biological impacts due to chemicals present in freshwater and marine sediments. These sediment quality criteria are available for only five organic compounds: acenapthene, dieldrin, endrin, fluoranthene, and phenanthrene. The criteria values are based on mass of contaminant per mass of organic carbon. The criteria documents (USEPA, 1993a-e) state that the freshwater criteria values should be acceptably protective of benthic organisms in freshwater sediments with the exceptions of sediment with less than 0.2 percent organic carbon content and areas with very sensitive locally important species.

The following Federal freshwater criteria were applied to the site.

Acenaphthene: 130 µg acenaphthene/TOC
Dieldrin: 11 µg dieldrin/g TOC
Endrin: 4.2 µg endrin/g TOC
Fluoranthene: 620 µg fluoranthene/g TOC
Phenanthrene: 180 µg phenanthrene/g TOC

Freshwater benthic organisms should not be unacceptably affected if none of the above sediment contaminant concentrations are exceeded. Based on review of the analytical data, CDM Federal determined that none of the sediment sample results exceeded the Federal sediment criteria. Table 4-5 presents the Federal criteria for the organic compounds detected in the wooded wetland and East Gill Creek sediment samples.

Since the State and Federal guidances offer criteria for only a limited number of compounds and analytes, CDM Federal determined that the sediment results required additional screening. Therefore, the wooded wetland sediment samples were also screened against the averaged results of the two wetland sediment background samples (WTSDBK1, WTSDBK2). The downstream East Gill Creek sediment samples were also screened against the upstream East Gill Creek sample (GCSD1) for additional comparison.

Wooded Wetland Sediment

TCL organic analytical results from the wooded wetland samples were compared to the averaged organic results of the two wetland sediment background samples. If an individual compound was not detected in either background sample, then the average of the compound method detection levels was used for the background level. A nondetected analyte was averaged into the calculation as half of its method detection level. Data that was rejected during validation activities was not used in the background calculation.

The sediment inorganic results were also screened against the averaged inorganic background results. As with the organics, if an individual analyte was not detected in either of the samples, then the analyte's method detection levels were averaged and used for the background value. A nondetected analyte was averaged into the calculation as half of its method detection level. Once

the background average was calculated, CDM Federal screened detected inorganics against two times the background number. This was done to obtain a conservative evaluation of onsite inorganic contamination. Any data that was rejected during validation activities was not used in the background calculation.

Table 4-6 presents the NYSDEC and Ontario MEE sediment criteria and the background values for the organic compounds detected in the wooded wetland samples. Table 4-7 presents the NYSDEC and Ontario MEE sediment criteria and two times the background values for the inorganic analytes detected in the wooded wetland samples.

East Gill Creek Sediment

Each round of downstream sediments results was screened against its upstream, background sample (GCSD1) for comparison. As with the wooded wetland sediment results, CDM Federal screened detected inorganics against two times the background number. As stated above, the method detection level was used as the background value for those nondetected analytes.

Table 4-8 presents the NYSDEC and Ontario MEE sediment criteria and the background values for the organic compounds detected in the East Gill Creek samples. Table 4-9 presents the NYSDEC and Ontario MEE sediment criteria and two times the background values for the inorganic analytes detected in the East Gill Creek samples.

4.1.5 SURFACE WATER SCREENING CRITERIA

East Gill Creek is classified by New York State as a Class C surface water body. Class C waters are defined as those surface water bodies best used for fish propagation and survival as well as primary and secondary recreational contact. East Gill Creek surface water analytical results were screened against the New York State ambient water quality standards for Class C waters that are designed to be protective of human health. These standards were derived from scientifically valid human or animal health studies which considered, among other factors, exposure routes and duration. An explanation on how the standards were derived is provided in the New York Codes, Rules, and Regulations, Title 6 - Environmental Conservation, Chapters V and X.

The critical evaluation criteria for surface water contamination are the New York regulatory standards. Each round of downstream surface water analytical results, however, was also screened against its respective upstream, background result (GCSW1) for comparison. The background, upstream water quality was evaluated to determine if onsite contaminants originated from an offsite source.

Table 4-10 lists the New York State surface water criteria and the background value for each detected organic compound. Table 4-11 lists the New York State surface water criteria and two times the background value for each detected inorganic analyte.

4.1.6 GROUNDWATER SCREENING CRITERIA

Groundwater analytical results were screened against the National Primary Drinking Water Standards. The Safe Drinking Water Act (SWDA) requires EPA to assess and regulate all contaminants in the drinking water supply that could have an adverse effect on public health. The National Drinking Water Standards identify maximum contaminant levels (MCLs). MCLs represent the maximum permissible level that a contaminant can be detected in the drinking water supply. The MCLs are developed based upon health risks, detection limits, treatability, and treatability costs associated with the best available treatment technology. Maximum contaminant level goals (MCLGs), which represent concentrations that present no adverse health effect, have also been established for groundwater contaminants. National Secondary Drinking Water Standards have also been established for contaminants that do not present adverse health effects. These secondary MCLs are based upon aesthetic considerations such as taste, color, odor, and appearance and are non-enforceable standards.

These Federal standards are implemented by the primary agency, which in New York State is the New York State Department of Health. Part 5 of the New York State Sanitary Code establishes MCLs for the same contaminants regulated under EPA's SDWA. State MCLs must be at least as stringent as the Federal standards. Both the Federal and State drinking water standards are ARARs.

Groundwater analytical results were also screened against NYSDEC Groundwater Quality Standards as provided in NYCRR Title 6, Chapter X, Part 703. These standards have been promulgated by the statutory authority of Environmental Conservation Law (Sections 3-0301 [2][m], 15-0313, 17-0301, 17-0303, 17-0809). These State standards are ARARs. Tables 4-12 and 4-13 list the ARARs for the contaminants detected in the groundwater samples.

While the critical evaluation criteria for groundwater contamination are regulatory standards, not background concentrations, upgradient groundwater quality was evaluated to determine at what point contaminants may be entering the aquifer system.

4.2 NATURE AND EXTENT OF CONTAMINATION BY AREA OF CONCERN

4.2.1 DATA PRESENTATION

The analytical results from the RI were input into CDM Federal's database for evaluation purposes. A full set of analytical data is presented in Appendix K. Data presentation tables were also generated for each AOC by sample media (i.e., surface soil) and analytical parameter (Appendix L). These tables present all data above method detection limits, as well as results of analytes which have exceeded screening criteria discussed above. Where data were compared against one criterion, an exceedance is denoted with an (a) flag. Where data were compared against more than one criteria, an exceedance is denoted with an (a) flag for exceedance of the first criterion, and a (b) flag for exceedance of a second criterion, or an (a), (b) for exceedance of both criteria.

The data presentation tables were exported into figures for each AOC to illustrate data collected during the RI. The figures present detected organic compounds and inorganic analytes that have exceeded the evaluation criteria. An explanation of data validation qualifiers is presented on Figure 4-1A and is included in Appendix L.

4.2.2 AOC 1 - BERM

AOC 1, the berm, is located in the northern aspect (AOC 2) and is approximately 1,300 feet long, 50 feet wide and 11 feet high at its widest and highest points. Historical records and anecdotal reports indicate that the northern aspect at one time had been targeted for residential development. It is believed that the berm was created when soil was moved as the ground surface of the northern aspect was leveled. CDM Federal installed five soil borings in the berm. The borings were advanced through the fill material and were terminated when native soil was encountered in the split spoon sampler, generally at 14 to 16 BGS. CDM Federal collected one analytical sample from each boring location and an additional sample from two borings where fill material and visual contamination were noted.

It should be noted that some of the analytical results contained within this data set were qualified as estimated during data validation review. Data was estimated due to exceeded quality control criteria including holding time exceedances and poor surrogate recovery. Although the data was estimated, it was still determined to be usable.

Based upon review of the analytical results, CDM Federal identified the targeted organics, benzothiazole, phenothiazine, perylene, N,N-diphenyl-1,4-benzenediamine, 2-mercaptobenzothiazole, 2-anilinobenzothiazole, diphenylamine, and phenyl isothiocyanate, as well as, phenol, benzo(a)anthracene, benzo(k)fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene, 2-methylphenol, mercury, arsenic, chromium, cobalt, copper, nickel, lead, and vanadium as contaminants of concern for AOC 1. Table 4-14 summarizes the subsurface soil contaminants of concern detected in the berm.

4.2.2.1 Subsurface Soil

Organic Compounds

Targeted Organic Compounds - Figure 4-1 illustrates all targeted organic compound detections present in the subsurface soil samples collected from the berm. Targeted organic compounds were detected to concentrations of 1,100,000 ppb. Detections of the targeted organic compounds were confined to BERM2, BERM3, and BERM4, the three center berm locations. Benzothiazole, phenothiazine, perylene, N,N-diphenyl-1,4-benzenediamine, 2-mercaptobenzothiazole, 2-anilinobenzothiazole, and diphenylamine were detected in the majority of the five analytical samples collected from the three boring locations. Phenyl isothiocyanate was also detected in one of the five analytical samples. The highest concentrations of the targeted organic compounds were consistently detected in sample BERM2A, a waste sample collected from 4.00-6.00' BGS at location BERM2. Sample BERM2A was a dry, brown silty clay stained with white and yellow

powder intermixed with black plastic-like pieces. Boring location BERM2 was located approximately 300 feet south of the berm's northern end..

Volatile Organic Compounds - Acetone, 1,1-dichloroethane, 1,2-dichloroethene, 2-butanone, 1,1,1-trichloroethane, trichloroethene, tetrachloroethane, and xylene were sporadically detected in several of the berm samples. The detected concentrations were below the NYS TAGM screening levels.

Semivolatile Organic Compounds - Figure 4-1 also illustrates the semivolatile compounds detected in berm samples at concentrations that exceeded screening criteria. Semivolatile organic compounds and the semivolatile organic COCs were detected in all seven of the berm samples. The highest contaminant levels, however, were generally detected in those samples collected from the center berm locations. Additionally, with the exception of the phenol and 2-methylphenol detections in BERM1, any exceedances of the NYS TAGMs, were noted in samples collected from the center berm locations.

Four semivolatile organic COCs, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)anthracene were consistently detected in the five samples collected from the three center berm locations. The four compounds, all of which are semivolatile PAHs, were noted to exceed their respective NYS TAGM screening criteria in at least three of the samples. The maximum observed benzo(a)pyrene concentration exceeded the TAGM level by more than 60 times. Phenol was detected in five samples at concentrations that exceeded the compound's screening criteria by up to 300 times. Related compounds, 2-methylphenol and 4-methylphenol were noted in BERM1, the most northern berm sample, and in BERM 2. Both BERM2 concentrations exceeded their respective NYS TAGM screening levels. The highest concentrations of the semivolatile COCs were detected in sample BERM2. The sample, collected from 8.00 to 10.00 feet BGS, was black stained silty clay and contained white powder residue and black plastic-like pieces.

Other semivolatile organic compounds detected in the berm samples, but at concentrations below their respective screening criteria, included naphthalene, and several PAH compounds (fluorene, phenanthrene, anthracene, pyrene, chrysene, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene). As with the semivolatile COCs, the highest contaminant concentrations were detected in sample BERM2.

Pesticide/PCB Compounds - The following pesticide compounds were sporadically detected in the berm samples: alpha-BHC, aldrin, dieldrin, 4,4'-DDE, endrin, endosulfan II, endosulfan sulfate, methoxychlor, and endrin ketone. None of the detected pesticide concentrations exceeded any of the NYS TAGM screening levels.

Inorganic Analytes

Figure 4-2 illustrates the inorganic analytes detected in the AOC subsurface soil samples at concentrations that exceeded the background screening criteria. Cobalt and nickel were both

detected in all seven berm samples at concentrations greater than two times their respective background values. The highest cobalt concentration was noted in sample BERM2A. The highest nickel detection was observed in sample BERM3A. Arsenic and chromium were both detected in all seven samples with five concentrations noted to exceed each analyte's respective background value. The highest concentration of each analyte was detected in sample BERM3A. Mercury was detected in four samples at concentrations that exceeded the analyte's NYSDEC recommended soil cleanup objective. The highest mercury concentration was detected in sample BERM2A. Mercury was not detected in CDM Federal's subsurface soil background samples. Lead and copper were detected in all seven berm samples with at least three detections noted to exceed each analyte's respective background screening criteria. The highest detection of both analytes was noted in sample BERM2. Vanadium was detected in all seven berm samples with three detections exceeding the analyte's background criteria. The highest vanadium concentration was noted in sample BERM5.

Aluminum and barium were detected in all seven samples with at least two detections noted to exceed their respective background screening values. However, due to infrequency and magnitude of their screening criteria exceedances, CDM Federal did not consider the analytes as COCs.

Several other non-COC inorganics including beryllium, iron, silver, thallium and zinc, as well as essential human nutrients such as calcium, potassium, and sodium were detected in many of the berm samples. As with the COC inorganics, the highest detections were generally observed in samples BERM2, BERM2A, and BERM3A.

4.2.2.2 Summary of Contamination

The highest levels of organic contamination were noted in samples collected from the three center berm locations, BERM2, BERM3, and BERM4. Contaminants in these samples were observed at concentrations that exceeded NYS TAGM screening criteria. Generally, the highest contaminant levels were observed in those samples collected from 4.00-12.00' BGS. A comparison of contaminant levels also indicates that concentrations appear to decrease with depth.

Inorganic COCs were generally observed in all berm samples. However, the highest contaminant levels were detected in the center berm samples where heavily stained fill material was noted. As with the organic contamination, the highest detections were generally observed in samples collected from 4.00-12.00' BGS. Inorganic contaminant concentrations were also noted to generally decrease with depth.

Within this fill area, targeted organic compounds were detected to concentrations up to 1,100,000 ppb (2-mercaptobenzothiazole) and PAH detections exceeded TAGM screening levels by more than 60 times (benzo(a)pyrene). Other semivolatile detections (phenol) exceeded the TAGM levels by more than 300 times. Generally, inorganic contamination was detected at concentrations between two to four times the background screening criteria. However, mercury concentrations in this area ranged to 135 times the TAGM cleanup objective.

Generally, the highest levels of contamination were detected in those samples collected from the central berm locations where heavily stained fill material was encountered. Generally, fill material was observed to 14.00' BGS while the highest levels of contamination were documented to depths of 12.00' BGS. These three locations represent an area of approximately 750 feet of the 1,300 long berm. The volume of soil requiring remediation in this area will be evaluated further during the FS. Figures 4-3 and 4-4 illustrates both the vertical and horizontal extent of the fill material within the berm. Refer to Figure 4-4 for the locations of the cross sections.

4.2.3 AOC 2 - NORTHERN ASPECT

AOC 2, the northern aspect, is an 18-acre open field located to the north of East Gill Creek (AOC 4) and the wooded wetland (AOC 3) and east of the berm (AOC 1). A review of city tax and zoning maps revealed that the northern aspect was once targeted for residential development. Anecdotal reports from area residents suggest that the northern aspect was subjected to illegal landfilling throughout the years. These reports were later confirmed when drums containing chemical wastes were discovered and removed from the area during the EPA removal actions in 1989.

The initial site characterization's geophysical survey indicated several subsurface anomalies in the northern aspect. Test pits, located to correlate with the geophysical anomalies, were excavated during field data collection activities and unearthed several isolated pockets of miscellaneous trash, scrap metal, and stained fill material.

CDM Federal completed 16 soil borings in the northern aspect and collected a surface and subsurface soil sample from each boring location. Two surface soil samples were collected from a soil mound located in the eastern portion of the AOC. Additionally, CDM Federal collected one soil sample from each of the ten test pit locations. A total of 18 surface soil and 26 subsurface soil samples were collected from the northern aspect.

It should be noted that some of the analytical results contained within this data set were qualified as estimated during data validation review. Data was estimated due to exceeded quality control criteria including holding time exceedances and poor surrogate recovery. Although the data was estimated, it was still determined to be usable.

Based upon review of the analytical results, CDM Federal identified the targeted organics perylene and 2-anilinobenzothiazole, as well as, benzo(a)pyrene, dibenzo(a,h)anthracene, barium, beryllium, nickel, and mercury as surface soil contaminants of concern. The targeted organic compounds perylene, 2-anilinobenzothiazole, diphenylamine, 2-mercaptobenzothiazole, aniline, phenothiazine, and benzothiazole, as well as, phenol, benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, arsenic, chromium, nickel, mercury, vanadium, and selenium were identified as subsurface soil contaminants of concern. Table 4-15 summarizes the surface and subsurface soil contaminants of concern detected in the northern aspect.

4.2.3.1 Surface Soil

Organic Compounds

Targeted Organic Compounds - Figure 4-5 illustrates all targeted organic compound detections present in the surface soil samples collected in the northern aspect. Perylene, detected twice, and 2-anilinobenzothiazole, detected once, were the only targeted organic compounds detected in the northern aspect surface soil samples. The highest perylene detection was observed in SS01 (0.0 to 0.5 feet) the surface soil sample collected from the south side of the soil mound. The sole detection of 2-anilinobenzothiazole (80 ppb) was noted in DP029-SS. Sample DP029-SS was located adjacent to the berm and south of berm sample BERM 3.

Volatile Organic Compounds - Methylene chloride and acetone were detected in several samples. The observed concentrations, however, were all qualified during data validation activities as laboratory blank contamination.

Semivolatile Organic Compounds - Figure 4-5 also illustrates the semivolatile compounds detected in northern aspect surface soil samples at concentrations that exceeded screening criteria. Benzo(a)pyrene, detected four times, was noted in samples SS01 and SS02 at concentrations that exceeded its NYS TAGM criteria. SS02 (0.0-0.5' BGS) was the surface soil sample collected from the north side of the soil mound. Dibenzo(a,h)anthracene was detected in samples DP023-SS (0.0-2.00' BGS) and DP025-SS (0.0 to 2.00' BGS) at concentrations above the compound's screening criteria. The semivolatile compounds were detected in the surface soil samples at concentrations that exceeded screening criteria by up to four times. Sample DP023-SS was located adjacent to the berm and approximately 100 feet southeast of berm sample BERM4. DP025-SS was located approximately 210 feet east of the berm and approximately 70 feet northeast of sample BERM4.

Several semivolatile PAHs including phenanthrene, fluoranthene, chrysene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene were detected in several of the surface soil samples. All observed compounds were detected at levels below their respective screening criteria. The majority of detections were present in samples SS01, SS02, DP023-SS, and SB018-SS (0.0-2.00' BGS). SB018-SS was located in the northernmost part of the AOC, approximately 150 feet northeast of sample BERM1.

Pesticide and PCB Compounds - Several pesticides, including alpha-BHC, heptachlor epoxide, dieldrin, beta-BHC, delta-BHC, alpha-chlordane, gamma-chlordane, endosulfan sulfate, 4,4-DDE, and 4,4-DDT, were detected in numerous surface soil samples. The PCB compounds Aroclor 1248 and Aroclor 1254 were each detected once. All detected concentrations were below NYS TAGM screening criteria.

Inorganic Analytes

Figure 4-6 illustrates the inorganic analytes detected in the northern aspect surface soil samples at concentrations that exceeded background screening criteria. Barium was detected in all of the surface soil samples with 14 of the detections noted to exceed the analyte's background criteria. The highest barium concentration was noted in DP023-SS. Beryllium was detected in 11 samples with six of the observed concentrations noted to exceed the analyte's screening criteria. The highest concentration of all three analytes was noted in sample DP023-SS. Mercury was detected in four of the samples at concentrations that exceeded the analyte's NYS TAGM cleanup objective. Only one of the detections, however, exceeded the analyte's background screening criteria. The highest mercury detection was noted in sample SB018-SS. Inorganic COCs were detected at concentrations that exceeded their respective screening criteria by up to one to two times.

Aluminum, iron, potassium, manganese and sodium were detected in the majority of the surface soil samples with many of the detections noted to exceed background screening criteria. CDM Federal did not consider these analytes as COCs since they are commonly occurring elements that are ubiquitous in soils. Thallium, vanadium, copper, cobalt, and chromium were commonly detected with sporadic concentrations noted to exceed background screening criteria. Due to the infrequency of screening criteria exceedances, these analytes were not evaluated as COCs. Finally, several inorganics including lead, arsenic, calcium, and zinc were frequently detected at concentration below screening.

4.2.3.2 Subsurface Soil

Organic Compounds

Targeted Organic Compounds - Figures 4-7 and 4-8 illustrate all targeted organic compounds detected in the northern aspect subsurface soil boring and test pit samples. Targeted organic compounds were detected to concentrations of 27,000 ppb. Perylene and 2-anilinobenzothiazole were each detected in three of the subsurface soil samples. The highest observed concentration of perylene was detected in sample TPEXP (0.0-6.00' BGS). Test pit TPEXP was located adjacent and perpendicular to the berm and was just slightly northeast of location BERM3. The highest concentration of 2-anilinobenzothiazole was detected in TP09 (0.0-2.00' BGS). Test Pit TP09 was located adjacent and parallel to the berm and directly east of location BERM5. Diphenylamine, benzothiazole, and N,N-diphenyl-1,4-benzenediamine were each detected twice with the highest concentration of each compound noted in TPEXP. Aniline, 2-mercaptobenzothiazole, and phenothiazine were also each detected twice with their respective highest concentrations detected in test pit TP09. Both samples contained black stained fill material with black plastic-like pieces noted in the TP09 sample. Targeted organic compound detections were limited to those sample locations in closest proximity to the berm and include SB03, TP01, TP03, TP09, and TPEXP.

Volatile Organic Compounds - Methylene chloride, acetone, carbon disulfide, and total xylene were detected in several of the subsurface soil samples. All observed compounds were detected at concentrations below their respective screening criteria.

Semivolatile Organic Compounds - Figures 4-7 and 4-9 illustrate the semivolatile compounds detected in northern aspect subsurface soil boring samples at concentrations that exceeded screening criteria. Semivolatile organic COCs were detected at concentrations that exceeded TAGM screening criteria by more than 40 times. Benzo(a)pyrene was detected in five of the subsurface soil samples at concentrations that exceeded its screening criteria. Benzo(a)anthracene was detected in five samples with two of the concentrations noted to exceed its screening criteria. Chrysene, benzo(b)fluoranthene, and benzo(k)fluoranthene were each detected in five of the samples. Only one detection of each of the compounds was noted to exceed their respective screening criteria. Dibenzo(a,h)anthracene was detected twice with both concentrations noted to exceed the compound's screening criteria. The highest detections of each of the aforementioned compounds were noted in sample TPEXP. Phenol was detected in two samples with concentrations that exceeded the compound's screening criteria. The highest phenol detection was observed in TP01 (0.0- 4.00' BGS). TP01 was located approximately 60 feet east of the berm and approximately 70 feet northeast of sample location BERM1 and consisted of moist green stained clay mixed with asphalt and black stained fill material.

Several semivolatile organic compounds including 1,2,4-trichlorobenzene, phenanthrene, anthracene, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene were detected in subsurface soil samples at concentrations below their respective screening criteria. The highest concentrations of these compounds were detected in samples TPEXP or TP01. Overall, semivolatile detections were generally confined to samples collected from DP023 (10.00-12.00' BGS), SB03 (12.00-14.00' BGS), TP01, TP03 (5.5-6.00' BGS), TP08 (0.0 to 6.00' BGS), TP09 and TPEXP.

Pesticide and PCB Compounds - Several pesticides, including alpha-BHC, heptachlor, dieldrin, beta-BHC, aldrin, delta-BHC, alpha-chlordane, gamma-chlordane, endosulfan sulfate, 4,4'-DDE, and 4,4'-DDT, were detected in numerous subsurface soil samples. The PCB compound Aroclor 1248 was detected once. All detected concentrations were below NYS TAGM screening criteria.

Inorganic Analytes

Figures 4-10 and 4-11 illustrate the inorganic analytes detected in the northern aspect subsurface soil boring and test pit soil samples at concentrations that exceeded background screening criteria. Nickel was detected in all of the samples with 10 of the detections exceeding the analyte's background screening criteria. Vanadium was detected in all of the samples with eight of the observed concentrations noted to exceed background criteria. Arsenic was detected in 25 of the samples with seven of the detections that exceeded the analyte's background criteria. The highest nickel, vanadium, and arsenic concentrations were noted in sample TPEXP. Mercury was detected in four samples with three of the observed concentrations exceeding the NYS TAGM soil cleanup objective for the analyte. The highest mercury detection exceeded the TAGM soil cleanup objective by more than 25 times. Selenium was detected in 11 samples with five

detections exceeding the analyte's NYS TAGM soil cleanup objective. Neither mercury nor selenium was detected in CDM Federal's background subsurface soil samples. The highest concentration of both analytes was detected in sample TP09. Chromium was detected in 15 samples with five of the observed concentrations exceeding the analyte's background screening criteria. The highest chromium detection was noted in sample DP032 (8.00-10.00' BGS). DP032, a moist reddish brown clay, was collected from drive point boring DP032, which was located approximately 110 feet east of the berm. Subsurface inorganic COCs exceeded their background criteria by one to two times.

Several analytes, including aluminum, barium, beryllium, cobalt, copper, iron, lead, magnesium, potassium, and sodium were commonly detected with sporadic concentrations exceeding background screening criteria. Due to the infrequency of screening criteria exceedances and because many of these elements are ubiquitous in soil, these analytes were not evaluated as COCs. Several inorganics, including calcium, cadmium, manganese, and zinc, were frequently noted in the surface soil samples, but were consistently detected at concentrations below screening criteria.

4.2.3.3 Summary of Contamination

Surface soil contamination in the northern aspect was limited to only sporadic semivolatile and targeted organic compound detections. Inorganic detections in the surface soil were more frequent, with the highest contaminant concentrations usually detected in the sample locations that were in closest proximity to the berm.

Targeted organic compounds were detected in the northern aspect fill at concentrations ranging to 27,000 ppb (2-anilinobenzothiazole) while PAH detections exceeded TAGM screening levels by more than 40 times (benzo(a)pyrene). Inorganic analytes in this area were generally detected at concentrations between one or two times above the background screening criteria. However, mercury concentrations in the fill ranged over 25 times the TAGM cleanup objective. The volume of soil requiring remediation in this area will be evaluated further during the FS.

Organic and inorganic contaminant detections and concentrations, as well as screening criteria exceedances, increased in some cases by an order of magnitude in subsurface samples. Generally, the highest observed contaminant concentrations and screening criteria exceedances were noted in samples associated with fill material. Fill material was primarily observed in test pit sample locations in close proximity to the berm. Fill material was observed to depths of 6.00' BGS, therefore, screening criteria exceedances and contaminant detections were generally limited to samples collected from depths to 6.00' BGS. Contaminant detections, however, were noted to depths of 14.00' BGS. Figures 4-12 and 4-13 illustrate the extent of the fill material in the northern aspect. Refer to Figure 4-13 for the locations of the cross sections.

4.2.4 AOC 3 - WOODED WETLAND

AOC 3, the 11.5-acre wooded wetland, is located in the southeastern portion of the northern aspect (AOC 2), north of East Gill Creek (AOC 4) and west of the end of the Service Road. Household trash, discarded tires, and black plastic-like material (commonly associated with fill found in the subdivision) were present in this area during CDM Federal's sampling activities. An intermittent steambed exists in this area and is a potential contaminant migration pathway to East Gill Creek. CDM Federal collected ten sediment samples from the intermittent streambed at a depth of zero to 0.50'.

It should be noted that some of the analytical results contained within this data set were qualified as estimated during data validation review. Data was estimated due to exceeded quality control criteria, including holding time exceedances, poor surrogate recovery, and rejected internal standards. Although the data was estimated, it was still determined to be usable.

Based upon review of the analytical results, CDM Federal identified perylene, benzo(b)fluoranthene, benzo(k)fluoanthene, benzo(a)pyrene, chrysene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, fluoranthene, pyrene, benzo(a)anthracene, 4,4'-DDE, Aroclor 1254, alpha-BHC, beta-BHC, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc as contaminants of concern for AOC 3. Table 4-16 summarizes the AOC 3 contaminants of concern.

4.2.4.1 Organic Compounds

Targeted Organic Compounds - Figure 4-14 illustrates the targeted organic compounds detected in the wooded wetland samples. Perylene was detected in all ten of the wooded wetland samples with its highest concentration noted in WTSD10. The sample was collected from the northeastern portion of the wooded wetland. All of the perylene concentrations detected in the wooded wetland were noted to exceed background values.

Volatile Organic Compounds - The volatile organic compound 1,1,1-trichloroethane was detected in two of the wooded wetland samples. Both sample detections were observed at concentrations less than the compound's background value.

Semivolatile Organic Compounds - Figure 4-14 also illustrates the semivolatile organic compounds detected in the wooded wetland samples at concentrations that exceeded screening criteria. The highest contaminant levels were generally detected in samples WTSD05 and WTSD06, which were collected from the center of the wooded wetland.

Chrysene, detected in all ten samples with the highest concentration in sample WTSD06, exceeded its Ontario MEE sediment screening value in nine samples. Benzo(b)fluoranthene was detected in all ten of the samples with the compound's NYSDEC sediment screening value exceeded in one sample. Benzo(k)fluoranthene was detected in all ten samples with all of the observed concentrations noted to exceed the Ontario MEE sediment screening criteria.

Benzo(g,h,i)perylene was noted in all ten samples with nine detections that exceeded the compound's Ontario MEE sediment screening value. Benzo(a)pyrene was detected in all ten of the samples with four detections noted to exceeded the Ontario MEE sediment screening value. Fluoranthene, detected in all ten samples, exceeded the Ontario MEE sediment screening value. Pyrene was detected in all ten samples with three concentrations exceeding the Ontario MEE sediment screening criteria. The highest concentrations of the aforementioned compounds were detected in WTSD06. Indeno(1,2,3-cd)pyrene was detected in all ten of the samples with seven of the observed concentrations exceeding the compound's Ontario MEE screening criteria. The highest concentration of the compound was detected in WTSD05. Benzo(a)anthracene, detected in all ten of the samples, exceeded its respective Ontario screening criteria in four samples. The highest concentration was detected in WTSD05 and WTSD06. Dibenzo(a,h)anthracene was detected in two samples with the highest concentration, reported in WTSD02, noted to exceed the Ontario MEE criteria.

Carbazole, di-n-butylphthalate, butylbenzylphthalate, and bis(2-ethylhexyl)phthalate were detected in samples at concentrations that exceeded their respective average background values. None of the four compounds, however, possess corresponding NYSDEC or Ontario MEE sediment screening criteria. These compounds were not evaluated as COCs due to their infrequent detections and low concentrations.

Pesticide/PCB Compounds - Figure 4-14 also illustrates the pesticide/PCB compounds detected in the wooded wetland sediment samples at concentrations that exceeded screening criteria. Aroclor1254, detected in seven samples, exceeded the NYSDEC and Ontario MEE sediment screening criteria at five locations with its highest concentration in WTSD02, WTSD06, and WTSD08. Aroclor1254 was not detected in the background wetland sediment samples. The DDT metabolite 4,4'-DDE was detected in eight samples, with the highest concentration observed at WTSD03. Four detections of the compound exceeded the Ontario MEE screening value while the NYSDEC sediment screening criteria was exceeded once. Two of the 4,4'-DDE concentrations exceeded the background criteria. Beta-BHC was detected in two samples, with the highest concentration reported in sample WTSD03, at concentrations that exceeded the Ontario MEE sediment screening value. Alpha-BHC was detected in all of the wooded wetland samples at concentrations above the compound's nondetected background level. The highest concentration of the compound was noted in WTSD03.

Other frequently detected pesticides included delta-BHC, heptachlor epoxide, 4,4'-DDT, endrin ketone, and alpha-chlordane. These compounds, while detected in several samples at concentrations that exceeded background criteria, were not evaluated as COCs since they were detected at relatively low concentrations.

4.2.4.2 Inorganic Analytes

Figure 4-15 illustrates the inorganic analytes detected in the wooded wetland sediments at concentrations that exceeded screening criteria. Chromium, copper, lead, mercury, nickel, and zinc were detected in every wooded wetland sample at levels exceeding their respective NYSDEC

and Ontario MEE sediment screening criteria. However, only one mercury detection and five zinc detections exceeded their respective background criteria. Cadmium was detected in seven samples with all detections exceeding the analyte's NYSDEC and Ontario MEE screening criteria. Six of the cadmium detections exceeded the background criteria. Arsenic was detected in all 10 of the samples, with four of the observed concentrations exceeding the NYSDEC and Ontario MEE sediment screening criteria. Silver was detected in four samples with all detections exceeding the analyte's NYSDEC sediment screening criteria. It should be noted, however, that the concentrations of arsenic, chromium, copper, lead, nickel, and silver detected in the wooded wetland sediment samples were below the background values for those analytes.

Manganese was detected in one sample at a concentration that exceeded the analyte's screening criteria. Additionally, magnesium, sodium, and thallium were detected in several samples at levels greater than two times their respective background levels. Due to the infrequency of screening criteria exceedances and because several of these elements are ubiquitous to soil, these analytes were not evaluated as COCs. Aluminum, barium, calcium, iron, and potassium were also present in several of the wetland sediment samples at concentrations below background criteria.

4.2.4.3 Summary of Contamination

In general, PAH, pesticide, and PCB contamination was found throughout the wooded wetland. The highest semivolatile organic compound concentrations were generally from locations WTSD05 and WTSD06. No pattern for inorganic contamination was observed in the wooded wetland. Several inorganic analytes were detected at concentrations above their respective NYSDEC and Ontario MEE sediment screening criteria. However, it should be noted that most of the wooded wetland inorganic detections were below their respective background detections.

4.2.5 AOC 4 - EAST GILL CREEK

East Gill Creek (AOC4) is a narrow, shallow, low flowing creek that serves as the subdivision's northern boundary. Aerial photographs indicate that sometime in the late 1960's, a section of the creek was rerouted from its original location, the area now between Lisa Lane and Carrie Drive, 400 feet north to its current location. The creek flows on site from the east after being directed under Interstate-190 by a series of culverts. It then flows westward across the northern portion of the subdivision and is directed offsite through a culvert which allows it to pass under the Conrail Railroad yard. The creek ultimately emerges through another culvert located west of the railroad yard before it is directed underground through another westward flowing culvert. Subdivision surface runoff is directed into the creek via two outfalls.

CDM Federal collected sediment and surface water samples from four onsite creek locations during each of two sampling rounds: Round 1, August 1995, and Round 2, November 1995. One of the onsite sample locations, GCSW/SD1, was designated as a background location because of its position upstream of site influences. Based on Round 1 analytical results, CDM Federal determined it was necessary to sample an additional, off-site, downstream sample location

(GCSW/SD6) during Round 2. Surface water samples were collected first from the sampling locations. Sediments then were collected from a depth of zero to 6 inches.

It should be noted that some of the analytical results contained within this data set were qualified as estimated during data validation review. Data was estimated due to exceeded quality control criteria, including holding time exceedances and poor spike and surrogate recovery. Although the data was estimated, it was still determined to be usable.

Based upon review of the analytical results, CDM Federal identified diphenylamine, 2-mercaptobenzothiazole, 2-anilinobenzothiazole, perylene, N,N-diphenyl-1,4-benzendiamine, phenothiazine, benzothiazole, dibenzo(a,h)anthracene, phenanthrene, benzo(a)anthracene, anthracene, chrysene, benzo(g,h,i)perylene, arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, and zinc as contaminants of concern for sediment. AOC4 surface water COCs included alpha-BHC, beta-BHC, aluminum, cobalt, iron, selenium, vanadium, zinc, copper, and cyanide. Tables 4-17 and 4-18 summarize the contaminants of concern for East Gill Creek sediment. Tables 4-19 and 4-20 summarize the contaminants of concern for East Gill Creek surface water.

4.2.5.1 Sediment Contamination

Organic Compounds

Targeted Organic Compounds - Figure 4-16 illustrates all targeted organic compounds detected in the Round 1 sediment samples. 2-Anilinobenzothiazole was detected in samples GCSD3 and GCSD4. Benzothiazole, 2-mercaptobenzothiazole, and N,N-diphenyl-1,4-benzendiamine were each detected once in sample GCSD4. Perylene was detected in GCSD4 and in the background sample. With the exception of perylene, no targeted organic compounds were detected in the background sample. The highest targeted organic compound detections ranging to 6,000 ppb, were noted in the downstream sample, GCSD4.

Figure 4-17 illustrates all targeted organic compounds detected in the Round 2 sediment samples. 2-Anilinobenzothiazole was detected in all of the downstream sediment samples, with the highest concentration noted in GCSD4. Perylene was detected in three of the downstream samples and in the upstream background sample. The highest perylene detection was observed in GCSD6. Benzothiazole was detected in two samples with the highest concentration noted in GCSD4. N,N-diphenyl-1,4-benzendiamine was detected twice, with the highest concentration noted in GCSD6. 2-Mercaptobenzothiazole and phenothiazine were each detected once in GCSD4. With the exception of perylene, no targeted organic compounds were noted in the background sediment sample. Targeted organic detections in Round 2 ranged to concentrations of 81,000 ppb in the downstream samples.

The number of targeted organic compounds and their respective concentrations were noted to increase in Round 2. The additional detections, and the highest compound concentrations, were primarily noted in the two most downstream samples, GCSD4 and GCSD6.

Volatile Organic Compounds - Acetone, carbon disulfide, and 2-butanone were sporadically detected in Round 1 sediment samples at relatively low concentrations; however, some of the detections were noted to exceed background criteria. These compounds were not evaluated as COCs since they were either infrequently detected or were detected at relatively low concentrations. The highest detection of the compounds were noted in sample GCSD4.

Acetone and methylene chloride were detected in several of the Round 2 sediment samples at relatively low concentrations.

Semivolatile Organic Compounds - Several semivolatile PAHs, including fluoranthene, pyrene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, and benzo(a)pyrene were noted in all four of the Round 1 sediment samples. The highest concentrations of each of these compounds were detected in GCSD1, the upstream sediment sample, which suggests a possible offsite source for these contaminants. As these compounds are also site-specific, site contribution to onsite sediment contamination can not be dismissed. It should be noted that many of the background detections exceeded Ontario MEE sediment screening criteria.

Figure 4-16 illustrates the semivolatile organic compounds detected in Round 1 at concentrations above screening criteria. Dibenzo(a,h)anthracene was noted in all downstream samples with all three detections exceeding the Ontario MEE criteria. Phenanthrene was detected in all three downstream samples with the highest concentration noted to exceed its Ontario MEE criteria. Benzo(a)anthracene wad detected in all three downstream samples at concentrations that exceeded the Ontario MEE criteria. Anthracene, noted in one downstream sample, was present at a concentration that exceeded the Ontario MEE screening value. The highest concentrations of all of the aforementioned compounds were detected in GCSD4. Additionally, single detections of several compounds, that do not have screening criteria, including, phenol, 4-methylphenol, 2,4-dimethylphenol, carbazole, and dibenzofuran were also noted in GCSD4.

In Round 2, several semivolatile PAHs, including acenaphthene, fluoranthene, phenanthrene, pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(a)pyrene were present in the majority of the downstream sediment samples. However, the highest concentration of all of these compounds were detected in GCSD1, the upstream sediment sample, which suggests a potential offsite source of these compounds. As these compounds are also site-specific, site contribution to the onsite sediment contamination cannot be dismissed. It should be noted that many of the background detections exceeded Ontario MEE screening criteria.

Figure 4-17 illustrates the semivolatile organic compounds detected in Round 2 sediment samples at concentrations above screening criteria. Benzo(g,h,i)perylene was detected in all four downstream sediment samples with three of the concentrations exceeding the Ontario MEE screening criteria for the compound. Benzo(a)anthracene was detected in two downstream samples at concentrations that exceeded its Ontario MEE screening value. The highest detection of both compounds was noted in GCSD6. Chrysene was detected in all of the downstream samples with

the highest concentration noted in GCSD4. Three of the four chrysene detections exceeded the compound's Ontario MEE screening criteria.

Several compounds, that have no screening criteria, were detected in the downstream samples, GCSD4 and GCSD6, at concentrations above background values. These compounds include phenol, z-methylphenol, 4-methylphenol, acenapthylene, and dibenzofuran.

The number of semivolatile organic compound detections and their respective concentrations increased in Round 2. The additional detections, and the highest compound concentrations, were primarily found in the two most downstream samples, GCSD4 and GCSD6.

Pesticide/PCB Compounds - Six pesticides, including alpha-BHC, beta-BHC, endosulfan II, endosulfan sulfate, 4,4'-DDT, and gamma-chlordane, were detected in several of the Round 1 sediment samples. The maximum pesticide detections were generally in samples GCSD2 and GCSD4. None of the detected pesticide concentrations exceeded the NYSDEC sediment criteria or background values. Beta-BHC was, however, detected in and exceeded its Ontario MEE sediment screening criteria at all three Round 1 downstream samples.

The pesticide 4,4'-DDT was detected in the Round 2 GCSD4 sample at a concentration that exceeded both its NYSDEC and Ontario MEE sediment criteria and its background value. As the compound was not detected in Round 1; it was not evaluated as a contaminant of concern due its infrequent detection. No other pesticide or PCBs compounds were detected in Round 2.

Inorganic Analytes

Figure 4-18 illustrates the inorganic analytes detected in the Round 1 sediment samples at concentrations above screening criteria.

Nine inorganic analytes were detected in the majority of Round 1 downstream sediment samples at concentrations that exceeded their corresponding NYSDEC and Ontario MEE sediment screening criteria. These analytes include arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, and zinc. It should be noted that only one concentration of manganese, detected in GCSD4, was observed to exceed background criteria.

Aluminum, barium, beryllium, cobalt, iron, potassium, and vanadium were also detected in several samples at concentrations below background values.

Figure 4-19 illustrates the inorganic analytes detected in the Round 2 sediment samples at concentrations above screening criteria. Arsenic, chromium, copper, lead, manganese, mercury, nickel, and zinc were detected in Round 2 downstream samples at levels that exceeded their corresponding NYSDEC and Ontario MEE sediment screening criteria. However, only arsenic, manganese, and zinc were observed at concenrations that exceeded their respective background screening criteria. The highest arsenic and zinc values were detected in GCSD2 while the maximum manganese concentration was noted in GCSD4. Manganese, magnesium, calcium,

cobalt, and potassium were also detected in several samples at concentrations that exceeded background values.

Inorganic analytical detections in the two sampling rounds were comparable. Generally, the detected inorganics were observed at concentrations below background screening criteria.

4.2.5.2 Surface Water

Organic Compounds

Targeted Organic Compounds - There were no targeted organic compounds detected in either round of East Gill Creek surface water samples.

Volatile Organic Compounds - Carbon disulfide, trichloroethene, and tetrachloroethene were each detected in one of the surface water samples. No volatile organic compounds were detected in the background sample. During Round 2, tetrachloroethene was the only volatile organic detected in the downstream surface water samples above background.

Semivolatile Organic Compounds - One semivolatile organic compound, diethylphthalate, was detected in a downstream sample during Round 1. In Round 1, single detections of phenanthrene, fluoranthene, chrysene, pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene were noted in GCSW1, the upstream sample. Fluoranthene and benzo(b)fluoranthene were each detected once in a downstream sample (GCSW4) during Round 2.

Pesticide/PCB Compounds - Two pesticides, alpha-BHC and beta-BHC, were detected in all three of the Round 1 downstream surface water samples, with the highest concentration in GCSW3. Both alpha-BHC and beta-BHC concentrations matched or exceeded the NYSDEC water quality screening criteria for total hexachlorocyclohexanes (BHCs). Both compounds were also observed at concentrations that matched or exceeded each analyte's respective background value.

Beta-BHC was detected in all four of the downstream Round 2 surface water samples, with the highest concentration in GCSW2. All of the beta-BHC concentrations exceeded the NYSDEC water quality screening criteria. Beta-BHC was not detected in the Round 2 background surface water sample.

Inorganic Analytes

Figure 4-18 illustrates the inorganic analytes detected in the Round 1 surface water samples at concentrations that exceeded screening criteria. The maximum detection of all the analytes was in GCSW2.

Aluminum, copper, cobalt, iron, lead, selenium, vanadium, and zinc were detected in the downstream Round 1 samples at concentrations that exceeded their respective NYSDEC water quality screening criteria. None of the detected analyte concentrations exceeded their respective

background concentrations, suggesting that a possible offsite source may have been responsible for the Round 1 inorganic surface water contamination. Additionally, contaminant concentrations decreased as the creek flowed through the site with the lowest levels noted in GCSW4. However, these contaminants are also site-specific. Therefore, site contribution to the onsite samples can not be dismissed.

Figure 4-19 illustrates the inorganic analytes detected in the Round 2 surface water samples at concentrations that exceeded screening criteria. Ten inorganic analytes and cyanide were detected in the downstream Round 2 surface water samples, with maximum detections generally noted in samples GCSW4 or GCSW6.

Aluminum, iron, and zinc were detected in all four surface water samples at concentrations that exceeded their respective NYSDEC water quality screening criteria. The highest concentration of all three analytes was observed in GCSW4. All of the observed concentrations of selenium, and cyanide, exceeded their respective NYSDEC screening criteria; with the highest concentration of both analytes in GCSW6. The background values for all of the analytes were exceeded in at least one sample. Manganese and chromium were detected in several samples, with sporadic concentrations exceeding their respective background concentrations.

4.2.5.3 Summary of Contamination

The highest detections of targeted organic and semivolatile PAH organic compounds were generally in the two downstream sediment samples, GCSD4 and GCSD6. As discussed in Chapter 3, East Gill Creek receives both storm water and surface water runoff from the site. Analytical results suggest that surface soil contamination has been transported, via storm water and surface water runoff, into East Gill Creek. As the highest contaminants have been observed in the downstream samples, it appears that East Gill Creek is acting as a transport mechanism which is permitting the offsite migration of organic contaminants. Inorganic analytes were detected in the majority of the East Gill Creek sediments. However, most observed detections were at concentrations below background screening values.

Surface water quality in East Gill Creek was generally characterized by pesticide concentrations at or exceeding NYSDEC surface water screening criteria. The two pesticides which exceeded the NYSDEC criteria, alpha-BHC and beta-BHC, were commonly detected in the wooded wetland (AOC 3) sediment samples. It is suspected that an intermittent stream located in the wooded wetland, which flows into East Gill Creek during certain times of the year, could be acting as a contaminant migration pathway. Inorganic analytes were commonly detected in both rounds of surface water samples. Several analytes were detected above NYSDEC screening levels. However, many of the detections were below background concentrations. However, these contaminants are also site-specific. Therefore, site contribution to the onsite samples can not be dismissed.

4.2.6 AOC 5 - EDGEWOOD DRIVE WOODED LOTS

AOC 5 consists of the wooded lots north and south of Edgewood Drive. The AOC is bordered by East Gill Creek (AOC 4) to the north, T Mark Drive to the west, the two permanent Edgewood Drive residences to the east, and an undeveloped wooded area to the south. The north lot is approximately 3 acres and is bounded to the north by East Gill Creek. The south lot area of concern is approximately 3.3 acres and extends approximately 250 feet south of Edgewood Drive. Historical reports, stressed vegetation, and visual contamination indicated that these lots had been subjected to illegal landfilling activities. Black stained soil and fill material detected during soil boring activities confirmed that both lots had historically been used for illegal landfilling.

CDM Federal completed seven soil borings in the lot north of Edgewood Drive and collected seven surface soil and five subsurface soil samples from those locations. Due to poor split spoon recovery, only surface soil samples were collected at two boring locations (SBEXP1, SB01). CDM Federal completed eight soil borings in the lot south of Edgewood Drive and collected nine surface and eight subsurface soil samples from those locations. The borings were terminated when the clay till was encountered in the split spoon sampler, generally at 8.00 -10.00' BGS. At locations where fill material was detected, borings were completed when native soil was first encountered in the split spoon sampler to limit the potential for contaminant migration. CDM Federal generally collected one surface and one subsurface soil sample from each boring location. One additional sample was collected from boring location SB14 where fill material and visual contamination were noted.

Some of the analytical results contained within this data set were qualified as estimated during data validation review. Data was estimated due to exceeded quality control criteria including holding time exceedances and poor spike recovery. Although the data was estimated, it was still determined to be usable.

Based upon review of the analytical data, CDM Federal identified the targeted organic compounds perylene, 2-mercaptobenzothiazole, 2-anilinobenzothiazole, N,N-diphenyl-1,4-benzenediamine, benzothiazole, and diphenylamine, as well as benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, arsenic, beryllium, lead, mercury, nickel, and vanadium as surface soil COCs for AOC 5. The targeted organic compound, perylene, and benzo(a)anthracene, chrysene, benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene, barium, beryllium, chromium, cobalt, lead, mercury, and nickel were identified as subsurface soil COCs for the Edgewood Drive wooded lots. Table 4-21 summarizes the surface and subsurface soil COCs detected in the Edgewood Drive wooded lots.

4.2.6.1 Surface Soil

Organic Compounds

Targeted Organic Compounds - Figure 4-20 illustrates all targeted organic compound detections in the surface soil samples collected in the Edgewood Drive wooded lots. Targeted organic concentrations in the surface soil ranged to 12,000 ppb. Perylene was detected in eight of the 16 samples, with its highest concentration in SB14-SS. SB14-SS, collected from 0.0-2.00' BGS, was located in the south lot, approximately 160 feet east of T Mark Drive and contained heavily stained black fill material. The compound 2-anilinobenzothiazole was detected twice, with its highest concentration also in sample SB14-SS. N, N-diphenyl-1,4-benzenediamine, benzothiazole, and diphenylamine were each detected in sample SB07-SS. SB07-SS, collected from 0.0-2.00' BGS, was located in the north lot, approximately 50 east of T Mark Drive and 40 feet north of Edgewood Drive. The sample was a silty clay mixed with black stained fill material and contained black plastic-like pieces. Additionally, 2-mercaptobenzothiazole was detected twice, with its highest concentration in sample SB04-SS, located approximately 50 feet east of T Mark Drive and 140 feet north of Edgewood Drive. This sample contained silty clay and black stained fill material.

Volatile Organic Compounds - Methylene chloride, a common laboratory contaminant, was detected once at a concentration that exceeded its NYS TAGM screening criteria. Additionally, toluene and 2-butanone were each detected once at concentrations below their respective screening criteria.

Semivolatile Organic Compounds - Figure 4-21 illustrates the semivolatile compounds detected in the Edgewood Drive surface soil samples at concentrations that exceeded screening criteria. Chrysene was detected in 10 of the 16 surface soil samples, with seven of the detections exceeding the compound's screening criteria. Benzo(a)anthracene, in eight of the surface soil samples, had seven detections that exceeded screening criteria. Benzo(b)fluoranthene and benzo(k)fluoranthene were detected in eight samples, with six detections exceeding each compound's respective screening criteria. Benzo(a)pyrene was detected in eight samples, with seven detections exceeding the compound's screening criteria. Dibenzo(a,h)anthracene was in six of the surface soil samples at concentrations that exceeded the compound's screening criteria. Indeno(1,2,3-cd)pyrene was detected in seven samples, with four concentrations exceeding the compound's screening criteria. Fluoranthene was observed in nine samples; three detections exceeded screening criteria.

The semivolatile COCs exceeded their respective screening criteria by more than 1100 times in the AOC 5 surface soil samples. The maximum detections of all eight semivolatile organic COCs were observed in the north lot sample, SB07-SS. While the AOC 5 COCs were detected in several of the north lot samples, the COC screening exceedances in the north lot were confined to samples SB07-SS and SBEXP-1-SS. Both of these sample locations were located approximately 50 feet east of T Mark Drive and 40 feet north of Edgewood Drive. SBEXP-1-SS consisted of black stained soil. Several COC exceedances were also noted in sample SB04-SS.

In the south lot, COC detections and exceedances were generally noted in samples SBCenter-SS, SB10-SS, SB13-SS, and SB14-SS. The highest contaminant levels were detected in sample SBCenter-SS. All four sample locations were no more than 160 feet east of T Mark Drive and 130 feet south of Edgewood Drive. All of the south lot surface soil samples were described as black stained fill material.

Several non-COC semivolatile organic compounds were frequently detected in the AOC 5 surface soil samples. Pyrene, phenanthrene, phenol, and 2-methylphenol were in several samples, with limited detections exceeding screening criteria. These compounds were not selected as COCs since their respective screening criteria were exceeded infrequently. Naphthalene, acenapthene, dibenzofuran, fluorene, anthracene, and benzo(g,h,i)perylene were frequently detected at concentrations below their respective screening levels.

Generally, in the north lot, non-COC detections were confined to samples SB04-SS, SB07-SS, and SBEXP-1-SS, with the highest concentrations observed in SB07-SS. In the south lot, the non-COC detections were generally limited to SB10-SS, SB13-SS, SB14-SS, and SBCenter-SS, with the highest concentrations noted in sample SBCenter-SS.

Pesticide/PCB Compounds - Several pesticides, including heptachlor, heptachlor epoxide, dieldrin, beta-BHC, endosulfan, endosulfan II, 4,4-DDE, and 4,4-DDT, were detected in numerous surface soil samples. All detected concentrations were below NYS TAGM screening criteria.

Inorganic Analytes

Figure 4-22 illustrates the inorganic analytes detected in the AOC 5 surface soil samples, at concentrations that exceeded background screening criteria. Nickel was detected in all of the surface soil samples with 14 of the observed concentrations noted to exceed the analyte's screening criteria. The highest nickel concentration was noted in the south lot sample SB10-SS. Mercury was detected in nine of the surface soil samples. Seven of the observed concentrations exceeded the NYSDEC cleanup objective; however, only three of the concentrations exceeded the analyte's background screening value. Lead was detected in all of the surface soil samples, with five concentrations exceeding background screening criteria. The highest detection of both lead and mercury was in sample SB14-SS. Arsenic, beryllium, and vanadium were detected in all of the surface soil samples, with six of the concentrations exceeding background screening criteria. The highest concentrations of arsenic, beryllium, and vanadium were in SBEXP-1-SS, SB12-SS, and SB10-SS, respectively. COC inorganics exceeded their respective background screening by two to five times.

In the north lot, the highest COC concentrations and screening criteria exceedances were limited to samples SB07-SS, SB04-SS, and SBEXP-1-SS. Screening criteria exceedances were also noted in samples SB05-SS and SB06-SS. In the south lot the highest COC concentrations and screening criteria exceedances were generally limited to SB10-SS, SB11-SS, SB-12-SS, SB-13-SS, SB-14-SS, and SBCenter-SS. Screening criteria exceedances were also noted in SB15-SS, SB16-SS, and SB-17-SS.

Several inorganic analytes, including cadmium, chromium, copper, iron, potassium, sodium and thallium were commonly detected, with sporadic concentrations exceeding background screening criteria. Due to the infrequency of screening criteria exceedances and because many of these elements are ubiquitous in soil, these analytes were not selected as COCs. Several inorganics including calcium, cobalt, magnesium, and zinc were frequently detected in the surface soil samples, but were consistently at concentrations below screening criteria.

4.2.6.2 Subsurface Soil

Organic Compounds

Targeted Organic Compounds - Figure 4-23 illustrates all targeted organic compound detections in the AOC 5 subsurface soil samples. Perylene, the only targeted organic compound in the subsurface soil, was detected in three of the 14 Edgewood Drive Lot samples. All three detections were in samples collected from borings SB14 and SBCenter with the highest concentration (6,800 ppb) in SBCenter(4.00 to 6.00 BGS). Both borings are located in the south lot and are approximately 160 feet east of T Mark Drive and 130 feet south of Edgewood Drive. Both samples contained black stained clay.

Volatile Organic Compounds - Toluene and 2-butanone were each detected once at concentrations below their respective NYS TAGM screening criteria.

Semivolatile Organic Compounds - Figure 4-23 also illustrates the semivolatile compounds detected in the AOC 5 subsurface soil samples at concentrations that exceeded screening criteria. Benzo(b)fluoranthene and benzo(k)fluoranthene were detected in six of the 14 subsurface soil samples, with two concentrations exceeding each of the compound's respective screening criteria. Benzo(a)anthracene, chrysene, and benzo(a)pyrene were detected in five of the subsurface soil samples. Two of the detected concentrations of both benzo(a)anthracene and chrysene and three benzo(a)pyrene exceeded their respective screening criteria. Semivolatile COC detections were limited to the north lot sample SB04 and south lot samples SB10, SB13, SB14A, SB14, and SBCenter. However, the highest concentrations of the COC semivolatiles were noted in sample SBCenter (4.00-6.00' BGS). Semivolatile COC concentrations exceeded TAGM screening by up to 250 times.

Pentachlorophenol was detected in sample SB17(10.00-12.00'BGS) at a concentration that exceeded its NYS TAGM screening criteria. Since detections of this compound were limited to this one location, it was not selected as a COC.

Several non-COC semivolatile compounds were also detected in the subsurface soil samples at concentrations below screening criteria. As with the COCs, the non-COC detections were generally limited to samples collected from the western end of both lots, with the highest concentrations in sample SBCenter (4.00-6.00' BGS). Overall, semivolatile organic concentrations, both COCs and non-COCs, were noted to decrease with depth.

Pesticide and PCB Compounds - The following pesticides were sporadically detected in the subsurface soil samples: alpha-BHC, delta-BHC, gamma-BHC, dieldrin, 4,4'-DDE, endosulfan sulfate, endrin aldehyde, and gamma-chlordane. All detected concentrations were below screening criteria.

Inorganic Analytes

Figure 4-24 illustrates inorganic analytes that were detected in the AOC 5 subsurface soil samples at concentrations that exceeded background screening criteria. Nickel was detected in all of the subsurface soil samples, with nine detections exceeding the analyte's background screening criteria. Mercury was detected in five of the subsurface soil samples; all of the observed concentrations exceeded the NYSDEC TAGM soil cleanup objective. Mercury was not detected in CDM Federal's subsurface background samples. The highest nickel and mercury concentrations were detected in sample SBCenter. Cobalt was detected in all of the samples, with five of the observed concentrations exceeding the analyte's background screening criteria. Chromium was detected in all of the samples; four detections exceeded screening criteria. The highest concentrations of chromium and cobalt were detected in sample SB14A(4.00-6.00' BGS). Sample SB14A was a black stained fill material mixed with white powder. Beryllium was detected in all samples, with five detections exceeding the analyte's screening criteria. Barium was also detected in all of the samples, with four of the observed detections exceeding the analyte's background criteria. The highest concentration of both analytes was detected in sample SB13(6.00-8.00' BGS). Sample SB13 consisted of black stained clay.

Inorganic COCs were generally detected at concentrations that exceeded background by one to three times. The highest COC concentrations and screening criteria exceedances were generally in south lot samples. COC detections and exceedances were observed in samples SB10, SB13, SB14, SB14A, SB15, SB16, SB17, and SBCenter. In the north lot, the highest COC concentrations and screening criteria exceedances were generally limited to samples SB04 and SB05.

Several analytes, including aluminum, arsenic, barium, cadmium, copper, iron, lead, and vanadium, were commonly detected, with sporadic concentrations exceeding background screening criteria. Due to the infrequency of screening criteria exceedances and because many of these elements are ubiquitous to soil, these analytes were not evaluated as COCs. Several inorganics including calcium, magnesium, potassium, sodium, and zinc were frequently detected in the subsurface soil samples, but at concentrations below screening criteria.

4.2.6.3 Summary of Contamination

Surface soil contamination in AOC 5 was primarily characterized by semivolatile PAHs at concentrations above the NYS TAGM screening criteria including, benzo(a)pyrene, concentrations over 1400 times the screening criteria, dibenzo(a)anthracene, concentrations over 1100 times the screening levels, benzo(a)anthracene, concentrations over 440 times the screening criteria, and chrysene, concentrations over 230 times the screening criteria. In the north lot, semivolatile

contamination was generally confined to sample locations SB04-SS, SB07-SS and SBEXP-1-SS. These three borings, all located in the north lot's southwestern corner, represent an area of approximately 70 feet by 100 feet. In the south lot, contamination was primarily detected in samples SBCENTER-SS, SB10-SS, SB13-SS, and SB14-SS. These locations in the western end of the south lot closest to T Mark Drive, represent an area of approximately 160 feet by 150 feet. These surface soil samples, collected from 0.0-2.00' BGS, all contained silty clay mixed with black stained fill material.

Inorganic surface soil contamination was noted throughout the AOC. In the north lot, the highest COC concentrations were detected in samples collected from the western end of the lot closest to T Mark Drive. Contaminant detections and screening exceedances were noted, however, in samples collected from throughout the north lot. COC screening exceedances were also noted in samples collected from throughout the south lot. The highest contaminant levels, however, were generally detected in samples collected from the western end of the south lot. In both lots, contaminant levels were highest in those samples associated with the black stained fill. Inorganic analytes in this area were generally detected at concentrations between two to five times above the background screening criteria.

Semivolatile PAH contaminant levels generally decreased in the subsurface soil. As with the surface soil, contaminant detections were generally limited to samples collected from the western end of both lots and were associated with heavily stained fill material. Contaminant screening exceedances, however, were noted only in south lot samples SB14A, SB14, and SBCenter. PAH compounds detected above TAGM soil cleanup objectives included, benzo(a)pyrene, concentrations over 680 times above its screening criteria, benzo(a)anthracene, concentrations up to 250 times its screening criteria, chrysene, concentrations up to 125 times above its criteria, benzo(b)fluoranthene, concentrations over 80 times above its criteria, and benzo(k)fluoranthene, concentrations over 70 times above its screening criteria.

Inorganic subsurface soil contamination was widespread in both lots, with the highest COC concentrations and screening criteria exceedances generally noted in the south lot. As with the surface soil, the highest contaminant levels were detected in those samples associated with fill material. Inorganic analytes in this area were generally detected at concentrations between one to three times above the background screening criteria.

Generally, the highest levels of contamination were in the AOC's surface soil and were associated with fill material. Fill material and stained clay was noted to extend 4.00' BGS in the north lot and to 6.00' BGS in the south lot. Contaminant levels were observed to decrease in samples collected from beneath the fill and stained clay layer. However, screening criteria exceedances were noted to depths of 10.00-12.00' BGS. The volume of soil in these areas to be remediated will be further evaluated during the FS.

The horizontal and vertical extent of the fill material in the north and south lots is illustrated on Figures 4-25 and 4-26, respectively. Figure 4-27 illustrates the areal extent of the fill material within AOC 5. Refer to Figure 4-27 for the cross-section locations.

4.2.7 AOC 6 - SUBDIVISION

This AOC includes the abandoned residential subdivision which is located in the southeast corner of the site and consists of 51 mobile homes situated on 10 acres. It is bounded by T Mark Drive to the east, the Conrail Railroad yard to the west, Lisa Lane to the south, and East Gill Creek (AOC 4) to the north and accessed via Edgewood Drive.

Historical reports of illegal landfilling and resident complaints of waste materials in the surface soils were later confirmed by EPA site investigations conducted in the late 1980s. Analytical results from the EPA studies indicated extensive soil contamination extending from the northern portion of Lisa Lane to the subdivision's northern boundary at East Gill Creek.

CDM Federal's field investigation also served to confirm the historical reports. Areas of black stained fill and elevated contaminant concentrations were delineated in the northern end of the subdivision. CDM Federal collected 26 subsurface soil samples from 22 soil borings from locations throughout the subdivision. Borings were terminated when clay till was encountered, generally at 10.00 to 12.00' BGS, in the split spoon sampler. CDM Federal collected one analytical sample from each boring location and an additional sample from four borings where fill material and visual contamination were noted. Surface soil samples were also collected from four of the boring locations.

CDM Federal also collected 10 surface soil samples from locations previously sampled during EPA investigations, where elevated levels of contamination had been detected. Four surface soil samples were collected from the two covered piles of soil and waste that are located along the Carrie Drive cul-de-sac.

It should be noted that some of the analytical results contained within this data set were qualified as estimated during data validation review. Data was estimated due to exceeded quality control criteria including poor surrogate recovery and laboratory blank contamination. Although the data was estimated, it was still determined to be usable.

Based upon review of the analytical results, CDM Federal identified the targeted organic compounds 2-mercaptobenzothiazole, perylene, 2-anilinobenzothiazole, benzothiazole, N,N-diphenyl-1,4-benzenediamine, diphenylamine, phenyl isothiocynate, and phenothiazine, as well as, benzo(a)pyrene, benzo(a)anthracene, chrysene, dibenzo(a,h)anthracene, benzo(k)fluoranthene, benzo(b)fluoranthene, phenol, 2-methylphenol, cobalt, copper, mercury, and beryllium as surface soil contaminants of concern. The target organic compounds, perylene, 2-anilinobenzothiazole, diphenylamine, 2-mercaptobenzothiazole, aniline, phenothiazine, benzothiazole, and N,N-diphenyl-1,4-benzenediamine, and benzo(a)anthracene, benzo(k)fluoranthene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenzo(a,h)anthracene, phenol, arsenic, beryllium, chromium, cobalt, nickel, mercury, and vanadium were identified as subsurface soil contaminants of concern. Table 4-22 summarizes the surface and subsurface soil contaminants of concern detected in the subdivision.

4.2.7.1 Surface Soil

Organic Compounds

Targeted Organic Compounds - Figure 4-28 illustrates all targeted organic compound detections present in the subdivision surface soil samples. Targeted organic compound detections in the surface soil ranged to 330,000 ppb. The compound 2-anilinobenzothiazole was the most commonly detected targeted organic compound, present in 16 of the 18 samples. The highest detection of the compound was noted in sample SS05, collected from one of the Carrie Drive waste piles. Additionally, the highest detections of diphenylamine, detected nine times, phenothiazine, detected seven times, and phenyl isothiocyanate, detected twice, were present in sample SS05. Benzothiazole and 2-mercaptobenzothiazole were detected in 13 and 14 of the samples, respectively. The highest detections of both compounds were in sample SS10, collected from between the Carrie Drive and Lisa Lane cul-de sacs. The highest concentrations of perylene, detected 13 times, and N,N-diphenyl-1,4-benzenediamine, detected 12 times, were in samples SS17 and SS18, respectively. Sample SS17 was located on the east side of the Lisa Lane cul-de-sac while SS18 was collected from its western side. All of the samples were clayey brown top soil mixed with black plastic-like pieces.

Volatile Organic Compounds - Benzene, toluene, total xylenes, trichloroethene, 1,1-dichloroethane, and 1,1,1-trichloroethane were each detected once in sample DP034-SS. Acetone and methylene chloride were also detected in several of the samples. All of the detected concentrations were below NYS TAGM screening criteria.

Semivolatile Organic Compounds - Figure 4-29 illustrates the semivolatile organic compounds detected in the subdivision surface soils at concentrations that exceeded screening criteria. Benzo(a)pyrene was detected in 15 of the surface samples, with all of the observed concentrations exceeding the compound's screening criteria. Benzo(a)anthracene was detected 15 times, with 12 of the observed concentrations exceeding screening criteria. Chrysene, detected 16 times, exceeded screening in nine of the samples. Benzo(b)fluoranthene and benzo(k)fluoranthene, each detected 15 times, with five and four concentrations respectively, noted to exceed their screening levels. The highest concentrations of all five compounds were in sample SS17. Dibenzo(a,h,)anthracene was detected five times, with four of the observed concentrations exceeding its screening criteria. The highest detection of the compound was in sample DP013-SS. Semivolatile PAH COCs were detected at concentrations that exceeded screening by up to 41 times.

Phenol was detected nine times, with all of the observed concentrations exceeding the compound's screening criteria. The highest phenol detection, which exceeded screening criteria by 260 times, was in sample SS10.

The compound 2-methylphenol was detected four times, with three of the observed concentrations exceeding its screening criteria. The highest 2-methylphenol detection was in sample SS06, which

was collected from the eastern Carrie Drive waste pile and was a clayey brown top soil mixed with black plastic-like pieces.

Numerous semivolatile organic compounds, including naphthalene, fluorene, acenapthene, anthracene, pyrene, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene, were detected in the surface soil samples. As with the COC semivolatiles, the highest concentrations were generally in samples SS17 and SS10. None of the detected compounds, however, exceeded NYS TAGM screening criteria.

Pesticide and PCB Compounds - The following pesticides were detected in the surface soil samples: alpha-BHC, delta-BHC, beta-BHC, aldrin, dieldrin, 4,4'-DDE, 4,4'-DDT, gamma chlordane, endosulfan sulfate, endosulfan I, endosulfan II, heptachlor epoxide, endrin aldehyde, methoxychlor, and alpha-chlordane. The PCB Aroclor 1254 and 1260 were also sporadically detected in the surface soils. All detected concentrations were below screening criteria.

Inorganic Analytes

Figure 4-30 illustrates the inorganic analytes detected in the subdivision surface soil samples at concentrations that exceeded background screening criteria. Copper was detected in 18 of the samples, with nine of the observed concentrations exceeding the analyte's screening criteria. The highest copper concentration was detected in sample SS06. Cobalt was detected in 17 of the samples, with six of the detections exceeding screening criteria. The highest cobalt concentration was also in SS06. Mercury was noted in 12 samples, all of the detected concentrations exceeded the NYSDEC TAGM soil cleanup objective. However, only five of the 12 detections exceeded the analyte's background criteria. The highest mercury concentration was in sample DP033-SS. DP033-SS (0.00-2.00' BGS), a brown silty clay mixed with black plastic-like pieces and white powder, was collected from drive point boring DP033, located on the south side of Carrie Drive. Beryllium was detected in 15 samples, with seven of the observed concentrations exceeding the analyte's background criteria. The highest beryllium concentration was in SS12 (0.00 -0.50' BGS). The sample, collected approximately 50 feet south of Carrie Drive, was a brown clayey soil mixed with black plastic-like pieces. Inorganic COCs were detected at concentrations that exceeded background criteria by eight to nine times.

Several analytes, including aluminum, arsenic, barium, calcium, iron, lead, magnesium, nickel, sodium, and vanadium, were commonly detected, with sporadic concentrations exceeding background screening criteria. Due to the infrequency of screening criteria exceedances and because many of these elements are ubiquitous to soil, these analytes were not evaluated as COCs.

4.2.7.2 Subsurface Soils

Organic Compounds

Targeted Organic Compounds - Figure 4-31 illustrates all the targeted organic compounds detected in the subdivision subsurface soil samples. Targeted organic compound concentrations in the subsurface soil ranged from 40 ppb to 50,000 ppb. Perylene, detected six times, was the most frequently detected target organic compound. The highest perylene detection was observed in sample DP013B which was collected from 2.00-4.00' BGS and was a moist fine sand and clay mixed with black stained fill material and black plastic-like pieces. Drive point boring DP013 was located approximately 100 feet east of the Lisa Lane cul-de-sac. N,N-diphenyl-1,4-benzenediamine was detected in five samples, with the highest concentration in DP018B. Benzothiazole was detected three times, with the highest detection noted in DP018B. Diphenylamine, 2-mercaptobenzothiazole, 2-anilinobenzothiazole, and phenothiazine were each detected twice, with their respective highest concentrations in sample DP018B. Sample DP018B, collected from 2.00-4.00' BGS in drive-point boring DP018, was a gray silty clay mixed with white powder granules and black fill material. Drive point boring DP018 was located approximately 100 feet northeast of the Lisa Lane cul-de-sac. A single occurrence of aniline was detected in sample DP033 (10.00-12.00' BGS). Targeted organic compound detections were confined to samples collected from six borings located in the northern end of the subdivision.

Volatile Organic Compounds - Figure 4-32 illustrates the volatile organic compounds detected in the subdivision subsurface soils that exceeded screening criteria. Total xylenes were detected in three samples, with the concentration in sample DP034B noted to exceed the compound's screening criteria. Sample DP034B, collected from 4.00-6.00' BGS in drive point boring DP034, was a gray sand and silt intermixed with white and yellow powder and black fill material. Drive point boring DP034 was located in the center of the Carrie Drive cul-de-sac. Vinyl chloride, 1,1-dichloroethene, 1,1-dichloroethane, 1,2-dichloroethene, 1,1,1-trichloroethane, trichloroethene, toluene, and ethylbenzene were also sporadically detected in the subsurface soils at concentrations below screening criteria. However, the highest observed detections were consistently noted in samples collected from the northern end of the subdivision.

Semivolatile Organic Compounds - Figure 4-32 also illustrates the semivolatile organic compounds detected in the subdivision subsurface soil samples that exceeded screening criteria. Benzo(a)pyrene, chrysene, and benzo(a)anthracene were detected in four samples at concentrations that exceeded each compound's screening criteria. Benzo(b)fluoranthene was also detected four times, with three concentrations exceeding the compound's screening criteria. Dibenzo(a,h)anthracene was detected in two samples; both observed concentrations exceeded the compound's respective screening criteria. Dibenzofuran, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, fluoranthene, anthracene, and benzo(g,h,i)perylene were each detected in several samples with at least one observed concentration of each compound exceeding screening criteria. The highest concentrations of the above listed compounds were all detected in sample DP013B.

Phenol, detected twice, and 2-methylphenol, detected three times, each had two observed concentrations that exceeded exceed each compound's respective screening criteria. A related compound, 4-methylphenol, was detected three times, with one of the concentrations exceeding the compound's screening criteria. The highest concentrations of the phenol compounds were in sample DP018B. Semivolatile COC concentrations exceeded NYS TAGM screening criteria by up to 2787 times.

Other semivolatile compounds detected in the subsurface soils included 2,4-methylphenol, acenapthalene, acenaphthene, fluorene, carbazole, and n-nitrosodiphenylamine. None of these detected concentrations exceeded to exceed NYS TAGM screening criteria.

Semivolatile organic compound detections were generally limited to four samples, DP013B, DP017, DP017B, and DP018B, collected from borings located in the northern end of the subdivision.

Pesticide and PCB Compounds - Several pesticides including alpha-BHC, delta-BHC, heptachlor, aldrin, heptachlor epoxide, dieldrin, 4,4'-DDT, endosulfan sulfate, endosulfan II, endrin aldehyde, endrin ketone, alpha-chlordane, and gamma-chlordane were sporadically detected in the subsurface soil samples. The PCB Aroclors 1254 and 1260 were also detected in several samples. All detected concentrations were below screening criteria.

Inorganic Analytes

Figure 4-33 illustrates the inorganic analytes in the AOC 6 subsurface soil samples detected at concentrations that exceeded background screening criteria. Nickel was detected in all 26 of the samples, with 12 of the observed concentrations exceeding the analyte's background screening criteria. Vanadium and chromium were also detected in all of the samples, with seven of the detections of each analyte exceeding the background screening criteria. The highest nickel, vanadium, and chromium concentrations were all detected in DP017B (2.00-4.00' BGS), a sample of black stained fill material mixed with black plastic-like pieces. Sample DP017B was collected from drive point boring DP017, located 110 feet west of T Mark Drive. Arsenic was detected in all of the samples, with seven concentrations exceeding the analyte's screening criteria. The highest arsenic concentration was noted in DP020 (8.00-10.00' BGS). The sample collected from drive point boring DP020, located at the eastern end of Carrie Drive, was a moist reddish brown clay. Mercury was detected in five samples, with all of the detected concentrations exceeding the NYS TAGM soil cleanup objective for mercury. The highest mercury concentration was in sample DP014 (10.00-12.00' BGS), collected from drive point boring DP014, located in the Lisa Lane cul-de-sac. The sample was a moist reddish brown clay. Mercury was not detected in CDM Federal's subsurface background samples. Inorganic COC detections generally exceeded background criteria by four times.

Several analytes, including aluminum, barium, calcium, iron, lead, magnesium, potassium, sodium, and zinc, were commonly detected, with sporadic concentrations exceeding background

screening criteria. Due to the infrequency of screening criteria exceedances and because many of these elements are ubiquitous to soil, they were not evaluated as COCs.

4.2.7.3 Summary of Contamination

CDM Federal's surface soil sampling program confirmed the presence of historically reported contaminants in the northern end of the subdivision. Within this area of fill, targeted organic compounds were detected up to concentrations of 330,000 ppb (2-anilinobenzothiazole) while PAH compounds were detected at concentrations that exceeded TAGM screening criteria by more than 40 times (benzo(a)pyrene). Additionally, phenol was detected in the surface soil samples at concentrations up to 260 times the screening criteria. While elevated levels of targeted organic and semivolatile organic compounds were detected in the surface soils, contaminant concentrations were significantly less than what had been historically reported. Contaminant concentrations may have been reduced by flooding conditions, resulting from leaking trailer pipes, and the subsequent surface water runoff. Inorganic contamination of the surface soil was also confirmed, with the highest concentrations in the Carrie Drive waste pile samples and in those samples associated with fill material. Inorganic analytes in this area were generally detected at concentrations between eight or nine times above the background screening criteria.

Organic compound and inorganic detections and screening criteria exceedances were generally limited to the northern end of the subdivision. The number and contaminant concentrations of targeted organic compound detections generally decreased in the subsurface soil samples. Additionally, the frequency of semivolatile organic compound detections also decreased in the subsurface soils; however, contaminant concentrations in the limited detections increased in the subsurface fill samples. In the subsurface fill material of this AOC, targeted organic compounds were detected up to concentrations of 50,000 ppb (2-mercaptobenzothiazole). PAH compounds were detected at concentrations that exceeded TAGM screening criteria by more than 2700 times (benzo(a)pyrene). Inorganic analytes in this area were generally detected at concentrations between eight or nine times above the background screening. However, mercury concentrations in the fill samples ranged over 250 times the TAGM cleanup objective. The fill material was concentrated in the northern end of the subdivision and was generally found to depths of 8.00 feet BGS. Contaminant concentrations, if detected at all, were significantly lower in samples collected below the fill layer.

No targeted organic compounds or organic screening criteria exceedances were noted in the southern portion of the subdivision. Several inorganic analytes were above screening, levels in samples collected from the center of the subdivision. The volume of both the surface and subsurface soils to be remediated in this area will be evaluated further in the FS.

Figures 4-34, 4-35, and 4-36 illustrate the horizontal and vertical extent of the fill material in the subdivision. Refer to Figure 4-36 for the cross-section locations.

4.2.8 SITEWIDE GROUNDWATER

Groundwater at the site flows both vertically and horizontally through an interconnected system of closely spaced joints and bedding plane fractures. Groundwater flow in the shallow bedrock zone, as discussed in Chapter 3, closely follows the top of bedrock elevation contours toward a bedrock surface depression beneath the MW-5 cluster. The groundwater high at MW-7S results in localized flow to the east, toward MW-5S, and south toward MW-8S. This causes the local flow to deviate from the expected regional flow to the west. Groundwater in the deep bedrock zone generally flows to the west/southwest with MW-1D being upgradient of the site and MW-7D and 8D being downgradient.

Vertical groundwater flow at each monitoring well cluster was downward, as evidenced by the higher groundwater elevations of the shallow wells versus those of the deep wells. This indicates that the site is located in a groundwater recharge area.

CDM Federal collected two rounds of groundwater samples from the nine newly installed monitoring well clusters. Groundwater samples were analyzed for targeted organic compounds, TCL volatile organics, semivolatile organics, pesticides and PCB compounds, TAL metals and cyanide, and other physical parameters.

Some of the analytical results contained within this data set were qualified as estimated during data validation review. Data was estimated due to exceeded quality control criteria including holding time exceedances and poor surrogate recovery. Although the data was estimated, it was still determined to be usable.

Based upon review of the analytical results of the two rounds, CDM Federal identified the targeted organic compound, benzothiazole, as well as benzene, 1,1-dichloroethane (1,1,-DCA), 1,2-dichloroethene (total) (1,2-DCE), vinyl chloride, trichloroethene (TCE), xylenes, 1,1,1-trichloroethane (1,1,1-TCA), benzo(a)pyrene, pentachlorophenol, phenol, 2-chlorophenol, 4-chloro-3-methylphenol, 4-nitrophenol, pyrene, di-n-octylphthalate, hexachlorobutadiene, chromium, iron, manganese, lead and nickel as groundwater contaminants of concern. Table 4-23 and 4-24 summarize the Round 1 and Round 2 groundwater contaminants of concern.

4.2.8.1 Organic Compounds

Targeted Organic Compounds - Figure 4-37 illustrates the targeted organic compound detections in the Round 1 groundwater samples. Low levels of benzothiazole were detected in wells MW4S and MW9. No other targeted organics were detected in the Round 1 samples. No targeted organic compounds were detected in the Round 2 groundwater samples.

Volatile Organic Compounds - Figure 4-37 also illustrates the volatile organic compounds detected in the Round 1 groundwater samples at concentrations that exceed State and Federal standards. 1,2-DCE was detected in seven samples, with five of the observed concentrations exceeding the compound's State standards. Vinyl chloride was detected in three of the samples,

with all of the observed concentrations exceeding the compound's Federal standard. TCE was also detected in three samples; one detection exceeded the Federal and State standards for the compound. The highest concentration of all three compounds was in well MW-5S. Total xylenes were detected in six of the samples, with two of the detections exceeding the State standards for the compound. The highest total xylene concentration was in sample MW-9D. 1,1-DCA was detected in three samples, with one of the observed concentrations exceeding the State standards for the compound. 1,1,1-TCA was detected in two samples, with both detections exceeding the compound's State standards. The highest detected concentrations of both compounds were in sample MW-5D. Benzene was detected in four samples, all concentrations exceeding the state's groundwater standard. The highest detected concentration of benzene was in wells MW-3D and MW-9D. In Round 1, volatile organics compounds were detected at concentrations that exceeded State and Federal MCLs by up to 26 times.

Chloromethane, bromomethane, acetone, 2-butanone, toluene, and ethylbenzene were detected in several of the samples. The compounds were all detected at concentrations below State and Federal standards.

Figure 4-38 illustrates the volatile organic compounds detected in the Round 2 groundwater samples at concentrations that exceeded State and Federal water standards. 1,2-DCE (total) was detected in four samples, with all of the observed concentrations exceeding the compound's State standards. Vinyl chloride was detected in three of the samples, with all of the observed concentrations exceeding the compound's Federal and State standards. TCE was also detected in three samples with one detection exceeding both the Federal and State standards for the compound. 1,1-DCA was detected in three samples, with two of the observed concentrations exceeding the State standards for the compound. 1,1,1-TCA was detected in two samples, with both of the detections exceeding the compound's State standards. The highest concentration of all five compounds was in well MW-5S. Tetrachloroethene was also detected in several of the samples, but at concentrations below State and Federal standards. In Round 2, volatile organic compounds were detected at concentrations that exceeded State and Federal MCLs by up to 260 times.

COC volatile organics compounds were consistently detected in both rounds. However, COC concentrations were noted to be significantly higher in the second round.

Semivolatile Organic Compounds - Figure 4-37 illustrates the semivolatile organic compounds detected in the Round 1 groundwater samples at concentrations that exceeded State drinking water standards. Phenol was detected in samples MW-6D and MW-6S at concentrations that slightly exceeded the compound's State standards. 2-Chlorophenol, 4-chloro-3-methylphenol, 4-nitrophenol, and pyrene were detected in sample MW-6D at concentrations that slightly exceeded their respective State groundwater standards. Hexachlorobutadiene and pentachlorophenol were also detected in sample MW-6D at concentrations that slightly exceeded their State standards, with pentachlorophenol also exceeding it Federal standard.

Acenaphthene, 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, and 2,4-dinitrophenol, were also detected in the MW-6D sample at concentrations below their respective standards. Sporadic detections of diethylphthlate, butylbenzylphthlate, bis(2-ethylhexyl)phthlate, 2-methylphenol, and 2,4,6-trichlorophenol were noted in the groundwater samples. All detected concentrations were below drinking water standards.

Figure 4-38 illustrates the semivolatile organic compounds detected in the Round 2 groundwater samples at concentrations that exceeded State water standards. Benzo(a)pyrene was detected in well MW-3PW at a concentration that slightly exceeded the compound's Federal drinking water standard. Di-n-octylphthalate was detected in five samples, with the detection in sample MW-55 slightly exceeding the compound's State groundwater standard. Several PAH semivolatile organic compounds, including phenanthrene, fluoranthene, pyrene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene, were also in the MW-3PW groundwater sample, at concentrations below their respective drinking water standards.

Diethylphthlate, di-n-butylphthlate, butylbenzylphthlate, and bis(2ethylhexyl)phthlate were also sporadically detected in the groundwater samples at concentrations below State and Federal drinking water standards.

Semivolatile organic detections varied between the two sampling rounds, with no consistent pattern of distribution noted. The majority of Round 1 detections were in sample MW-6D, while Round 2 detections were primarily in MW-3PW.

Pesticide and PCB Compounds - The pesticides Alpha-BHC and gamma-BHC(lindane) were each detected once in sample MW6D at concentrations below State and Federal standards. There were no pesticide/PCB compounds detected in the Round 2 groundwater samples.

4.2.8.2 Inorganic Analytes

Figure 4-39 illustrates the inorganic analytes detected in the Round 1 groundwater samples at concentrations above Federal and State water standards. Chromium was detected in all 20 samples: four of the detected concentrations exceeded the analyte's State and Federal standards and three of the detected concentrations exceeding only the State groundwater standard. The highest concentration of chromium was detected in sample MW-3OB. Iron was detected in all of the samples at concentrations that exceeded the analyte's State groundwater standard. The highest concentration of iron was detected in sample MW-4S. Manganese was detected in all of the samples, with seven of the detections exceeding the analyte's State groundwater standard. The highest concentration of manganese was detected in sample MW-3PW. Nickel was detected in all of the samples, with five of the detections exceeding the analyte's Federal standard. No State standard exists for nickel. The highest concentration of nickel was detected in sample MW-3OB. Lead was detected in 17 samples, with two of the observed concentrations exceeding the analyte's State and Federal standards. The highest lead concentration was noted in sample MW-4S. In Round 1, inorganic concentrations exceeded State and Federal MCLs by up to 108 times.

Aluminum, iron, and manganese were detected in all of the Round 1 groundwater samples. All of the observed iron and manganese concentrations, and one aluminum concentration, exceeded Federal secondary drinking water standards. Table 4-25 compares the detected analyte values with the Federal secondary standards.

Arsenic, barium, beryllium, cobalt, copper, lead, magnesium, mercury, potassium, vanadium, sodium, and zinc were frequently detected in the Round 1 groundwater samples, at concentrations below Federal and State standards.

Figure 4-40 illustrates the inorganic analytes detected in the Round 2 groundwater samples at concentrations above State and Federal drinking water standards. Chromium was detected in 10 samples, one detection exceeded the analyte's State and Federal standards and one detection exceeded only the analyte's State groundwater standard. The highest concentration of chromium was detected in sample MW-4S. Iron was detected in all of the 20 samples, with nineteen detections exceeding the analyte's State groundwater standard. Manganese was detected in eighteen samples, with three detections exceeding the analyte's State groundwater standard. The highest concentration of manganese was detected in sample MW-3PW. Zinc was detected in twelve samples, with one detection exceeding the analyte's State groundwater standard. The highest concentration of zinc was detected in sample MW-4S. Lead was detected in 11 samples, with one of the observed concentrations exceeded the analyte's Federal, but not State, standard. The highest concentration of lead was detected in sample MW-4S. Nickel was detected in three samples, with one detection exceeding the analyte's Federal standard. The highest nickel concentration was detected in sample MW-4D. In Round 2, inorganic concentrations exceeded State and Federal MCLs by up to sixty-four times.

Aluminum, iron, and manganese were detected in the majority of the Round 2 groundwater samples. Several of the iron and manganese concentrations, and one aluminum concentration exceeded Federal secondary drinking water standards. Table 4-26 compares the detected analyte values with the Federal secondary standards. Calcium, copper, lead, magnesium, sodium, and potassium were frequently detected in the Round 2 groundwater samples at concentrations below State and Federal standards.

COC inorganic analytes were consistently detected in both rounds. However, COC detections and cocentrations were noted to be significantly lower in the second round. Additionally, the number of non-COC inorganic detections decreased in the second round.

4.2.8.3 Summary of Contamination

In both sampling rounds, volatile organic compounds, including vinyl chloride, 1,2-DCE, 1,1-DCA, and TCE were consistently detected in the wells downgradient of the fill areas. While volatile organic compounds were not commonly detected in soil samples collected during the RI field investigation, their presence in the site soils and fill materials was documented during previous site investigations. Generally, the highest volatile organic compound detections were in well MW-5S. As discussed in Chapter 3, shallow groundwater flows from all directions

toward a slight bedrock depression in the vicinity of MW-5S. This flows regime could be responsible for transporting groundwater contamination from throughout the site to the MW-5S area, explaining the elevated levels of volatile organic compounds detected in the well. Additionally, volatile organic concentrations increased in Round 2, when groundwater elevations were three to four feet higher than in Round 1.

Semivolatile organic compound detections and standard exceedances in the groundwater were generally limited to two wells, MW-6D and MW3-PW. The Round 1 exceedances, pentachlorophenol and hexachlorobutadiene, were noted in well MW-6D, downgradient of the Edgewood Drive and subdivision fill areas. Pentachlorophenol was detected in three soil samples from both the south lot of Edgewood Drive wooded lots. Hexachlorobutadiene was not detected in any of the soil samples collected during the RI field investigation.

The Round 2 semivolatile organic detections, mainly semivolatile PAHs, and the one standard exceedance, benzo(a)pyrene, were generally noted in MW-3PW the perched water well. The MW-3 well cluster was installed in the fill, and potential source area, that was delineated during drive point boring activities. Soil samples collected from the MW-3 fill area (DP013B, DP013) contained some of the highest PAH concentrations observed during the RI field investigation.

Inorganic analytes were widely detected in both rounds of groundwater sampling. Chromium, nickel, and lead, however, were the only analytes with concentrations that exceeded State and Federal drinking water standards. All three analytes were widely detected in the site surface and subsurface soils, with the highest analytes concentrations noted in the fill material. Accordingly, the highest inorganic concentrations were generally detected in samples collected from source area wells, MW-3OB and MW-3S, and wells downgradient of the subdivision and Edgewood Drive fill area, MW-4S, MW-4D, and MW-5D. The presence of these analytes, commonly detected in the subsurface fill material, in the deep monitoring wells suggests that inorganic contamination has migrated vertically. Inorganic detections and concentrations decreased in Round 2, when groundwater elevations rose three to four feet.

Volatile organic compounds and inorganic analytes were noted in the offsite well MW-8S at concentrations that exceeded State and Federal drinking water standards. Since the same contaminants were detected in onsite wells at higher concentrations, it appears that contamination is migrating offsite.

4.2.9 Relationship Between Soil and Groundwater Contamination

The initial investigations conducted by NUS in the late 1980s consisted of surface soil and solid waste samples. These samples showed elevated levels of numerous volatile, semivolatile, inorganic, and targeted organic compounds. Groundwater was not sampled by NUS, because no monitoring wells were installed.

The RI performed by CDM Federal has shown that many of the compounds identified by NUS are still present in the surface soils, subsurface soils and fill material, but generally at lower

concentrations. Since the late 1980's, the concentrations of volatile organics in soils has been substantially reduced. During the CDM Federal RI, volatile organic detections in soil were limited.

Groundwater at the site was sampled for the first time in 1995. Based on the analytical results it appears that site soil contamination has migrated vertically to the underlying groundwater. This suggests that the overburden clay layer, found throughout the site, may have been breached during illegal landfilling activities. It is also possible that fill-related contamination may have migrated through the clay layer where the natural horizon may have been thinned by landfilling activities. Figure 4-41 illustrates the depth of suspended fill material across the site.

Contaminants identified in the groundwater are very similar to those identified in the site soils, especially the more soluble volatile organics. The primary VOCs in the groundwater include vinyl chloride, 1,2-dichloroethene, 1,1-dichloroethane, trichloroethene, and xylenes. The same compounds were identified in several rounds of surface soil/solid waste sampling by NUS in 1987 and 1988.

A similar comparison of groundwater and soil sampling results for semivolatile compounds in the subdivision and Edgewood Drive wooded lots indicate that these compounds do not migrate as readily from soils to the groundwater. Only a few semivolatile compounds were detected in the groundwater, while many were detected in soils. The semivolatile compounds are generally significantly less soluble than VOCs and are not expected to migrate into the groundwater.

Numerous inorganic analytes have been detected in subdivision soils and fill material. These same inorganics have also been detected in the groundwater, with chromium, nickel, and lead exceeding State and Federal drinking water standards.

The following chapter of the RI report discusses the fate and transport of the various compounds detected at the site. Good correlation is found between the predicted relationship of soil and groundwater contamination and the observed contamination in the two media at the site.

TABLE 4-1
BACKGROUND SAMPLE LOCATIONS
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

SAMPLE ID	LOCATION	SAMPLE DEPTH (ft. bgs)
SURFACE SOIL BACKGROUND SAMPLES		
MW1-SS	East of Service Road	0.0-2.0
SSBK01	South of Subdivision	0.0-.050
SSBK02	South of Subdivision	0.0-0.50
SSBK03	South of Subdivision	0.0-0.50
SUBSURFACE SOIL BACKGROUND SAMPLES		
MW1	East of Service Road	12.0-14.0
WETLAND BACKGROUND SEDIMENT SAMPLES		
WTSDBK1	South of Subdivision	0.0-0.50
WTSDBK2	South of Subdivision	0.0-0.50
SURFACE WATER/SEDIMENT BACKGROUND SAMPLES		
GCSD1/GCSW1	East Gill Creek immediately West of Service Road	0.0-0.50 (sediment)
GROUNDWATER BACKGROUND SAMPLES		
MW1S	East of Service Road	NA
MW1D	East of Service Road	NA

NA - Not Applicable

TABLE 4-2
SOIL SCREENING CRITERIA FOR
ORGANIC COMPOUNDS DETECTED IN FOREST GLEN SOIL SAMPLES

COMPOUND	SOIL CLEANUP OBJECTIVES (ug/kg) NYSDEC TAGM HWR-94-4046
VOLATILE ORGANICS	
VINYL CHLORIDE	200
METHYLENE CHLORIDE	100
ACETONE	200
CARBON DISULFIDE	2,700
1,1-DICHLOROETHENE	400
1,1-DICHLOROETHANE	200
1,2-DICHLOROETHENE (total)	300*
2-BUTANONE	300
1,1,1 -TRICHLOROETHANE	800
TRICHLOROETHENE	760
1,1,2-TRICHLOROETHANE	NS
BENZENE	60
TETRACHLOROETHENE	1,400
TOLUENE	1,500
ETHYLBENZENE	5,500
XYLENES (total)	1,200
SEMIVOLATILE ORGANICS	
PHENOL	30
2-METHYLPHENOL	100
4-METHYLPHENOL	900
N-NITROSO-DI-N-PROPYLAMINE	NS
2,4-DIMETHYLPHENOL	NS
1,2,4-TRICHLOROBENZENE	NS
NAPHTHALENE	13,000
2-METHYLNAPTHALENE	36,400
DIMETHYLPHTHALATE	2,000
ACENAPHTHYLENE	41,000
ACENAPHTHENE	50,000

Note: NS - NO STANDARD
Source: NYSDEC Technical and Administrative Guidance Memorandum 4046 (NYSDEC, 1994)

* Standard is for trans only.

TABLE 4-2 (CONT'D)
SOIL SCREENING CRITERIA FOR
ORGANIC COMPOUNDS IN SOIL DETECTED IN FOREST GLEN SOIL SAMPLES

COMPOUND	SOIL CLEANUP OBJECTIVES (ug/kg) NYSDEC TAGM HWR-94-4046
SEMIVOLATILE ORGANICS (CONT'D)	
DIBENZOFURAN	6,200.00
DIETHYLPHTHALATE	7,100.00
FLUORENE	50,000.00
N-NITROSODIPHENYLAMINE	NS
PENTACHLOROPHENOL	1,000.00
PHENANTHRENE	50,000.00
ANTHRACENE	50,000.00
CARBAZOLE	NS
DI-N-BUTYLPHTHALATE	8,100.00
FLUORANTHENE	50,000.00
PYRENE	50,000.00
BENZO(A)ANTHRACENE	224.00
CHRYSENE	400.00
BIS(2-ETHYLHEXYL)PHTHALATE	50,000.00
DI-N-OCTYLPHTHALATE	50,000.00
BENZO(B)FLUORANTHENE	1,100.00
BENZO(K)FLUORANTHENE	1,100.00
BENZO(A)PYRENE	61.00
INDENO(1,2,3-CD)PYRENE	3,200.00
DIBENZO(A,H)ANTHRACENE	14.00
BENZO(G,H,I)PERYLENE	50,000.00

Note: NS - NO STANDARD
Source: NYSDEC Technical and Administrative Guidance Memorandum 4046 (NYSDEC, 1994)

TABLE 4-2 (CONT'D)
SOIL SCREENING CRITERIA FOR
ORGANIC COMPOUNDS DETECTED IN FOREST GLEN SOIL SAMPLES

COMPOUND	SOIL CLEANUP OBJECTIVES (ug/kg) NYSDEC TAGM HWR-94-4046
PESTICIDES/PCBs	
ALPHA-BHC	110.00
BETA-BHC	200.00
DELTA-BHC	300.00
gamma-BHC (Lindane)	60.00
HEPTACHLOR	100.00
ALDRIN	41.00
HEPTACHLOR EPOXIDE	20.00
ENDOSULFAN I	900.00
DIELDRIN	44.00
4,4'-DDE	2,100.00
ENDRIN	100.00
ENDOSULFAN II	900.00
4,4'-DDD	2,900.00
ENDOSULFAN SULFATE	1,000.00
4,4'-DDT	2,100.00
METHOXYCHLOR	0.00
ENDRIN KETONE	0.00
ENDRIN ALDEHYDE	NS
ALPHA-CHLORDANE	NS
GAMMA-CHLORDANE	NS
AROCLOR 1248	1,000.00
AROCLOR 1254	1,000.00
AROCLOR 1260	1,000.00

Note: NS - NO STANDARD
Source: NYSDEC Technical and Administrative Guidance Memorandum 4046 (NYSDEC, 1994)

TABLE 4-3
SOIL SCREENING CRITERIA FOR
INORGANIC ANALYTES DETECTED IN FOREST GLEN SURFACE SOIL SAMPLES

ANALYTE	BACKGROUND AVERAGE TIMES TWO (SSBK1, SSBK2, SSBK3, MW01-SS) (mg/kg)
INORGANICS	
ALUMINUM	20,615.00
ANTIMONY*	20.70
ARSENIC	9.20
BARIUM	143.40
BERYLLIUM	0.68
CADMIUM	3.10
CALCIUM	97,120.00
CHROMIUM	134.26
COBALT	21.52
COPPER	40.26
IRON	29,610.00
LEAD	106.8 *
MAGNESIUM	53,380.00
MANGANESE	864.60
MERCURY**	0.58
NICKEL	27.68
POTASSIUM	1538.00
SELENIUM	1.46
SILVER*	3.16
SODIUM	223.86
THALLIUM	2.20
VANADIUM	50.80
ZINC	445.50
CYANIDE	1.564

Notes: * The background number provided represents an average of the analytes method detection level divided by two.
** This value represents two times the average site background. The NYSDEC TAGM recommended soil cleanup objective for mercury is 0.1 ppm.

TABLE 4-4
SOIL SCREENING CRITERIA FOR
INORGANIC ANALYTES IN FOREST GLEN SUBSURFACE SOIL SAMPLES

ANALYTE	BACKGROUND AVERAGE TIMES TWO (mg/kg) (DP-01, DP-02, DP-03, MW-01)
INORGANICS	
ALUMINUM	17,245.00
ANTIMONY*	5.52
ARSENIC	5.52
BARIUM	163.44
BERYLLIUM*	0.84
CADMIUM	1.06
CALCIUM	130,300.00
CHROMIUM	27.60
COBALT	14.84
COPPER	41.60
IRON	28,750.00
LEAD	37.16
MAGNESIUM	49,600.00
MANGANESE	1114.60
MERCURY**	0.22
NICKEL	28.36
POTASSIUM	3,365.60
SELENIUM*	1.18
SILVER*	1.38
SODIUM	520.00
THALLIUM*	2.06
VANADIUM	35.40
ZINC	636.00
CYANIDE	4.74

Note: * The background represents an average of the analyte's method detection level divided by two.

** This value represents two times the average site background. The NYSDEC TAGM recommended soil cleanup objective for mercury is 0.1 ppm.

Source: NYSDEC Technical and Administrative Guidance Memorandum 4046 (NYSDEC, 1994)

TABLE 4-5
FEDERAL FRESHWATER SEDIMENT CRITERIA
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

		WOODED WETLAND SEDIMENT								
		WTSD01			WTSD02			WTSD03		
Compound	Criteria (ug/g TOC)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)
Acenaphthene	130	72400	9412	U	102000	13260	55 J	87900	11427	U
Dieldrin	11	72400	796.4	U	102000	1122	U	87900	966.9	U
Endrin	4.2	72400	304	U	102000	428.4	U	87900	369.18	U
Fluoranthene	620	72400	44888	500	102000	63240	480 J	87900	54498	300 J
Phenanthrene	180	72400	13032	230 J	102000	18360	340 J	87900	15822	190 J

		WOODED WETLAND SEDIMENT								
		WTSD04			WTSD05			WTSD06		
Compound	Criteria (ug/g TOC)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)
Acenaphthene	130	68000	8840	U	151000	19630	71 J	90400	11752	66 J
Dieldrin	11	68000	748	U	151000	1661	U	90400	994.4	U
Endrin	4.2	68000	285.6	U	151000	634.2	U	90400	379.68	U
Fluoranthene	620	68000	42160	450	151000	93620	890	90400	56048	920
Phenanthrene	180	68000	12240	240 J	151000	27180	420 J	90400	16272	430 J

TABLE 4-5
FEDERAL FRESHWATER SEDIMENT CRITERIA
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

		WOODED WETLAND SEDIMENT								
		WTSD07			WTSD08			WTSD09		
Compound	Criteria (ug/g TOC)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)
Acenaphthene	130	79700	10361	55 J	60000	7800	U	104000	13520	58 J
Dieldrin	11	79700	876.7	U	60000	660	R	104000	1144	2.1 NJ
Endrin	4.2	79700	334.74	R	60000	252	R	104000	437	R
Fluoranthene	620	79700	49414	620	60000	37200	670	104000	64480	570
Phenanthrene	180	79700	14346	290 J	60000	10800	310 J	104000	18720	270 J

		WOODED WETLAND			EAST GILL CREEK SEDIMENT - ROUND 1					
		WTSD10			GCSD2			GCSD3		
Compound	Criteria (ug/g TOC)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)
Acenaphthene	130	99000	12870	58 J	66600	8658	U	34600	4498	U
Dieldrin	11	99000	1089	1.2 NJ	66600	732.6	U	34600	380.6	U
Endrin	4.2	99000	415.8	R	66600	279.72	U	34600	145.32	R
Fluoranthene	620	99000	61380	450 J	66600	41292	1400 J	34600	21452	370 J
Phenanthrene	180	99000	17820	240 J	66600	11988	490 J	34600	6228	140 J

TABLE 4-5
FEDERAL FRESHWATER SEDIMENT CRITERIA
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

		EAST GILL CREEK SEDIMENT - ROUNDS 1 AND 2								
		GCSD4			GCSD2-B			GCSD3-B		
Compound	Criteria (ug/g TOC)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)
Acenaphthene	130	40500	5265	260 J	35000	4550	U	39100	508.3	U
Dieldrin	11	40500	455.5	U	35000	385	U	39100	430.1	U
Endrin	4.2	40500	170.1	U	35000	147	U	39100	164.22	U
Fluoranthene	620	40500	25110	1900	35000	21700	520 J	39100	24242	350 J
Phenanthrene	180	40500	7290	1200	35000	6300	240 J	39100	7038	240 J

		EAST GILL CREEK SEDIMENT - ROUND 2					
		GCSD4-B			GCSD6-B		
Compound	Criteria (ug/g TOC)	TOC (mg/kg)	Sample Criteria (ug/kg)	Sample Specific Criteria Value[1] (ug/kg)	TOC (mg/kg)	Sample Specific Criteria Value[1] (ug/kg)	Sample Concentration (ug/kg)
Acenaphthene	130	34900	4537	86 J	65800	8554	U
Dieldrin	11	34900	383.9	U	65800	723.8	U
Endrin	4.2	34900	146.58	U	65800	276.36	U
Fluoranthene	620	34900	21638	1300	65800	40796	1100
Phenanthrene	180	34900	6282	1200	65800	11844	590 J

[1] Sample Specific Criteria Value = Criteria/TOC; i.e., ug Compound/kg soil or sediment = (ug compound/g TOC)/((mg TOC/kg soil or sediment) x (1g/1000 mg))

U denotes compound was undetected.

J denotes compound concentration is estimated.

N denotes reported compound is presumed to be present based on analytical evidence.

R denotes data is rejected.

TABLE 4-6

NYSDEC SEDIMENT SCREENING CRITERIA, ONTARIO SEDIMENT SCREENING VALUES AND BACKGROUND AVERAGE FOR ORGANICS DETECTED IN THE FOREST GLEN WOODED WETLAND SEDIMENT SAMPLES

COMPOUND	(A) NYSDEC SEDIMENT CRITERIA (ug/kg)	(B) ONTARIO SEDIMENT SCREENING VALUES (ug/kg)	(C) BACKGROUND AVERAGE (ug/kg) (WTSDBK1, WTSDBK2)
VOLATILE ORGANICS			
1,1,1-TRICHLOROETHANE	NS	NS	6.5 J
SEMIVOLATILE ORGANICS			
ACENAPHTHENE	NS	NS	82 J
PHENANTHRENE	NS	560	480 J
ANTHRACENE	NS	220	114.5 J
CARBAZOLE	NS	NS	78 J
DI-N-BUTYLPHTHALATE	NS	NS	490 U
FLUORANTHENE	NS	750	950
PYRENE	NS	490	1,010
BUTYLBENZYLPHTHALATE	NS	NS	129 J
BENZO(A)ANTHRACENE	1,300	320	630 J
CHRYSENE	1,300	340	720 J
BIS(2-ETHYLHEXYL)PHTHALATE	NS	NS	490 U
BENZO(B)FLUORANTHENE	1,300	NS	790
BENZO(K)FLUORANTHENE	NS	240	645 J
BENZO(A)PYRENE	NS	370	700 J
INDENO(1,2,3-CD)PYRENE	1,300	200	565 J
DIBENZO(A,H)ANTHRACENE	NS	60	158 J
BENZO(G,H,I)PERYLENE	NS	170	530 J
PESTICIDES/PCBs			
ALPHA-BHC	NS	6	2.5 U
BETA-BHC	NS	5	2.5 U
DELTA-BHC	NS	NS	2.5 U
ALDRIN	NS	2	2.5 U
HEPTACHLOR EPOXIDE	NS	5	2.5 U
DIELDRIN	NS	2	4.9 U
4,4'-DDE	10	5	8.65
ENDOSULFAN II	NS	NS	4.9 U
ENDOSULFAN SULFATE	NS	NS	4.9 U
4,4'-DDT	10	8*	4.9 U
ENDRIN KETONE	NS	NS	4.9 U
ALPHA-CHLORDANE	NS	7**	2.5 U
GAMMA-CHLORDANE	NS	7**	2.5 U
AROCLOR 1254	1	60***	49 U

Note: NS - NO STANDARD

Sources: (A) NYSDEC, Technical Guidance for Screening Contaminated Sediments, July 1994

(B) D. Persaud, et al., Guidelines for the Protection and Mangement of Aquatic Sediment Quality in Ontario, August 1993

* As 2,4'- and 4,4'-DDT

** As total chlordane

*** Tentative value

TABLE 4-7

NYSDEC SEDIMENT SCREENING CRITERIA, ONTARIO SEDIMENT SCREENING VALUES AND TWICE BACKGROUND AVERAGE FOR INORGANIC ANALYTES DETECTED IN THE FOREST GLEN WOODED WETLAND SEDIMENT SAMPLES

ANALYTE	(A) NYSDEC SEDIMENT CRITERIA (mg/kg)	(B) ONTARIO SEDIMENT SCREENIG VALUES (mg/kg)	(C) BACKGROUND AVERAGE TIMES TWO (mg/kg) (WTSDBK1, WTSDBK2)
INORGANICS			
ALUMINUM	NS	NS	36700 *
ARSENIC	6	6	13
BARIUM	NS	NS	301
BERYLLIUM	NS	NS	1.9 B
CADMIUM	0.6	1	1.16 B
CALCIUM	NS	NS	12,340
CHROMIUM	26	26	349
COBALT	NS	16	46
COPPER	16	20,000	76
IRON	20,000	31	41,800
LEAD	31	NS	156
MAGNESIUM	NS	460	7,570
MANGANESE	460	0	1,319
MERCURY	0.15	16	1
NICKEL	16	NS	61
POTASSIUM	NS	NS	4,190
SILVER	1.0	NS	3.6 U
SODIUM	NS	NS	175 B
THALLIUM	NS	NS	3.68 U
VANADIUM	NS	NS	69
ZINC	120	120	292 NJ

Note: NS - NO STANDARD

Sources: (A) NYSDEC, Technical Guidance for Screening Contaminated Sediments, July 1994

(B) D. Persaud, et al., Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, August 1993

TABLE 4-8

NYSDEC SEDIMENT SCREENING CRITERIA, ONTARIO SEDIMENT SCREENING VALUES AND BACKGROUND VALUES FOR ORGANICS DETECTED IN EAST GILL CREEK SEDIMENT SAMPLES

COMPOUND	(A) NYSDEC SEDIMENT CRITERIA (ug/kg)	(B) ONTARIO SEDIMENT SCREENING VALUES (ug/kg)	(C) BACKGROUND VALUE ROUND 1 - 8/95 (ug/kg) (GCSD1)	(C) BACKGROUND VALUE ROUND 2 - 11/95 (ug/kg) (GCSD1-B)
VOLATILE ORGANICS				
METHYLENE CHLORIDE	NS	NS	7 J	29 UJ
ACETONE	NS	NS	190 UJ	76 J
CARBON DISULFIDE	NS	NS	38 UJ	3 J
2-BUTANONE	NS	NS	37 J	29 UJ
SEMIVOLATILE ORGANICS				
PHENOL	NS	NS	1,300 UJ	1,100 U
2-METHYLPHENOL	NS	NS	1,300 UJ	1,100 U
4-METHYLPHENOL	NS	NS	1,300 UJ	60 J
N-NITROSO-DI-N-PROPYLAMINE	NS	NS	1,300 UJ	1,100 U
ISOPHORONE	NS	NS	1,300 UJ	1,100 U
2,4-DIMETHYLPHENOL	NS	NS	1,300 UJ	1,100 U
1,2,4-TRICHLOROBENZENE	NS	NS	1,300 UJ	1,100 U
NAPHTHALENE	NS	NS	1,300 UJ	1,100 U
2-METHYLNAPTHALENE	NS	NS	1,300 UJ	210 J
DIMETHYLPHTHALATE	NS	NS	1,300 UJ	1,100 U
ACENAPHTHYLENE	NS	NS	1,300 UJ	110 J
ACENAPHTHENE	NS	NS	1,300 UJ	110 J
DIBENZOFURAN	NS	NS	1,300 UJ	91 J
FLUORENE	NS	190	1,300 UJ	130 J
N-NITROSODIPHENYLAMINE	NS	NS	1,300 UJ	1,100 U
PHENANTHRENE	NS	560	960 J	1,200
ANTHRACENE	NS	220	190 J	1,100 U
CARBAZOLE	NS	NS	160 J	NA
DI-N-BUTYLPHTHALATE	NS	NS	1,300 UJ	1,100 U
FLUORANTHENE	NS	750	2,400 J	2,600
PYRENE	NS	490	1,700 J	2,200
BUTYLBENZYLPHTHALATE	NS	NS	1,300 UJ	270 J
BENZO(A)ANTHRACENE	1,300	320	820 J	1,100 U
CHRYSENE	1,300	340	1,400 J	1,100 U
BIS(2-ETHYLHEXYL)PHTHALATE	NS	NS	700J	1,100 U
DI-N-OCTYLPHTHALATE	NS	NS	1,300 J	84 J
BENZO(B)FLUORANTHENE	1,300	NS	1,600 J	2,700
BENZO(K)FLUORANTHENE	NS	240	1,200 J	800 J

Note: NS - NO STANDARD

Sources: (A) NYSDEC, Technical Guidance for Screening Contaminated Sediments, July 1994
(B) D. Persaud, et al., Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, August 1993

TABLE 4-8 (CONT'D)
NYSDEC SEDIMENT SCREENING CRITERIA, ONTARIO SEDIMENT SCREENING VALUES
AND BACKGROUND VALUES
FOR ORGANICS DETECTED IN EAST GILL CREEK SEDIMENT SAMPLES

COMPOUND	(A) NYSDEC SEDIMENT CRITERIA (ug/kg)	(B) ONTARIO SEDIMENT SCREENING VALUES (ug/kg)	(C) BACKGROUND VALUE ROUND 1 - 8/95 (ug/kg) (GCSD1)	(C) BACKGROUND VALUE ROUND 2 - 11/95 (ug/kg) (GCSD1-B)
SEMIVOLATILE ORGANICS (CONT'D)				
BENZO(A)PYRENE	NS	370	1,100 J	1,700
INDENO(1,2,3-CD)PYRENE	1,300	200	680 J	1,900
DIBENZO(A,H)ANTHRACENE	NS	60	300 J	360 J
BENZO(G,H,I)PERYLENE	NS	170	650 J	1,700
PESTICIDES/PCBs				
ALPHA-BHC	NS	6	3.2 J	4.6 U
BETA-BHC	NS	5	41 J	4.6 U
ENDOSULFAN I	NS	NS	6.5 UJ	4.6 U
ENDOSULFAN II	NS	NS	7.5 J	8.9 U
4,4'-DDD	10	8	13 UJ	8.9 U
4,4'-DDT	10	8*	R	8.9 U
GAMMA-CHLORDANE	NS	7**	5.2 J	4.6 U

Note: NS - NO STANDARD

Sources: (A) NYSDEC, Technical Guidance for Screening Contaminated Sediments, July 1994
(B) D. Persaud, et al., Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, August 1993

* As 2,4'- and 4,4'-DDT.

** As total chlordane.

TABLE 4-9

NYSDEC SEDIMENT SCREENING CRITERIA, ONTARIO SEDIMENT SCREENING VALUES AND TWICE BACKGROUND VALUE FOR INORGANIC ANALYTES DETECTED IN EAST GILL CREEK SEDIMENT SAMPLES

ANALYTE	(A) NYSDEC SEDIMENT (mg/kg)	(B) ONTARIO SEDIMENT SCREENING VALUES (mg/kg)	(C) BACKGROUND VALUE TIMES TWO ROUND 1 - 8/95 (mg/kg) (GCSD1)	(C) BACKGROUND VALUE TIMES TWO ROUND 2 - 11/95 (mg/kg) (GCSD1-B)
INORGANICS				
ALUMINUM	NS	NS	34,400 EJ	24,200
ARSENIC	6	6	11 BJ	10.4 J
BARIUM	NS	NS	258 BEJ	268
BERYLLIUM	NS	NS	1.42 BJ	3.2 U
CADMIUM	0.6	0.6	12.8 J	4
CALCIUM	NS	NS	120,800 EJ	122,000
CHROMIUM	26	26	244 J	246
COBALT	NS	NS	228 BJ	32 U
COPPER	16	16	128.2 J	138
IRON	20,000	20,000	51,200 J	40,600
LEAD	31	31	268 J	564
MAGNESIUM	NS	NS	41,000 EJ	37,400
MANGANESE	460	460	772 EJ	776
MERCURY	0.15	0.2	1.34 NJ	3 J
NICKEL	16	16	R	54
POTASSIUM	NS	NS	6,320 BEJ	3,180 U
SODIUM	NS	NS	3,520 BEJ	3,180 U
VANADIUM	NS	NS	67 BJ	56
ZINC	120	120	2,480 J	154

Note: NS - NO STANDARD

Sources: (A) NYSDEC, Technical Guidance for Screening Contaminated Sediments, July 1994
(B) D. Persaud, et al., Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, August 1993

TABLE 4-10
FOR NYS SURFACE WATER SCREENING CRITERIA AND BACKGROUND VALUES
ORGANIC COMPOUNDS DETECTED IN EAST GILL CREEK SURFACE WATER

COMPOUND	(A) NYS WATER QUALITY STANDARD (ug/l)	(B) BACKGROUND VALUE ROUND 1 - 8/95 (ug/l) (GCSW1)	(B) BACKGROUND VALUE ROUND 2 - 11/95 (ug/l) (GCSW1-B)
VOLATILE ORGANICS			
CARBON DISULFIDE	NS	10.00 U	10.00 U
TRICHLOROETHENE	NS	10.00 U	10.00 U
TETRACHLOROETHENE	NS	10.00 U	10.00 U
SEMIVOLATILE ORGANICS			
DIETHYLPHTHALATE	NS	R	4.00 U
FLUORANTHENE	NS	3.00 J	4.00 U
BENZO(B)FLUORANTHENE	NS	2.00 J	4.00 U
PESTICIDES/PCBs			
ALPHA-BHC	0.0100 (B)	0.01 J	0.10 U
BETA-BHC	0.0100 (B)	0.05 NJ	0.10 U

Note: NS - NO STANDARD
(B) Standard is for total hexachlorocyclohexanes
(C) Standard is for total Aroclors
Source: NYS Water Classifications and Quality Standards (Class C waters)

TABLE 4-11

NYS SURFACE WATER SCREENING CRITERIA AND BACKGROUND VALUES
FOR INORGANIC ANALYTES DETECTED IN EAST GILL CREEK SURFACE WATER

ANALYTE	(A) NYS WATER CLASSIFICATIONS AND QUALITY STANDARDS (ug/l)	(B) BACKGROUND VALUE ROUND 1 - 8/95 (ug/l) (GCSW1)	(B) BACKGROUND VALUE ROUND 2 - 11/95 (ug/l) (GCSW1-B)
INORGANICS			
ALUMINUM	100	143,000.00	291.00
ANTIMONY	NS	17.60 BNJ	60.0 U
ARSENIC	190	38.40	10.0 U
BARIUM	NS	1,140.00 EJ	200.0 U
BERYLLIUM	1100	6.90 J	5.0 U
CALCIUM	NS	538,000.00 EJ	105000.00
CHROMIUM	889	1,250.00	27.00
COBALT	5	90.20	50.0 U
COPPER	54.1	428.00 EJ	25.0 U
IRON	300	179,000.00 EJ	492.00
LEAD	30.6	1,250.00	3.0 U
MAGNESIUM	NS	191,000.00 EJ	35000.00
MANGANESE	NS	3,970.00	35.00
MERCURY	NS	5.50	0.2 U
NICKEL	370	271.00 J	40.0 U
POTASSIUM	NS	29,000.00 EJ	5000.0 U
SELENIUM	1.0	10.50 J	8.40
SODIUM	NS	490,000.00 E*J	162000.00
VANADIUM	14	294.00 EJ	50.0 U
ZINC	30	7,530.00	54.00
CYANIDE	5.20	10.00 U	10.30

Note: NS - NO STANDARD

Source: NYS Water Calssifications and Quality Standards (Class C waters)

TABLE 4-12

GROUNDWATER SCREENING CRITERIA FOR

ORGANIC COMPOUNDS DETECTED IN FOREST GLEN GROUNDWATER SAMPLES

COMPOUND	(A) NATIONAL PRIMARY DRINKING WATER STANDARDS (MCLs) (ug/L)	(B) NYS DEPARTMENT OF HEALTH DRINKING WATER STANDARDS (ug/L)	(C) NYSDEC GROUNDWATER STANDARDS (ug/L)
VOLATILE ORGANICS			
CHLOROMETHANE	NS	NS	5
BROMOETHANE	NS	5	5
VINYL CHLORIDE	2	2	2
ACETONE	NS	NS	NS
1,1-DICHLOROETHANE	NS	5	5
1,2-DICHLOROETHENE (total)	NS	5	5
2-BUTANONE	NS	NS	NS
1,1,1 -TRICHLOROETHANE	200	5	5
TRICHLOROETHENE	5	5	5
BENZENE	5	5	0.7
TETRACHLOROETHENE	5	5	NS
TOLUENE	1,000	5	5
ETHYLBENZENE	700	5	5
XYLENES (total)	10,000	5	5
SEMIVOLATILE ORGANICS			
PHENOL	NS	NS	1*
2-CHLOROPHENOL	NS	NS	5
1,4-DICHLOROBENZENE	NS	5	4.7**
2-METHYLPHENOL	NS	NS	5
N-NITROSO-DI-N-PROPYLAMINE	NS	NS	5
2-NITROPHENOL	NS	NS	5
2,4-DIMETHYLPHENOL	NS	NS	5
1,2,4-TRICHLOROBENZENE	70	5	5
HEXACHLOROBUTADIENE	NS	5	5
4-CHLORO-3-METHYLPHENOL	NS	NS	5
2,4,6-TRICHLOROPHENOL	NS	NS	5
ACENAPHTHENE	NS	NS	5

Note: NS - NO STANDARD

Sources: (A) National Primary Drinking Water Standards-40 CFR Part 141

(B) NYS Department of Health Drinking Water Standards-10 NYSCRR Part 5, Subpart 5-1

(C) NYSDEC, Groundwater Standards - NYSCRR, Title 6, Chapter X, Part 703.5

* Standard is phenolic compounds (total phenols).

** Standard is for sum of 1,2- and 1,4-dichlorobenzene.

TABLE 4-12 (CONT'D)
GROUNDWATER SCREENING CRITERIA FOR
ORGANIC COMPOUNDS DETECTED IN FOREST GLEN GROUNDWATER SAMPLES

COMPOUND	(A) NATIONAL PRIMARY DRINKING WATER STANDARDS (MCLs) (ug/L)	(B) NYS DEPARTMENT OF HEALTH DRINKING WATER STANDARDS (ug/L)	(C) NYSDEC GROUNDWATER STANDARDS (ug/L)
SEMIVOLATILE ORGANICS (CONT'D)			
4-NITROPHENOL	NS	NS	5
2,4-DINITROTOLUENE	NS	NS	5
DIETHYLPHTHALATE	NS	NS	5
PENTACHLOROPHENOL	1	1	1*
PHENANTHRENE	NS	NS	5
DI-N-BUTYLPHTHALATE	NS	NS	50
FLUORANTHENE	NS	NS	5
PYRENE	NS	NS	5
BUTYLBENZYLPHTHALATE	NS	NS	5
3,3-DICHLOROBENZIDINE	NS	NS	5
BENZO(A)ANTHRACENE	NS	NS	5
CHRYSENE	NS	NS	5
BIS(2-ETHYLHEXYL)PHTHALATE	NS	NS	50
DI-N-OCTYLPHTHALATE	NS	NS	5
BENZO(B)FLUORANTHENE	NS	NS	5
BENZO(K)FLUORANTHENE	NS	NS	5
BENZO(A)PYRENE	0.2	NS	5
INDENO(1,2,3-CD)PYRENE	NS	NS	5***
DIBENZO(A,H)ANTHRACENE	NS	NS	5
BENZO(G,H,I)PERYLENE	NS	NS	5
PESTICIDES/PCBs			
ALPHA-BHC	NS	NS	NV
gamma-BHC (Lindane)	0.2	0.2	NV
HEPTACHLOR	0.4	0.4	NV

Note: NS - NO STANDARD
NV = No value associated with this standard as value for standard is not detectable by the analytical tests specified or approved in NYSCRR Title 6, Chapter X, Part 700
Sources: (A) National Primary Drinking Water Standards-40 CFR Part 141
(B) NYS Department of Health Drinking Water Standards-10 NYCRR Part 5, Subpart 5-1
(C) NYSDEC, Groundwater Standards - NYSCRR, Title 6, Chapter X, Part 703.5

* Standard for phenolic compounds (total phenols).
*** Standard value not detectable by the analytical tests specified or approved in NYSCRR Title 6, Chapter X, Part 700, thus value for standard defaulted to the standard for principle organic contaminant classes.

TABLE 4-13
GROUNDWATER SCREENING CRITERIA FOR
INORGANIC ANALYTES DETECTED IN FOREST GLEN GROUNDWATER SAMPLES

ANALYTE	(A) NATIONAL PRIMARY DRINKING WATER STANDARDS (MCLs) (ug/L)	(B) NYS DEPARTMENT OF HEALTH DRINKING WATER STANDARDS (ug/L)	(C) NYSDEC GROUNDWATER STANDARDS (ug/L)
INORGANICS			
ALUMINUM	NS	NS	NS
ARSENIC	50	50	25*
BARIUM	2,000	2,000	1,000
BERYLLIUM	4	NS	NS
CADMIUM	5	5	10
CALCIUM	NS	NS	NS
CHROMIUM	100	100	50
COBALT	NS	NS	NS
COPPER	1,300	NS	200
IRON	NS	NS	300**
LEAD	15	50	25
MAGNESIUM	NS	NS	NS
MANGANESE	0	NS	300**
MERCURY	2	2	2
NICKEL	100	NS	NS
POTASSIUM	NS	NS	NS
SELENIUM	50	10	20
SILVER	NS	50	50
SODIUM	NS	NS	20,000
VANADIUM	NS	NS	NS
ZINC	NS	NS	300
CYANIDE	200	NS	100

Note: NS - NO STANDARD

Sources: (A) National Primary Drinking Water Standards-40 CFR Part 141
(B) NYS Department of Health Drinking Water Standards-10 NYSCRR Part 5, Subpart 5-1
(C) NYSDEC, Groundwater standards - NYSCRR, Title 6, Chapter X, Part 703.5

* Dissolved form.

** Standard for iron and manganese (together) is 500 ug/L.

TABLE 4-14
AOC #1 - BERM
CONTAMINANTS OF CONCERN
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Contaminant of Concern	Range of Detection	Frequency of Detection (#/total samples)	Screening Criteria	Frequency of Exceedance (#/total detections)	Magnitude of of Maximum Exceedance	Location of Highest Detection
Subsurface Soil						
Targeted Organic Compounds (ug/kg)						
Benzothiazole	410 - 150,000 D	4/7	NA	NA	NA	BERM 2A
Diphenylamine	400 - 11,000 J	4/7	NA	NA	NA	BERM 2A
2-Mercaptobenzothiazole	270 J - 1,100,000 DJ	5/7	NA	NA	NA	BERM 2A
2-Anilinobenzothiazole	90 J - 960,000 D	5/7	NA	NA	NA	BERM 2A
N,N-Diphenyl-1,4-benzenediamine	18,000 JD - 210,000 D	4/7	NA	NA	NA	BERM 2A
Perylene	1,400 J - 3,800 J	3/7	NA	NA	NA	BERM 2A
Phenothiazine	60 J - 4,600 J	4/7	NA	NA	NA	BERM 2A
Phenyl Isothiocyanate	1,100 J	1/6	NA	NA	NA	BERM 2A
Semivolatile Organic Compounds (ug/kg)						
Benzo(a)pyrene	210 J - 3,800 J	4/7	61	4/4	62.2	BERM 2
Benzo(b)fluoranthene	55 JX - 10,000 J	5/7	1,100	3/5	9	BERM 2
Benzo(k)fluoranthene	55 JX - 11,000 J	5/7	1,100	3/5	10	BERM 2
Benzo(a)anthracene	200 - 6,600 J	4/7	224	3/4	29.5	BERM 2
Phenol	330 J - 9,700 J	5/7	30	5/5	323.3	BERM 2
2-Methylphenol	120 J - 980 J	2/7	100	1/2	9.8	BERM 2
Inorganics (mg/kg)*						
Cobalt	15.30 - 30.70	7/7	14.84	7/7	2	BERM 2A
Nickel	29.60 - 47.90	7/7	28.36	7/7	1.7	BERM 3A
Arsenic	2.30 B - 15.80	7/7	5.20	5/7	3	BERM 3A
Chromium	21.40 - 120	7/7	27.60	5/7	4.3	BERM 3A
Mercury**	0.19 - 13.50	4/7	0.10**	4/4**	135	BERM 2A
Lead	8.60 - 73.60	7/7	37.16	4/7	2	BERM 2
Copper	25.00 - 185	7/7	41.60	3/7	4.4	BERM 2
Vanadium	28.10 J - 38.70 J	7/7	35.40	3/7	1.1	BERM 5

NA Denotes not "applicable", since no screening criteria is available.
J Denotes estimated value.
N For organic compounds this denotes uncertainty in identity of compound detected For inorganic analyses, this denotes that the spike sample recovery was not within control limits
B Denotes that the reported value is less than the contract required detection limit, but greater than or equal to the instrument detection limit
D Denotes diluted value
X Denotes a non-specific qualifier applied by the laboratory. This generally indicates difficulty in chromatographic separation of compounds
* Screening criteria shown for inorganics is two times the background concentration
** The NYS TAGM Soil Cleanup Objective for mercury was used as screening criteria since the analyte was not detected in the background subsurface soil

TABLE 4-15
AOC #2 - NORTHERN ASPECT
CONTAMINANTS OF CONCERN
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Contaminant of Concern	Range of Detection	Frequency of Detection (#/total samples)	Screening Criteria	Frequency of Exceedance (#/total detections)	Magnitude of Maximum Exceedance	Location of Highest Detection
Surface Soil						
Targeted Organic Compounds (ug/kg)						
Perylene	50 J - 100 J	2/18	NA	NA	NA	SS01
2-Anilinobenzothiazole	80J	1/18	NA	NA	NA	DP029-SS
Semivolatile Organic Compounds (ug/kg)						
Benzo(a)pyrene	27 - 260J	4/18	61	2/4	4.3	SS01
Dibenzo(a,h)athracene	25J - 50J	2/18	14	2/2	3.6	DP023-SS
Inorganics (mg/kg)*						
Barium	114 - 278	18/18	163.44	14/18	1.7	DP023-SS
Beryllium	0.26 B - 1.50	11/18	0.68	6/11	2.2	DP023-SS
Mercury	0.17 NJ - 1.50	4/18	0.58**	1/4**	2.6	SB18-SS
Nickel	18.70 - 49.10	16/16	27.68	14/16	1.8	DP023-SS
Subsurface Soil						
Targeted Organic Compounds (ug/kg)						
Perylene	130 J - 450 J	3/26	NA	NA	NA	TPEXP
2-Anilinobenzothiazole	130 J - 27,000 D	3/26	NA	NA	NA	TP09
Diphenylamine	320 - 330 J	2/26	NA	NA	NA	TPEXP
2-Mercaptobenzothiazole	3200 J - 24,000 JD	2/26	NA	NA	NA	TP09
Aniline	260 J - 280	2/26	NA	NA	NA	TP09
Phenothiazine	270 J - 470	2/26	NA	NA	NA	TP09
Benzothiazole	2,200 - 3,200	2/26	NA	NA	NA	TPEXP
Semivolatile Organic Compounds (ug/kg)						
Dibenzo(a,h)anthracene	26 J - 330J	2/25	14	2/2	23.6	TPEXP
Benzo(a)pyrene	78 J - 2,600	5/26	61	5/5	42.6	TPEXP
Benzo(a)anthracene	91 J - 7,700 D	5/26	224	2/5	34.4	TPEXP
Phenol	57 J - 200 J	2/25	30	2/2	6.7	TP01
Benzo(b)fluoranthene	150 J - 12,000 D	5/26	1,100	1/5	10.9	TPEXP
Chrysene	87 J - 2,700	5/26	400	1/5	6.8	TPEXP
Benzo(k)fluoranthene	75 J - 12,000 D	5/26	1,100	1/5	10.9	TPEXP

TABLE 4-15
AOC #2 - NORTHERN ASPECT
CONTAMINANTS OF CONCERN
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Contaminant of Concern	Range of Detection	Frequency of Detection (#/total samples)	Screening Criteria	Frequency of Exceedance (#/total detections)	Magnitude of Maximum Exceedance	Location of Highest Detection
Inorganics (mg/kg)*						
Arsenic	2.00 BJ - 9.40	25/26	5.20	7/25	1.8	TPEXP
Chromium	6.20 - 34.70	15/15	27.60	5/15	1.3	DP032
Nickel	8.30 B - 55.50	26/26	28.36	10/26	2	TPEXP
Mercury	0.07 B - 2.80	4/26	0.10**	3/4**	28	TP09
Vanadium	10.00 B - 70.40	26/26	35.40	8/26	2	TPEXP
Selenium	1.40 J - 2.60	11/26	2.0***	5/11***	1.3	TP09

NA Denotes not "applicable", since no values apply.

J Denotes estimated value.

N For organic compounds this denotes uncertainty in identity of compound detected For inorganic analyses, this denotes that the spike sample recovery was not within control limits

B Denotes that the reported value is less than the contract required detection limit, but greater than or equal to the instrument detection limit

D Denotes Diluted value.

* Screening criteria shown for inorganics is two times the background concentration

** NYS TAGM Soil Cleanup Objective for mercury is 0 10 mg/kg. Surface soil frequency of exceedance noted reflects exceedance of CDM Federal's background criteria, not of the NYS TAGM In subsurface soil, the NYS TAGM Soil Cleanup Objective was used since mercury was not detected in the background subsurface soil

** The NYS TAGM Soil Cleanup Objective for selenium was used as screening criteria since the analyte was not detected in the background subsurface soil

TABLE 4 - 16
AOC #3 - WOODED WETLAND
CONTAMINANTS OF CONCERN
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Parameter	Range of Detected Sample	Frequency of Detection (#/total samples)	Sediment Screening Criteria	Magnitude of Maximum Exceedance of Sediment Screening Criteria	Frequency of Exceedance (#/total detections)	Background Value'	Frequency of Exceedance (#/total detections)	Location of Highest Detection
Targeted Organic Compounds (ug/kg)								
Perylene	120 J - 250 J	10/10	NA	NA	NA	110 J	10/10	WTSD10
Semivolatiles Organic Compounds (ug/kg)								
Fluoranthene	300 J - 920	10/10	NA(a)/750b	NA(a)/1.2(b)	NA(a)/2/10(b)	950	0/10	WTSD06
Pyrene	320 J - 670	10/10	NA(a)/490b	NA(a)/1.4(b)	NA(a)/3/10(b)	1010	0/10	WTSD06
Benzo(a)anthracene	160 J - 510 J	10/10	1300(a)/320(b)	NA(a)/1.6(b)	0/10(a)/4/10(b)	630 J	0/10	WTSD05, 06
Chrysene	310 J - 680	10/10	1300(a)/340(b)	NA(a)/2(b)	0/10(a)/9/10(b)	720 J	0/10	WTSD06
Benzo(b)fluoranthene	570 X - 1400 X	10/10	1300(a)/NA(b)	1.1(a)/NA(b)	2/10(a)/NA(b)	790	7/10	WTSD06
Benzo(k)fluoranthene	620 X - 1400 X	10/10	NA(a)/240(b)	NA(a)/2.7(b)	NA(a)/2/10(b)	645 J	8/10	WTSD06
Indeno(1,2,3-CD)pyrene	150 J - 290 J	10/10	1300(a)/200(b)	NA(a)/1.45(b)	0/10(a)/7/10(b)	565 J	0/10	WTSD05
Dibenzo(a,h)anthracene	52 J - 80 J	2/10	NA(a)/60(b)	NA(a)/1.3(b)	NA(a)/1/2(b)	158 J	0/10	WTSD02
Benzo(g,h,i)perylene	160 J - 390 J	10/10	NA(a)/170(b)	NA(a)/2.3(b)	NA(a)/9/10(b)	530 J	0/10	WTSD06
Benzo(a)pyrene	260.00 J - 530.00 J	10/10	NA(a)/370(b)	NA(a)/1.4(b)	NA(a)/4/10(b)	700 J	0/10	WTSD06
Pesticides/PCBs (ug/kg)								
Alpha-BHC	0.47 NJ - 5.5 J	10/10	NA(a)/6(b)	NA(a)/(b)	NA(a)/0/10(b)	ND	10/10	WTSD03
4,4'-DDE	1.2 J - 12 J	8/9	10(a)/5(b)	1.2(a)/2.4(b)	1/8(a)/4/8(b)	8.65	2/8	WTSD03
Aroclor1254	68 J - 110 J	5/7	0.8(a)/60(b)	137.5(a)/1.8(b)	5/5(a)/5/5(b)	ND	5/5	WTSD02, 06, 08
Beta-BHC	2.1 J - 8.1 NJ	2/4	NA(a)/5(b)	NA(a)/1.6(b)	NA(a)/1/2(a)	ND	2/2	WTSD03
Inorganics (mg/kg) *								
Arsenic	4.6 - 7.7	10/10	6	1.3	4/10	12.5	0/10	WTSD06
Cadmium	1.1 B - 1.5 B	7/10	0.6	2.5	7/7	1.16 B	6/7	WTSD08
Chromium	36.7 - 53.5	10/10	26	2	10/10	349	0/10	WTSD07
Copper	29.2 - 51.9 J	10/10	16	3.2	10/10	75.6	0/10	WTSD07
Lead	84.8 - 114	10/10	31	3.7	10/10	155.6	0/10	WTSD06
Mercury	0.55 - 1.5	10/10	0.15(a)/0.20(b)	10(a)/7.5(b)	10/10	1.42	1/10	WTSD09
Nickel	30.5 - 39.2	10/10	16	2.5	10/10	61.4	0/10	WTSD03
Silver	1.2 B - 2 B	4/10	1(a)/NA(b)	2(a)/NA(b)	4/4(a)/NA(b)	ND	4/4	WTSD03
Zinc	214 - 374 NJ	10/10	120	3.1	10/10	292	5/10	WTSD05

1 These values represent one times the average background concentration for organic compounds and two times the average background concentration for inorganic analytes.

NA Denotes "not applicable", since no values apply.
ND Denotes that analyte was not detected in the background sample.
J Denotes estimated value.
N For organic compounds this denotes uncertainty in identity of compound detected. For inorganic analytes, this denotes that the spike sample recovery was not within control limits.
B Denotes that the reported value is less than the contract required detection limit, but greater than or equal to the instrument detection limit.
X Represents a non-specific qualifier generally given by the laboratory to indicate difficulty in chromatographic separation of compounds.

Screening Criteria:
(a) Technical Guidance for Screening Contaminated Sediment, New York State Department of Environmental Conservation, July 1994.
(b) Guidelines for the Protection and Management of Aquatic Sediment in Ontario, Ministry of Environment and Energy, August 1993.

* It should be noted that both guidances employ the same inorganic screening criteria with the exception of the screening numbers for mercury and silver.

TABLE 4 - 17
AOC #4 - EAST GILL CREEK SEDIMENT
CONTAMINANTS OF CONCERN - ROUND 1
NIAGARA FALLS, NEW YORK

Parameter	Range of Detected Sample	Frequency of Detection (#/total samples)	Sediment Screening Criteria	Magnitude of Maximum Exceedance of Sediment Screening Criteria	Frequency of Exceedance (#/total detections)	Background Value[1]	Frequency of Exceedance (#/total detections)	Location of Highest Detection
Targeted Organic Compounds (ug/kg)								
2-Mercaptobenzothiazole	2000 J	1/3	NA	NA	NA	ND	1/1	GCSD4
2-Anilinobenzothiazole	800 J - 6000 DJ	2/3	NA	NA	NA	ND	2/2	GCSD4
Perylene	200 J	1/3	NA	NA	NA	400 J	0/3	GCSD4
N,N-Diphenyl-1,4-Benzenediamine	300 J	1/3	NA	NA	NA	ND	1/1	GCSD4
Benzothiazole	400	1/3	NA	NA	NA	ND	1/1	GCSD4
Semivolatile Organic Compounds (ug/kg)								
Anthracene	350 J	1/3	NA(a)/220(b)	NA(a)/1.6(b)	NA(a)/1/3(b)	190 J	1/3	GCSD4
Dibenzo(a,h) anthracene	62 J - 360 J	3/3	NA(a)/60(b)	NA(a)/6(b)	NA(a)/3/3(b)	300 J	1/3	GCSD4
Phenanthrene	140 J - 1200	3/3	NA(a)/560(b)	NA(a)/2.1(b)	NA(a)/1/3(b)	960 J	1/3	GCSD4
Benzo(a) anthracene	140 J - 1000	3/3	1300(a)/320(b)	NA(a)/3.1(b)	NA(a)/2/3(b)	820 J	1/3	GCSD4
Inorganics (mg/kg) *								
Arsenic	5.9 J - 6.3 J	3/3	6	1	2/3	5.5 BJ	3/3	GCSD4
Cadmium	3.6 - 4.4	3/3	0.6	7.3	3/3	6.4 J	0/3	GCSD3
Chromium	40.3 J - 62.7 J	3/3	26	2.4	3/3	122 J	0/3	GCSD2
Copper	33.2 J - 35.3 J	3/3	16	2.2	3/3	64.1 J	0/3	GCSD2
Lead	52.9 - 61.7 J	3/3	31	1.9	3/3	134 J	0/3	GCSD2
Manganese	375 EJ - 877 EJ	3/3	460	1.9	2/3	386 EJ	2/3	GSCD4
Mercury	0.29 NJ - 0.4 NJ	3/3	0.15(a)/0.20(b)	2.7(a)/2(b)	3/3(a)/3/3(b)	0.67 NJ	0/3	GCSD2
Nickel	25.9 J	1/1	16	1.6	1/1	R	NA	GCSD2
Zinc	379 - 497 J	3/3	120	4.1	3/3	1240 J	0/3	GCSD2

1 These values represent one times the average background value for organic compounds and two times the background value for inorganic compounds.

NA Denotes "not applicable", since no values apply.
ND Denotes that the analyte was not detected in the background.
J Denotes estimated value.
N For organic compounds this denotes uncertainty in identity of compound detected. For inorganic analytes, this denotes that the spike sample recovery was not within control limits.
B Denotes that the reported value is less than the contract required detection limit, but greater than or equal to the instrument detection limit.
R Denotes data rejected.
E Denotes estimated concentration due to matrix interference.

Screening Criteria:
(a) Technical Guidance for Screening Contaminated Sediment, New York State Department of Environmental Conversation, July 1994.
(b) Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, Ministry of Environment and Energy, August 1993.

* It should be noted that both guidances employ the same inorganic screening criteria with the exception of the mercury screening number.

TABLE 4 - 18
AOC #4 - EAST GILL CREEK SEDIMENT
CONTAMINANTS OF CONCERN - ROUND 2
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Parameter	Range of Detected Sample	Frequency of Detection (#/total samples)	Sediment Screening Criteria	Magnitude of Maximum Exceedance of Sediment Screening Criteria	Frequency of Exceedance (#/total detections)	Background Value[1]	Frequency of Exceedance (#/total detections)	Location of Highest Detection
Targeted Organic Compounds (ug/kg)								
Diphenylamine	150 J - 3000	2/4	NA	NA	NA	ND	2/2	GCSD6
2-Mercaptobenzothiazole	3600 J	1/4	NA	NA	NA	ND	1/1	GCSD4
2-Anilinobenzothiazole	90 J - 19000 D	4/4	NA	NA	NA	ND	4/4	GCSD4
Perylene	160 J - 850	3/4	NA	NA	NA	250 J	2/3	GCSD6
N,N-Diphenyl-1,4-Benzendiamine	1000 J - 81000 D	2/4	NA	NA	NA	ND	2/2	GCSD6
Phenothiazine	430	1/4	NA	NA	NA	ND	1/1	GCSD4
Benzothiazole	140 J - 1500	2/4	NA	NA(a)	NA	ND	2/2	GCSD4
Semivolatile Organic Compounds (ug/kg)								
Chrysene	260 J - 790	4/4	1,300(a)/340(b)	NA(a)/2.3(b)	0/4(a)/3/4(b)	ND	4/4	GCSD4
Benzo(a) anthracene	470 J - 500 J	2/4	1,300(a)/320(b)	NA(a)/1.6(b)	0/2(a)/2/2(b)	ND	2/2	GCSD6
Benzo(g,h,i) perylene	30 J - 3400 J	4/4	NA(a)/170(b)	NA(a)/20(b)	NA(a)/2/4(b)	1,700	1/4	GCSD6
Inorganics (mg/kg) *								
Arsenic	5.2 - 26.8 J	4/4	6	4.5	2/4	10.4	2/4	GCSD2
Chromium	37 - 100	4/4	26	3.8	4/4	246	0/4	GSCD6
Copper	28 - 42	4/4	16	2.6	4/4	138	0/4	GSCD2
Lead	32 - 65	4/4	31	2.1	4/4	564	0/4	GCSD2
Manganese	557 - 1290	4/4	460	2.8	4/4	776	2/4	GCSD4
Mercury	0.29 - 0.57 J	4/4	0.15(a)/0.20(b)	3.8(a)/2.0(b)	4/4	3 J	0/4	GCSD2
Nickel	17 - 31	4/4	16	1.9	4/4	54	0/4	GCSD3
Zinc	129 - 394	4/4	120	3.3	4/4	154	3/4	GCSD2

1 These values represent one times the background value for organic compound and two times the background value for inorganic compounds.

NA Denotes "not applicable", since no values apply.
ND Denotes that the analyte was not detected in the background sample.
J Denotes estimated value.
N For organic compounds this denotes uncertainty in identity of compound detected. For inorganic analytes, this denotes that the spike sample recovery was not within control limits.
D Denotes reported value was obtained through subsequent dilution of the sample.

Screening Criteria:
(a) Technical Guidance for Screening Contaminated Sediment, New York State Department of Environmental Conservation, July 1994.
(b) Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, Ministry of Environment and Energy, August 1993.

* It should be noted that both guidances employ the same inorganic screening criteria with the exception of the mercury screening number.

TABLE 4 - 19
AOC #4 - EAST GILL CREEK SURFACE WATER
CONTAMINANTS OF CONCERN - ROUND 1
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Parameter	Range of Detected Sample	Frequency of Detection (#/total samples)	NYSDEC Surface Water Standard[1]	Magnitude of Maximum NYSDEC Surface Water Standard	Frequency of Exceedance (#/total detections)	Background Value[2]	Frequency of Exceedance (#/total detections)	Location of Highest Detection
Pesticides/PCBs (ug/l)								
Alpha-BHC	0.01 J - 0.02 J	3/3	0.01*	2	3/3	0.01 J	3/3	GCSW3
Beta-BHC	0.11 - 0.15	3/3	0.01*	15	3/3	0.05 NJ	3/3	GCSW3
Inorganics (ug/l)								
Aluminum	4380 - 72500	3/3	100	725	3/3	143000	0/3	GCSW2
Cobalt	15.6 B - 44.5 B	2/3	5	8.9	2/2	90.2	0/2	GCSW2
Iron	4810 EJ - 90700 EJ	3/3	300	302	3/3	179000	0/3	GCSW2
Selenium	4.2 B	1/3	1	4.2	1/1	10.5 J	0/1	GCSW2
Vanadium	11.3 BE - 133 EJ	3/3	14	9.5	2/3	294 EJ	0/3	GCSW2
Zinc	113 - 1820	3/3	30	60.7	3/3	7530	0/3	GCSW2
Copper	10.7 BE - 130 EJ	3/3	54.1	2.4	1/3	428 EJ	0/3	GCSW2
Lead	7.8 J - 190	3/3	30.6	6.2	2/3	1258	0/3	GCSW2

1 NYSDEC Surface Water Quality Standards for Class C waters.
2 These values represent background concentrations.

J Denotes estimated value.
B Denotes that the reported value is less than the contract required detection limit, but greater than or equal to the instrument detection limit.
E Denotes that the reported value is estimated due to matrix interference.
N Denotes that the reported compound is presumed to be present based on analytical evidence.
* Standard noted is for total hexachlorocyclohexanes (BHCs).

TABLE 4 - 20
AOC #4 - EAST GILL CREEK SURFACE WATER
CONTAMINANTS OF CONCERN - ROUND 2
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Parameter	Range of Detected Sample	Frequency of Detection (#/total samples)	NYSDEC Surface Water Standard[1]	Magnitude of Maximum Exceedance of NYSDEC Surface Water Standard	Frequency of Exceedance (#/total detections)	Background Value[2]	Frequency of Exceedance (#/total detections)	Location of Highest Detection
Pesticides/PCBs (ug/l)								
Beta-BHC	0.06 J - 0.11 J	4/4	0.01	11	4/4	ND	4/4	GCSW2
Inorganics (ug/l)								
Aluminum	205 - 1650	4/4	100	16.5	4/4	291	3/4	GCSW4
Iron	347 - 2710	4/4	300	9	4/4	492	3/4	GCSW4
Selenium	8.1 - 9.1	4/4	1	9.1	4/4	8.4	3/4	GCSW6
Zinc	42 - 79	4/4	30	2.6	4/4	54	1/4	GCSW4
Cyanide	12 - 13.6	2/4	5.2	2.6	2/2	10.3	2/2	GCSW6

1 NYSDEC Surface Water Quality Standards for Class C waters.
2 These values represent background concentrations.

ND Denotes that the compound was not detected in the background sample.
J Denotes estimated value.

TABLE 4 - 21
AOC #5 - EDGEWOOD DRIVE LOTS
CONTAMINANTS OF CONCERN
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Contaminant of Concern	Range of Detection	Frequency of Detection (#/total samples)	Screening Criteria	Frequency of Exceedance (#/total detections)	Magnitude of Maximum Exceedance	Location of Highest Detection
Surface Soil						
Targeted Organic Compounds (ug/kg)						
Perylene	5 - 12,000	8/16	NA	NA	NA	SB14-SS
2-Mercaptobenzothiazole	570 J - 1,800 J	2/16	NA	NA	NA	SB04-SS
2-Anilinobenzothiazole	1,300 J - 2,100	2/16	NA	NA	NA	SB14-SS
Diphenylamine	50 J	1/16	NA	NA	NA	SB07-SS
N,N-diphenyl-1,4-benzediamine	2,800 J	1/16	NA	NA	NA	SB07-SS
Benzothiazole	260 J	1/16	NA	NA	NA	SB07-SS
Semivolatile Organic Compounds (ug/kg)						
Chrysene	40 J - 95,000 D	10/16	400	7/10	237.5	SB07-SS
Benzo(a)anthracene	54 J - 100,000 D	8/16	224	7/8	446.4	SB07-SS
Benzo(b)fluorathene	100 J - 130,000 DJ	8/16	1,100	6/8	118.2	SS07-SS
Benzo(k)fluoranthene	98 J - 120,000 DJ	8/16	1,100	6/8	109.1	SB07-SS
Benzo(a)pyrene	47 J - 88,000 DJ	8/16	61	7/8	1442.6	SB07-SS
Dibenzo(a,h)anthracene	68 J - 16,000 DJ	6/16	14	6/6	1142.8	SB07-SS
Indeno(1,2,3-cd)pyrene	240 J - 25,000 DJ	7/16	3,200	4/7	7.8	SB07-SS
Fluoranthene	56 J - 130,000 D	9/16	50,000	3/9	2.6	SB07-SS
Inorganics (mg/kg)*						
Nickel	23.60 J - 139.00	16/16	27.68	14/16	5	SB10-SS
Mercury	0.07 B - 2.50	9/16	0.58**	3/16**	4 3	SB14-SS
Lead	8.70 - 157.00 NJ	16/16	106.8	5/16	1.5	SB14-SS
Arsenic	4.60 - 21.30	16/16	9.20	6/16	2 3	SBEXP-1-SS
Beryllium	0.29 B - 1.50 B	16/16	0.68	6/16	2.2	SB12-SS
Vanadium	32.30J - 125.00	16/16	50.80	6/16	2 5	SB10-SS
Subsurface Soil						
Targeted Organic Compounds (ug/kg)						
Perylene	0.08J - 6,800 J	3/14	NA	NA	NA	SBCENTER
Semivolatile Organic Compounds (ug/kg)						
Benzo(b)fluoranthene	87XJ - 98,000 D	6/14	1,100	2/6	89	SBCENTER
Benzo(k)fluoranthene	85XJ - 79,000 D	6/14	1,100	2/6	71.8	SBCENTER
Benzo(a)anthracene	53 J - 56,000 D	5/14	224	2/5	250	SBCENTER
Chrysene	56 J - 50,000 D	5/14	400	2/5	125	SBCENTER
Benzo(a)pyrene	40 J - 42,000 D	5/14	61	3/5	688.5	SBCENTER

TABLE 4 - 21
AOC #5 - EDGEWOOD DRIVE LOTS
CONTAMINANTS OF CONCERN
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Contaminant of Concern	Range of Detection	Frequency of Detection (#/total samples)	Screening Criteria	Frequency of Exceedance (#/total detections)	Magnitude of Maximum Exceedance	Location of Highest Detection
Inorganics (mg/kg)*						
Nickel	8.50 B - 69.40	14/14	28.36	9/14	2.4	SBCENTER
Mercury	0.14 - 3.20	5/14	0.10**	5/5**	32	SBCENTER
Cobalt	4.30 B - 16.80 J	14/14	14.84	5/14	1.1	SB14A
Chromium	6.60 - 54.40	14/14	27.60	4/14	2	SB14A
Beryllium	0.44 B - 1.70	14/14	0.84	5/14	2	SB13
Barium	34.70 B - 182.00	14/14	163.44	4/14	1.1	SB13
Lead	6.30 - 114N*J	14/14	37.16	2/14	3.1	SBCENTER

NA Denotes not "applicable", since no values apply.

J Denotes estimates value.

N For organic compounds this denotes uncertainty in identity of compound detected. For inorganic analyses, this denotes that the spike sample recovery was not within control limits

B Denotes that the reported value is less than the contract required detection limit, but greater than or equal to the instrument detection limit.

D Denotes a Diluted value.

X Non specific qualifier applied by laboratory. Generally indicates difficulty in chromatographic separations of compounds

* Screening criteria shown for inorganics is two times the background concentration.

** NYS TAGM Soil Cleanup Objective for mercury is 0 10 mg/kg Surface soil Frequency of Exceedance noted reflects exceedance of CDM Federal's background criteria not the NYS TAGM cleanup objective. In subsurface soil, the NYS TAGM soil cleanup objective was used since mercury was not detected in the background subsurface soil samples

TABLE 4 - 22
AOC #6 - SUBDIVISION
CONTAMINANTS OF CONCERN
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Contaminant of Concern	Range of Detection	Frequency of Detection (#/total samples)	Screening Criteria	Frequency of Exceedance (#/total detections)	Magnitude of Maximum Exceedance	Location of Highest Detection
Surface Soil						
Targeted Organic Compounds (ug/kg)						
2-Anilinobenzothiazole	90 J - 330,000 D	16/18	NA	NA	NA	SS05
2-Mercaptobenzothiazole	120 J - 47,000 DJ	14/18	NA	NA	NA	SS10
Benzothiazole	120 J - 10,000 DJ	13/18	NA	NA	NA	SS10
Perylene	40 J - 650 J	13/18	NA	NA	NA	SS17
N,N-Diphenyl-1,4-benzenediamine	110 J - 13,000 DJ	12/18	NA	NA	NA	SS18
Diphenylamine	40 J - 1,600	9/18	NA	NA	NA	SS05
Phenothiazine	80 J - 3,800 J	7/18	NA	NA	NA	SS05
Phenyl Isothiocyanate	100 J - 130 J	2/18	NA	NA	NA	SS05
Semivolatile Organic Compounds (ug/kg)						
Benzo(a)pyrene	100 J - 2,500	15/18	61	15/15	41	SS17
Benzo(a)anthracene	130 J - 2,900	15/18	224	12/18	13	SS17
Chrysene	25 J - 2,400	16/18	400	9/16	6	SS17
Benzo(b)fluoranthene	220 J - 7,200 D	15/18	1,100	5/15	6.5	SS17
Benzo(k)fluoranthene	220 - 6,900 D	15/18	1,100	4/15	6.3	SS17
Dibenzo(a,h)athracene	74 J - 530	5/18	14	5/5	37.9	DP013-SS
Phenol	85 J - 7,800 J	9/18	30	9/9	260	SS10
2-Methylphenol	60 J - 360	4/18	100	3/4	3.6	SS06
Inorganics (mg/kg)*						
Copper	4.30*B - 387*J	18/18	40.26	9/18	9.6	SS06
Cobalt	1.10 B - 193	17/18	21.52	6/17	9.0	SS06
Mercury	0.11 NJ - 5.70 J	12/14	0.58**	5/12**	9.8	DP033-SS
Beryllium	0.08 B - 0.97 B	15/18	0.68	7/15	1.4	SS12
Subsurface Soil						
Volatile Organic Compounds (ug/kg)						
Total Xylenes	2 J - 10,000 J	3/18	1,200	1/3	8.3	DP034B
Targeted Organic Compounds (ug/kg)						
Perylene	60 J - 8,000	6/26	NA	NA	NA	DP013B
N,N-Diphenyl-1,4-benzenediamine	40 J - 25,000 D	5/26	NA	NA	NA	DP018B
Benzothiazole	100 J - 16,000 D	3/26	NA	NA	NA	DP018B
Diphenylamine	800 - 8,000 DJ	2/26	NA	NA	NA	DP018B
2-Mercaptobenzothiazole	200 J - 50,000 DJ	2/26	NA	NA	NA	DP018B
2-Anilinobenzothiazole	1,000 - 170,000 D	2/26	NA	NA	NA	DP018B
Phenothiazine	800	2/26	NA	NA	NA	DP018B/DP033
Aniline	400	1/26	NA	NA		DP033
Semivolatile Organic Compounds (ug/kg)						
Benzo(a)pyrene	320 J - 170,000	4/26	61	4/4	2784	DP013B
Benzo(a)anthracene	460 - 250,000 J	4/26	224	4/4	1116	DP013B

TABLE 4 - 22
AOC #6 - SUBDIVISION
CONTAMINANTS OF CONCERN
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Contaminant of Concern	Range of Detection	Frequency of Detection (#/total samples)	Screening Criteria	Frequency of Exceedance (#/total detections)	Magnitude of Maximum Exceedance	Location of Highest Detection
Chrysene	530 - 160,000	4/26	400	4/4	400	DP013B
Benzo(b)fluoranthene	340 J - 220,000	4/26	1,100	3/4	200	DP013B
Dibenzo(a,h)anthracene	8,600 D - 8,700 J	2/26	14	2/2	621	DP013B
Phenol	250 J - 7500	2/26	30	2/2	25	DP018B
Inorganics (mg/kg)*						
Nickel	0.02 - 132.00	26/26	28.36	12/26	4.7	DP017B
Chromium	0.02 - 46.60	26/26	27.60	7/26	1.7	DP017B
Vanadium	0.03 - 147.00	26/26	35.40	7/26	4.2	DP017B
Arsenic	2.50 - 14.60	26/26	5.20	7/26	2.8	DP020
Mercury	0.13 NJ - 25.60 NJ	5/26	0.10**	5/5**	256	DP014

NA Denotes not "applicable", since screening is not available.

J Denotes estimated value.

N For organic compounds this denotes uncertainty in identity of compound detected. For inorganic analyses, this denotes that the spike sample recovery was not within control limits.

B Denotes that the reported value is less than the contract required detection limit, but greater than or equal to the instrument detection limit.

* Denotes duplicate analysis is not within control limits.

D Denotes a diluted value.

* Screening criteria shown for inorganics is two times the background concentration.

** NYS TAGM Soil Cleanup Objective for mercury is 0.10 mg/kg. Surface soil frequency of exceedance noted reflects exceedance of CDM Federal's background criteria not of the NYS TAGM Cleanup Objective. In subsurface soil, the NYS TAGM Soil Cleanup Objective was used since mercury was not detected in the background subsurface soil.

TABLE 4 - 23
GROUNDWATER CONTAMINANTS OF CONCERN - ROUND 1
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Parameter	Range of Detected Sample	Frequency of Detection	Drinking Water Criteria	Frequency of Drinking Water Criteria Exceedances	Magnitude of Maximum Exceedance of Drinking Water Criteria	NYSDEC Groundwater Standard (c)	Frequency of NYSDEC Standard Exceedances	Magnitude of Maximum Exceedance of NYSDEC Standards	Location of Highest Detection
Targeted Organic Compounds (ug/l)									
Benzothiazole	1J	2/20	NA	NA	NA	NA	NA	NA	MW4S
Volatile Organic Compounds (ug/l)									
Vinyl Chloride	3.00J - 16.00	3/20	2(a)/(b)	3/3(a)/(b)	8(a)/(b)	2	3/3	8	MW5S
1,1-Dichloroethane	3.00J - 8.00J	3/20	NA(a)/5(b)	NA(a)/1/3(b)	NA(a)/1.6(b)	5	1/3	1.6	MW5D
Trichloroethene	1.00J - 8.00J	3/20	5(a)/(b)	1/3(a)/(b)	1.6(a)/(b)	5	1/3	1.6	MW5S
Xylenes	3.00J - 8.00J	6/20	10,000(a)/5(b)	0/6(a)/2/6(b)	NA(a)/1.6(b)	5	2/6	1.6	MW9D
1,2-Dichloroethene (total)	1J- 130	7/20	NA(a)/5(b)	NA(a)/5/7(b)	NA(a)/26(b)	5	5/7	26	MW5S
Benzene	1.00 J - 2.00 J	4/20	5(a)/(b)	0/4(a)/(b)	NA(a)/(b)	0.7	4/4	2.9	MW3D, MW9D
Semivolatile Organic Compounds (ug/l)									
Pentachlorophenol	6.00J	1/18	1(a)/(b)	1/1(a)/(b)	1.2(a)/(b)	1	1/1	1.2	MW6D
Hexachlorobutadiene	10.00J	1/18	NA(a)/5(b)	NA(a)/1/1(b)	NA(a)/2(b)	5	1/1	2	MW6D
Phenol	4.00 J - 8.00 J	2/18	NA(a)/(b)	NA(a)/(b)	NA(a)/(b)	1	2/2	8	MW6D
2-Chlorophenol	10.00 J	1/18	NA(a)/(b)	NA(a)/(b)	NA(a)/(b)	5	1/1	2	MW6D
4-Chloro-3-methylphenol	10.00 J	1/18	NA(a)/(b)	NA(a)/(b)	NA(a)/(b)	5	1/1	2	MW6D
4-Nitrophenol	10.00 J	1/18	NA(a)/(b)	NA(a)/(b)	NA(a)/(b)	5	1/1	2	MW6D
Pyrene	6.00 J	1/18	NA(a)/(b)	NA(a)/(b)	NA(a)/(b)	5	1/1	1.2	MW6D
Inorganics (ug/l)									
Chromium	4.30J - 749.00J	20/20	100(a)/(b)	4/20(a)/(b)	7.5(a)/(b)	50	6/20	15	MW3OB
Iron	417.00 - 32,500.00	20/20	NA(a)/(b)	NA(a)/(b)	NA(a)/(b)	300	20/20	108.3	MW4S
Lead	2.20BJ - 105.00	17/20	15(a)/50(b)	2/17(a)/(b)	NA/2.1(b)	25	2/17	4.2	MW4S
Manganese	17.50 - 6,790.00 J	20/20	NA(a)/(b)	NA(a)/(b)	NA(a)/(b)	300	7/20	22.6	MW3PW
Nickel	9.30B - 725.00J	20/20	100(a)/NA(b)	5/20(a)/NA(b)	7.3(a)/NA(b)	NA	NA	NA	MW3B

NA Not applicable since no standards are available.
J Denotes an estimated value.

Screening Criteria:
(a) National Primary Drinking Water Standards, 40 CFR Part 141.
(b) New York State Department of Health, Drinking Water Standards.
(c) New York State Department of Environmental Conservation, Groundwater Quality Standards 6 NYCRR, Chapter X, Part 703.

TABLE 4 - 24
GROUNDWATER CONTAMINANTS OF CONCERN - ROUND 2
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

Parameter	Range of Detected Sample	Frequency of Detection	Drinking Water Criteria	Frequency Drinking Water Criteria Exceedances	Magnitude of Maximum Exceedance of Drinking Water Criteria	Federal NYSDEC Groundwater Standard	NYSDEC Standard Exceedances (c)	Magnitude of Maximum Exceedance of NYSDEC Standards	Location of Highest Detection
Volatile Organic Compounds (ug/l)									
Vinyl Chloride	44.00J - 220.00	3/20	2(a)/(b)	3/3(a)/(b)	110(a)/(b)	2	3/3	110	MW5S
1,1-Dichloroethane	2.00J - 70.00J	3/20	NA(a)/5(b)	2/3(b)	NA(a)/14(b)	5	2/3	14	MW5S
1,1,1-Trichloroethane	12.00 - 65.00J	2/20	200(a)/5(b)	0/2(a)/2/2(b)	NA(a)/13(b)	5	2/2	13	MW5S
Trichloroethene	2.00J - 76.00J	3/20	5(a)/(b)	1/3(a)/(b)	15.2(a)/(b)	5	1/3	15.2	MW5S
1,2-Dichloroethene (total)	11 - 1,300	4/20	NA(a)/5(b)	NA(a)/4/4(b)	NA(a)/260(b)	5	4/4	260	MW5S
Semivolatile Organic Compounds (ug/l)									
Benzo(a)pyrene	0.70J	1/20	0.20(a)/NA(b)	1/1(a)/NA(b)	3.5(a)/NA(b)	5	0/1	NA	MW3PW
Di-n-octylphthalate	0.70 J - 10.00	5/20	NA(a)/(b)	NA(a)/(b)	NA(a)/(b)	5	1/5	2	MW5S
Inorganics (ug/l)									
Chromium	11.00 - 488.00	10/20	100(a)/(b)	1/10(a)/(b)	4.9(a)/(b)	50	1/10	9.8	MW4S
Iron	182.00 - 19,300.00	20/20	NA(a)/(b)	NA(a)/(b)	NA(a)/(b)	300	19/20	64.3	MW4S
Lead	3.10 - 37.50	11/20	15(a)/50(b)	1/11(a)/11(b)	2.5(a)/NA(b)	15	1/11	3.3	MW4S
Manganese	35.00 - 1,330.00	18/20	NA(a)/(b)	NA(a)/(b)	NA(a)/(b)	300	3/18	4.4	MW3PW
Nickel	59.00 - 125.00	3/20	NA(a)/(b)	NA(a)/(b)	NA(a)/(b)	100	1/3	1.3	MW4D

NA Not applicable since no standards are available.
J Denotes an estimated value.

Screening Criteria:
(a) National Primary Drinking Water Standards, 40 CFR Part 141.
(b) New York State Department of Health, Drinking Water Standards.
(c) New York State Department of Environmental Conservation, Groundwater Quality Standards 6 NYCRR, Chapter X, Part 703.

TABLE 4 - 25
INORGANIC EXCEEDANCES OF SECONDARY DRINKING WATER STANDARDS
ROUND 1 GROUNDWATER SAMPLES
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
(All units ug/l)

Analyte	Standard	Sample Location MW1D	MW1S	MW2D	MW2S	MW30B	MW3PW	MW3D	MW3S	MW4D	MW4S
Aluminum	2,000	105.00	984.00	95.70	202.00	1430.00	104.00	148.00	1,220.00	129.00	**20,000.00**
Iron	300	**2,290.00**	**1,520.00**	**417.00**	**1,140.00**	**11,000.00**	**6,040.00**	**5,730.00**	**3,550.00**	**937.00**	**32,500.00**
Manganese	50	**63.40**	**255.00**	17.50	**275.00**	**677.00**	**6,790.00**	**54.60**	**352.00**	**83.00**	**1,780.00**

Analyte	Standard	Sample Location MW5D	MW5S	MW6D	MW6S	MW7D	MW7S	MW8D	MW8S	MW9D	MW9S
Aluminum	2,000	1,090.00	1,460.00	341.00	465.00	132.00	310.00	159.00	426.00	134.00	476.00
Iron	300	**15,100.00**	**5,050.00**	**5,450.00**	**785.00**	**2,550.00**	**879.00**	**6,290.00**	**2,210.00**	**1,320.00**	**3,950.00**
Manganese	50	**157.00**	**393.00**	**111.00**	**66.30**	**47.90**	**469.00**	**78.10**	**144.00**	**68.00**	**685.00**

Bold font indicates exceedances of the secondary standard.

TABLE 4 - 26
INORGANIC EXCEEDANCES OF SECONDARY DRINKING WATER STANDARDS
ROUND 2 GROUNDWATER SAMPLES
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK
(All units ug/l)

Analyte	Standard	Sample Location MW1D	MW1S	MW2D	MW2S	MW30B	MW3PW	MW3D	MW3S	MW4D	MW4S
Aluminum	2,000	-----	-----	-----	568.00	349.00	206.00	-----	-----	-----	**7,560.00**
Iron	300	**1,510.00**	**491.00**	**437.00**	**1,740.00**	**407.00**	**606.00**	**1,530.00**	339.00	2060.00	19,300.00
Manganese	50	**99.00**	**203.00**	-----	**279.00**	**136.00**	**1,330.00**	**57.00**	55.00	113.00	893.00

Analyte	Standard	Sample Location MW5D	MW5S	MW6D	MW6S	MW7D	MW7S	MW8D	MW8S	MW9D	MW9S
Aluminum	2,000	-----	308.00	-----	-----	-----	536.00	-----	-----	-----	-----
Iron	300	**2,620.00**	**1,930.00**	182.00	**2560.00**	**1,250.00**	**503.00**	**1,530.00**	**905.00**	**565.00**	**3,490.00**
Manganese	50	35.00	**216.00**	-----	**136.00**	**75.00**	49.00	**54.00**	**127.00**	**65.00**	**588.00**

Bold font indicates exceedances of secondary standard.

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BERM1 14.00 – 16.00′	
PHENOL	330.00 J
2-METHYLPHENOL	120.00 J

BERM2 8.00 – 10.00′	
DIPHENYLAMINE	3,100.00 J
2-MERCAPTOBENZOTHIAZOLE	30,000.00 BJ
2-ANILINOBENZOTHIAZOLE	39,000.00 BJ
PERYLENE	1,400.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	28,000.00 BJ
PHENOTHIAZINE	1,900.00 J
BENZOTHIAZOLE	14,000.00 J

BERM2 8.00 – 10.00′	
PHENOL	9,700.00 J
2-METHYLPHENOL	980.00 J
4-METHYLPHENOL	920.00 J
BENZO(A)ANTHRACENE	6,600.00 J
CHRYSENE	5,000.00 J
BIS(2-ETHYLHEXYL)PHTHALATE	53,000.00 BJ
BENZO(B)FLUORANTHENE	10,000.00 J
BENZO(K)FLUORANTHENE	11,000.00 J
BENZO(A)PYRENE	3,800.00 J

BERM2A 4.00 – 6.00′	
PHENYL ISOTHIOCYANATE	1,100.00 J
DIPHENYLAMINE	11,000.00 J
2-MERCAPTOBENZOTHIAZOLE	1100,000.00 DJ
2-ANILINOBENZOTHIAZOLE	960,000.00 D
PERYLENE	3,800.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	210,000.00 D
PHENOTHIAZINE	4,600.00 J
BENZOTHIAZOLE	150,000.00 D

BERM2A 4.00 – 6.00′	
PHENOL	2,800.00 J
BENZO(A)ANTHRACENE	1,600.00 J
CHRYSENE	1,400.00 J
BENZO(B)FLUORANTHENE	2,600.00 J
BENZO(K)FLUORANTHENE	2,600.00 J
BENZO(A)PYRENE	1,300.00 J

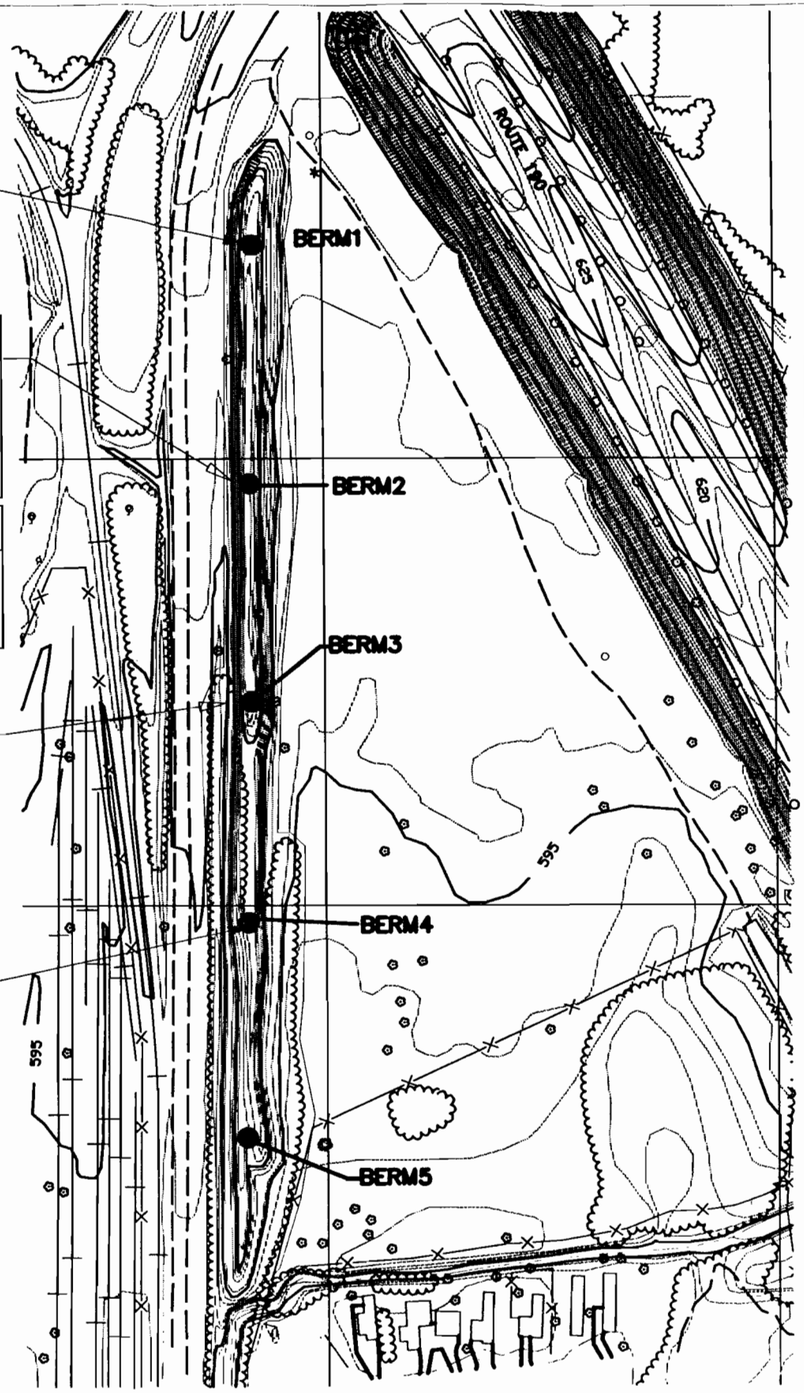
BERM3 16.00 – 18.00′	
2-MERCAPTOBENZOTHIAZOLE	270.00 J
2-ANILINOBENZOTHIAZOLE	90.00 J

BERM3A 10.00 – 12.00′	
DIPHENYLAMINE	2,500.00
2-MERCAPTOBENZOTHIAZOLE	69,000.00 JB
2-ANILINOBENZOTHIAZOLE	140,000.00 JB
N,N-DIPHENYL-1,4-BENZENEDIAMINE	18,000.00 JB
PHENOTHIAZINE	1,800.00
BENZOTHIAZOLE	14,000.00

BERM3A 10.00 – 12.00′	
PHENOL	3,300.00
BENZO(A)PYRENE	210.00 J

BERM4 12.00 – 14.00′	
PHENOL	420.00 J
BENZO(A)ANTHRACENE	1,400.00 J
CHRYSENE	1,400.00 J
BIS(2-ETHYLHEXYL)PHTHALATE	61,000.00 BJ
BENZO(B)FLUORANTHENE	2,200.00 XJ
BENZO(K)FLUORANTHENE	2,200.00 XJ
BENZO(A)PYRENE	1,100.00 J

BERM4 12.00 – 14.00′	
DIPHENYLAMINE	400.00
2-MERCAPTOBENZOTHIAZOLE	1,700.00 J
2-ANILINOBENZOTHIAZOLE	4,700.00 JB
PERYLENE	3,100.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	51,000.00 JB
PHENOTHIAZINE	60.00 J
BENZOTHIAZOLE	410.00



NYS TAGM SOIL CLEANUP OBJECTIVES	
PHENOL	30.00
2-METHYLPHENOL	100.00
4-METHYLPHENOL	900.00
BENZO(A)ANTHRACENE	224.00
CHRYSENE	400.00
BIS(2-ETHYLHEXYL)PHTHALATE	50,000.00
BENZO(B)FLUORANTHENE	1,100.00
BENZO(K)FLUORANTHENE	1,100.00
BENZO(A)PYRENE	61.00

LEGEND:

● SOIL BORING SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
COMPOUND	CONCENTRATION (ug/kg)

SCALE: 1"=170'

FIGURE 4-1

AOC 1 – BERM: SOIL BORING SAMPLES TARGETED ORGANIC COMPOUND DETECTIONS AND SEMIVOLATILE ORGANIC COMPOUND EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

SAMPLE DATA VALIDATION QUALIFIERS

Organic Qualifiers:

U	-	Compound was analyzed for but not detected. The associated numerical value is the sample quantitation.
J	-	Estimated data due to exceeded quality control criteria.
N	-	Presumptive evidence of a compound.
P	-	The difference for detected concentration of a pesticide/Aroclor target analyte is greater than 25% between the two GC columns.
C	-	Identification of pesticide results was confirmed by GC/MS.
B	-	Analyte is found in the associated blank and in the sample.
E	-	Compound concentration exceeds the calibration range of the GC/MS instrument for that specific analysis.
D	-	Compound is identified at a secondary dilution factor.
A	-	TIC is suspected aldol - condensation product.
R	-	Data is rejected due to exceeded quality control criteria.

Inorganic Qualifiers:

B	-	Reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).
U	-	Analyte was analyzed for but not detected.
E	-	The reported value is estimated because of the presence of interference.
M	-	Duplicate injection precision not met.
N	-	Sample recovery is not within control limits.
S	-	The reported value was determined by the Method of Standard Additions (MSA).
W	-	Post-digestion spike for Furnace AA analysis is out of control limits(85-115%), while sample absorbance is less than 50% of spike absorbance.
R	-	Data is rejected.
*	-	Duplicate analysis not within control limits.
+	-	Correlation coefficient for the MSA is less than 0.995.

Note that these qualifiers should be used for all Data Presentation Figures.

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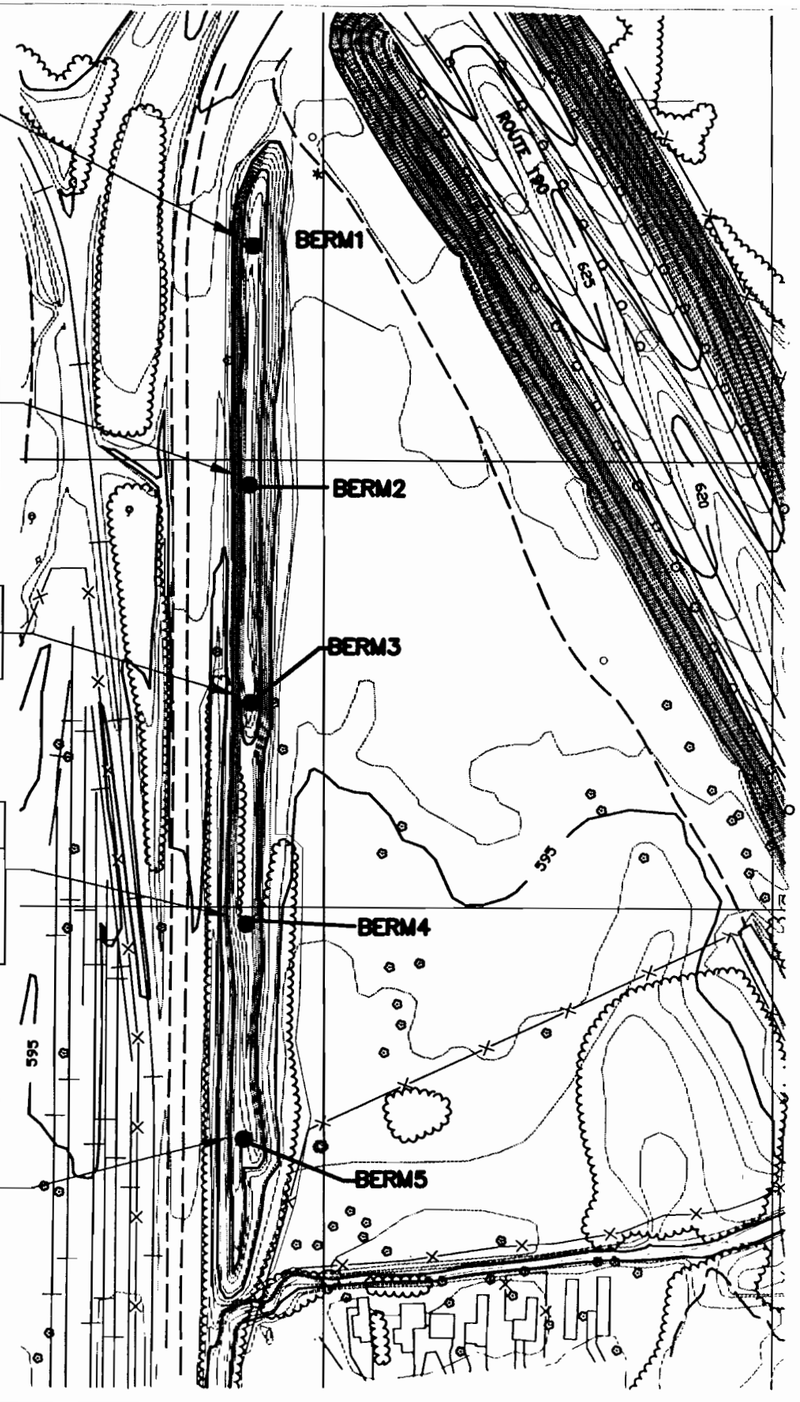


BERM1
14.00 – 16.00′

COBALT	15.30
NICKEL	29.60

BERM2A
4.00 – 6.00′

ALUMINUM	18,000.00 ■
ARSENIC	5.70
BARIUM	174.00
CHROMIUM	31.10
COBALT	30.70
COPPER	108.00
IRON	30,600.00 ■
MANGANESE	2,580.00
NICKEL	44.80

BERM2
8.00 – 10.00′

ARSENIC	6.80
CHROMIUM	91.50
COBALT	21.40
COPPER	185.00
LEAD	73.60
NICKEL	45.30

BERM3A
10.00 – 12.00′

ARSENIC	15.80
CHROMIUM	120.00
COBALT	29.20
COPPER	63.60
LEAD	51.40
NICKEL	47.90
VANADIUM	36.70 J

BERM3
16.00 – 18.00′

COBALT	15.30
NICKEL	31.30

BERM4
12.00 – 14.00′

ARSENIC	6.60
CHROMIUM	97.50
COBALT	16.60
COPPER	52.40
LEAD	50.40
NICKEL	29.70
VANADIUM	35.60 J

BERM5
6.00 – 8.00′

ALUMINUM	22,000.00 ■
ARSENIC	6.00
CHROMIUM	35.10
COBALT	15.60
IRON	33,300.00 ■
NICKEL	33.30
VANADIUM	38.70 J

BACKGROUND SCREENING CRITERIA

ALUMINUM	17,245.00
ARSENIC	5.52
BARIUM	163.44
CHROMIUM	27.60
COBALT	14.84
COPPER	41.60
IRON	28,750.00
LEAD	37.16
MANGANESE	1,114.60
NICKEL	28.36
VANADIUM	35.40

LEGEND:

● SUBSURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
ANALYTE	CONCENTRATION (mg/kg)

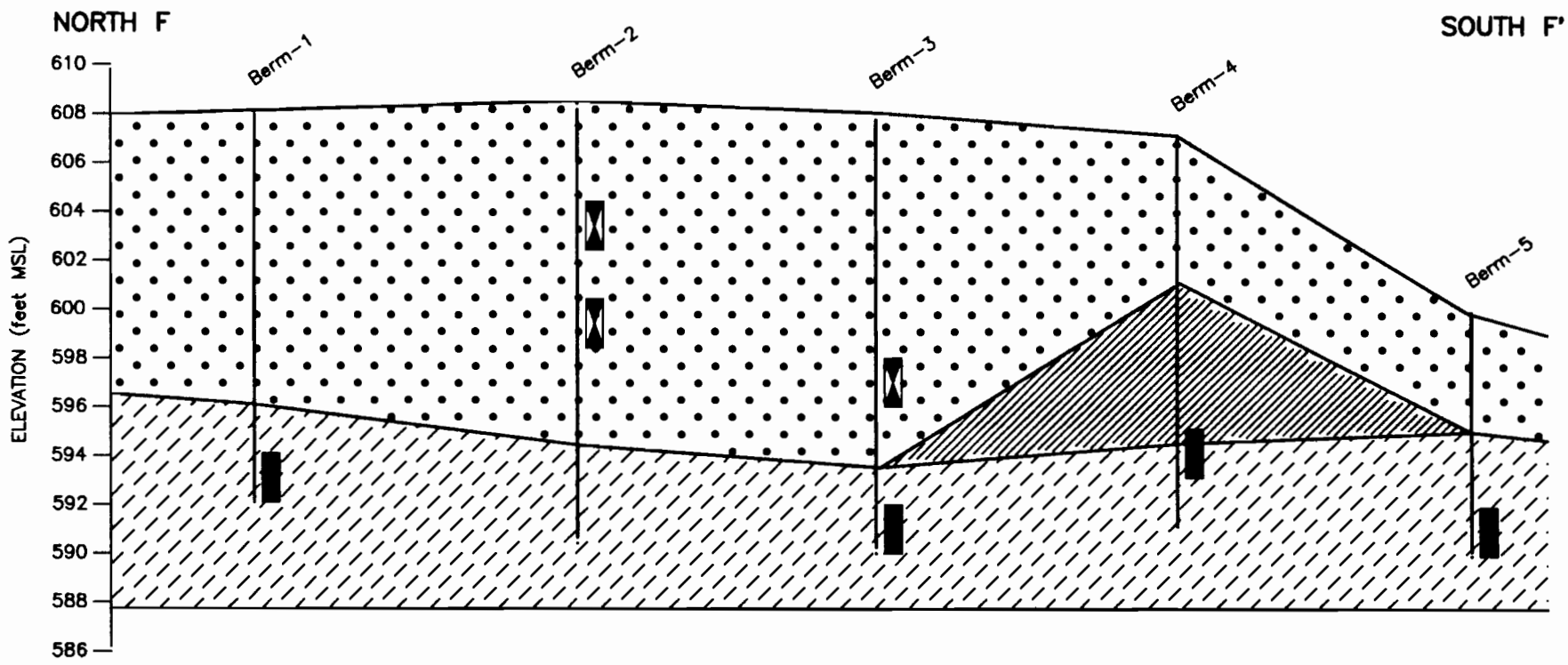
SCALE: 1"=170'

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FIGURE 4-2

AOC 1 – BERM: SUBSURFACE SOIL SAMPLE LOCATIONS INORGANIC EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York



LEGEND

- FILL
- BLACK STAINED CLAY
- CLAY/SILTY CLAY
- FILL SAMPLE
- SUBSURFACE SOIL SAMPLE

0 140
feet

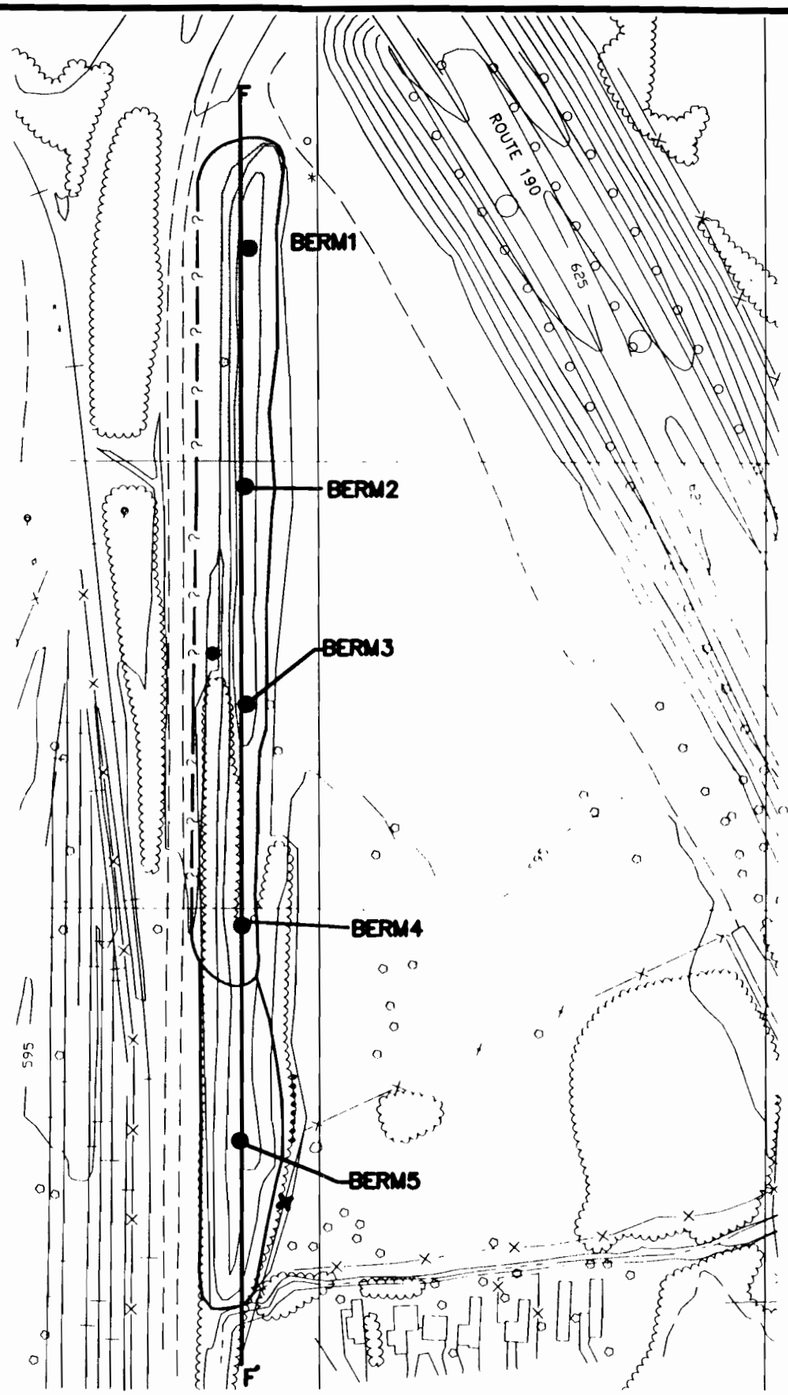
Vertical Exaggeration = 20.00

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FIGURE 4-3

VERTICAL EXTENT OF FILL MATERIAL IN AOC 1

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York



LEGEND:

- CROSS SECTION LOCATION
- APPROXIMATE EXTENT OF FILL
- —?— ESTIMATED EXTENT
- SOIL BORING SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SCALE: 1"=170'

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee inc.

FIGURE 4-4

AOC 1 – BERM:
EXTENT OF FILL MATERIAL

WORK ASSIGNMENT 053-2L3U

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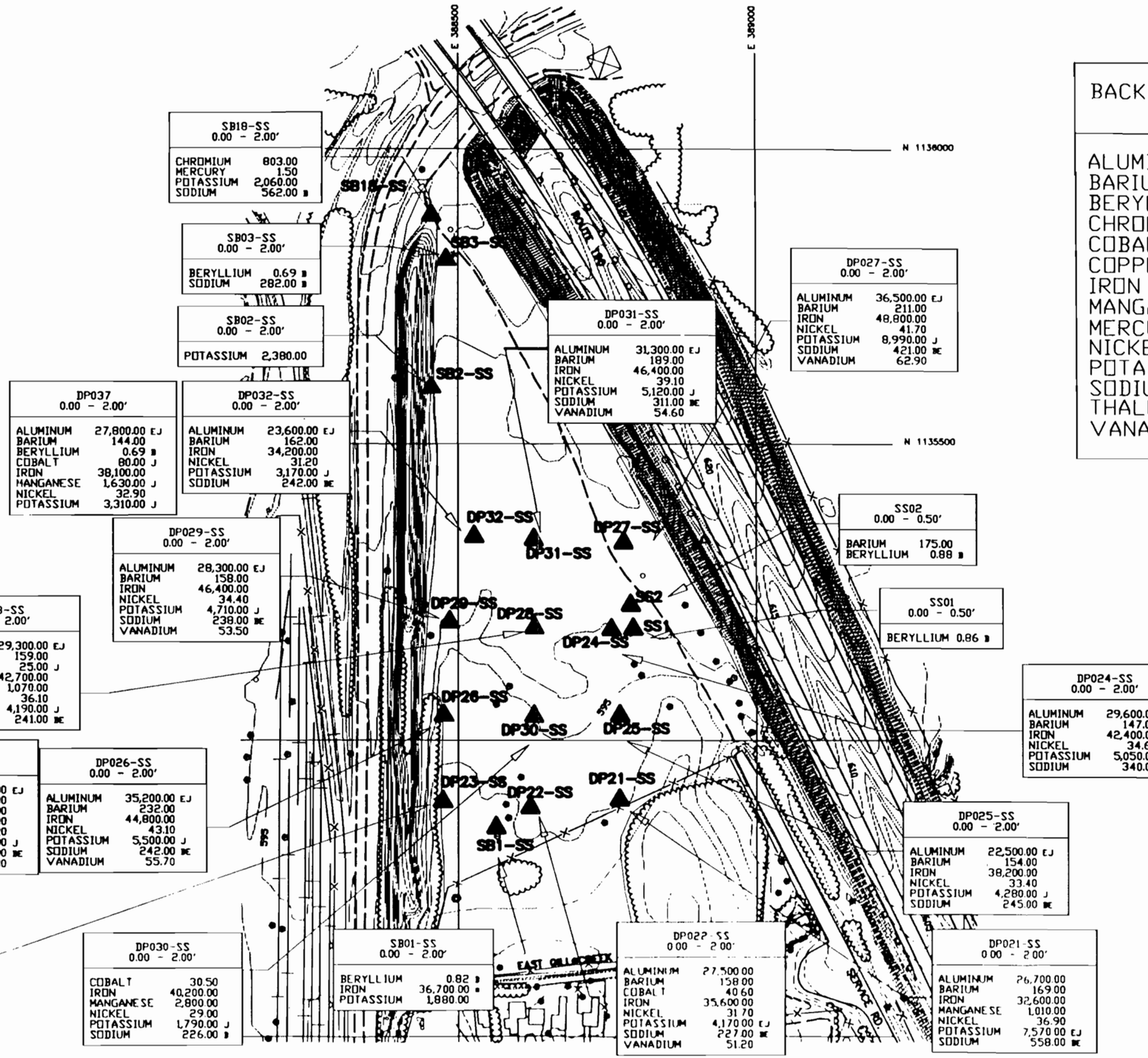

BACKGROUND SCREENING CRITERIA

ALUMINUM	20,615.00
BARIUM	143.40
BERYLLIUM	0.68
CHROMIUM	134.26
COBALT	21.52
COPPER	40.26
IRON	29,610.00
MANGANESE	864.60
MERCURY	0.58
NICKEL	27.68
POTASSIUM	1,538.00
SODIUM	223.86
THALLIUM	2.20
VANADIUM	50.80

LEGEND:

▲ SURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER
DEPTH (FT)

ANALYTE — CONCENTRATION (mg/kg)

SCALE: 1"=195'

FIGURE 4-6

AOC2 – NORTHERN ASPECT: SURFACE SOIL SAMPLE LOCATIONS INORGANIC EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

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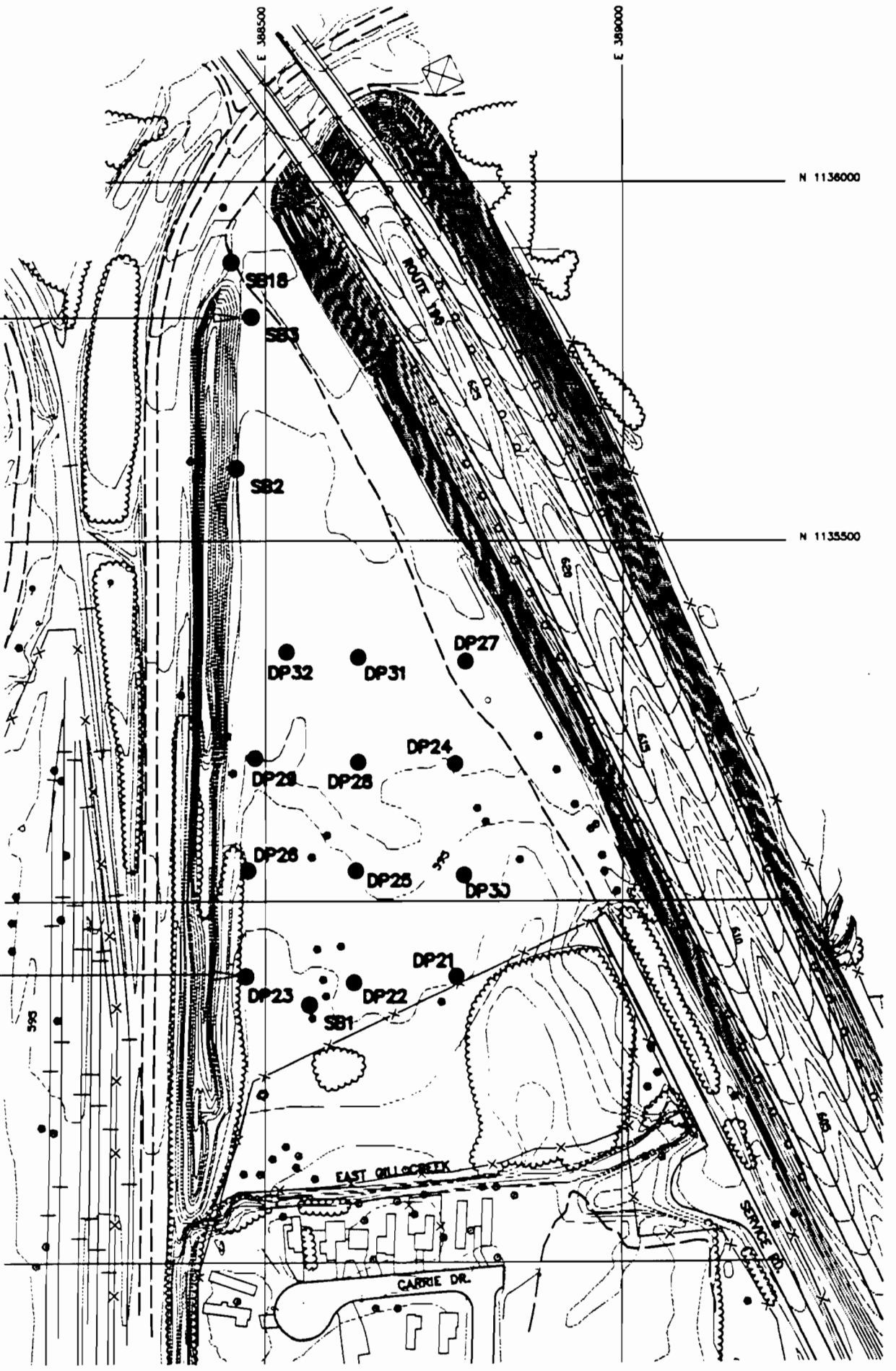

SB03 12.00 - 14.00'	
2-ANILINOBENZOTHIAZOLE	130.00 J

DP023 10.00 - 12.00'	
DIBENZO(A,H)ANTHRACENE	26.00 J

NYS TAGM SOIL CLEANUP OBJECTIVES	
DIBENZO(A,H)ANTHRACENE	14.00

LEGEND:

● SUBSURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER (DEPTH -FT.)	
COMPOUND	CONCENTRATION (ug/kg)

SCALE: 1"=195'

FIGURE 4-7

AOC 2 - NORTHERN ASPECT: SUBSURFACE SOIL SAMPLE LOCATIONS TARGETED ORGANIC COMPOUND DETECTIONS AND SEMIVOLATILE ORGANIC COMPOUND EXCEEDANCES

CDM FEDERAL PROGRAMS CORPORATION

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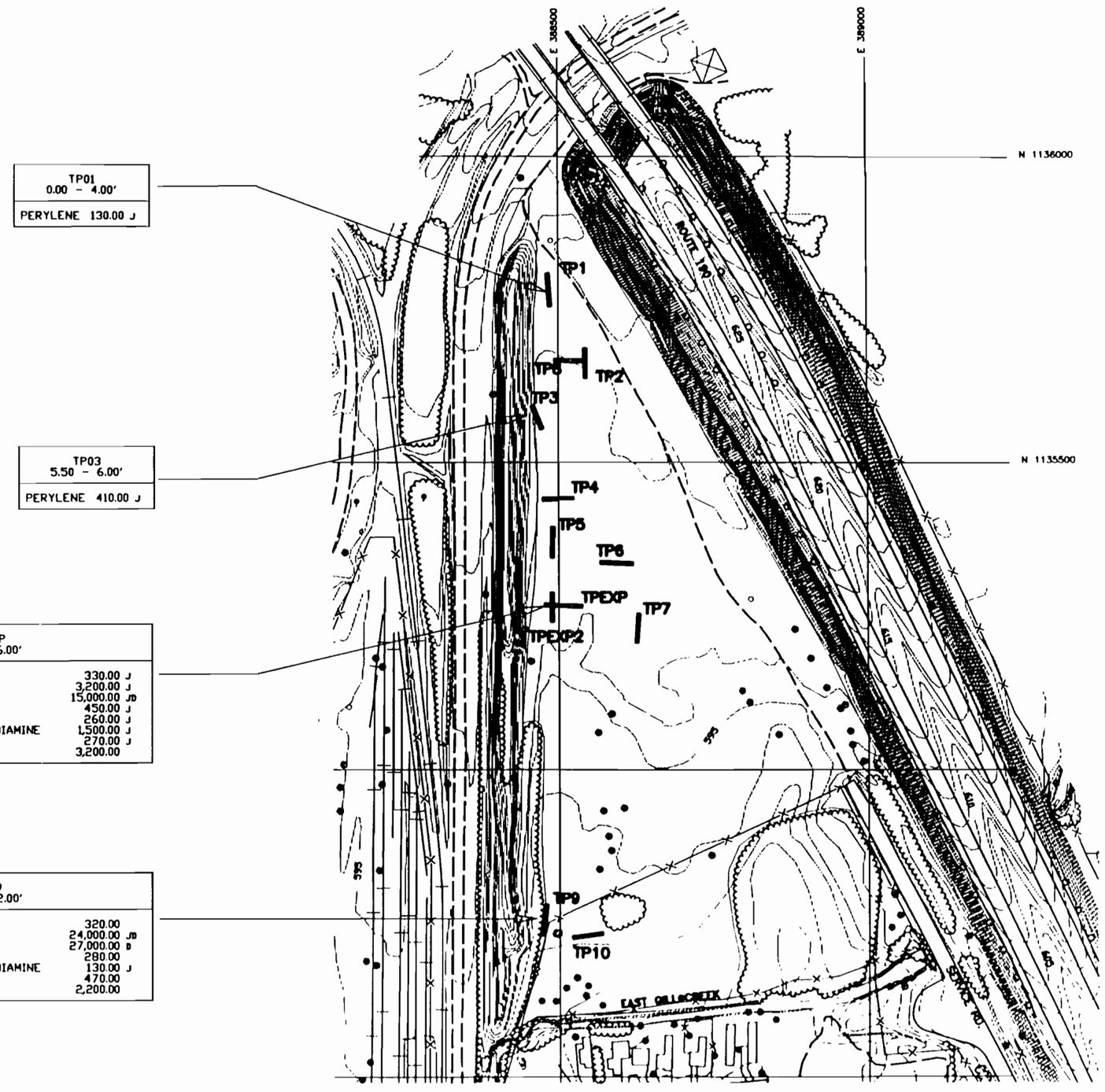


TP01 0.00 - 4.00'	
PERYLENE	130.00 J

TP03 5.50 - 6.00'	
PERYLENE	410.00 J

TPEXP 0.00 - 6.00'	
DIPHENYLAMINE	330.00 J
2-MERCAPTOBENZOTHIAZOLE	3,200.00 J
2-ANILINOBENZOTHIAZOLE	15,000.00 JB
PERYLENE	450.00 J
ANILINE	260.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	1,500.00 J
PHENOTHIAZINE	270.00 J
BENZOTHIAZOLE	3,200.00

TP09 0.00 - 2.00'	
DIPHENYLAMINE	320.00
2-MERCAPTOBENZOTHIAZOLE	24,000.00 JB
2-ANILINOBENZOTHIAZOLE	27,000.00 B
ANILINE	280.00
N,N-DIPHENYL-1,4-BENZENEDIAMINE	130.00 J
PHENOTHIAZINE	470.00
BENZOTHIAZOLE	2,200.00

LEGEND:

TEST PIT SAMPLE LOCATIONS

REFER TO FIGURE 1-3A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER (DEPTH -FT.)	
COMPOUND	CONCENTRATION (ug/kg)

SCALE: 1"=195'

FIGURE 4-8

AOC 2 - NORTHERN ASPECT: TEST PIT SAMPLE LOCATIONS DETECTED TARGETED ORGANIC COMPOUNDS

WORK ASSIGNMENT 053-2L3U

FILE: C:\FG\A2TPSBSV.DWG D.N. 4/3/96

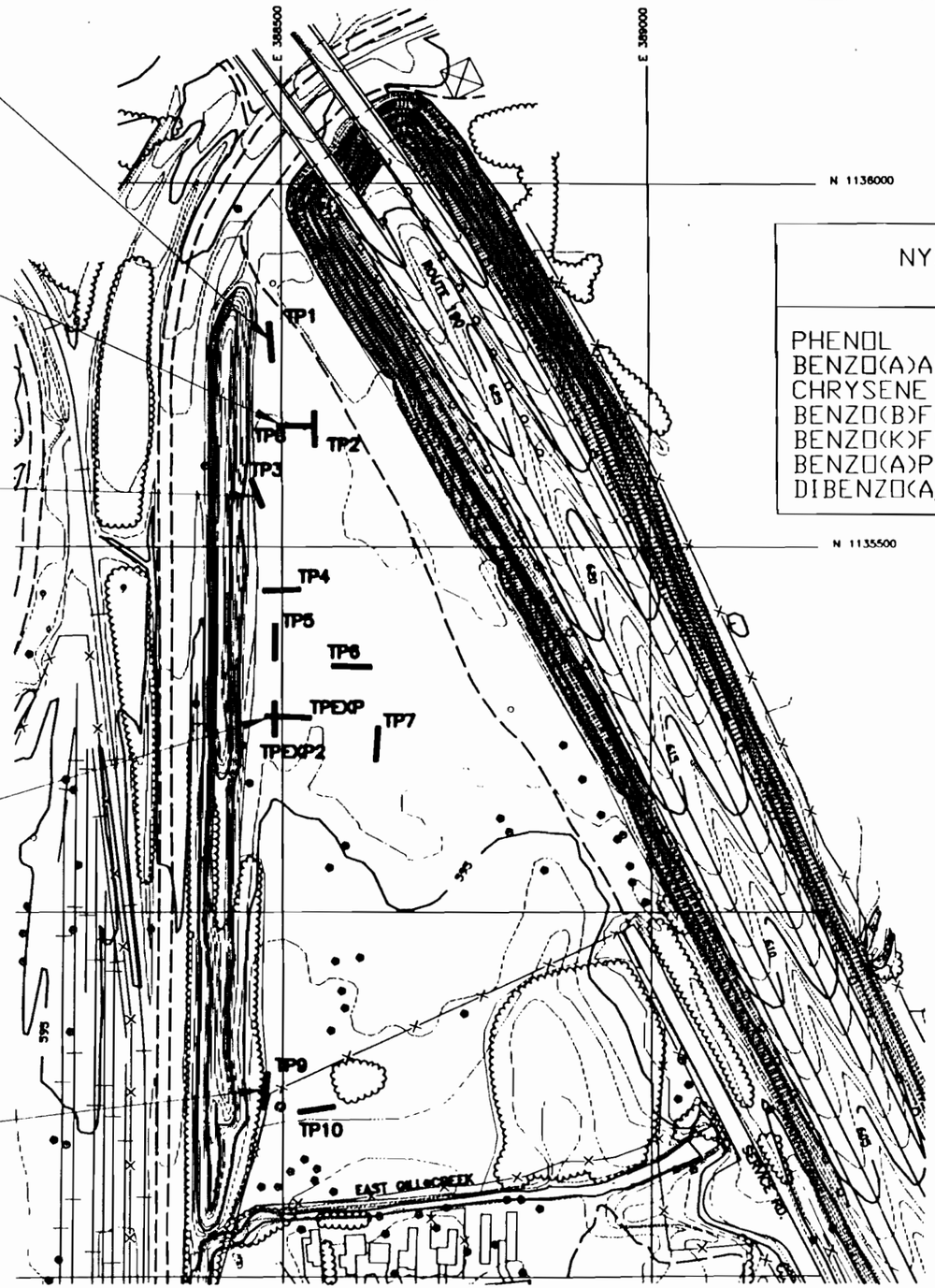
TP01 0.00 - 4.00'	
PHENOL	200.00 J
BENZO(A)ANTHRACENE	290.00 J
BENZO(A)PYRENE	290.00 J

TP08 0.00 - 6.00'	
BENZO(A)PYRENE	110.00 J

TP03 5.50 - 6.00'	
BENZO(A)PYRENE	78.00 J

TPEXP 0.00 - 6.00'	
PHENOL	57.00 J
BENZO(A)ANTHRACENE	7,700.00 D
CHRYSENE	2,700.00
BENZO(B)FLUORANTHENE	12,000.00 D
BENZO(K)FLUORANTHENE	12,000.00 D
BENZO(A)PYRENE	2,600.00
DIBENZO(A,H)ANTHRACENE	330.00 J

TP09 0.00 - 2.00'	
BENZO(A)PYRENE	180.00 J



NYS TAGM SOIL CLEANUP OBJECTIVES	
PHENOL	30.00
BENZO(A)ANTHRACENE	224.00
CHRYSENE	400.00
BENZO(B)FLUORANTHENE	1,100.00
BENZO(K)FLUORANTHENE	1,100.00
BENZO(A)PYRENE	61.00
DIBENZO(A,H)ANTHRACENE	14.00

LEGEND:

TEST PIT SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
COMPOUND	CONCENTRATION (ug/kg)

SCALE: 1"=195'

FIGURE 4-

AOC 2 - NORTHERN ASPECT: TEST PIT SAMPLE LOCATION SEMIVOLATILE ORGANIC COMPOUND EXCEEDANCE

WORK ASSIGNMENT 053-2L3
Forest Glen Site, Niagara Falls, New Yo

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

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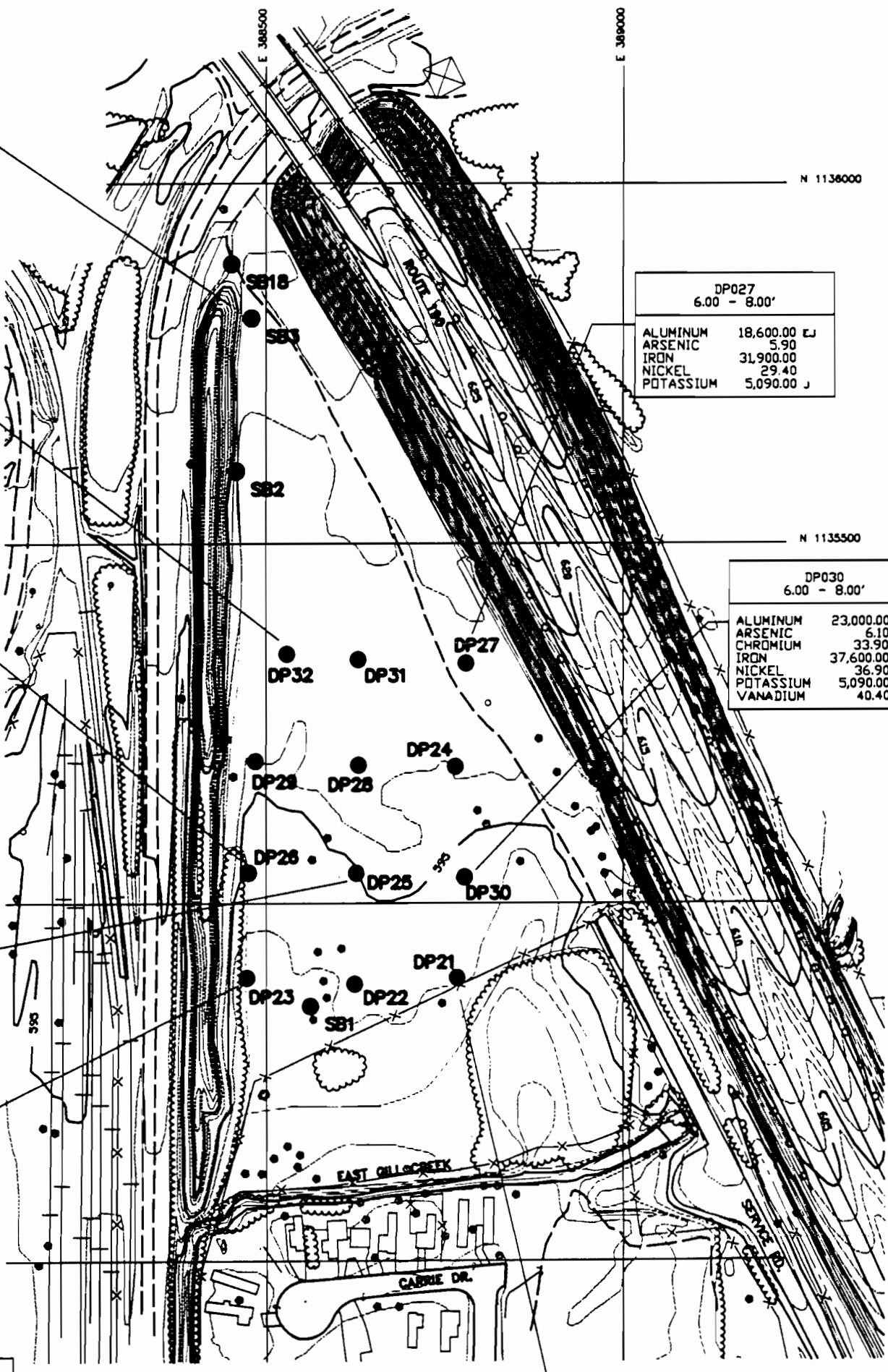

SB03
12.00 - 14.00'

BERYLLIUM	0.92 B
LEAD	66.00

DP032
8.00 - 10.00'

ALUMINUM	24,800.00 EJ
ARSENIC	5.40
CHROMIUM	34.70
COBALT	16.30 J
IRON	40,200.00
NICKEL	37.30
POTASSIUM	6,560.00 J
VANADIUM	43.50

DP026
9.00 - 11.00'

ALUMINUM	22,500.00 EJ
CHROMIUM	31.60
IRON	39,200.00
NICKEL	33.60
POTASSIUM	5,900.00 J
VANADIUM	39.90

DP025
6.00 - 8.00'

MAGNESIUM	49,900.00

DP023
10.00 - 12.00'

ALUMINUM	20,100.00
ARSENIC	5.90 J
BARIUM	325.00
CHROMIUM	28.80
IRON	31,800.00
NICKEL	29.40
POTASSIUM	5,650.00 EJ
VANADIUM	37.70

DP027
6.00 - 8.00'

ALUMINUM	18,600.00 EJ
ARSENIC	5.90
IRON	31,900.00
NICKEL	29.40
POTASSIUM	5,090.00 J

DP030
6.00 - 8.00'

ALUMINUM	23,000.00
ARSENIC	6.10 J
CHROMIUM	33.90
IRON	37,600.00
NICKEL	36.90
POTASSIUM	5,090.00 J
VANADIUM	40.40

DP021
10.00 - 12.00'

ALUMINUM	22,000.00
ARSENIC	5.30 J
CHROMIUM	31.90
IRON	31,300.00
NICKEL	31.80
POTASSIUM	6,560.00 EJ
VANADIUM	39.90

BACKGROUND SCREENING CRITERIA

ALUMINUM	17,245.00
ARSENIC	5.52
BARIUM	163.44
BERYLLIUM	0.84
CHROMIUM	27.60
COBALT	14.84
IRON	28,750.00
LEAD	37.16
MAGNESIUM	49,600.00
NICKEL	28.36
POTASSIUM	3,365.60
VANADIUM	35.40

LEGEND:

● SUBSURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
ANALYTE	CONCENTRATION (mg/kg)

SCALE: 1" = 195'

FIGURE 4-10

AOC 2 - NORTHERN ASPECT: SUBSURFACE SOIL SAMPLE LOCATIONS INORGANIC EXCEEDANCES

CDM FEDERAL PROGRAMS CORPORATION

WORK ASSIGNMENT 053-2L3U

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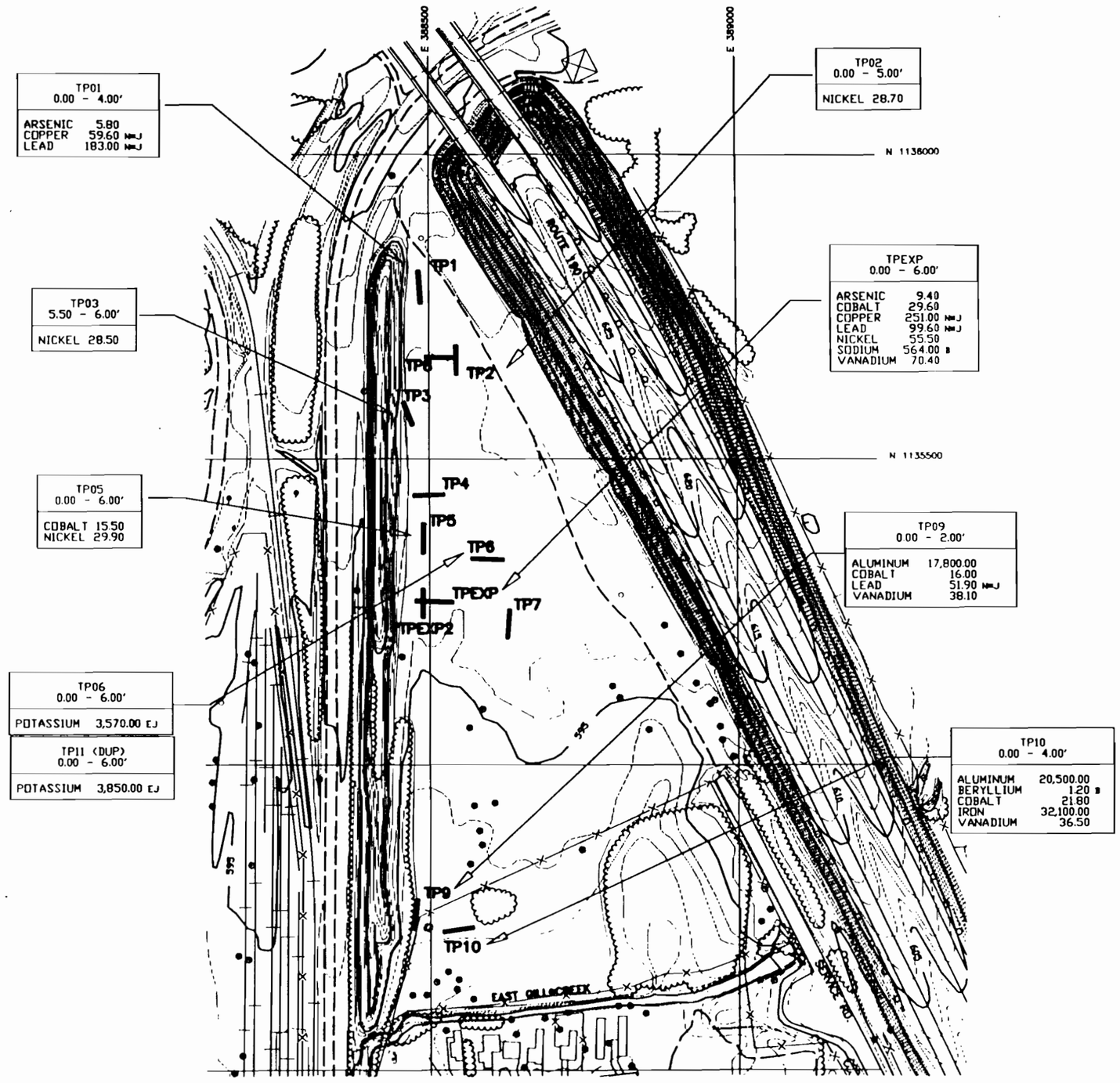
BACKGROUND SCREENING CRITERIA	
ALUMINUM	17,245.00
ARSENIC	5.52
BERYLLIUM	0.84
COBALT	14.84
COPPER	41.60
IRON	28,750.00
LEAD	37.16
NICKEL	28.36
POTASSIUM	3,365.60
SODIUM	520.00
VANADIUM	35.40



TP01
0.00 - 4.00'

ARSENIC	5.80
COPPER	59.60 NEJ
LEAD	183.00 NEJ

TP02
0.00 - 5.00'

NICKEL	28.70

TP03
5.50 - 6.00'

NICKEL	28.50

TPEXP
0.00 - 6.00'

ARSENIC	9.40
COBALT	29.60
COPPER	251.00 NEJ
LEAD	99.60 NEJ
NICKEL	55.50
SODIUM	564.00 B
VANADIUM	70.40

TP05
0.00 - 6.00'

COBALT	15.50
NICKEL	29.90

TP09
0.00 - 2.00'

ALUMINUM	17,800.00
COBALT	16.00
LEAD	51.90 NEJ
VANADIUM	38.10

TP06
0.00 - 6.00'

POTASSIUM	3,570.00 EJ

TP11 (DUP)
0.00 - 6.00'

POTASSIUM	3,850.00 EJ

TP10
0.00 - 4.00'

ALUMINUM	20,500.00
BERYLLIUM	1.20 B
COBALT	21.80
IRON	32,100.00
VANADIUM	36.50

LEGEND:

TEST PIT SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER (DEPTH -FT.)	
COMPOUND	CONCENTRATION (mg/kg)

SCALE: 1"=195'

FIGURE 4-

AOC 2 - NORTHERN ASPECT: TEST PIT SAMPLE LOCATION INORGANIC EXCEEDANCE

WORK ASSIGNMENT 053-2L

Forest Glen Site, Niagara Falls, New Yo

CDM FEDERAL PROGRAMS CORPORATION
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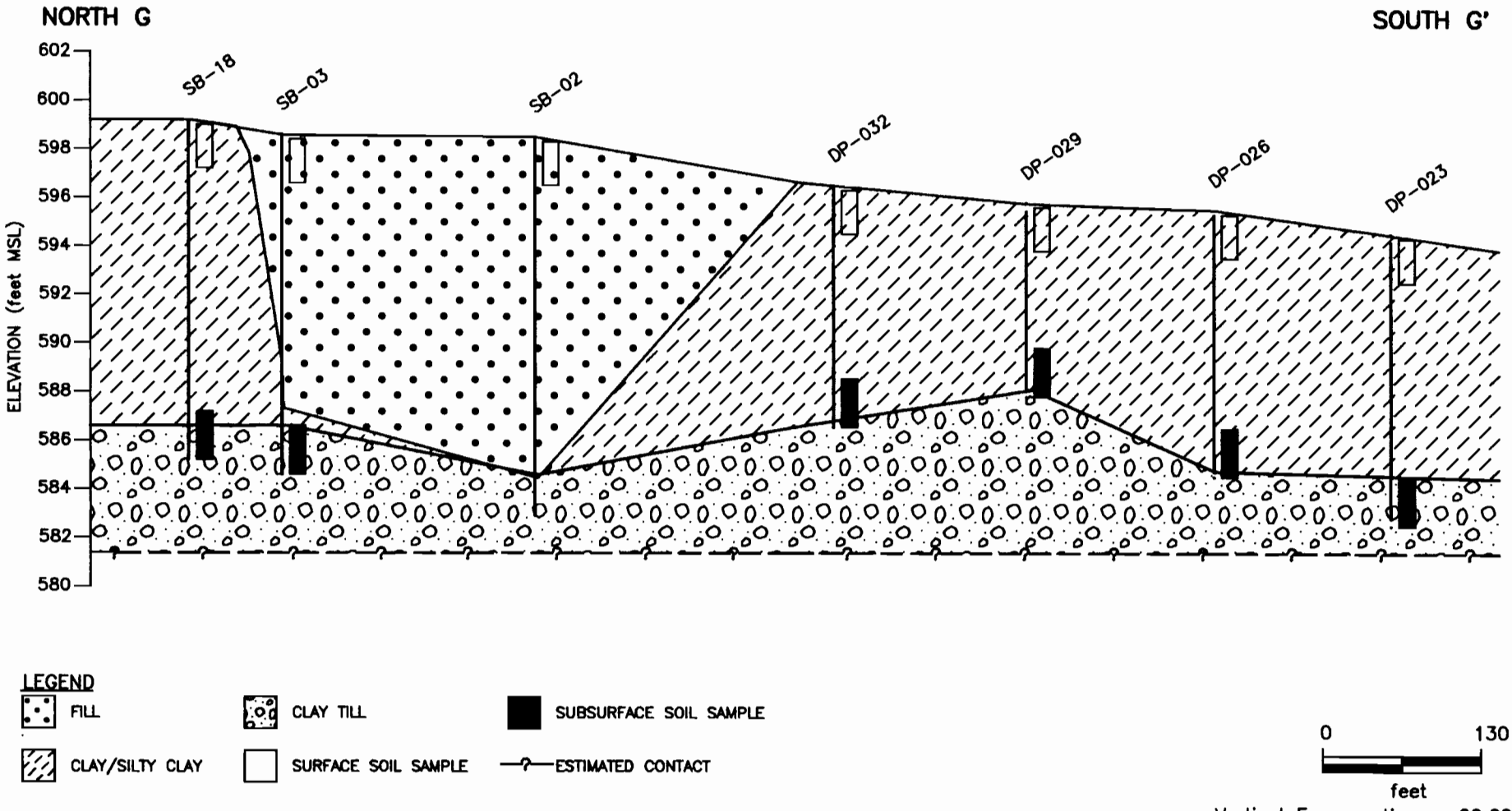

CDM FEDERAL PROGRAMS CORPORATION
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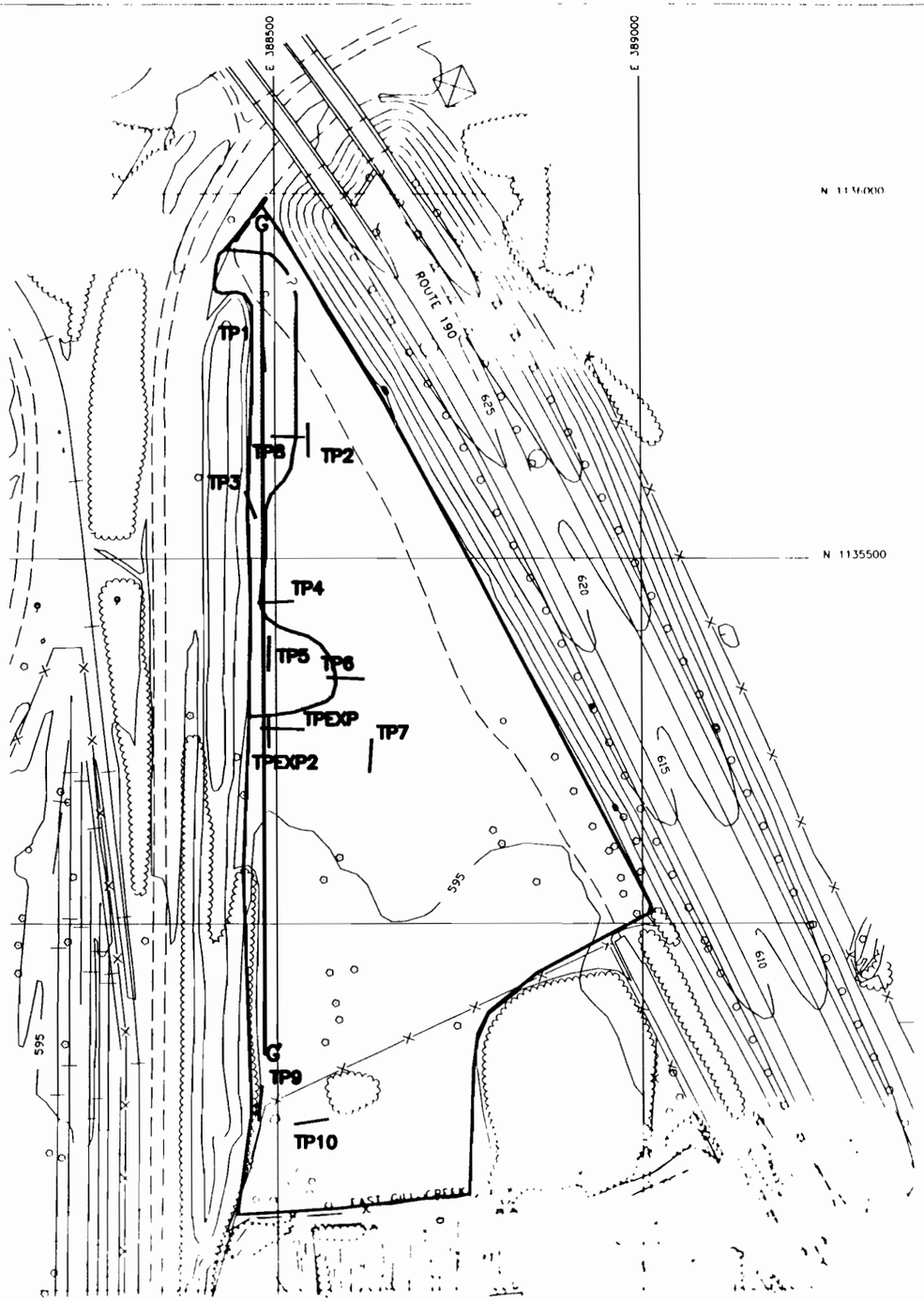
FIGURE 4-12

VERTICAL EXTENT OF FILL MATERIAL IN AOC 2

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York



LEGEND:

- CROSS SECTION LOCATION
- APPROXIMATE EXTENT OF FILL
- ? ESTIMATED EXTENT
- TEST PIT SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SCALE: 1"=195'

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FIGURE 4-13

AOC 2 – NORTHERN ASPECT: EXTENT OF FILL MATERIAL

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

DENISE NELSON

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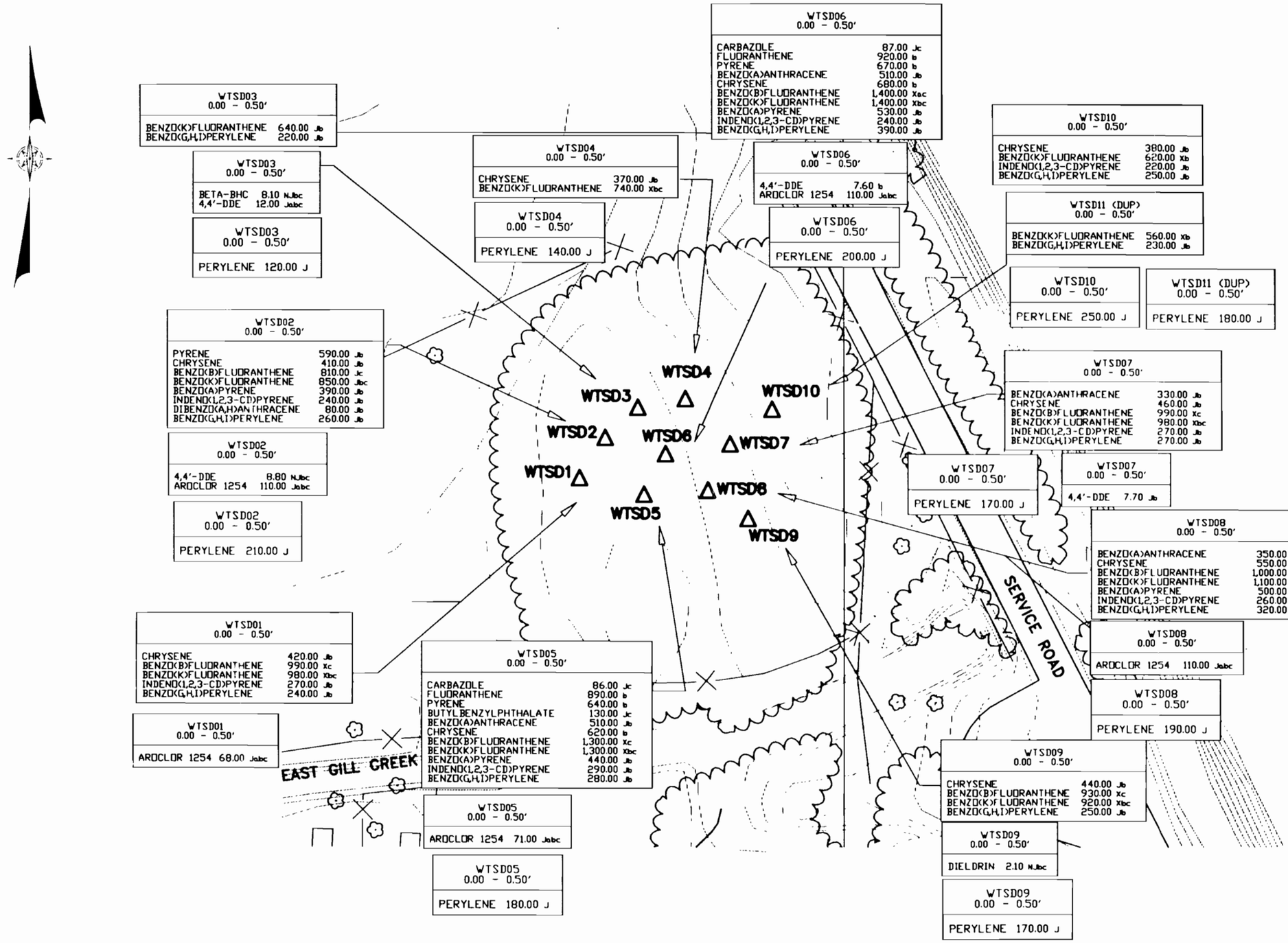


NYSDEC SEDIMENT CRITERIA (a)	
CARBAZOLE	NO STANDARD
BUTYLBENZYLPHTHALATE	NO STANDARD
BENZO(B)FLUORANTHENE	1,300.00
BENZO(K)FLUORANTHENE	NO STANDARD
PHENANTHRENE	NO STANDARD
FLUORANTHENE	NO STANDARD
PYRENE	NO STANDARD
BENZO(A)ANTHRACENE	NO STANDARD
CHRYSENE	NO STANDARD
BENZO(A)PYRENE	NO STANDARD
INDENO(1,2,3-CD)PYRENE	NO STANDARD
DIBENZO(A,H)ANTHRACENE	NO STANDARD
BENZO(G,H,I)PERYLENE	NO STANDARD
AROCLOR 1254	0.80
DIELDRIN	NO STANDARD
4,4'-DDE	10.00
BETA-BHC	NO STANDARD

ONTARIO MEE SEDIMENT CRITERIA (b)	
CARBAZOLE	NO STANDARD
BUTYLBENZYLPHTHALATE	NO STANDARD
BENZO(B)FLUORANTHENE	NO STANDARD
BENZO(K)FLUORANTHENE	240.00
PHENANTHRENE	560.00
FLUORANTHENE	750.00
PYRENE	490.00
BENZO(A)ANTHRACENE	320.00
CHRYSENE	340.00
BENZO(A)PYRENE	370.00
INDENO(1,2,3-CD)PYRENE	200.00
DIBENZO(A,H)ANTHRACENE	60.00
BENZO(G,H,I)PERYLENE	170.00
AROCLOR 1254	60.00
DIELDRIN	2.00
4,4'-DDE	5.00
BETA-BHC	5.00

BACKGROUND AVERAGE (c)	
CARBAZOLE	78.00
BUTYLBENZYLPHTHALATE	129.00
BENZO(B)FLUORANTHENE	790.00
BENZO(K)FLUORANTHENE	645.00
PHENANTHRENE	480.00
FLUORANTHENE	950.00
PYRENE	1,010.00
BENZO(A)ANTHRACENE	630.00
CHRYSENE	720.00
BENZO(A)PYRENE	700.00
INDENO(1,2,3-CD)PYRENE	565.00
DIBENZO(A,H)ANTHRACENE	158.00
BENZO(G,H,I)PERYLENE	530.00
AROCLOR 1254	NOT DETECTED
DIELDRIN	NOT DETECTED
4,4'-DDE	8.65
BETA-BHC	NOT DETECTED

LEGEND:

△ SEDIMENT SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
ANALYTE	CONCENTRATION (ug/kg)

SCALE: 1"=70'

FIGURE 4-14

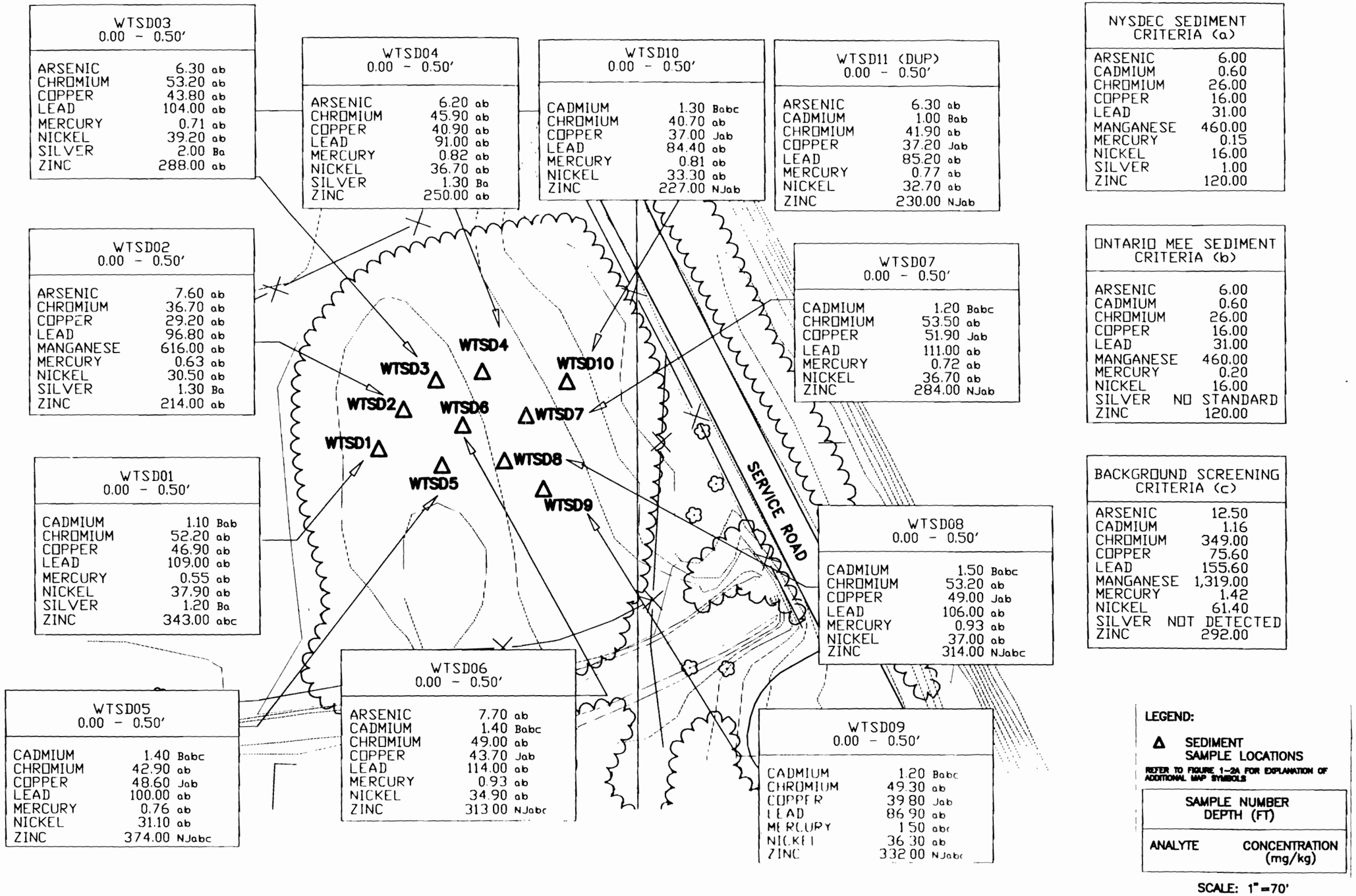
AOC 3 - WOODED WETLANDS: SEDIMENT LOCATIONS TARGETED ORGANIC COMPOUND DETECTIONS AND TCL ORGANIC COMPOUND EXCEEDANCES

WORK ASSIGNMENT 053-2L3U

Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION

a subsidiary of Camp Dresser & McKee Inc.



WTSD03 0.00 - 0.50′	
ARSENIC	6.30 ab
CHROMIUM	53.20 ab
COPPER	43.80 ab
LEAD	104.00 ab
MERCURY	0.71 ab
NICKEL	39.20 ab
SILVER	2.00 Ba
ZINC	288.00 ab

WTSD04 0.00 - 0.50′	
ARSENIC	6.20 ab
CHROMIUM	45.90 ab
COPPER	40.90 ab
LEAD	91.00 ab
MERCURY	0.82 ab
NICKEL	36.70 ab
SILVER	1.30 Ba
ZINC	250.00 ab

WTSD10 0.00 - 0.50′	
CADMIUM	1.30 Babc
CHROMIUM	40.70 ab
COPPER	37.00 Jab
LEAD	84.40 ab
MERCURY	0.81 ab
NICKEL	33.30 ab
ZINC	227.00 NJab

WTSD11 (DUP) 0.00 - 0.50′	
ARSENIC	6.30 ab
CADMIUM	1.00 Bab
CHROMIUM	41.90 ab
COPPER	37.20 Jab
LEAD	85.20 ab
MERCURY	0.77 ab
NICKEL	32.70 ab
ZINC	230.00 NJab

WTSD02 0.00 - 0.50′	
ARSENIC	7.60 ab
CHROMIUM	36.70 ab
COPPER	29.20 ab
LEAD	96.80 ab
MANGANESE	616.00 ab
MERCURY	0.63 ab
NICKEL	30.50 ab
SILVER	1.30 Ba
ZINC	214.00 ab

WTSD07 0.00 - 0.50′	
CADMIUM	1.20 Babc
CHROMIUM	53.50 ab
COPPER	51.90 Jab
LEAD	111.00 ab
MERCURY	0.72 ab
NICKEL	36.70 ab
ZINC	284.00 NJab

WTSD01 0.00 - 0.50′	
CADMIUM	1.10 Bab
CHROMIUM	52.20 ab
COPPER	46.90 ab
LEAD	109.00 ab
MERCURY	0.55 ab
NICKEL	37.90 ab
SILVER	1.20 Ba
ZINC	343.00 abc

WTSD08 0.00 - 0.50′	
CADMIUM	1.50 Babc
CHROMIUM	53.20 ab
COPPER	49.00 Jab
LEAD	106.00 ab
MERCURY	0.93 ab
NICKEL	37.00 ab
ZINC	314.00 NJabc

WTSD05 0.00 - 0.50′	
CADMIUM	1.40 Babc
CHROMIUM	42.90 ab
COPPER	48.60 Jab
LEAD	100.00 ab
MERCURY	0.76 ab
NICKEL	31.10 ab
ZINC	374.00 NJabc

WTSD06 0.00 - 0.50′	
ARSENIC	7.70 ab
CADMIUM	1.40 Babc
CHROMIUM	49.00 ab
COPPER	43.70 Jab
LEAD	114.00 ab
MERCURY	0.93 ab
NICKEL	34.90 ab
ZINC	313.00 NJabc

WTSD09 0.00 - 0.50′	
CADMIUM	1.20 Babc
CHROMIUM	49.30 ab
COPPER	39.80 Jab
LEAD	86.90 ab
MERCURY	1.50 abc
NICKEL	36.30 ab
ZINC	332.00 NJabc

NYSDEC SEDIMENT CRITERIA (a)	
ARSENIC	6.00
CADMIUM	0.60
CHROMIUM	26.00
COPPER	16.00
LEAD	31.00
MANGANESE	460.00
MERCURY	0.15
NICKEL	16.00
SILVER	1.00
ZINC	120.00

ONTARIO MEE SEDIMENT CRITERIA (b)	
ARSENIC	6.00
CADMIUM	0.60
CHROMIUM	26.00
COPPER	16.00
LEAD	31.00
MANGANESE	460.00
MERCURY	0.20
NICKEL	16.00
SILVER	NO STANDARD
ZINC	120.00

BACKGROUND SCREENING CRITERIA (c)	
ARSENIC	12.50
CADMIUM	1.16
CHROMIUM	349.00
COPPER	75.60
LEAD	155.60
MANGANESE	1,319.00
MERCURY	1.42
NICKEL	61.40
SILVER	NOT DETECTED
ZINC	292.00

LEGEND:

△ SEDIMENT SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
ANALYTE	CONCENTRATION (mg/kg)

SCALE: 1"=70'

FIGURE 4-15

AOC 3 – WOODED WETLANDS: SEDIMENT LOCATIONS INORGANIC EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

GCSW3 ROUND 1	
ALPHA-BHC	0.02 Jab
BETA-BHC	0.15 ab

GCSW5 (DUP OF GCSW3)	
ALPHA-BHC	0.01 Jab
BETA-BHC	0.11 ab

GCSD3 0-0.5' Round 1	
DIBENZO(A,H)ANTHRACENE	62.00 Jb

GCSD3 0-0.5' Round 1	
2-ANILINOBENZOTHIAZOLE	800.00 J

GCSD5 (DUP) 0-0.5' Round 1	
DIBENZO(A,H)ANTHRACENE	83.00 Jb

GCSD5 (DUP) 0-0.5' Round 1	
N,N-DIPHENYL-1,4-BENZENEDIAMINE	600.00 J

GCSD1 0-0.5' Round 1	
PHENANTHRENE	960.00 Jb
FLUORANTHENE	2,400.00 Jb
PYRENE	1,700.00 Jb
BENZO(A)ANTHRACENE	820.00 Jab
CHRYSENE	1,400.00 Jab
BENZO(B)FLUORANTHENE	1,600.00 Ja
BENZO(K)FLUORANTHENE	1,200.00 Jb
BENZO(A)PYRENE	1,100.00 Jb
INDENO(1,2,3-CD)PYRENE	680.00 Jb
DIBENZO(A,H)ANTHRACENE	300.00 Jb
BENZO(G,H,I)-PERYLENE	650.00 Jb

GCSD1 0-0.5' Round 1	
PERYLENE	400.00 J

GCSW1 ROUND 1	
ALPHA-BHC	0.01 J
BETA-BHC	0.05 NJa

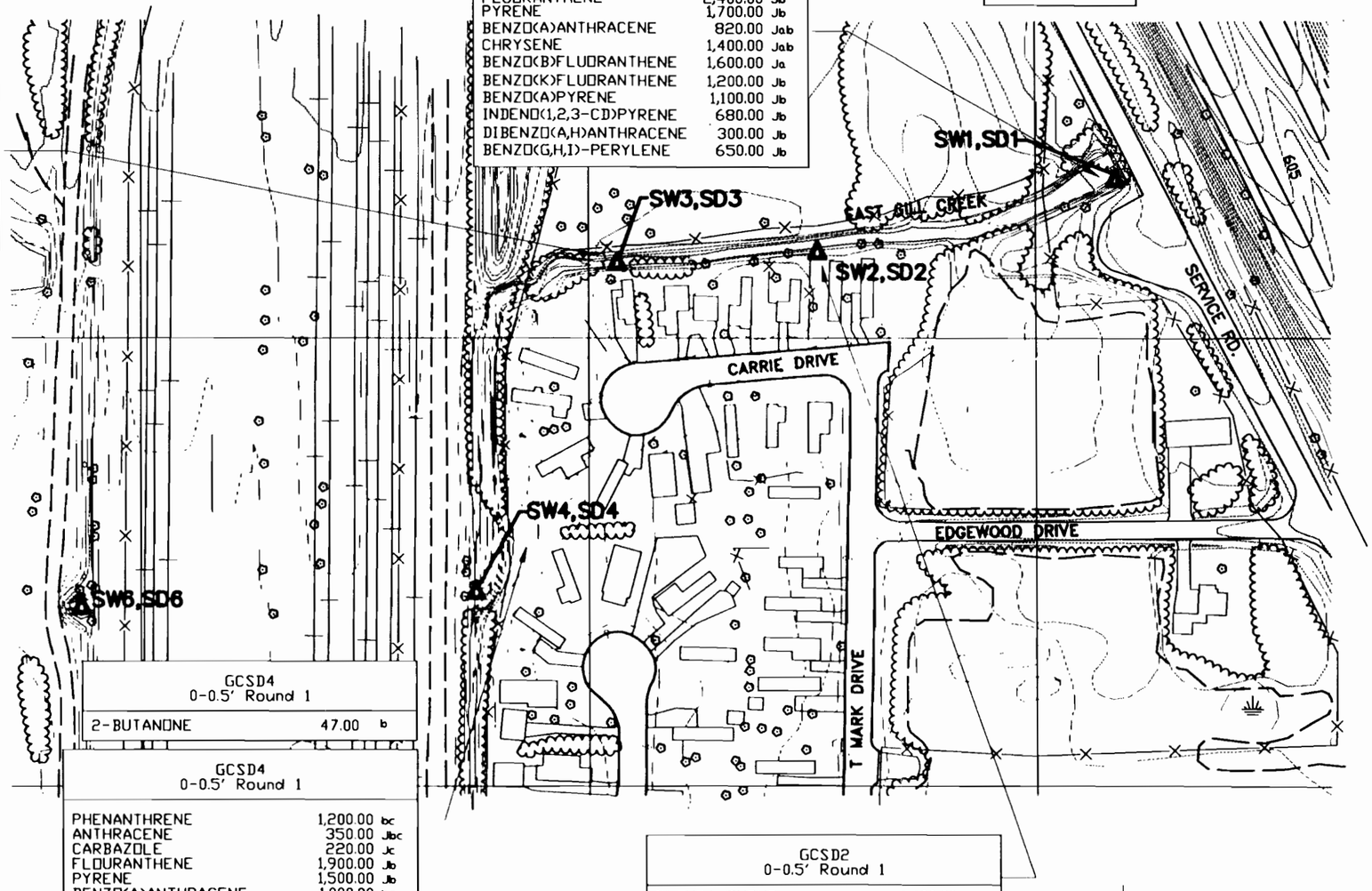
NYSDEC SEDIMENT CRITERIA (a)	
2-BUTANONE	NO STANDARD
PHENANTHRENE	NO STANDARD
ANTHRACENE	NO STANDARD
CARBAZOLE	NO STANDARD
FLUORANTHENE	NO STANDARD
PYRENE	NO STANDARD
BENZO(A)ANTHRACENE	1,300.00
CHRYSENE	1,300.00
BENZO(B)FLUORANTHENE	1,300.00
BENZO(K)FLUORANTHENE	NO STANDARD
BENZO(A)PYRENE	NO STANDARD
INDENO(1,2,3-CD)PYRENE	1,300.00
DIBENZO(A,H)ANTHRACENE	NO STANDARD
BENZO(G,H,I)PERYLENE	NO STANDARD

NYS SURFACE WATER CRITERIA (a)	
ALPHA-BHC	0.01
BETA-BHC	0.01

BACKGROUND VALUE (b)	
ALPHA-BHC	0.01 J
BETA-BHC	0.05 NJ

ONTARIO SEDIMENT CRITERIA (b)	
2-BUTANONE	NO STANDARD
PHENANTHRENE	560.00
ANTHRACENE	220.00
CARBAZOLE	NO STANDARD
FLUORANTHENE	750.00
PYRENE	490.00
BENZO(A)ANTHRACENE	320.00
CHRYSENE	340.00
BENZO(B)FLUORANTHENE	NO STANDARD
BENZO(K)FLUORANTHENE	240.00
BENZO(A)PYRENE	370.00
INDENO(1,2,3-CD)PYRENE	200.00
DIBENZO(A,H)ANTHRACENE	60.00
BENZO(G,H,I)PERYLENE	170.00

SEDIMENT BACKGROUND CRITERIA (c)	
2-BUTANONE	37.00
PHENANTHRENE	960.00 J
ANTHRACENE	190.00 J
CARBAZOLE	160.00 J
FLUORANTHENE	2,400.00 J
PYRENE	1,700.00 J
BENZO(A)ANTHRACENE	820.00 J
CHRYSENE	1,400.00 J
BENZO(B)FLUORANTHENE	1,600.00 J
BENZO(K)FLUORANTHENE	1,200.00 J
BENZO(A)PYRENE	1,100.00 J
INDENO(1,2,3-CD)PYRENE	680.00 J
DIBENZO(A,H)ANTHRACENE	300.00 J
BENZO(G,H,I)PERYLENE	650.00 J



GCSD4 0-0.5' Round 1	
2-BUTANONE	47.00 b

GCSD4 0-0.5' Round 1	
PHENANTHRENE	1,200.00 bc
ANTHRACENE	350.00 Jbc
CARBAZOLE	220.00 Jc
FLUORANTHENE	1,900.00 Jb
PYRENE	1,500.00 Jb
BENZO(A)ANTHRACENE	1,000.00 bc
CHRYSENE	1,200.00 Jb
BENZO(K)FLUORANTHENE	710.00 Jbc
BENZO(A)PYRENE	1,000.00 Jb
INDENO(1,2,3-CD)PYRENE	540.00 Jb
DIBENZO(A,H)ANTHRACENE	360.00 Jbc
BENZO(G,H,I)PERYLENE	540.00 Jb

GCSD4 0-0.5' Round 1	
2-MERCAPTOBENZOTHIAZOLE	2,000.00 J
2-ANILINOBENZOTHIAZOLE	6,000.00 BJ
PERYLENE	200.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	300.00 J
BENZOTHIAZOLE	400.00

GCSW4 ROUND 1	
ALPHA-BHC	0.01 b
BETA-BHC	0.11 ab

GCSD2 0-0.5' Round 1	
FLUORANTHENE	1,400.00 Jb
PYRENE	980.00 Jb
BENZO(A)ANTHRACENE	470.00 Jb
CHRYSENE	930.00 Jb
BENZO(A)PYRENE	750.00 Jb
INDENO(1,2,3-CD)PYRENE	510.00 Jb
DIBENZO(A,H)ANTHRACENE	230.00 Jb
BENZO(G,H,I)PERYLENE	480.00 Jb

GCSW2 ROUND 1	
ALPHA-BHC	0.01 Jab
BETA-BHC	0.12 ab

LEGEND:

△ SURFACE WATER/SEDIMENT SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER ROUND	
COMPOUND	CONCENTRATION
SEDIMENT	(ug/kg)
SURFACE WATER	(ug/l)

SCALE: 1"=150'

FIGURE 4-16

AOC 4 – EAST GILL CREEK: ROUND 1 SURFACE WATER/SEDIMENT SAMPLE LOCATIONS DETECTED TARGETED ORGANIC COMPOUNDS AND TCL ORGANIC COMPOUND EXCEEDANCES

CDM FEDERAL PROGRAMS CORPORATION

GCSW3 ROUND 2	
BETA-BHC	0.10 Jab

GCSD3-B 0-0.5' Round 2	
BENZO(K)FLUORANTHENE	270.00 Jb
DIBENZO(A,H)ANTHRACENE	68.00 Jb
BENZO(G,H,I)PERYLENE	180.00 Jb

GCSD3-B 0-0.5' Round 2	
2-ANILINOBENZOTHIAZOLE	170.00 J

GCSD5-B (DUP) 0-0.5' Round 2	
2-METHYLPHENOL	1,300.00 c
DI-N-OCTYLPHTHALATE	100.00 Jb

GCSD5-B (DUP) 0-0.5' Round 2	
2-ANILINOBENZOTHIAZOLE	490.00

GCSD1-B 0-0.5' Round 2	
PHENANTHRENE	1,200.00 b
FLUORANTHENE	2,600.00 b
PYRENE	2,200.00 b
BENZO(B)FLUORANTHENE	2,700.00 b
BENZO(K)FLUORANTHENE	800.00 Jb
BENZO(A)PYRENE	1,700.00 b
INDENO(1,2,3-CD)PYRENE	1,900.00 ab
DIBENZO(A,H)ANTHRACENE	360.00 Jb
BENZO(G,H,I)PERYLENE	1,700.00 b

GCSD1-B 0-0.5' Round 2	
PERYLENE	250.00 J

GCSW6 ROUND 2	
BETA-BHC	0.06 Jab

GCSD6-B 0-0.5' Round 2	
PHENOL	610.00 Jc
ACENAPHTHYLENE	140.00 Jc
PHENANTHRENE	590.00 Jb
FLUORANTHENE	1,100.00 b
PYRENE	850.00 b
BENZO(A)ANTHRACENE	500.00 Jbc
CHRYSENE	640.00 Jbc
BENZO(A)PYRENE	550.00 Jb
INDENO(1,2,3-CD)PYRENE	430.00 Jb
DIBENZO(A,H)ANTHRACENE	110.00 Jb
BENZO(G,H,I)PERYLENE	3,400.00 Jbc

GCSD6-B 0-0.5' Round 2	
DIPHENYLAMINE	3,000.00
2-ANILINOBENZOTHIAZOLE	2,800.00
PERYLENE	850.00
N,N-DIPHENYL-1,4-BENZENEDIAMINE	81,000.00 B
BENZOTHIAZOLE	140.00 J

NYS SURFACE WATER CRITERIA (a)	
BETA-BHC	0.01

BACKGROUND VALUE (b)
BETA-BHC NOT DETECTED

GCSD2-B 0-0.5' Round 2	
CHRYSENE	420.00 Jbc
DI-N-OCTYLPHTHALATE	620.00 Jc
INDENO(1,2,3-CD)PYRENE	330.00 Jb
DIBENZO(A,H)ANTHRACENE	69.00 Jb

GCSD2-B 0-0.5' Round 2	
2-ANILINOBENZOTHIAZOLE	90.00 J
PERYLENE	160.00 J

GCSW2 ROUND 2	
BETA-BHC	0.11 Jab

GCSD4-B 0-0.5' Round 2	
PHENOL	5,500.00 c
4-METHYLPHENOL	480.00 Jc
2-METHYLNAPHTHALENE	260.00 Jc
DIBENZOFURAN	200.00 Jc
PHENANTHRENE	1,200.00 b
FLUORANTHENE	1,300.00 b
PYRENE	840.00 b
BENZO(A)ANTHRACENE	470.00 Jbc
CHRYSENE	790.00 bc
INDENO(1,2,3-CD)PYRENE	240.00 Jb
DIBENZO(A,H)ANTHRACENE	74.00 Jb
BENZO(G,H,I)PERYLENE	220.00 Jb

GCSW4 ROUND 2	
BETA-BHC	0.07 Jab

GCSD4-B 0-0.5' Round 2	
DIPHENYLAMINE	150.00 J
2-MERCAPTOBENZOTHIAZOLE	3,600.00 J
2-ANILINOBENZOTHIAZOLE	19,000.00 B
PERYLENE	310.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	1,000.00 J
PHENOTHIAZINE	430.00
BENZOTHIAZOLE	1,500.00

NYSDEC SEDIMENT CRITERIA (a)	
PHENOL	NO STANDARD
2-METHYLPHENOL	NO STANDARD
4-METHYLPHENOL	NO STANDARD
2-METHYLNAPHTHALENE	NO STANDARD
ACENAPHTHYLENE	NO STANDARD
DIBENZOFURAN	NO STANDARD
PHENANTHRENE	NO STANDARD
FLUORANTHENE	NO STANDARD
PYRENE	NO STANDARD
BENZO(A)ANTHRACENE	1,300.00
CHRYSENE	1,300.00
DI-N-OCTYLPHTHALATE	NO STANDARD
BENZO(B)FLUORANTHENE	1,300.00
BENZO(K)FLUORANTHENE	NO STANDARD
BENZO(A)PYRENE	NO STANDARD
INDENO(1,2,3-CD)PYRENE	1,300.00
DIBENZO(A,H)ANTHRACENE	NO STANDARD
BENZO(G,H,I)PERYLENE	NO STANDARD

ONTARIO MEE SEDIMENT CRITERIA (b)	
PHENOL	NO STANDARD
2-METHYLPHENOL	NO STANDARD
4-METHYLPHENOL	NO STANDARD
2-METHYLNAPHTHALENE	NO STANDARD
ACENAPHTHYLENE	NO STANDARD
DIBENZOFURAN	NO STANDARD
PHENANTHRENE	560.00
FLUORANTHENE	750.00
PYRENE	490.00
BENZO(A)ANTHRACENE	320.00
CHRYSENE	340.00
DI-N-OCTYLPHTHALATE	NO STANDARD
BENZO(B)FLUORANTHENE	NO STANDARD
BENZO(K)FLUORANTHENE	240.00
BENZO(A)PYRENE	370.00
INDENO(1,2,3-CD)PYRENE	200.00
DIBENZO(A,H)ANTHRACENE	60.00
BENZO(G,H,I)PERYLENE	170.00

BACKGROUND VALUE (c)	
PHENOL	NOT DETECTED
2-METHYLPHENOL	NOT DETECTED
4-METHYLPHENOL	60.00 J
2-METHYLNAPHTHALENE	210.00 J
ACENAPHTHYLENE	110.00 J
DIBENZOFURAN	91.00 J
PHENANTHRENE	1,200.00
FLUORANTHENE	2,600.00
PYRENE	2,200.00
BENZO(A)ANTHRACENE	NOT DETECTED
CHRYSENE	NOT DETECTED
DI-N-OCTYLPHTHALATE	84.00 J
BENZO(B)FLUORANTHENE	2,700.00
BENZO(K)FLUORANTHENE	800.00 J
BENZO(A)PYRENE	1,700.00
INDENO(1,2,3-CD)PYRENE	1,900.00
DIBENZO(A,H)ANTHRACENE	360.00 J
BENZO(G,H,I)PERYLENE	1,700.00

SW1,SD1
SW2,SD2
SW3,SD3
SW4,SD4
SW6,SD6
EAST GILL CREEK
CARRIE DRIVE
EDGEWOOD DRIVE
T MARK DRIVE
SERVICE RD.
605

LEGEND:

△ SURFACE WATER/SEDIMENT SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER ROUND	
ANALYTE	CONCENTRATION
SEDIMENT	(ug/kg)
SURFACE WATER	(ug/l)

SCALE: 1" = 150'

FIGURE 4-17

AOC 4 – EAST GILL CREEK: ROUND 2 SURFACE WATER/SEDIMENT SAMPLE LOCATIONS DETECTED TARGETED ORGANIC COMPOUNDS AND SEMIVOLATILE ORGANIC COMPOUND EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

DENISE .ELSON

2:08:51

10/18/96 13:26:23

A4SWSDM1

F:\FFG\

GCSD3 0-0.5' Round 1		
CADMIUM	4.40	ab
CHROMIUM	59.60	ab
COPPER	33.20	Jab
LEAD	54.20	ab
MANGANESE	498.00	EJab
MERCURY	0.29	NJab
ZINC	406.00	ab

GCSD5 (DUP) 0-0.5' Round 1		
ARSENIC	7.40	Jab
CADMIUM	3.90	ab
CHROMIUM	46.10	Jab
COPPER	27.80	Jab
LEAD	43.60	ab
MANGANESE	491.00	EJab
MERCURY	0.24	NJab
ZINC	319.00	ab

GCSW3 Round 1		
ALUMINUM	22,400.0	a
COBALT	15.6	Ba
IRON	27,300.0	EJa
LEAD	59.00	a
VANADIUM	43.3	BEa
ZINC	580.0	a

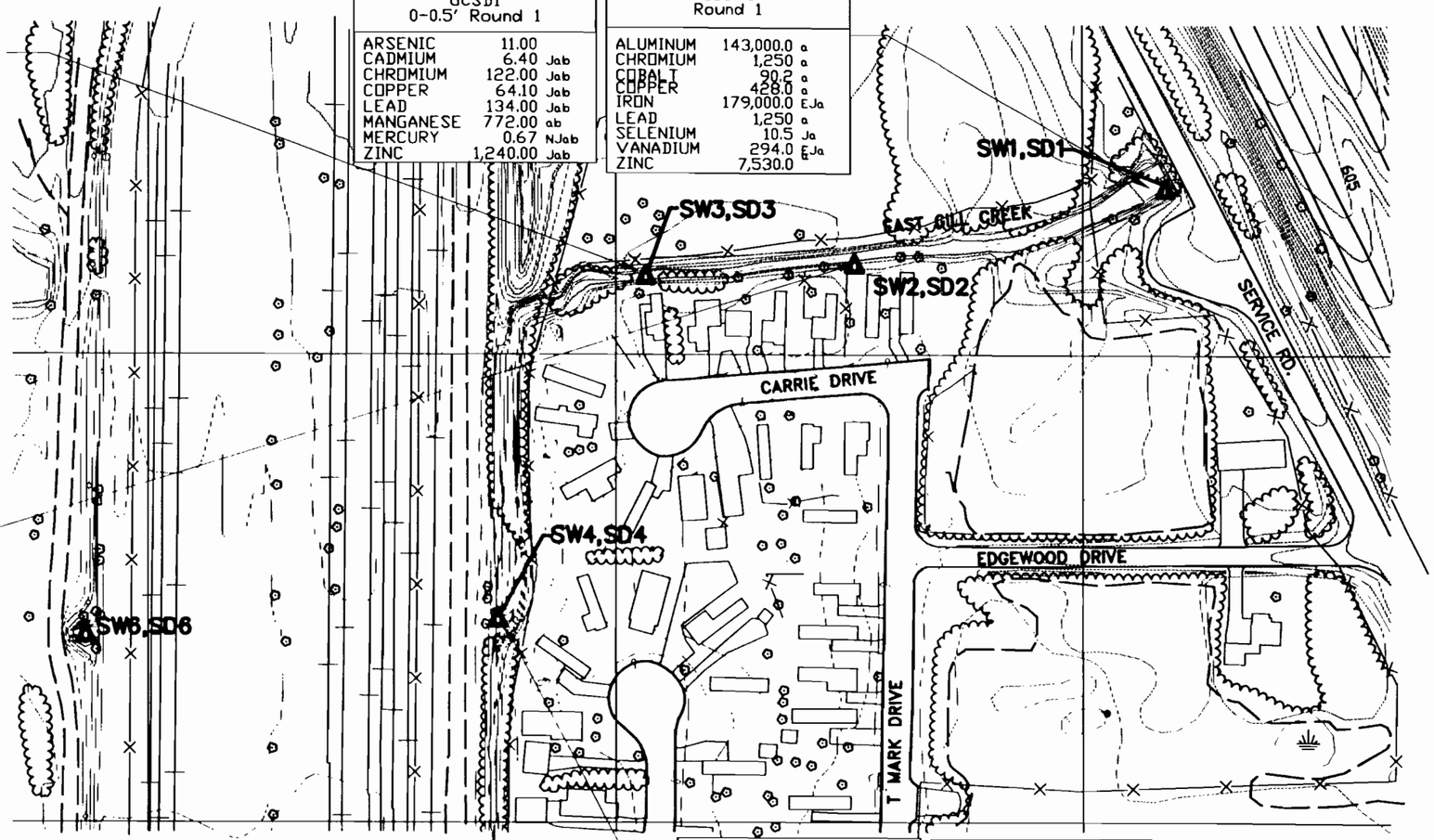
GCSW5 (DUP) Round 1		
ALUMINUM	38,300.0	a
COBALT	27.8	Ba
COPPER	75.20	EJa
IRON	48,100.0	EJa
LEAD	112.00	a
SELENIUM	5.0	Ba
VANADIUM	73.2	EJa
ZINC	1,050.0	a

GCSD2 0-0.5' Round 1		
CADMIUM	3.70	Jab
CHROMIUM	62.70	Jab
COPPER	35.30	Jab
LEAD	61.70	Jab
MERCURY	0.40	NJab
NICKEL	25.90	Jabc
ZINC	497.00	Jab

GCSW2 Round 1		
ALUMINUM	72,500.0	a
COBALT	44.5	Ba
COPPER	130	EJa
IRON	90,700.0	EJa
LEAD	190.00	a
SELENIUM	4.2	Ba
VANADIUM	133.0	EJa
ZINC	1,820.0	a

GCSD1 0-0.5' Round 1		
ARSENIC	11.00	
CADMIUM	6.40	Jab
CHROMIUM	122.00	Jab
COPPER	64.10	Jab
LEAD	134.00	Jab
MANGANESE	772.00	ab
MERCURY	0.67	NJab
ZINC	1,240.00	Jab

GCSW1 Round 1		
ALUMINUM	143,000.0	a
CHROMIUM	1,250	a
COBALT	90.2	a
COPPER	428.0	a
IRON	179,000.0	EJa
LEAD	1,250	a
SELENIUM	10.5	Ja
VANADIUM	294.0	EJa
ZINC	7,530.0	



GCSD4 0-0.5' Round 1		
ARSENIC	6.30	Jab
CADMIUM	3.60	ab
CHROMIUM	40.30	Jab
COPPER	35.30	Jab
LEAD	52.90	ab
MANGANESE	877.00	EJabc
MERCURY	0.32	NJab
ZINC	379.00	ab

GCSW4 Round 1		
ALUMINUM	4,380.0	a
IRON	4,810.0	EJa
ZINC	113.0	a

NYSDEC SEDIMENT CRITERIA (a)	
ARSENIC	6.00
CADMIUM	0.60
CHROMIUM	26.00
COPPER	16.00
LEAD	31.00
MANGANESE	460.00
MERCURY	0.15
NICKEL	16.00
ZINC	120.00

ONTARIO MEE SEDIMENT CRITERIA (b)	
ARSENIC	6.00
CADMIUM	0.60
CHROMIUM	26.00
COPPER	16.00
LEAD	31.00
MANGANESE	460.00
MERCURY	0.20
NICKEL	16.00
ZINC	120.00

BACKGROUND CRITERIA (c)	
ARSENIC	11.00
CADMIUM	12.80
CHROMIUM	244.00
COPPER	128.20
LEAD	268.00
MANGANESE	772.00
MERCURY	1.34
NICKEL	NOT DETECTED
ZINC	2,480.00

NYS SURFACE WATER CRITERIA (a)	
ALUMINUM	100.00
CHROMIUM	889.00
COBALT	5.00
COPPER	54.10
IRON	300.00
LEAD	30.60
SELENIUM	1.00
VANADIUM	14.00
ZINC	30.00

BACKGROUND CRITERIA (b)	
ALUMINUM	143,000.00
CHROMIUM	1,250.00
COBALT	90.20
COPPER	428.00
IRON	179,000.00
LEAD	1,250.00
SELENIUM	10.50
VANADIUM	294.00
ZINC	7,530.00

LEGEND:

△ SURFACE WATER/SEDIMENT SAMPLE LOCATION

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH/ROUND	
ANALYTE	CONCENTRATION
SEDIMENT	(mg/kg)
SURFACE WATER	(ug/l)

SCALE: 1"=150'

FIGURE 4-18

AOC 4 – EAST GILL CREEK: ROUND 1 SURFACE WATER/SEDIMENT SAMPLE LOCATIONS INORGANIC EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

GCSD3-B 0-0.5' Round 2	
CHROMIUM	37.00 ab
COPPER	28.00 ab
LEAD	32.00 ab
MANGANESE	832.00 abc
MERCURY	0.33 ab
NICKEL	31.00 abc
ZINC	129.00 abc

GCSW3-B Round 2	
ALUMINUM	205.00 a
IRON	347.00 a
MANGANESE	36.00 b
SELENIUM	8.70 ab
ZINC	42.00 a
CYANIDE	12.00 ab

GCSD5-B (DUP) 0-0.5' Round 2	
CHROMIUM	49.00 ab
COPPER	29.00 ab
MANGANESE	869.00 abc
MERCURY	0.24 ab
NICKEL	33.00 abc
ZINC	125.00 abc

GCSW5-B (DUP) Round 2	
ALUMINUM	220.00 a
IRON	366.00 a
MANGANESE	36.00 b
SELENIUM	8.20 a
ZINC	42.00 a
CYANIDE	10.90 ab

GCSD1-B 0-0.5' Round 2	
CADMIUM	1.80 ab
CHROMIUM	123.00 ab
COPPER	69.00 ab
LEAD	282.00 ab
MERCURY	1.50 Jab
NICKEL	27.00 ab

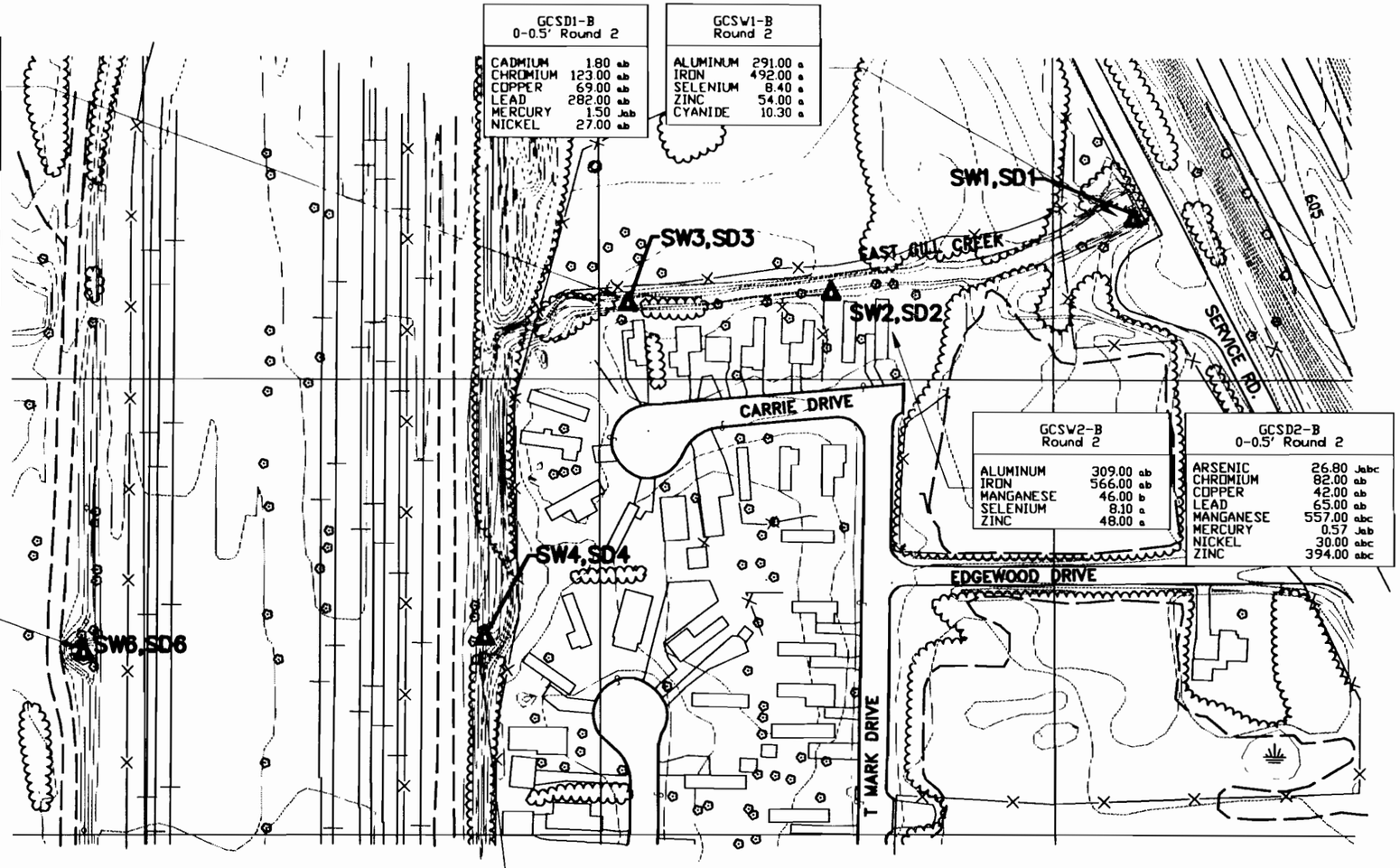
GCSW1-B Round 2	
ALUMINUM	291.00 a
IRON	492.00 a
SELENIUM	8.40 a
ZINC	54.00 a
CYANIDE	10.30 a

GCSW2-B Round 2	
ALUMINUM	309.00 ab
IRON	566.00 ab
MANGANESE	46.00 b
SELENIUM	8.10 a
ZINC	48.00 a

GCSD2-B 0-0.5' Round 2	
ARSENIC	26.80 Jabc
CHROMIUM	82.00 ab
COPPER	42.00 ab
LEAD	65.00 ab
MANGANESE	557.00 abc
MERCURY	0.57 Jab
NICKEL	30.00 abc
ZINC	394.00 abc

GCSD6-B 0-0.5' Round 2	
ARSENIC	23.90 Jabc
CHROMIUM	100.00 ab
COPPER	30.00 ab
LEAD	50.00 ab
MANGANESE	560.00 abc
MERCURY	0.40 ab
NICKEL	17.00 ab
ZINC	340.00 abc

GCSW6-B Round 2	
ALUMINUM	539.00 ab
CALCIUM	1114,000.00 b
CHROMIUM	139.00 b
IRON	836.00 ab
MANGANESE	44.00 b
SELENIUM	9.10 ab
ZINC	48.00 a
CYANIDE	13.60 ab



NYSDEC SEDIMENT CRITERIA (a)	
ARSENIC	6.00
CADMIUM	0.60
CHROMIUM	26.00
COPPER	16.00
LEAD	31.00
MANGANESE	460.00
MERCURY	0.15
NICKEL	16.00
ZINC	120.00

ONTARIO MEE SEDIMENT CRITERIA (b)	
ARSENIC	6.00
CADMIUM	0.60
CHROMIUM	26.00
COPPER	16.00
LEAD	31.00
MANGANESE	460.00
MERCURY	0.20
NICKEL	16.00
ZINC	120.00

SEDIMENT BACKGROUND CRITERIA (c)	
ARSENIC	10.40
CADMIUM	3.60
CHROMIUM	246.00
COPPER	138.00
LEAD	564.00
MANGANESE	776.00
MERCURY	3.00
NICKEL	54.00
ZINC	154.00

NYS SURFACE WATER CRITERIA (a)	
ALUMINUM	100.00
CALCIUM	NO STANDARD
CHROMIUM	889.00
IRON	300.00
LEAD	2,642.00
MANGANESE	NO STANDARD
SELENIUM	1.00
ZINC	30.00
CYANIDE	5.20

SURFACE WATER BACKGROUND CRITERIA (b)	
ALUMINUM	291.00
CALCIUM	105,000.00
CHROMIUM	27.00
IRON	492.00
LEAD	NOT DETECTED
MANGANESE	35.00
SELENIUM	8.40
ZINC	54.00
CYANIDE	10.30

GCSD4-B 0-0.5' Round 2	
CHROMIUM	42.00 ab
COPPER	39.00 ab
LEAD	39.00 ab
MANGANESE	1,290.00 abc
MERCURY	0.29 ab
NICKEL	29.00 abc
ZINC	199.00 abc

GCSW4-B Round 2	
ALUMINUM	1,650.00 ab
IRON	2,710.00 ab
LEAD	8.50 b
MANGANESE	171.00 b
SELENIUM	9.00 ab
ZINC	79.00 ab

LEGEND:

△ SURFACE WATER/SEDIMENT SAMPLE LOCATION

REFER TO FIGURE 1-3A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER ROUND	
ANALYTE	CONCENTRATION
SEDIMENT	(mg/kg)
SURFACE WATER	(ug/l)

SCALE: 1" = 150'

FIGURE 4-19

AOC 4 – EAST GILL CREEK: ROUND 2 SURFACE WATER/SEDIMENT SAMPLE LOCATIONS INORGANIC EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FILE: C:\FG\A5SSTSV.DWG D.N. 4/3/96

SB04-SS 0.00 - 2.00'	
2-MERCAPTOBENZOTHIAZOLE	1,800.00 J
PERYLENE	970.00 J

SBEXP-1-SS 0.00 - 2.00'	
PERYLENE	550.00 J

SB07-SS 0.00 - 2.00'	
DIPHENYLAMINE	50.00 J
2-MERCAPTOBENZOTHIAZOLE	570.00 J
2-ANILINOBENZOTHIAZOLE	1,300.00 J
PERYLENE	3,900.00 DJ
N,N-DIPHENYL-1,4-BENZENEDIAMINE	2,800.00 J
BENZOTHIAZOLE	260.00 J

SB20 (DUP) 0.00 - 2.00'	
2-ANILINOBENZOTHIAZOLE	2,800.00 J
PERYLENE	14,000.00 DJ
BENZOTHIAZOLE	990.00

SB08-SS 0.00 - 2.00'
PERYLENE 60.00 J

SB10-SS 0.00 - 2.00'	
PERYLENE	1,800.00

SB13-SS 0.00 - 2.00'	
PERYLENE	5.00

SB14-SS 0.00 - 2.00'	
2-ANILINOBENZOTHIAZOLE	2,100.00
PERYLENE	12,000.00

CARRIE DRIVE
SERVICE ROAD
EDGEWOOD DRIVE
T MARK DRIVE
SB04-SS
SB06-SS
SB05-SS
SBEXP1-SS
SB08-SS
SB09-SS
SB07-SS
SB10-SS
SB11-SS
SB12-SS
SBCENTER-SS
SB15-SS
SB14-SS
SB16-SS
SB17-SS

LEGEND:

▲ SURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
ANALYTE	CONCENTRATION (ug/kg)

SCALE: 1"=75'

FIGURE 4-20

AOC 5 - WOODED LOTS - NORTH AND SOUTH OF EDGEWOOD DRIVE: SURFACE SOIL SAMPLE LOCATIONS DETECTED TARGETED ORGANIC COMPOUNDS

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FILE: C:\FG\A5SSSV.DWG D.N. 4/3/96

SB04-SS 0.00 - 2.00'	
BENZO(A)ANTHRACENE	600.00
CHRYSENE	600.00
BENZO(A)PYRENE	530.00
DIBENZO(A,H)ANTHRACENE	68.00 J

SBEXP-1-SS 0.00 - 2.00'	
BENZO(A)ANTHRACENE	2,100.00
CHRYSENE	1,700.00
BENZO(B)FLUORANTHENE	3,500.00 D
BENZO(K)FLUORANTHENE	3,500.00 D
BENZO(A)PYRENE	1,100.00

SB07-SS 0.00 - 2.00'	
2-METHYLPHENOL	240.00 J
PHENANTHRENE	80,000.00 D
FLUORANTHENE	130,000.00 D
PYRENE	130,000.00 D
BENZO(A)ANTHRACENE	100,000.00 D
CHRYSENE	95,000.00 D
BENZO(B)FLUORANTHENE	130,000.00 DJ
BENZO(K)FLUORANTHENE	120,000.00 DJ
BENZO(A)PYRENE	88,000.00 DJ
INDENO(1,2,3-CD)PYRENE	25,000.00 DJ
DIBENZO(A,H)ANTHRACENE	16,000.00 DJ

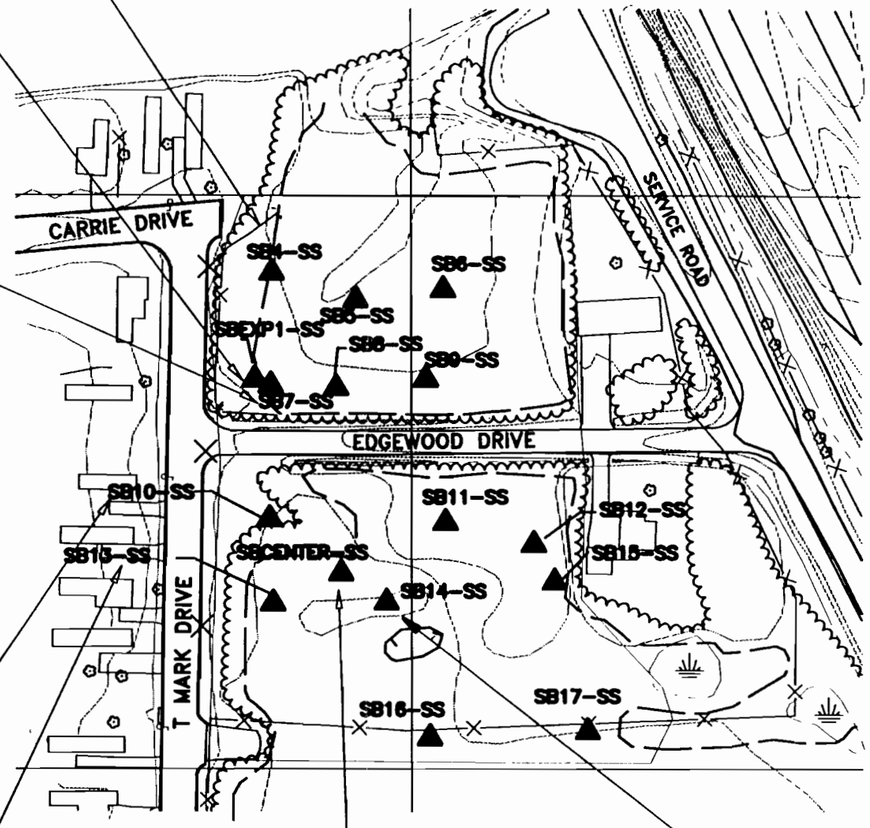
SB20 (DUP) 0.00 - 2.00'	
PENTACHLOROPHENOL	1,600.00 J
BENZO(A)ANTHRACENE	12,000.00
CHRYSENE	9,300.00
BENZO(B)FLUORANTHENE	15,000.00 D
BENZO(K)FLUORANTHENE	14,000.00 D
BENZO(A)PYRENE	9,800.00
DIBENZO(A,H)ANTHRACENE	890.00 J

SB10-SS 0.00 - 2.00'	
BENZO(A)ANTHRACENE	3,700.00
CHRYSENE	4,500.00
BENZO(B)FLUORANTHENE	6,500.00 X
BENZO(K)FLUORANTHENE	5,000.00 X
BENZO(A)PYRENE	1,900.00
DIBENZO(A,H)ANTHRACENE	200.00 J

SB13-SS 0.00 - 2.00'	
PHENOL	100.00 J
BENZO(A)ANTHRACENE	15,000.00 D
CHRYSENE	14,000.00 D
BENZO(B)FLUORANTHENE	31,000.00 D
BENZO(K)FLUORANTHENE	24,000.00 D
BENZO(A)PYRENE	3,000.00
INDENO(1,2,3-CD)PYRENE	3,700.00 D
DIBENZO(A,H)ANTHRACENE	1,100.00

SBCENTER-SS 0.00 - 2.00'	
PHENANTHRENE	53,000.00 D
FLUORANTHENE	98,000.00 D
PYRENE	81,000.00 D
BENZO(A)ANTHRACENE	77,000.00 D
CHRYSENE	64,000.00 D
BENZO(B)FLUORANTHENE	130,000.00 D
BENZO(K)FLUORANTHENE	110,000.00 D
BENZO(A)PYRENE	56,000.00 D
INDENO(1,2,3-CD)PYRENE	20,000.00
DIBENZO(A,H)ANTHRACENE	3,900.00 J

SB14-SS 0.00 - 2.00'	
FLUORANTHENE	85,000.00 D
PYRENE	78,000.00 D
BENZO(A)ANTHRACENE	73,000.00 D
CHRYSENE	63,000.00 D
BENZO(B)FLUORANTHENE	130,000.00 D
BENZO(K)FLUORANTHENE	100,000.00 D
BENZO(A)PYRENE	44,000.00
INDENO(1,2,3-CD)PYRENE	14,000.00
DIBENZO(A,H)ANTHRACENE	2,600.00 J



NYS TAGM SOIL CLEANUP OBJECTIVES	
2-METHYLPHENOL	100.00
PHENANTHRENE	50,000.00
FLUORANTHENE	50,000.00
PYRENE	50,000.00
BENZO(A)ANTHRACENE	224.00
CHRYSENE	400.00
BENZO(B)FLUORANTHENE	1,100.00
BENZO(K)FLUORANTHENE	1,100.00
BENZO(A)PYRENE	61.00
INDENO(1,2,3-CD)PYRENE	3,200.00
DIBENZO(A,H)ANTHRACENE	14.00
PENTACHLOROPHENOL	1,000.00
PHENOL	30.00

LEGEND:

▲ SURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
ANALYTE	CONCENTRATION (ug/kg)

SCALE: 1"=75'

FIGURE 4-21

AOC 5 - WOODED LOTS - NORTH AND SOUTH OF EDGEWOOD DRIVE: SURFACE SOIL SAMPLE LOCATIONS SEMIVOLATILE ORGANIC COMPOUND EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

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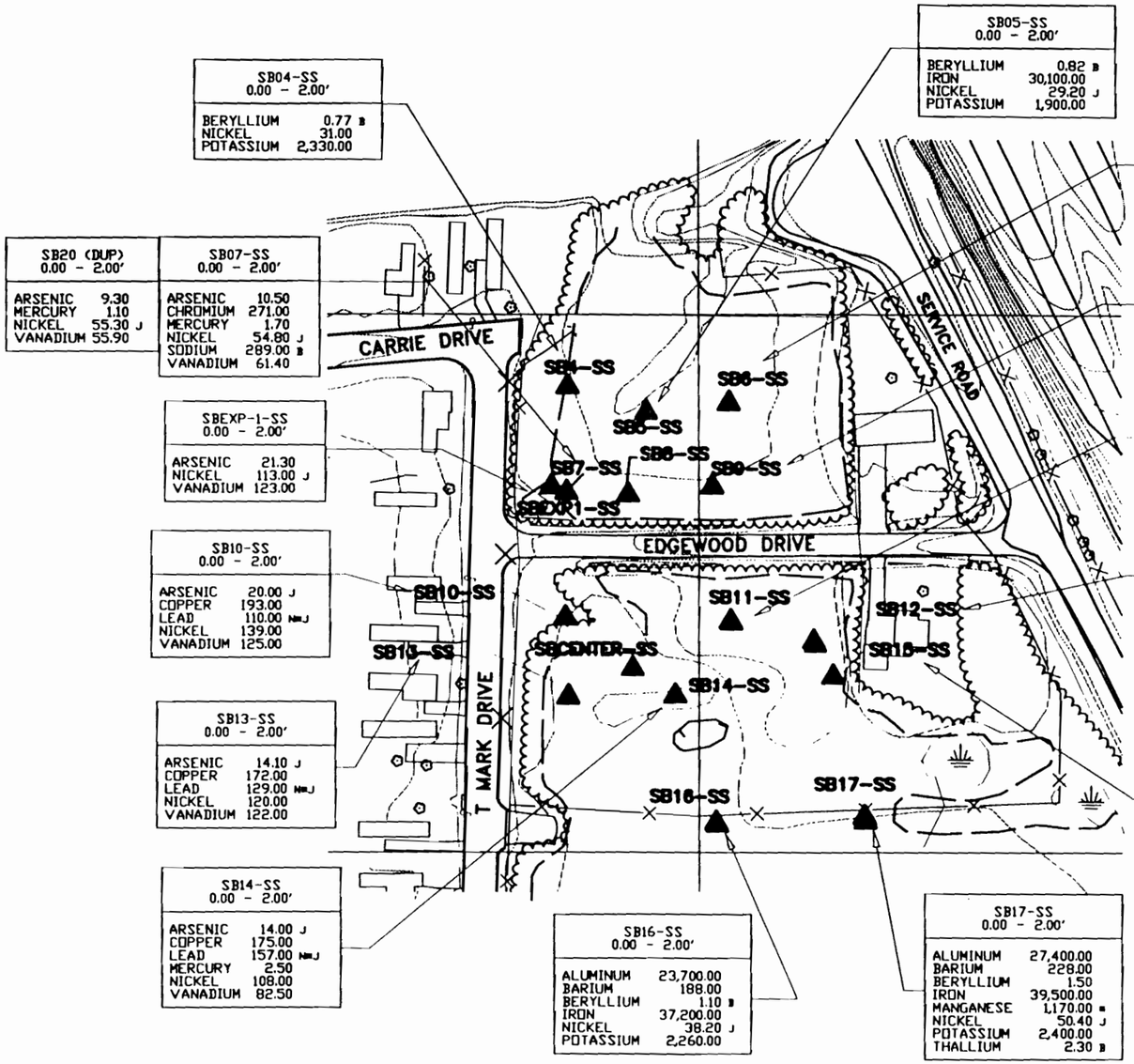

BACKGROUND SCREENING CRITERIA	
ALUMINUM	20,615.00
ARSENIC	9.20
BARIUM	143.40
BERYLLIUM	0.68
CHROMIUM	134.26
COPPER	40.26
IRON	29,610.00
LEAD	106.80
MAGANESE	864.60
MERCURY	0.58
NICKEL	27.68
POTASSIUM	1,538.00
SODIUM	223.86
THALLIUM	2.20
VANADIUM	50.80

LEGEND:

▲ SURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER
DEPTH (FT)

ANALYTE CONCENTRATION (mg/kg)

SCALE: 1"=75'

FIGURE 4-2

AOC 5 - WOODED LOTS - NORTH AND SOUTH OF EDGEWOOD DRIVE: SURFACE SOIL SAMPLE LOCATIONS INORGANIC EXCEEDANCES

WORK ASSIGNMENT 053-2L3
Forest Glen Site, Niagara Falls, New Yo

FEDERAL PROGRAMS CORPORATION

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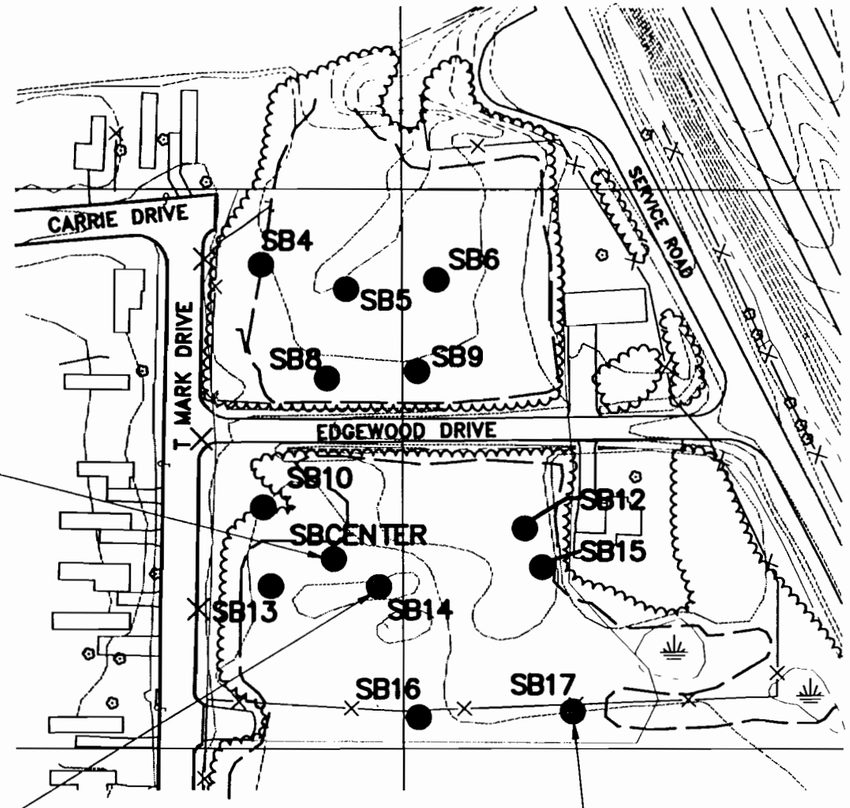


SBCENTER 4.00 - 6.00'		
FLUORANTHENE	66,000.00	D
PYRENE	61,000.00	D
BENZO(A)ANTHRACENE	56,000.00	D
CHRYSENE	50,000.00	D
BENZO(B)FLUORANTHENE	98,000.00	D
BENZO(K)FLUORANTHENE	79,000.00	D
BENZO(A)PYRENE	42,000.00	D
INDENO(1,2,3-CD)PYRENE	16,000.00	
DIBENZO(A,H)ANTHRACENE	2,400.00	J

SBCENTER 4.00 - 6.00'		
PERYLENE	6,800.00	J

SB14 6.00 - 8.00'		
BENZO(A)PYRENE	150.00	J

SB14A 4.00 - 6.00'		
BENZO(A)ANTHRACENE	20,000.00	D
CHRYSENE	18,000.00	D
BENZO(B)FLUORANTHENE	36,000.00	D
BENZO(K)FLUORANTHENE	29,000.00	D
BENZO(A)PYRENE	16,000.00	D
INDENO(1,2,3-CD)PYRENE	5,200.00	D
DIBENZO(A,H)ANTHRACENE	1,700.00	

SB14 6.00 - 8.00'		
PERYLENE	0.08	J

SB14A 4.00 - 6.00'		
PERYLENE	1,500.00	

SB17 10.00 - 12.00'		
PENTACHLOROPHENOL	1,800.00	J

NYS TAGM SOIL CLEANUP OBJECTIVES	
FLUORANTHENE	50,000.00
PYRENE	50,000.00
BENZO(A)ANTHRACENE	224.00
CHRYSENE	400.00
BENZO(B)FLUORANTHENE	1,100.00
BENZO(K)FLUORANTHENE	1,100.00
BENZO(A)PYRENE	61.00
INDENO(1,2,3-CD)PYRENE	3,200.00
DIBENZO(A,H)ANTHRACENE	14.00

LEGEND:

● SUBSURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER
DEPTH (FT)

COMPOUND CONCENTRATION (ug/kg)

SCALE: 1"=75'

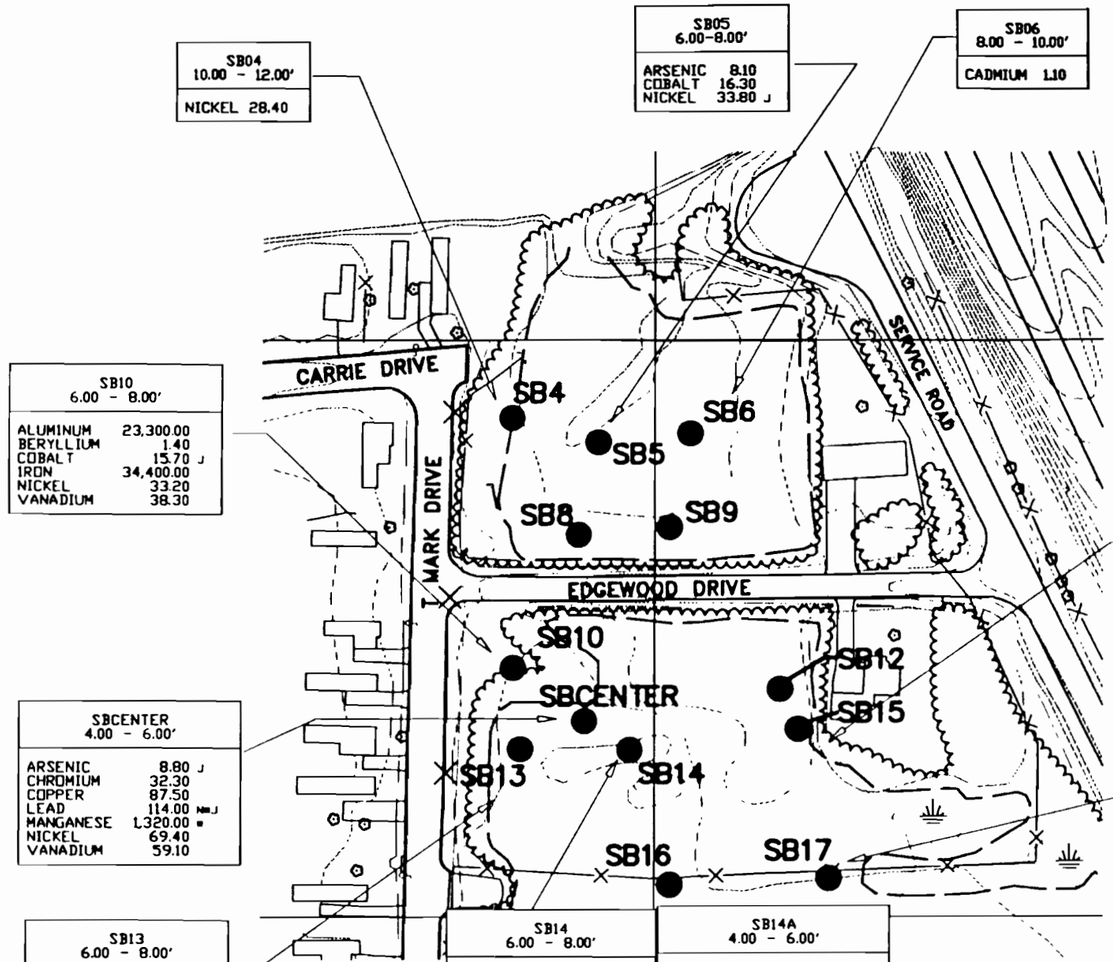
FIGURE 4-23

AOC 5 - WOODED LOTS - NORTH AND SOUTH OF EDGEWOOD DRIVE: SUBSURFACE SOIL SAMPLE LOCATIONS DETECTED TARGETED ORGANIC COMPOUNDS AND SEMIVOLATILE ORGANIC COMPOUND EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FILE: C:\FG\A55BM.DWG D.N. 4/3/96



BACKGROUND SCREENING CRITERIA

ALUMINUM	17,245.00
ARSENIC	5.52
BARIUM	163.44
BERYLLIUM	0.84
CADMIUM	1.06
CHROMIUM	27.60
COBALT	14.84
COPPER	41.60
IRON	28,750.00
LEAD	37.16
MANGANESE	1,114.60
NICKEL	28.36
VANADIUM	35.40

LEGEND:

● SUBSURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
ANALYTE	CONCENTRATION (mg/kg)

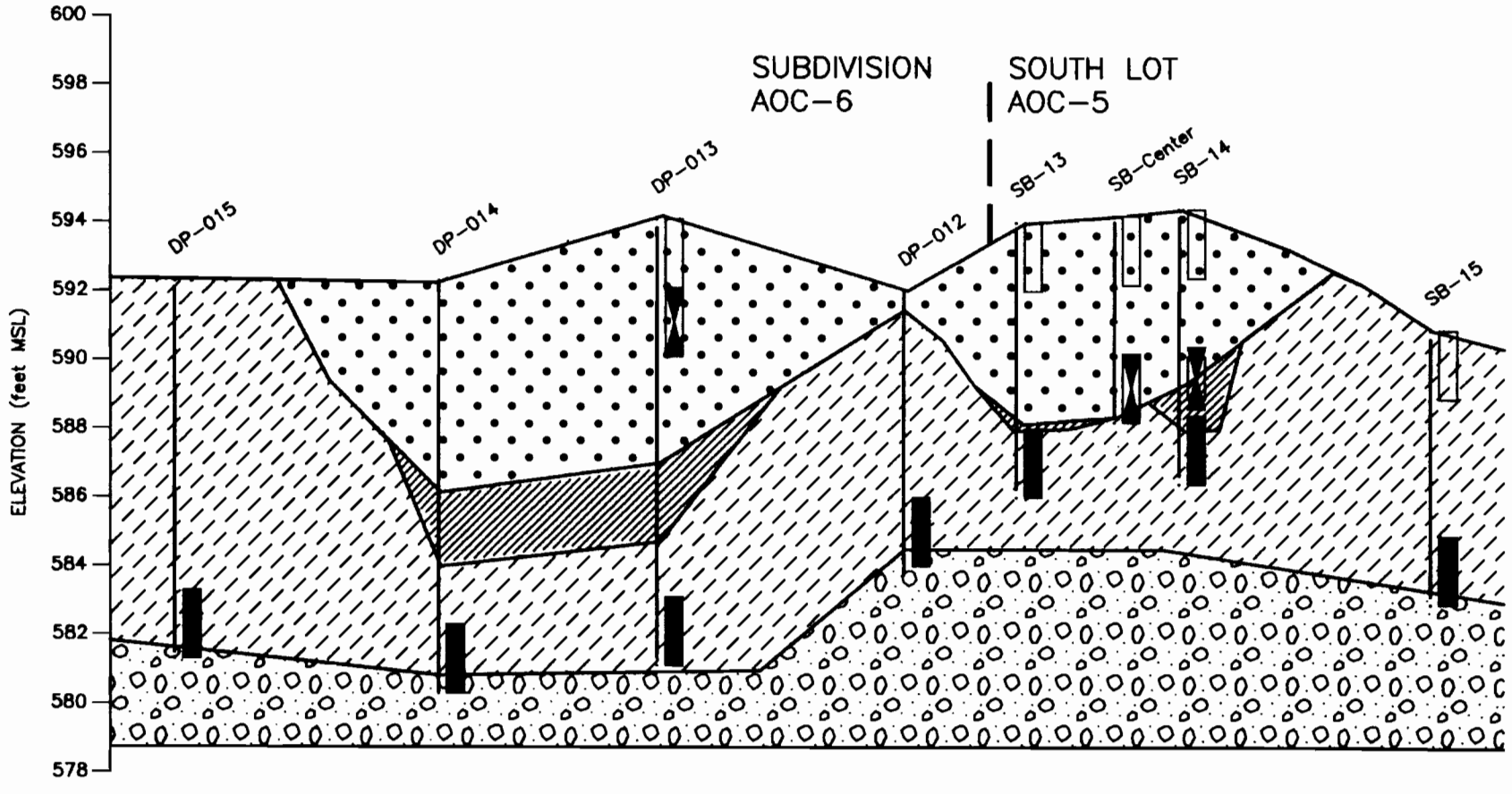
SCALE: 1" = 75'

FIGURE 4-24

AOC 5 – WOODED LOTS – NORTH AND SOUTH OF EDGEWOOD DRIVE: SUBSURFACE SOIL SAMPLE LOCATIONS INORGANIC EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.



LEGEND

- FILL
- BLACK STAINED CLAY
- CLAY/SILTY CLAY
- CLAY TILL
- SURFACE SOIL SAMPLE
- FILL SAMPLE
- SUBSURFACE SOIL SAMPLE

0 100
feet

Vertical Exaggeration = 20.00

FIGURE 4-26

VERTICAL EXTENT OF FILL MATERIAL IN THE SOUTH LOT OF AOC 5

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

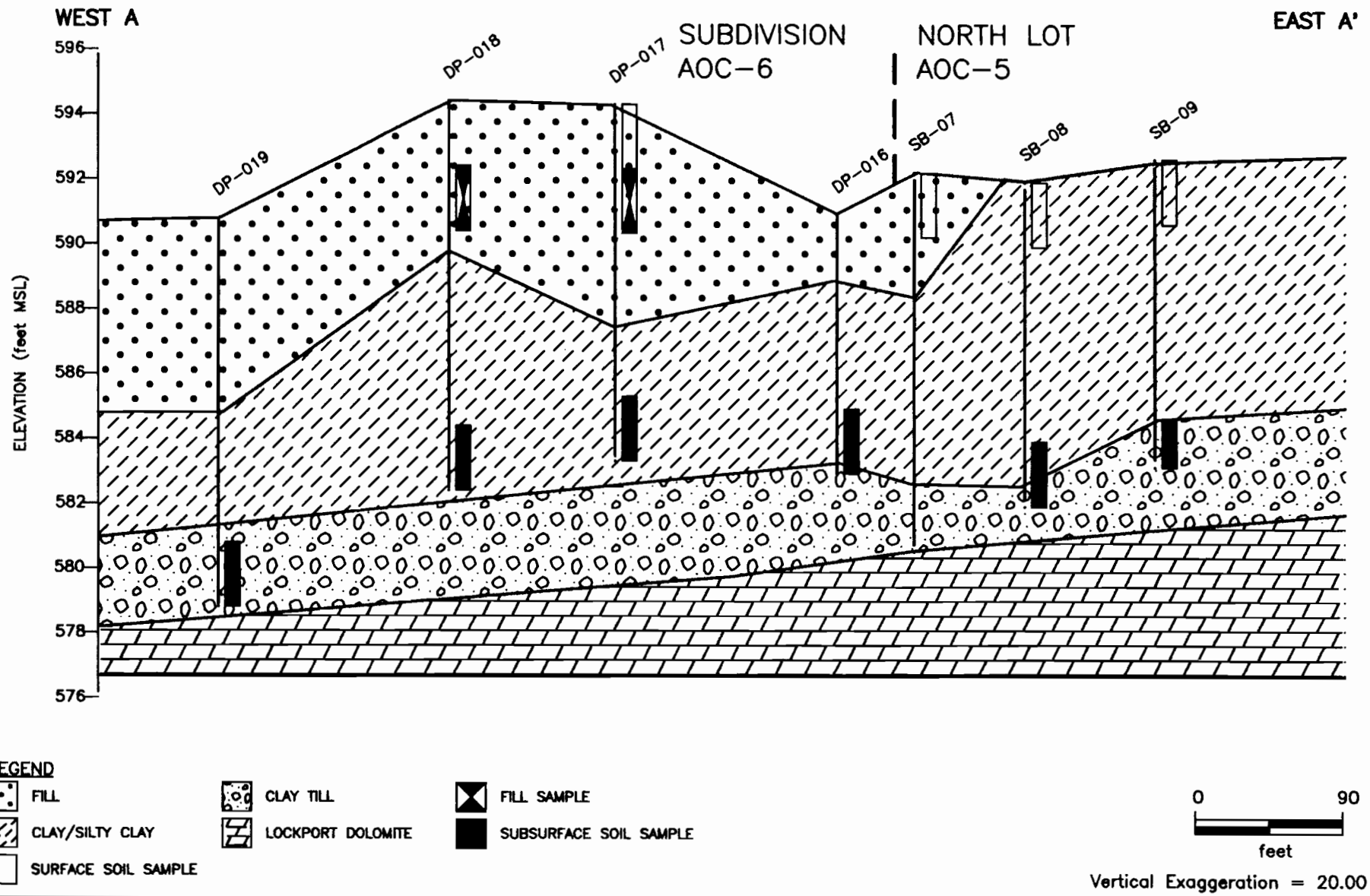
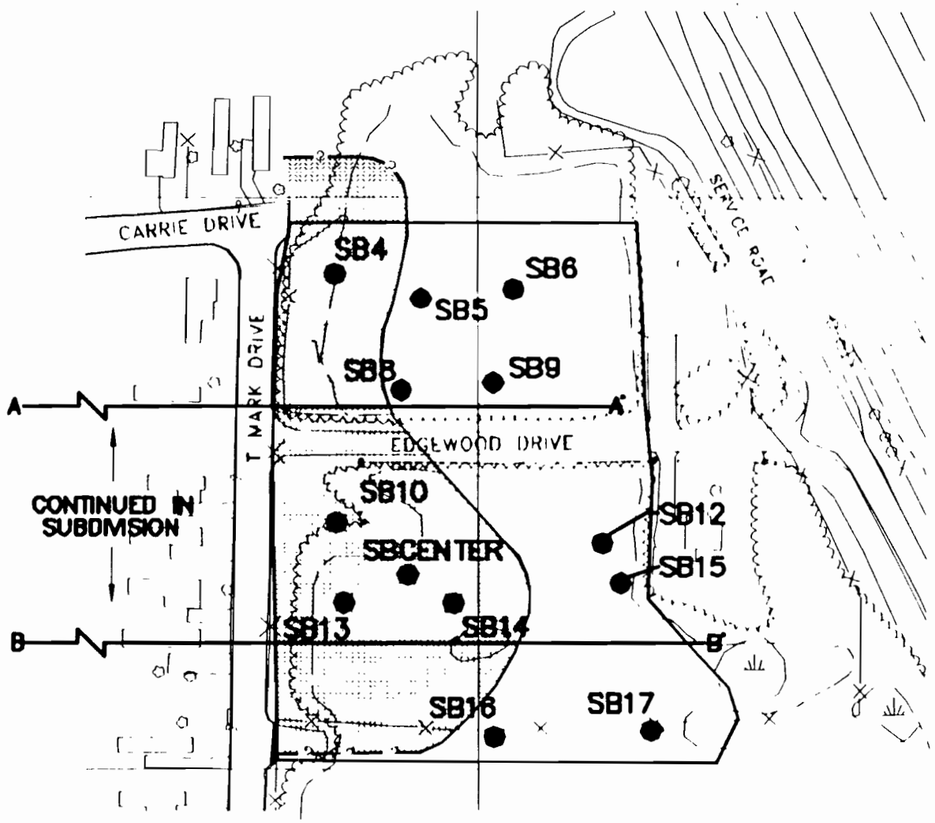


FIGURE 4-25

VERTICAL EXTENT OF FILL MATERIAL IN THE NORTH LOT OF AOC 5

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.



LEGEND:

- CROSS SECTION LOCATION
- APPROXIMATE EXTENT OF FILL
- —?— ESTIMATED EXTENT
- ● SOIL BORING LOCATIONS

SCALE: 1"=75'

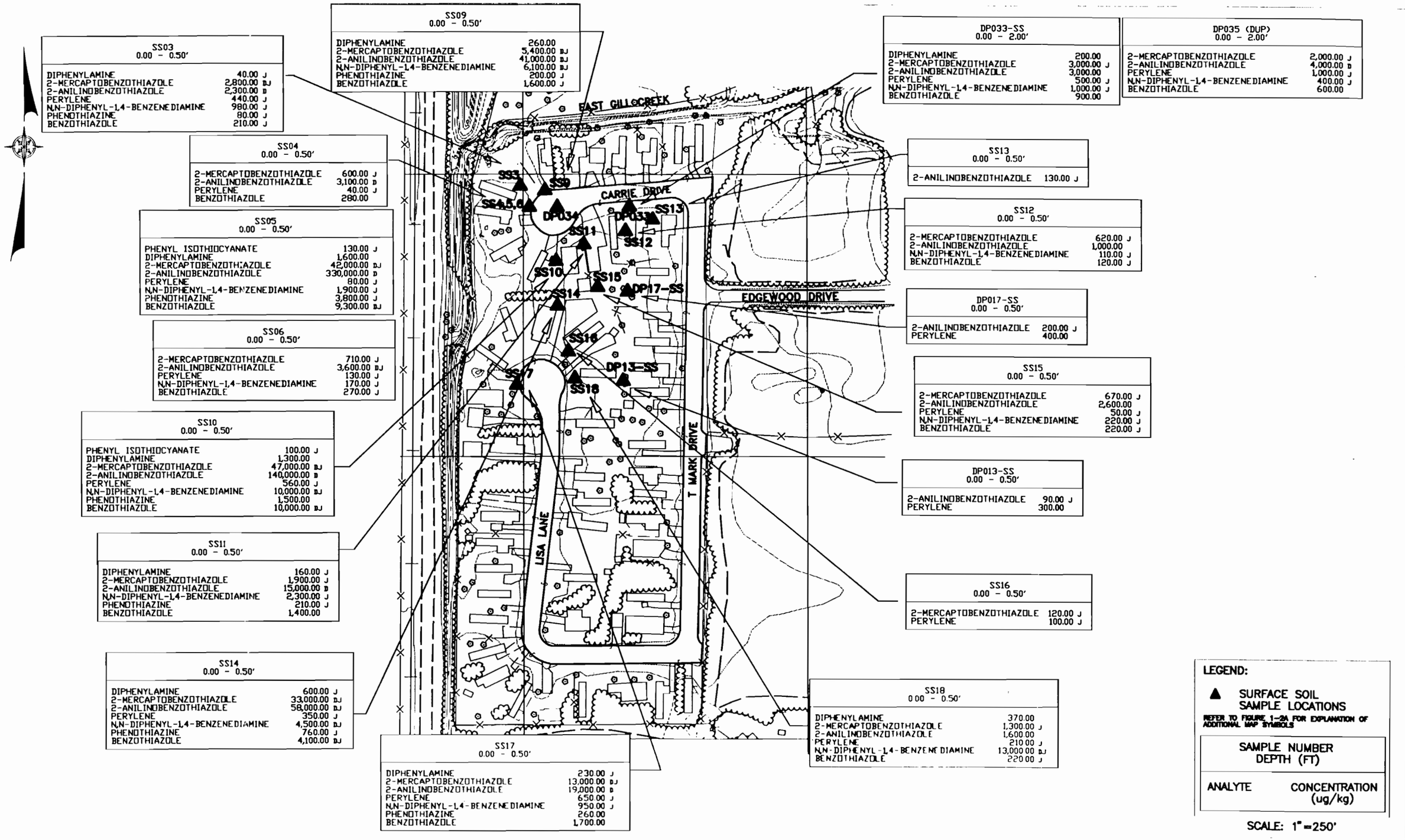
CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FIGURE 4-27

AOC 5 – WOODED LOTS: EXTENT OF FILL MATERIAL

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

FILE: C:\FOREST_G\AOSS.DWG J.J. 1/11/98



SS03
0.00 - 0.50'

DIPHENYLAMINE	40.00 J
2-MERCAPTOBENZOTHIAZOLE	2,800.00 BJ
2-ANILINOBENZOTHIAZOLE	2,300.00 B
PERYLENE	440.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	980.00 J
PHENOTHIAZINE	80.00 J
BENZOTHIAZOLE	210.00 J

SS09
0.00 - 0.50'

DIPHENYLAMINE	260.00
2-MERCAPTOBENZOTHIAZOLE	5,400.00 BJ
2-ANILINOBENZOTHIAZOLE	41,000.00 BJ
N,N-DIPHENYL-1,4-BENZENEDIAMINE	6,100.00 BJ
PHENOTHIAZINE	200.00 J
BENZOTHIAZOLE	1,600.00 J

DP033-SS
0.00 - 2.00'

DIPHENYLAMINE	200.00
2-MERCAPTOBENZOTHIAZOLE	3,000.00 J
2-ANILINOBENZOTHIAZOLE	3,000.00
PERYLENE	500.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	1,000.00 J
BENZOTHIAZOLE	900.00

DP035 (DUP)
0.00 - 2.00'

2-MERCAPTOBENZOTHIAZOLE	2,000.00 J
2-ANILINOBENZOTHIAZOLE	4,000.00 B
PERYLENE	1,000.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	400.00 J
BENZOTHIAZOLE	600.00

SS04
0.00 - 0.50'

2-MERCAPTOBENZOTHIAZOLE	600.00 J
2-ANILINOBENZOTHIAZOLE	3,100.00 B
PERYLENE	40.00 J
BENZOTHIAZOLE	280.00

SS13
0.00 - 0.50'

2-ANILINOBENZOTHIAZOLE	130.00 J

SS05
0.00 - 0.50'

PHENYL ISOTHIOCYANATE	130.00 J
DIPHENYLAMINE	1,600.00
2-MERCAPTOBENZOTHIAZOLE	42,000.00 BJ
2-ANILINOBENZOTHIAZOLE	330,000.00 B
PERYLENE	80.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	1,900.00 J
PHENOTHIAZINE	3,800.00 J
BENZOTHIAZOLE	9,300.00 BJ

SS12
0.00 - 0.50'

2-MERCAPTOBENZOTHIAZOLE	620.00 J
2-ANILINOBENZOTHIAZOLE	1,000.00
N,N-DIPHENYL-1,4-BENZENEDIAMINE	110.00 J
BENZOTHIAZOLE	120.00 J

SS06
0.00 - 0.50'

2-MERCAPTOBENZOTHIAZOLE	710.00 J
2-ANILINOBENZOTHIAZOLE	3,600.00 BJ
PERYLENE	130.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	170.00 J
BENZOTHIAZOLE	270.00 J

DP017-SS
0.00 - 0.50'

2-ANILINOBENZOTHIAZOLE	200.00 J
PERYLENE	400.00

SS15
0.00 - 0.50'

2-MERCAPTOBENZOTHIAZOLE	670.00 J
2-ANILINOBENZOTHIAZOLE	2,600.00
PERYLENE	50.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	220.00 J
BENZOTHIAZOLE	220.00 J

SS10
0.00 - 0.50'

PHENYL ISOTHIOCYANATE	100.00 J
DIPHENYLAMINE	1,300.00
2-MERCAPTOBENZOTHIAZOLE	47,000.00 BJ
2-ANILINOBENZOTHIAZOLE	140,000.00 B
PERYLENE	560.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	10,000.00 BJ
PHENOTHIAZINE	1,500.00
BENZOTHIAZOLE	10,000.00 BJ

DP013-SS
0.00 - 0.50'

2-ANILINOBENZOTHIAZOLE	90.00 J
PERYLENE	300.00

SS11
0.00 - 0.50'

DIPHENYLAMINE	160.00 J
2-MERCAPTOBENZOTHIAZOLE	1,900.00 J
2-ANILINOBENZOTHIAZOLE	15,000.00 B
N,N-DIPHENYL-1,4-BENZENEDIAMINE	2,300.00 J
PHENOTHIAZINE	210.00 J
BENZOTHIAZOLE	1,400.00

SS16
0.00 - 0.50'

2-MERCAPTOBENZOTHIAZOLE	120.00 J
PERYLENE	100.00 J

SS14
0.00 - 0.50'

DIPHENYLAMINE	600.00 J
2-MERCAPTOBENZOTHIAZOLE	33,000.00 BJ
2-ANILINOBENZOTHIAZOLE	58,000.00 BJ
PERYLENE	350.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	4,500.00 BJ
PHENOTHIAZINE	760.00 J
BENZOTHIAZOLE	4,100.00 BJ

SS18
0.00 - 0.50'

DIPHENYLAMINE	370.00
2-MERCAPTOBENZOTHIAZOLE	1,300.00 J
2-ANILINOBENZOTHIAZOLE	1,600.00
PERYLENE	210.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	13,000.00 BJ
BENZOTHIAZOLE	220.00 J

SS17
0.00 - 0.50'

DIPHENYLAMINE	230.00 J
2-MERCAPTOBENZOTHIAZOLE	13,000.00 BJ
2-ANILINOBENZOTHIAZOLE	19,000.00 B
PERYLENE	650.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	950.00 J
PHENOTHIAZINE	260.00
BENZOTHIAZOLE	1,700.00

LEGEND:

▲ SURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
ANALYTE	CONCENTRATION (ug/kg)

SCALE: 1" = 250'

FIGURE 4-28

AOC 6 - SUBDIVISION: SURFACE SOIL SAMPLE LOCATIONS DETECTED TARGETED ORGANIC COMPOUNDS

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

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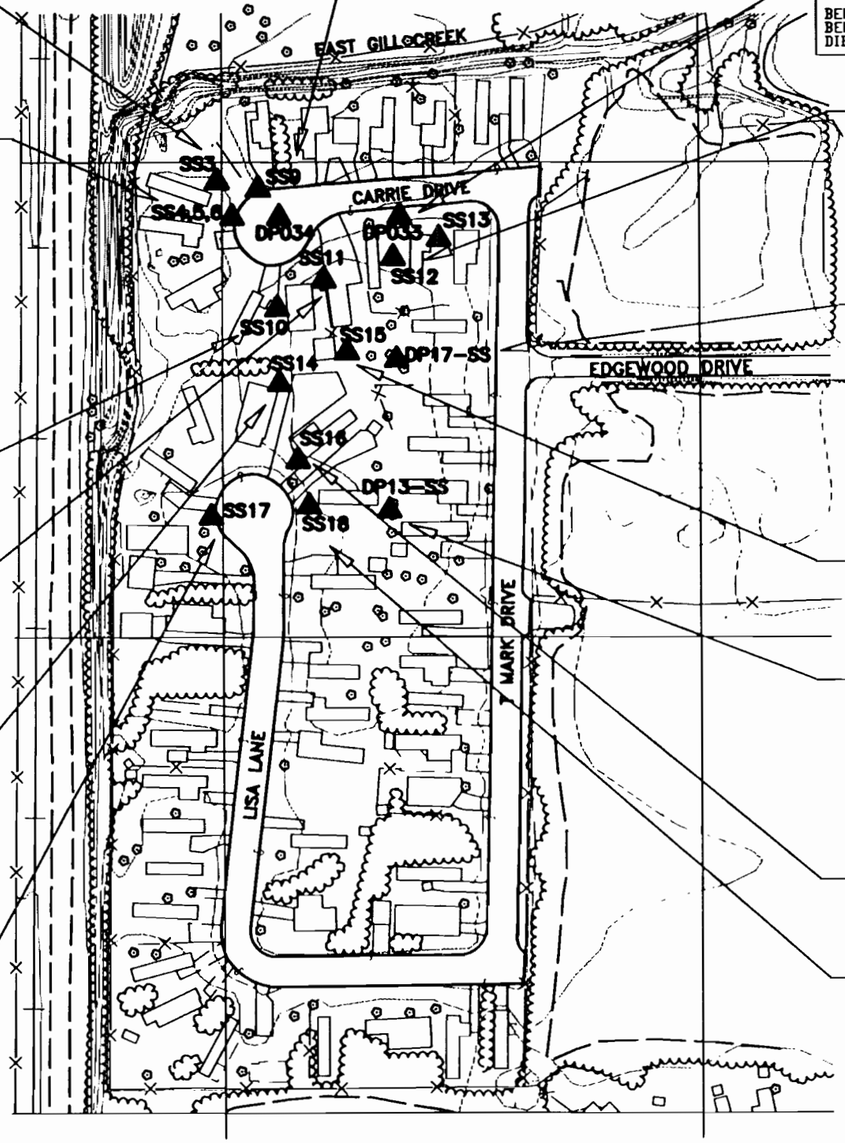


SS03
0.00 – 0.50'

BENZO(A)ANTHRACENE	550.00
CHRYSENE	540.00
BENZO(B)FLUORANTHENE	1,200.00
BENZO(K)FLUORANTHENE	1,300.00
BENZO(A)PYRENE	780.00
DIBENZO(A,H)ANTHRACENE	120.00 J

SS09
0.00 – 0.50'

PHENOL	380.00 J
BENZO(A)PYRENE	140.00 J

DP033-SS
0.00 – 2.00'

BENZO(A)ANTHRACENE	280.00 J
BENZO(A)PYRENE	250.00 J
DIBENZO(A,H)ANTHRACENE	74.00 J

DP035 (DUP)
0.00 – 2.00'

BENZO(A)ANTHRACENE	860.00
CHRYSENE	910.00
BENZO(A)PYRENE	780.00

SS05
0.00 – 0.50'

PHENOL	1,100.00 J
2-METHYLPHENOL	230.00 J
BENZO(A)ANTHRACENE	430.00
CHRYSENE	460.00
BENZO(A)PYRENE	410.00

SS04
0.00 – 0.50'

PHENOL	420.00
BENZO(A)ANTHRACENE	400.00
CHRYSENE	510.00
BENZO(A)PYRENE	490.00

SS12
0.00 – 0.50'

BENZO(A)PYRENE	180.00 J

SS06
0.00 – 0.50'

PHENOL	2,500.00
2-METHYLPHENOL	360.00
BENZO(A)ANTHRACENE	640.00
CHRYSENE	740.00
BENZO(B)FLUORANTHENE	1,600.00
BENZO(K)FLUORANTHENE	1,600.00
BENZO(A)PYRENE	680.00

DP017-SS
0.00 – 0.50'

BENZO(A)ANTHRACENE	1,000.00
CHRYSENE	1,100.00
BENZO(A)PYRENE	980.00
DIBENZO(A,H)ANTHRACENE	410.00 J

NYS TAGM SOIL CLEANUP OBJECTIVES

PHENOL	30.00
BENZO(A)ANTHRACENE	224.00
CHRYSENE	400.00
BENZO(B)FLUORANTHENE	1,100.00
BENZO(K)FLUORANTHENE	1,100.00
BENZO(A)PYRENE	61.00
DIBENZO(A,H)ANTHRACENE	14.00
2-METHYLPHENOL	100.00
4-METHYLPHENOL	900.00
DIETHYLPHTHALATE	7,100.00

SS10
0.00 – 0.50'

PHENOL	7,800.00 J
4-METHYLPHENOL	5,800.00 J
DIETHYLPHTHALATE	16,000.00

SS15
0.00 – 0.50'

BENZO(A)PYRENE	100.00 J

SS11
0.00 – 0.50'

PHENOL	540.00 J
BENZO(A)ANTHRACENE	280.00 J
BENZO(A)PYRENE	250.00 J

DP013-SS
0.00 – 0.50'

BENZO(A)ANTHRACENE	1,400.00
CHRYSENE	1,500.00
BENZO(B)FLUORANTHENE	1,500.00
BENZO(A)PYRENE	1,300.00
DIBENZO(A,H)ANTHRACENE	530.00

SS14
0.00 – 0.50'

PHENOL	1,100.00 J
4-METHYLPHENOL	7,400.00 J
BENZO(A)ANTHRACENE	990.00 J
CHRYSENE	960.00 J
BENZO(B)FLUORANTHENE	2,400.00
BENZO(K)FLUORANTHENE	2,400.00
BENZO(A)PYRENE	980.00 J

SS16
0.00 – 0.50'

BENZO(A)ANTHRACENE	380.00 J
CHRYSENE	460.00
BENZO(A)PYRENE	390.00 J

SS17
0.00 – 0.50'

PHENOL	100.00 J
BENZO(A)ANTHRACENE	2,900.00
CHRYSENE	2,400.00
BENZO(B)FLUORANTHENE	7,200.00 B
BENZO(K)FLUORANTHENE	6,900.00 B
BENZO(A)PYRENE	2,500.00
DIBENZO(A,H)ANTHRACENE	270.00 J

SS18
0.00 – 0.50'

PHENOL	85.00 J
BENZO(A)ANTHRACENE	250.00 J
BENZO(A)PYRENE	320.00 J

LEGEND:

▲ SURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
ANALYTE	CONCENTRATION (ug/kg)

SCALE: 1"=250'

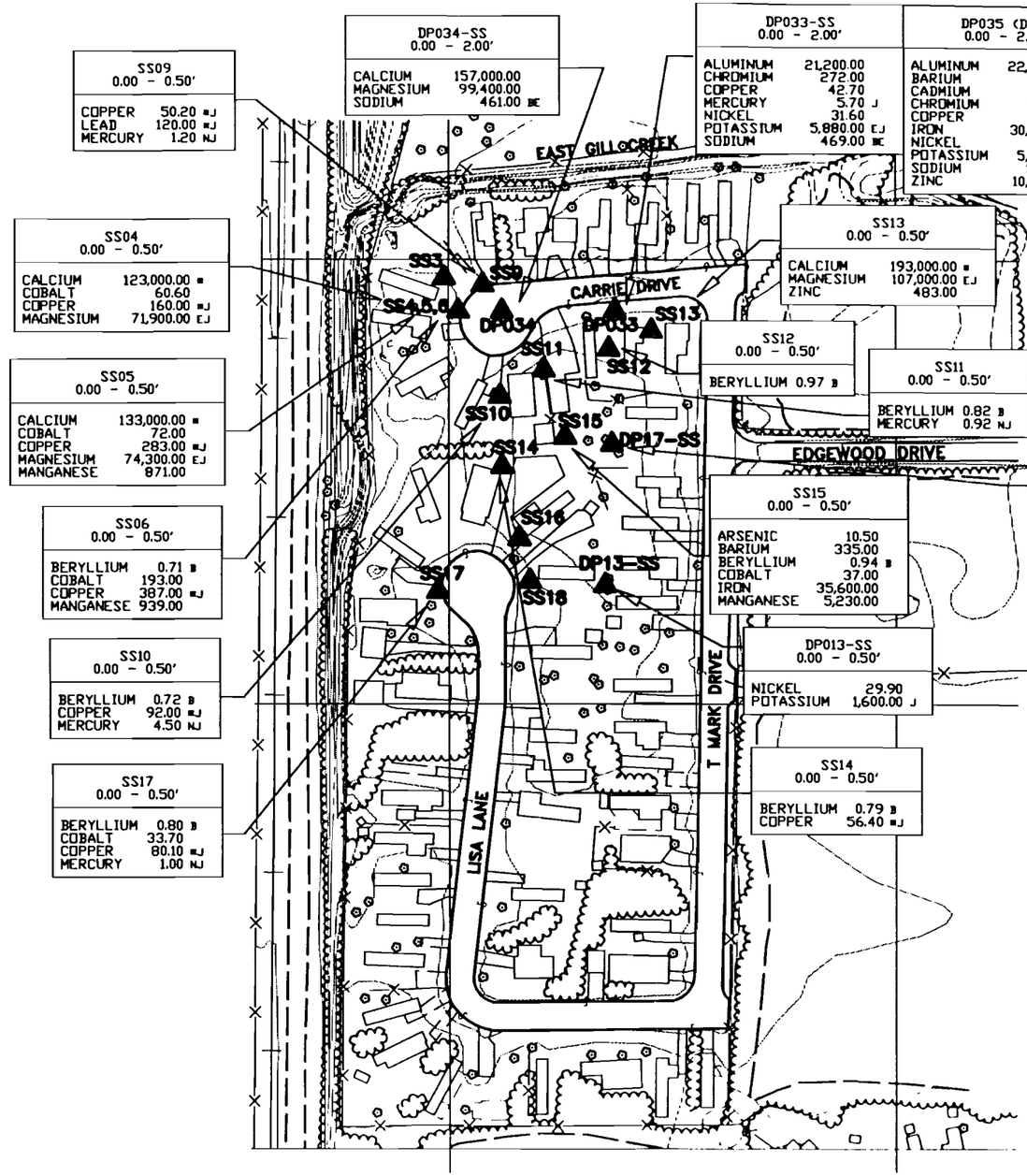
FIGURE 4-29

AOC 6 – SUBDIVISION: SURFACE SOIL SAMPLE LOCATIONS SEMIVOLATILE ORGANIC EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FILE: C:\FG\A6SSM.DWG D.N. 4/3/98



BACKGROUND SCREENING CRITERIA

ALUMINUM	20,615.00
BARIUM	143.40
BERYLLIUM	0.68
CADMIUM	3.10
CALCIUM	97,120.00
CHROMIUM	134.26
COBALT	21.52
COPPER	40.26
IRON	29,610.00
MAGNESIUM	53,380.00
MANGANESE	864.60
MERCURY	0.58
NICKEL	27.68
POTASSIUM	1,538.00
SODIUM	223.86
ZINC	445.50

LEGEND:

▲ SURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER
DEPTH (FT)

ANALYTE CONCENTRATION (mg/kg)

SCALE: 1"=250'

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FIGURE 4-30

AOC 6 - SUBDIVISION: SURFACE SOIL SAMPLE LOCATIONS INORGANIC EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

FILE: C:\FG\ASSBTSV.DWG D.N. 4/3/98

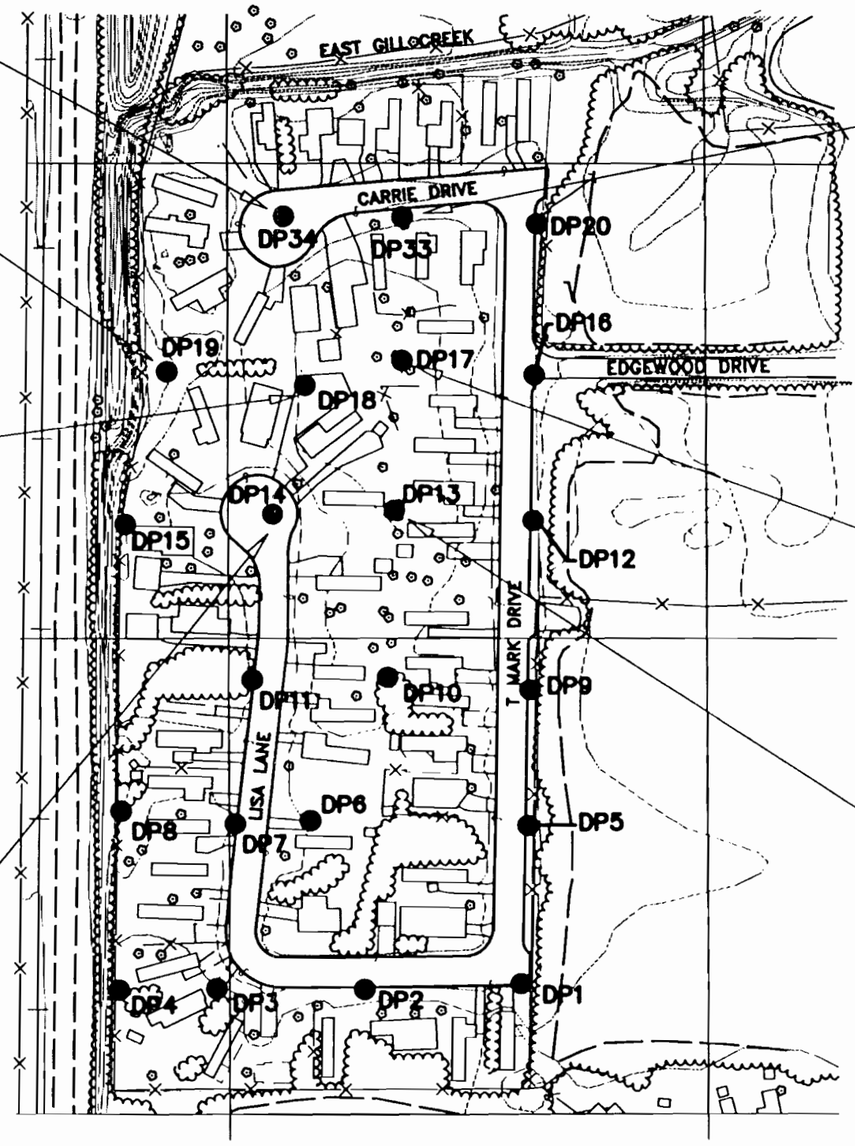
DP034B 4.00 - 6.00′	
PERYLENE	100.00 J

DP019 10.00 - 12.00′	
N,N-DIPHENYL-1,4-BENZENEDIAMINE	40.00 J

DP018 10.00 - 12.00′	
N,N-DIPHENYL-1,4-BENZENEDIAMINE	60.00 J

DP018B 2.00 - 4.00′	
DIPHENYLAMINE	8,000.00 DJ
2-MERCAPTOBENZOTHIAZOLE	50,000.00 DJ
2-ANILINOBENZOTHIAZOLE	170,000.00 D
PERYLENE	400.00
N,N-DIPHENYL-1,4-BENZENEDIAMINE	25,000.00 D
PHENOTHIAZINE	800.00
BENZOTHIAZOLE	16,000.00 D

DP014 10.00 - 12.00′	
2-MERCAPTOBENZOTHIAZOLE	200.00 J
2-ANILINOBENZOTHIAZOLE	1,000.00 J
PERYLENE	100.00 J
N,N-DIPHENYL-1,4-BENZENEDIAMINE	60.00 J J
BENZOTHIAZOLE	100.00 J



DP033 10.00 - 12.00′	
DIPHENYLAMINE	800.00
ANILINE	400.00
N,N-DIPHENYL-1,4-BENZENEDIAMINE	800.00
PHENOTHIAZINE	800.00
BENZOTHIAZOLE	1,000.00

DP017 9.00 - 11.00′	
PERYLENE	60.00 J

DP017B 2.00 - 4.00′	
PERYLENE	5,000.00 D

DP013B 2.00 - 4.00′	
PERYLENE	8,000.00 D

LEGEND:
● SUBSURFACE SOIL SAMPLE LOCATIONS
REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER (DEPTH -FT.)	
COMPOUND	CONCENTRATION (ug/kg)

SCALE: 1"=250'

FIGURE 4-31

AOC 6 - SUBDIVISION: SUBSURFACE SOIL SAMPLE LOCATIONS DETECTED TARGETED ORGANIC COMPOUNDS

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

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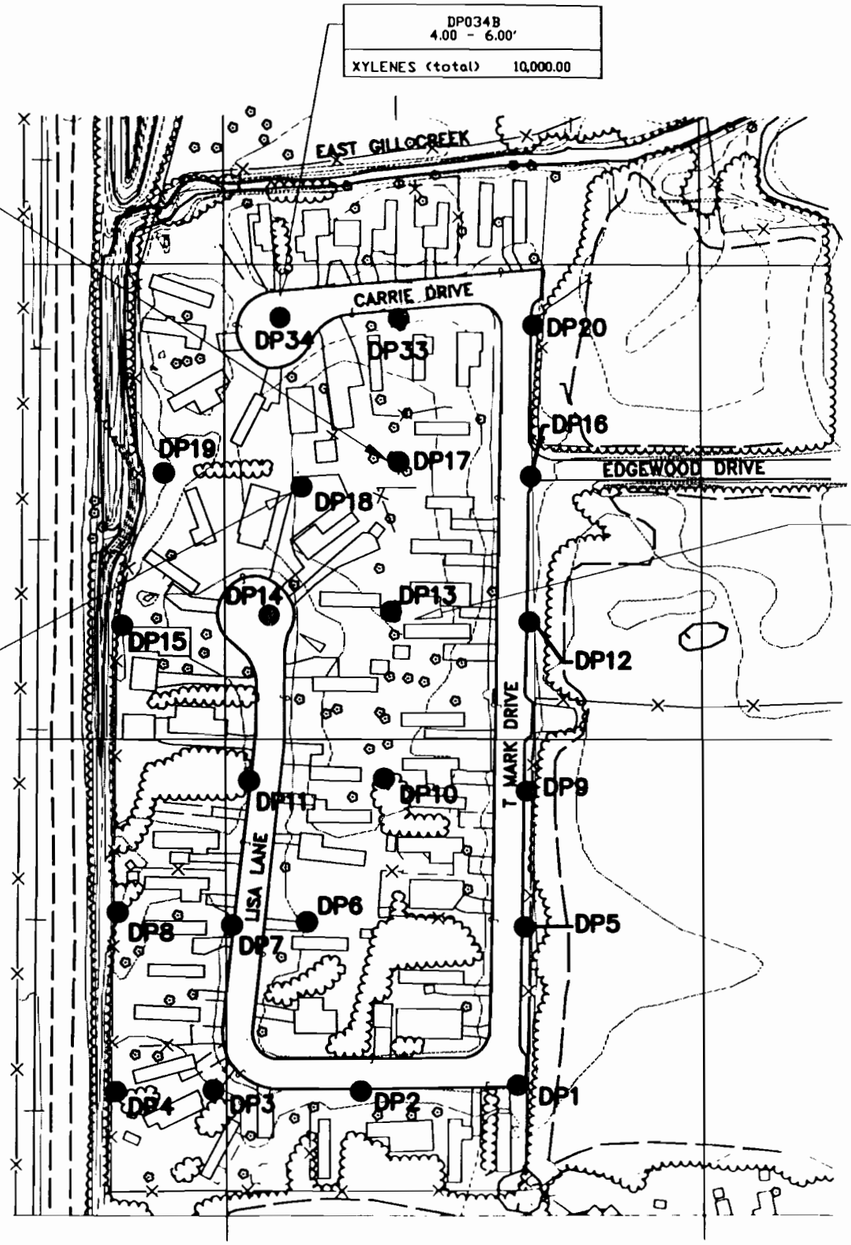
DP017 9.00 - 11.00'	
BENZO(A)ANTHRACENE	460.00
CHRYSENE	530.00
BENZO(A)PYRENE	320.00 J

DP017B 2.00 - 4.00'	
PHENOL	250.00 J
2-METHYLPHENOL	110.00 J
BENZO(A)ANTHRACENE	38,000.00 BJ
CHRYSENE	33,000.00 BJ
BENZO(B)FLUORANTHENE	29,000.00 B
BENZO(K)FLUORANTHENE	29,000.00 B
BENZO(A)PYRENE	35,000.00 B
INDENO(1,2,3-CD)PYRENE	26,000.00 B
DIBENZO(A,H)ANTHRACENE	8,600.00 B

DP018B 2.00 - 4.00'	
PHENOL	7,500.00
2-METHYLPHENOL	1,000.00 J
4-METHYLPHENOL	1,400.00 J
BENZO(A)ANTHRACENE	2,100.00
CHRYSENE	2,800.00
BENZO(B)FLUORANTHENE	4,900.00 J
BENZO(A)PYRENE	2,800.00 J

NYS TAGM SOIL CLEANUP OBJECTIVES	
XYLENES (total)	1,200.00
PHENOL	30.00
2-METHYLPHENOL	100.00
ANTHRACENE	50,000.00
FLUORANTHENE	50,000.00
PYRENE	50,000.00
BENZO(A)ANTHRACENE	224.00
CHRYSENE	400.00
BENZO(B)FLUORANTHENE	1,100.00
BENZO(K)FLUORANTHENE	1,100.00
BENZO(A)PYRENE	61.00
INDENO(1,2,3-CD)PYRENE	3,200.00
DIBENZO(A,H)ANTHRACENE	14.00
BENZO(G,H,I)PERYLENE	50,000.00
4-METHYLPHENOL	900.00
NAPHTHALENE	13,000.00
DIBENZOFURAN	6,200.00
PHENANTHRENE	50,000.00



DP013B 2.00 - 4.00'	
NAPHTHALENE	20,000.00 J
DIBENZOFURAN	11,000.00 J
PHENANTHRENE	170,000.00
ANTHRACENE	69,000.00
FLUORANTHENE	250,000.00
PYRENE	200,000.00 J
BENZO(A)ANTHRACENE	250,000.00 J
CHRYSENE	160,000.00
BENZO(B)FLUORANTHENE	220,000.00
BENZO(K)FLUORANTHENE	64,000.00
BENZO(A)PYRENE	170,000.00
INDENO(1,2,3-CD)PYRENE	84,000.00
DIBENZO(A,H)ANTHRACENE	8,700.00 J
BENZO(G,H,I)PERYLENE	71,000.00

LEGEND:

● SUBSURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
COMPOUND	CONCENTRATION (ug/kg)

SCALE: 1"=250'

FIGURE 4-32

AOC 6 - SUBDIVISION: SUBSURFACE SOIL SAMPLE LOCATIONS TCL ORGANIC COMPOUND EXCEEDANCES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

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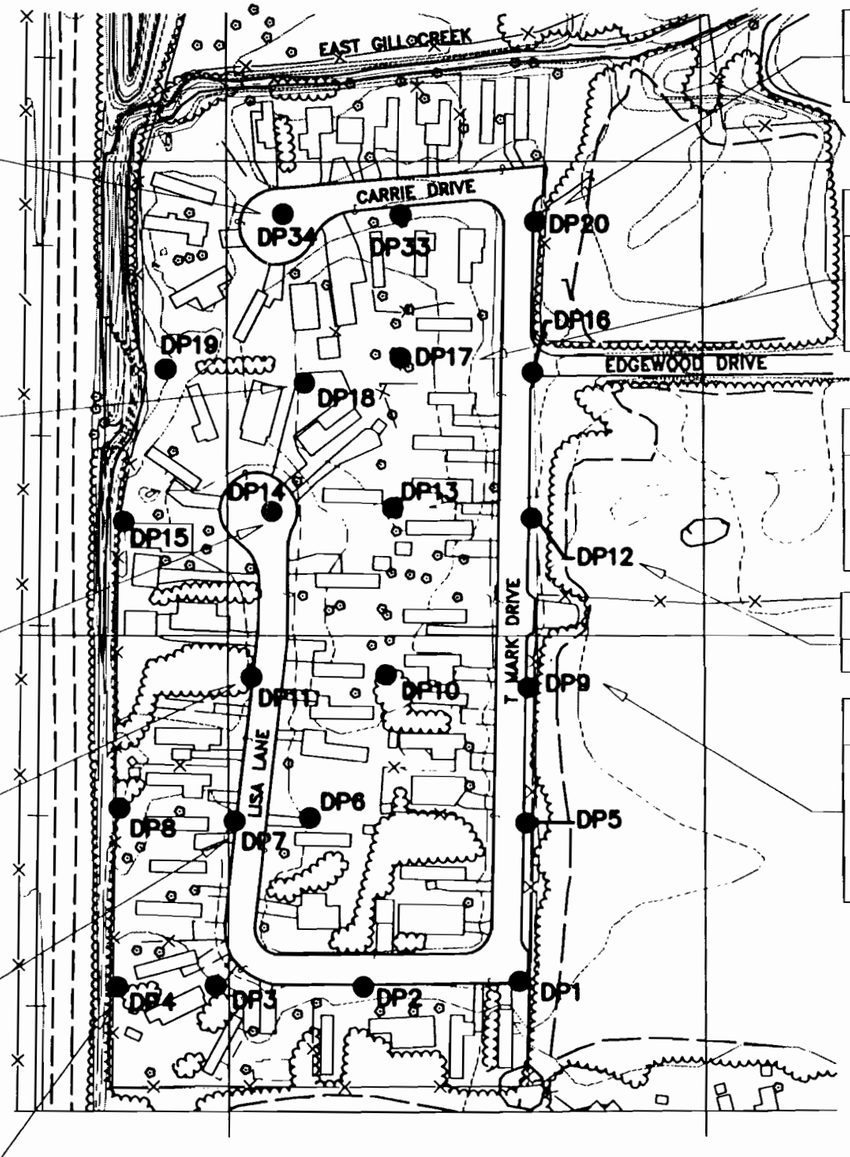


DP034B 4.00 - 6.00'	
ALUMINUM	28,300.00
ARSENIC	5.50 J
BARIUM	171.00
CHROMIUM	40.80
COBALT	27.00
IRON	42,300.00
MANGANESE	1,380.00
NICKEL	55.50
POTASSIUM	4,320.00 EJ
SODIUM	1,040.00 BE
VANADIUM	47.20
ZINC	856.00

DP018B 2.00 - 4.00'	
ARSENIC	13.40
CHROMIUM	39.20
COPPER	95.40
IRON	35,500.00
LEAD	61.70
NICKEL	51.70
VANADIUM	47.30

DP018 10.00 - 12.00'	
ALUMINUM	20,500.00
CHROMIUM	31.70
IRON	35,300.00
NICKEL	36.30
POTASSIUM	4,860.00 EJ
SODIUM	538.00 BE
VANADIUM	39.50

DP014 10.00 - 12.00'	
ALUMINUM	18,400.00
BERYLLIUM	0.90 B
COBALT	15.10
NICKEL	31.50
POTASSIUM	4,050.00

DP011 10.00 - 12.00'	
BERYLLIUM	0.88 B
COBALT	15.30
NICKEL	29.40
POTASSIUM	3,590.00

DP07 8.00 - 10.00'	
ALUMINUM	18,700.00
BERYLLIUM	0.99 B
CHROMIUM	40.10
COBALT	16.60
IRON	30,100.00
NICKEL	33.50
POTASSIUM	3,630.00
VANADIUM	36.40

DP04 10.00 - 12.00'	
ARSENIC	10.50
BERYLLIUM	0.92 B
IRON	29,800.00
NICKEL	28.40
POTASSIUM	3,780.00

DP020 8.00 - 10.00'	
ARSENIC	14.60
COBALT	18.10

DP017 9.00 - 11.00'	
ALUMINUM	22,400.00
BARIUM	192.00
CHROMIUM	34.00
COBALT	18.00
IRON	39,700.00
NICKEL	42.80
VANADIUM	44.70

DP017B 2.00 - 4.00'	
ARSENIC	11.40
CHROMIUM	46.60
COPPER	112.00
LEAD	75.50
NICKEL	132.00
VANADIUM	147.00

DP013 11.00 - 13.00'	
ALUMINUM	19,800.00
BERYLLIUM	1.00 B
COBALT	16.20
IRON	30,600.00
NICKEL	31.70
POTASSIUM	4,570.00
VANADIUM	38.60

DP013B 2.00 - 4.00'	
ARSENIC	9.60
COPPER	98.20
LEAD	109.00
NICKEL	63.60
VANADIUM	98.60

DP012 6.00 - 8.00'	
POTASSIUM	3,670.00

DP09 8.00 - 10.00'	
ALUMINUM	21,900.00
ARSENIC	10.70
BARIUM	241.00
BERYLLIUM	1.10 B
CHROMIUM	31.40
COBALT	16.20
IRON	37,200.00
NICKEL	36.80
POTASSIUM	4,690.00
VANADIUM	45.10

BACKGROUND SCREENING CRITERIA

ALUMINUM	17,245.00
ARSENIC	5.52
BARIUM	163.44
BERYLLIUM	0.84
CHROMIUM	27.60
COBALT	14.84
COPPER	41.60
IRON	28,750.00
LEAD	37.16
MANGANESE	1,114.60
NICKEL	28.36
POTASSIUM	3,365.60
SODIUM	520.00
VANADIUM	35.40
ZINC	636.00

LEGEND:

● SUBSURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
ANALYTE	CONCENTRATION (mg/kg)

SCALE: 1"=250'

FIGURE 4-33

AOC 6 – SUBDIVISION: SUBSURFACE SOIL SAMPLE LOCATIONS INORGANIC EXCEEDANCES

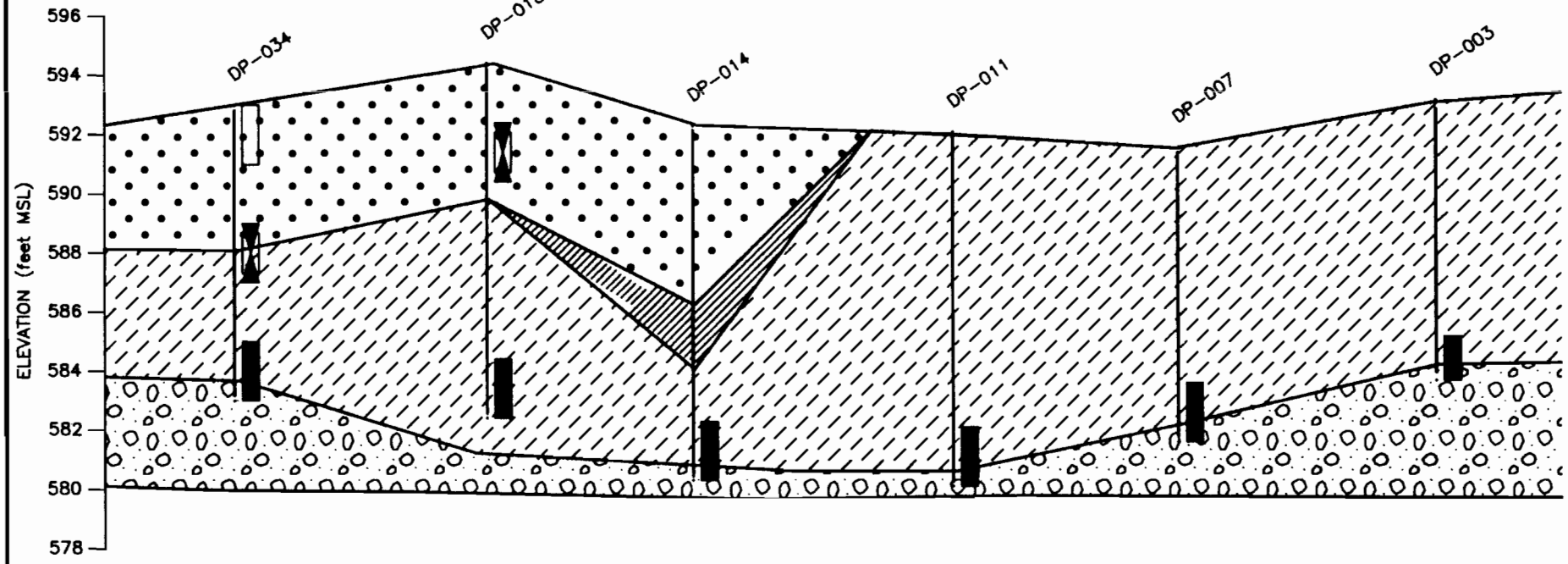
WORK ASSIGNMENT 053-2L3U

Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

NORTH C

SOUTH C'



LEGEND

- FILL
- BLACK STAINED CLAY
- CLAY/SILTY CLAY
- CLAY TILL
- LOCKPORT DOLOMITE
- SURFACE SOIL SAMPLE
- FILL SAMPLE
- SUBSURFACE SOIL SAMPLE

0 110

feet

Vertical Exaggeration = 20.00

FIGURE 4-34

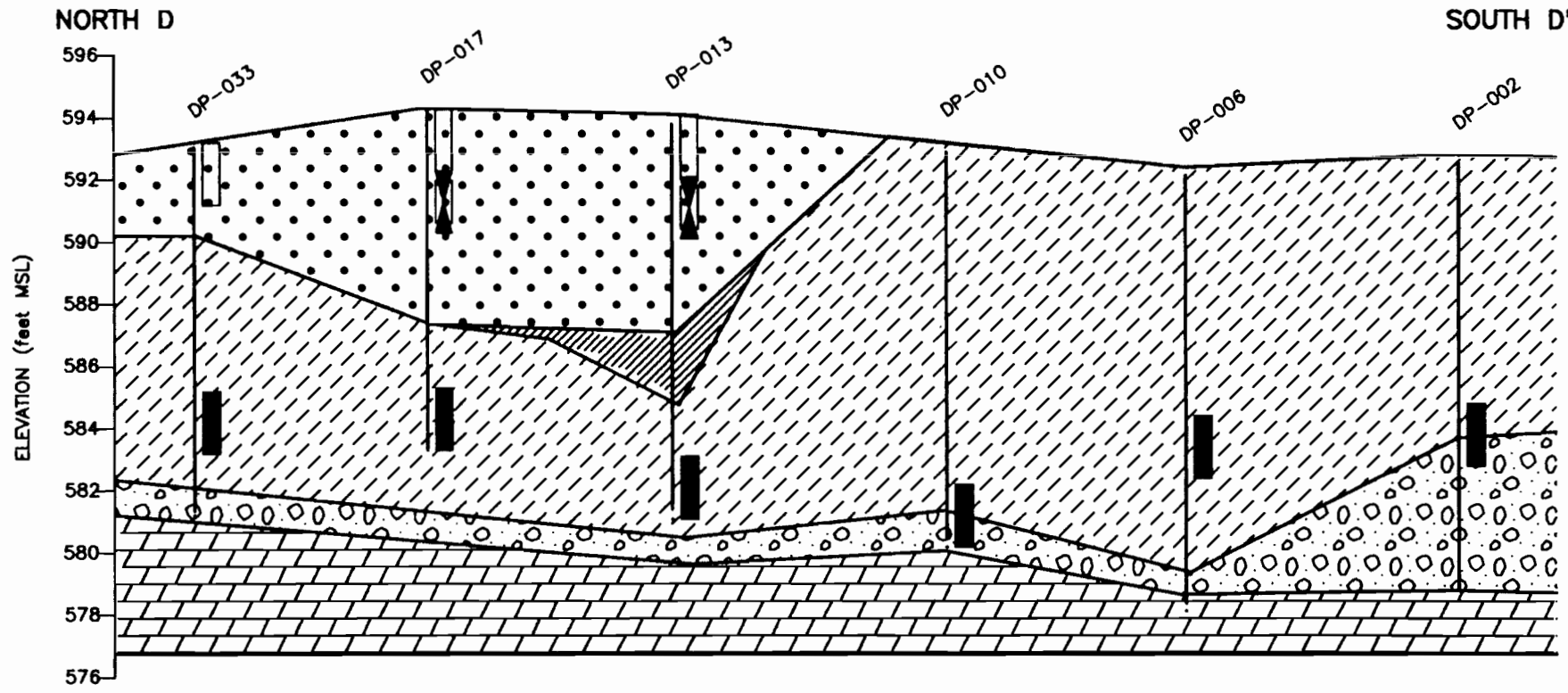
VERTICAL EXTENT OF FILL MATERIAL IN AOC 6

WORK ASSIGNMENT 053-2L3U

Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION

a subsidiary of Camp Dresser & McKee Inc.

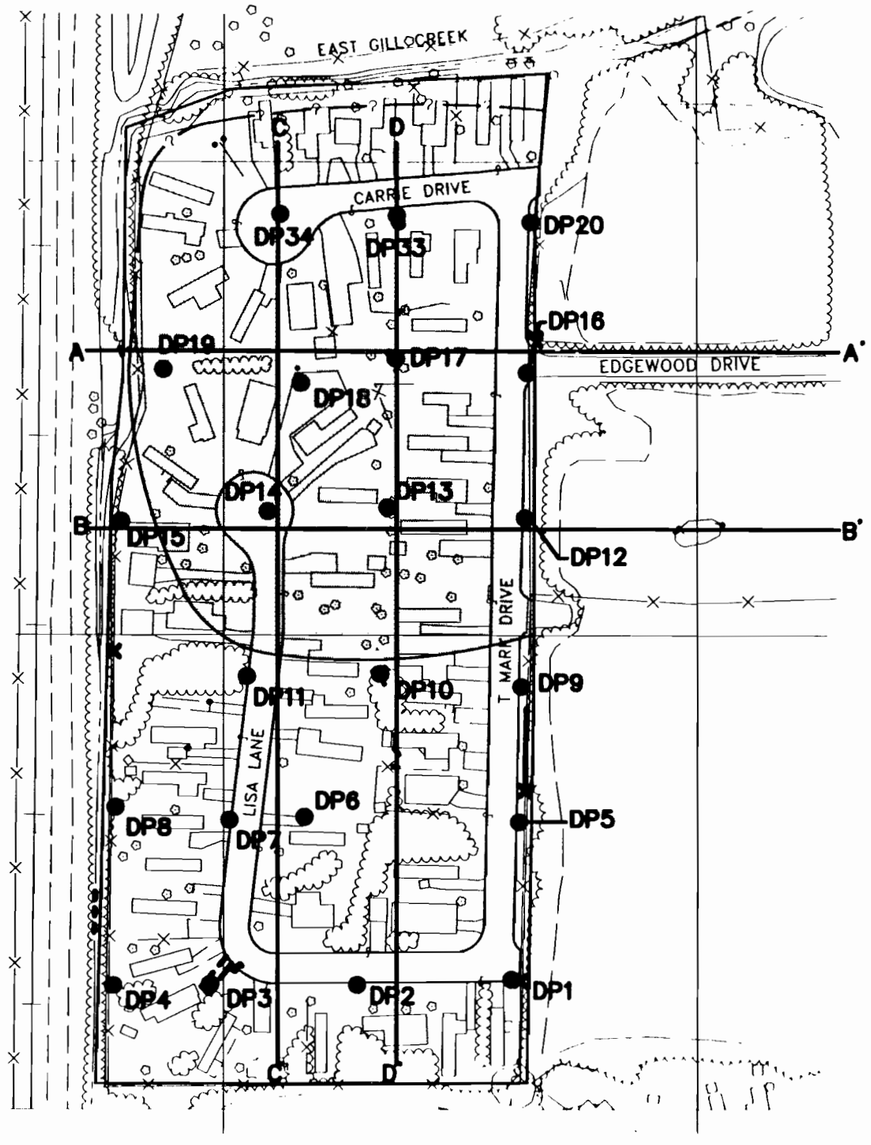


CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FIGURE 4–35

VERTICAL EXTENT OF FILL MATERIAL IN AOC 6

WORK ASSIGNMENT 053–2L3U
Forest Glen Site, Niagara Falls, New York



LEGEND:

- CROSS SECTION LOCATION
- APPROXIMATE EXTENT OF FILL
- ESTIMATED EXTENT
- SUBSURFACE SOIL SAMPLE LOCATIONS

REFER TO FIGURE 1-20 FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

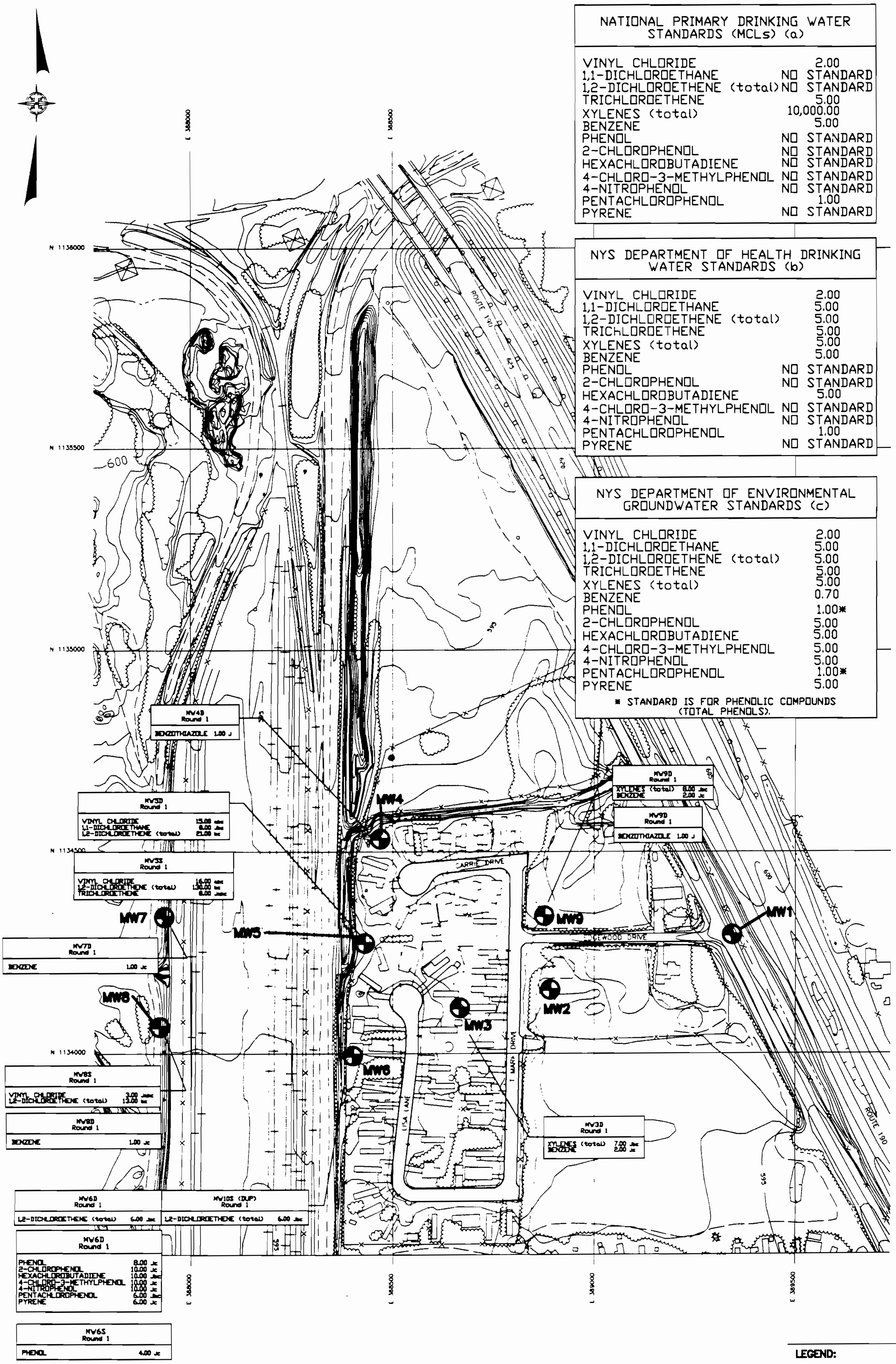
SCALE: 1"=250'

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FIGURE 4-36

AOC 6 – SUBDIVISION:
EXTENT OF FILL MATERIAL

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York



NATIONAL PRIMARY DRINKING WATER STANDARDS (MCLs) (a)

VINYL CHLORIDE	2.00
1,1-DICHLOROETHANE	NO STANDARD
1,2-DICHLOROETHENE (total)	NO STANDARD
TRICHLOROETHENE	5.00
XYLENES (total)	10,000.00
BENZENE	5.00
PHENOL	NO STANDARD
2-CHLOROPHENOL	NO STANDARD
HEXACHLOROBUTADIENE	NO STANDARD
4-CHLORO-3-METHYLPHENOL	NO STANDARD
4-NITROPHENOL	NO STANDARD
PENTACHLOROPHENOL	1.00
PYRENE	NO STANDARD

NYS DEPARTMENT OF HEALTH DRINKING WATER STANDARDS (b)

VINYL CHLORIDE	2.00
1,1-DICHLOROETHANE	5.00
1,2-DICHLOROETHENE (total)	5.00
TRICHLOROETHENE	5.00
XYLENES (total)	5.00
BENZENE	5.00
PHENOL	NO STANDARD
2-CHLOROPHENOL	NO STANDARD
HEXACHLOROBUTADIENE	5.00
4-CHLORO-3-METHYLPHENOL	NO STANDARD
4-NITROPHENOL	NO STANDARD
PENTACHLOROPHENOL	1.00
PYRENE	NO STANDARD

NYS DEPARTMENT OF ENVIRONMENTAL GROUNDWATER STANDARDS (c)

VINYL CHLORIDE	2.00
1,1-DICHLOROETHANE	5.00
1,2-DICHLOROETHENE (total)	5.00
TRICHLOROETHENE	5.00
XYLENES (total)	5.00
BENZENE	0.70
PHENOL	1.00*
2-CHLOROPHENOL	5.00
HEXACHLOROBUTADIENE	5.00
4-CHLORO-3-METHYLPHENOL	5.00
4-NITROPHENOL	5.00
PENTACHLOROPHENOL	1.00*
PYRENE	5.00

* STANDARD IS FOR PHENOLIC COMPOUNDS (TOTAL PHENOLS).

125' 0 250'

SCALE:

LEGEND:

MONITORING WELL CLUSTER LOCATIONS

REFER TO FIGURE 1-3A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER ROUND	
COMPOUND	CONCENTRATION (ug/l)

FIGURE 4-37

MONITORING WELL CLUSTER LOCATIONS DETECTED TARGETED ORGANIC COMPOUNDS AND TCL ORGANIC COMPOUND EXCEEDANCES IN ROUND 1 GROUNDWATER SAMPLES

WORK ASSIGNMENT 053-2L3U

Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION

a subsidiary of Camp Dresser & McKee Inc.

NATIONAL PRIMARY DRINKING WATER STANDARDS (MCLs) (a)	
VINYL CHLORIDE	2.00
1,1-DICHLOROETHANE	NO STANDARD
1,2-DICHLOROETHENE (total)	NO STANDARD
1,1,1-TRICHLOROETHANE	200.00
TRICHLOROETHENE	5.00
DI-N-OCTYLPHTHALATE	NO STANDARD
BENZO(A)PYRENE	0.20

NYS DEPARTMENT OF HEALTH DRINKING WATER STANDARDS (b)	
VINYL CHLORIDE	2.00
1,1-DICHLOROETHANE	5.00
1,2-DICHLOROETHENE (total)	5.00
1,1,1-TRICHLOROETHANE	5.00
TRICHLOROETHENE	5.00
DI-N-OCTYLPHTHALATE	NO STANDARD
BENZO(A)PYRENE	NO STANDARD

NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION GROUNDWATER STANDARDS (c)	
VINYL CHLORIDE	2.00
1,1-DICHLOROETHANE	5.00
1,2-DICHLOROETHENE (total)	5.00
1,1,1-TRICHLOROETHANE	5.00
TRICHLOROETHENE	5.00
DI-N-OCTYLPHTHALATE	5.00
BENZO(A)PYRENE	5.00

MW05D
Round 2

VINYL CHLORIDE	44.00 Jdic
1,1-DICHLOROETHANE	13.00 J
1,2-DICHLOROETHENE (total)	68.00
1,1,1-TRICHLOROETHANE	12.00

MW05S
Round 2

VINYL CHLORIDE	220.00 Jdic
1,1-DICHLOROETHANE	70.00 J
1,2-DICHLOROETHENE (total)	1,300.00
1,1,1-TRICHLOROETHANE	65.00 Jdic
TRICHLOROETHENE	76.00 Jdic
DI-N-OCTYLPHTHALATE	10.00 c

MW03PV
Round 2

BENZO(A)PYRENE	0.70 Jc

MW06D
Round 2

VINYL CHLORIDE	31.00 Jdic
1,2-DICHLOROETHENE (total)	17.00 Jdc

MW4
MW7
MW5
MW9
MW1
MW8
MW2
MW3
MW6

LEGEND:

MONITORING WELL CLUSTER LOCATIONS

REFER TO FIGURE 1-9A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER ROUND	
COMPOUND	CONCENTRATION (ug/l)

125' 0 250'

SCALE:

FIGURE 4-38

MONITORING WELL CLUSTER LOCATIONS TCL ORGANIC COMPOUND EXCEEDANCES IN ROUND 2 GROUNDWATER SAMPLES

WORK ASSIGNMENT 053-2L3U

CDM FEDERAL PROGRAMS CORPORATION

NATIONAL PRIMARY DRINKING WATER STANDARDS (MCLs) (a)	
CHROMIUM	100.00
IRON	NO STANDARD
LEAD	15.00
MANGANESE	NO STANDARD
NICKEL	100.00

NYS DEPARTMENT OF HEALTH DRINKING WATER STANDARDS (b)	
CHROMIUM	100.00
IRON	NO STANDARD
LEAD	50.00
MANGANESE	NO STANDARD
NICKEL	NO STANDARD

NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION GROUNDWATER STANDARDS (c)	
CHROMIUM	50.00
IRON	300.00
LEAD	25.00
MANGANESE	300.00
NICKEL	NO STANDARD

MW5D Round 1

CHROMIUM	541.00 Jabc
IRON	15,100.00 Jc
NICKEL	346.00 Ja

MW5S Round 1

IRON	5,050.00 Jc
MANGANESE	393.00 Jc

MW4S Round 1

IRON	32,500.00 c
LEAD	105.00 abc
MANGANESE	1,780.00 c

MW4D Round 1

IRON	937.00 c
NICKEL	124.00 a

MW7D Round 1

IRON	2,550.00 c

MW7S Round 1

IRON	879.00 c
MANGANESE	469.00 c

MW9D Round 1

IRON	1,320.00 Jc

MW9S Round 1

IRON	3,950.00 Jc
MANGANESE	685.00 Jc

MW2S Round 1

IRON	1,140.00 Jc

MW2D Round 1

IRON	417.00 c

MW8S Round 1

CHROMIUM	162.00 ab
IRON	2,210.00 c
NICKEL	104.00 a

MW8D Round 1

CHROMIUM	63.50 Jc
IRON	6,290.00 Jc
LEAD	83.50 Jabc

MW6D Round 1

CHROMIUM	97.90 c
IRON	5,450.00 c

MW10S (DUP OF MW6D) Round 1

CHROMIUM	78.90 Jc
IRON	4,590.00 Jc

MW6S Round 1

IRON	785.00 c

MW3OB Round 1

CHROMIUM	749.00 Jabc
IRON	11,000.00 Jc
MANGANESE	677.00 Jc
NICKEL	725.00 Ja

MW3D Round 1

CHROMIUM	64.20 Jc
IRON	5,730.00 Jc

MW3S Round 1

CHROMIUM	207.00 Jabc
IRON	3,550.00 Jc
MANGANESE	352.00 Jc
NICKEL	152.00 Ja

MW3PW Round 1

IRON	6,040.00 Jc
MANGANESE	6,790.00 Jc

MW4 MW5 MW7 MW9 MW1 MW8 MW3 MW2 MW6

LEGEND:

MONITORING WELL CLUSTER LOCATIONS

REFER TO FIGURE 1-3A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER DEPTH (FT)	
ANALYTE	CONCENTRATION (ug/l)

125' 0 250'

SCALE:

FIGURE 4-39

MONITORING WELL CLUSTER LOCATIONS INORGANIC EXCEEDANCES IN ROUND 1 GROUNDWATER SAMPLES

WORK ASSIGNMENT 053-2L3U

Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

NATIONAL PRIMARY DRINKING WATER STANDARDS (MCLs) (a)	
CHROMIUM	100.00
IRON	NO STANDARD
LEAD	15.00
MANGANESE	NO STANDARD
NICKEL	100.00
ZINC	NO STANDARD

NYS DEPARTMENT OF HEALTH DRINKING WATER STANDARDS (b)	
CHROMIUM	100.00
IRON	NO STANDARD
LEAD	50.00
MANGANESE	NO STANDARD
NICKEL	NO STANDARD
ZINC	NO STANDARD

NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION GROUNDWATER STANDARDS (c)	
CHROMIUM	50.00
IRON	300.00
LEAD	25.00
MANGANESE	300.00
NICKEL	NO STANDARD
ZINC	300.00

MW04D Round 2	
IRON	2,060.00 c
NICKEL	125.00 a

MW04S Round 2	
CHROMIUM	488.00 abc
IRON	19,300.00 c
LEAD	37.50 ac
MANGANESE	893.00 c
ZINC	328.00 c

MW05D Round 2	
IRON	2,620.00 c

MW05S Round 2	
IRON	1,930.00 c

MW07D Round 2	
IRON	1,250.00 c

MW07S Round 2	
IRON	503.00 c

MW09D Round 2	
IRON	565.00 c

MW09S Round 2	
IRON	3,490.00 c
MANGANESE	588.00 c

MW01D Round 2	
IRON	1,510.00 c

MW01S Round 2	
IRON	491.00 c

MW02D Round 2	
IRON	437.00 c

MW02S Round 2	
IRON	1,740.00 c

MW08D Round 2	
IRON	1,530.00 c

MW08S Round 2	
IRON	905.00 c

MW06S Round 2	
IRON	2,560.00 c

MW03D Round 2	
IRON	1,530.00 c

MW03S Round 2	
CHROMIUM	52.00 c
IRON	339.00 c

MW10S (DUP OF MW03S) Round 2	
IRON	352.00 c

MW03DB Round 2	
IRON	407.00 c

MW03PW Round 2	
IRON	606.00 c
MANGANESE	1,330.00 c

MW1 MW2 MW3 MW4 MW5 MW6 MW7 MW8 MW9

LEGEND:

MONITORING WELL CLUSTER LOCATIONS

REFER TO FIGURE 1-2A FOR EXPLANATION OF ADDITIONAL MAP SYMBOLS

SAMPLE NUMBER ROUND	
ANALYTE	CONCENTRATION (ug/l)

125' 0 250'

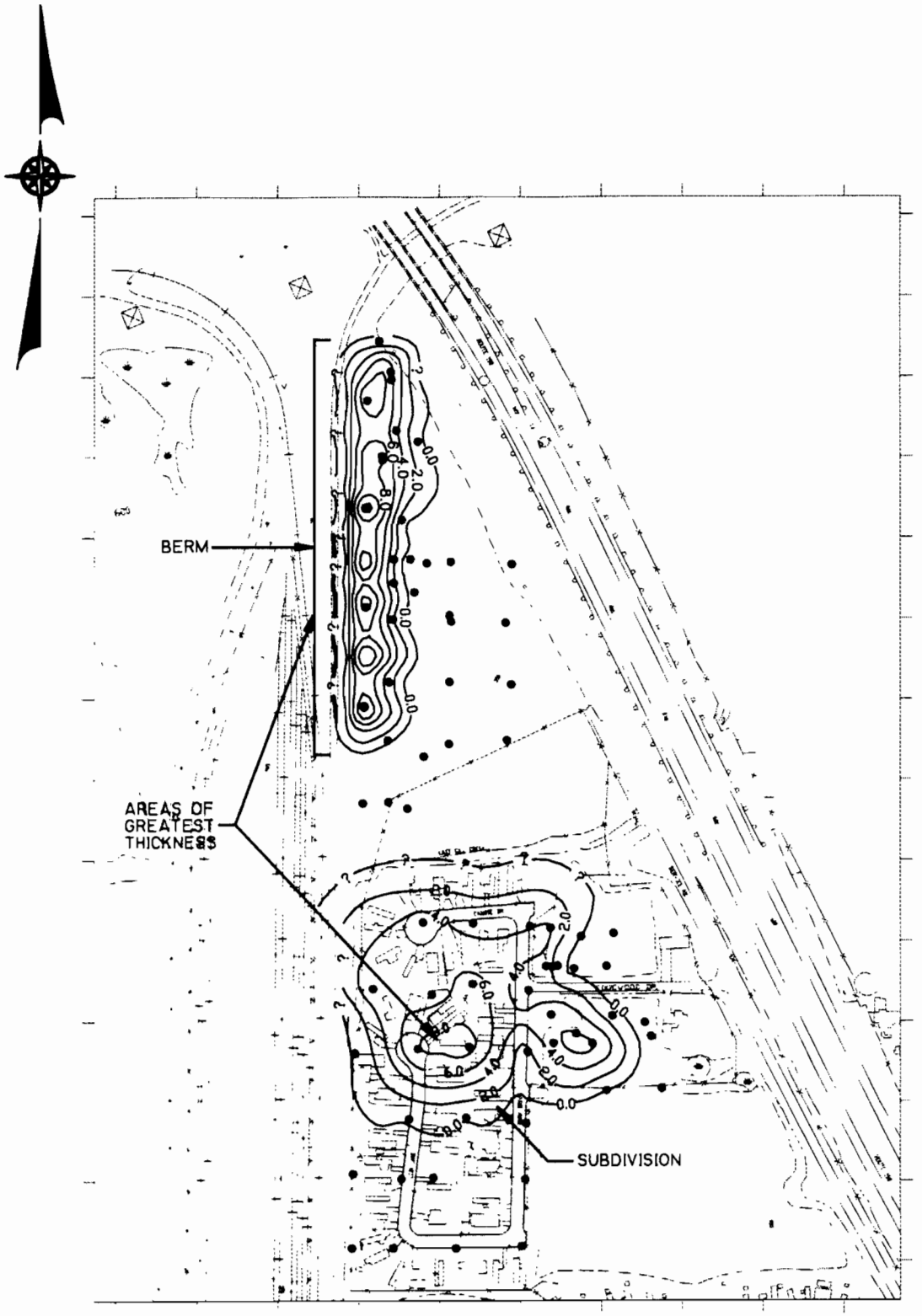
SCALE:

FIGURE 4-40

MONITORING WELL CLUSTER LOCATIONS INORGANIC EXCEEDANCES IN ROUND 2 GROUNDWATER SAMPLES

WORK ASSIGNMENT 053-2L3U
Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION



1" = 400'

200 0 400

LEGEND

—2.0 CONTOUR (ft)

—?— ESTIMATED CONTOUR

• SOIL SAMPLING LOCATION

NOTE: CONTOUR INTERVAL = 2 FEET

FIGURE 4-41

DEPTH OF SUSPECTED CONTAMINATED FILL IN FEET BELOW GROUND SURFACE

WORK ASSIGNMENT 053-2L3U

Forest Glen Site, Niagara Falls, New York

CDM FEDERAL PROGRAMS CORPORATION

a subsidiary of Camp Dresser & McKee Inc.

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5.0 CONTAMINANT FATE AND TRANSPORT

This chapter describes the persistence and the mobility of the TCL/TAL analytes identified above screening levels and all detected targeted organic compounds in the environment. An understanding of the fate and transport of contaminants provided in this chapter is necessary to realistically evaluate future potential exposure risks and to evaluate remedial technologies for the Feasibility Study.

This section provides the following:

- a listing of the contaminant groups of concern for each AOC by source media;
- a summary of potential contaminant transport pathways;
- the relevant physical-chemical properties of the contaminants, and;
- a summary of the fate and transport characteristics of contaminants.

5.1 CONTAMINANTS OF CONCERN

Fate and transport properties are important for contaminants that exceed ARARs, and contaminants identified as COCs for the human health or ecological risk assessment. COCs for the risk assessments are determined based on their toxicity characteristics, frequency, and the maximum concentration at which they were detected at the site in surface water, sediment, soil or groundwater. The Final Endangerment Assessment has been submitted as a separate document. Due to the extensive list of COCs, only risk-related contaminants and those that occur at higher frequencies will be discussed in this chapter. Therefore, the COCs discussed in this chapter will be similar to those identified in Chapter 4.

Table 5-1 summarizes the chemical classes of COCs in site media by AOC and chemical groups. These COCs may have been physically introduced to the site by illegal landfilling activities, as reported by area residents. For example 2-mercaptobenzothiazole, a yellow powder used as a vulcanizing accelerator in the rubber industry, was visibly detected in certain areas of the site. This was confirmed by analysis of 2-mercaptobenzothiazole (up to 1,100,000 ug/kg) in the subsurface soil of the berm. In the previous investigations, nuggets of the raw material were actually observed in the soils.

Significant COC classes, based on environmental concentration and potential human health and ecological risks, are listed below.

Targeted Organic Compounds. These compounds are present in the surface soils in the northern portion of the subdivision (perylene - 40 ug/kg, 2-anilinobenzothiazole - 330,000 ug/kg) and Edgewood Drive wooded lots (perylene - ranging from 1 to 12,000 ug/kg), the subsurface soils

of the berm (phenothiazine - 60 ug/kg, 2-mercaptobenzothiazole - 1,000,000 ug/kg), the northern aspect (perylene - 50 ug/kg, 2-anilinobenzothiazole - 27,000 ug/kg), wooded wetlands (perylene - ranging from 120 - 250 ug/kg), and the sediments of East Gill Creek (2-anilinobenzothiazole, 90 - N,N-diphenyl-1,4-benzenediamine, 81,000 ug/kg). These organic compounds are suspected to have been introduced to these areas during illegal landfilling activities. These compounds are by-products of petroleum products, used in rubber manufacturing, and other industrial processes.

Metals. Metals were detected in all AOCs in the groundwater, surface soils and sediments. The groundwater contained high levels of chromium (> 700 ug/l), lead (> 100 ug/l), and nickel (>700 ug/l). A few metals were also detected in the surface water collected in Round 1 (e.g. zinc at 1820 ug/l, vanadium at 133 ug/l, aluminum at 72,500 ug/l, and cobalt at 44 ug/l). Metals were detected in the sediments at various concentrations (e.g. chromium ranging from 37 to 100 mg/kg and in the soils, copper ranging from 4 to 387 mg/kg, and cobalt ranging from 1 to 193 mg/kg. The more important heavy metals from a risk standpoint are: arsenic, lead, nickel, mercury, and chromium. Other metals detected above screening criteria were aluminum and cobalt.

Phenols. Phenols were found present in the fill material throughout the site. Phenol (ranging from 330 to 9,700 ug/l), 2-methylphenol (o-cresol) (ranging from 120 to 980 ug/l) and 4-methylphenol (p-cresol) were detected above the NYS TAGMs in surface and subsurface soils of the berm, Edgewood Drive wooded lots and the subdivision. They were also found in the sediments of East Gill Creek. Phenol is a common and important industrial chemical. 2-Methylphenol and 4-methylphenol are also regularly used as resins, organic intermediates and to make herbicides, food flavors, dye, perfumes, and plastics.

Pesticides and PCBs. PCBs are used as lubricants in high pressure and electrical applications and as a plasticizer for resins and chlorinated rubber. Pesticides are normally used for control of insects. Alpha-BHC and beta-BHC are the main pesticide contaminants found at the site. Aroclor-1254 was detected above screening levels in the sediments of the wooded wetland (ranging from 68 to 110 ug/kg) and in surface soil in the subdivision. Aroclor 1248 was found in the subsurface soil of the northern aspect and Aroclor 1260 was detected in the subsurface soil of Edgewood Drive. Soil and sediments are the principal medium contaminated with pesticides and PCBs.

Polynuclear Aromatic Hydrocarbons (PAHs). These were detected in surface, subsurface soils and sediments in all AOCs, with the highest concentrations found in the berm (ranging to 12,000 ug/kg), Edgewood Drive wooded lots (with concentration ranging to 130,000 ug/kg), and the subdivision (maximum concentration found at 250,000 ug/kg). PAHs are the expected residual chemicals from petroleum products as a result of burning and detonation of chemicals. A reported site fire in the northern aspect may have produced some of these chemicals. PAHs are also used as starting materials for insecticide production and organic synthesis. Soil is the principal media contaminated by PAHs.

Volatiles. Volatiles were detected above screening criteria in the groundwater (ranging up to 1,300 ug/l) and in soils at low levels with one exceedance of xylene 10,000 ug/kg observed.

Vinyl chloride, 1,1-DCA, TCE, 1,2-DCE, 1,1,1-TCA, and xylenes are compounds of concern for this site. Chlorinated VOCs have a variety of uses in industry, including polymer production, degreasing, solvents, and organic synthesis. Groundwater is the principal media contaminated by chlorinated VOCs.

5.2 CONTAMINANT TRANSPORT PATHWAYS

5.2.1 PROPERTIES OF SITE MEDIA INFLUENCING CONTAMINANT TRANSPORT

The physical characteristics of the site are described in Chapter 3. The physical characteristics that affect the transport of contaminants are briefly described below.

5.2.1.1 Topography

The site is fairly flat except for a slight southern decline in the northern aspect and the elevated berm in the northern aspect. East Gill Creek, two surface water pools (one in the wooded wetland and the other to the south of Edgewood Drive), other seasonal water bodies, surface drainages, and several soil mounds provide conduits for potential surficial contaminant transport. The surface water pools ultimately drain into East Gill Creek on and off the site. Contaminants carried in surface water runoff will adsorb to suspended sediments in the water and eventually accumulate where the sediments are deposited.

5.2.1.2 Surficial Geology

The composition of the surficial geologic units exert a major control on the mobility of contaminants in the unsaturated zone. In undisturbed areas of the site, the overburden lithology, from ground surface to the Lockport Dolomite, is characterized by an 8 to 10-foot thick clay layer overlying a 2-feet clay till. In portions of the subdivision, north and south of Edgewood Drive, the northern aspect, and the berm, disturbed soils (fill) were encountered above the clay layer. Soil borings revealed that the fill is separated from the clay till and the Lockport Dolomite by at least 3 feet of clay. This fill material is permeable when compared to the underlying clay layer and can produce perched water zones during wet periods. Areas of perched water were encountered in the central subdivision and in the berm.

5.2.1.3 Groundwater Flow

Site-specific hydrogeologic properties determine contaminant transport rates and direction. In the overburden, rainwater or spills in contact with surface fill will be either absorbed by the fill material or may flow vertically down to the clay layer. Standing water pools are created in areas where surface clay material exists.

Groundwater flows, both vertically and horizontally, through an interconnected system of closely spaced joints and bedding plane fractures. Groundwater flow in the shallow bedrock zone, as

discussed in Chapter 3, closely follows the top of bedrock elevation contours toward a bedrock surface depression beneath the MW-5 cluster.

The groundwater high at MW-7S results in localized flow to the east, toward MW-5S, and south toward MW-8S, deviating from the expected regional flow to the west. Groundwater in the deep bedrock zone generally flows to the west/southwest with MW-1D being upgradient of the site and MW-7D and 8D being downgradient. Figures 3-20 through 3-23 show the groundwater flow patterns.

Vertical groundwater flow at each monitoring well cluster is downward, as evidenced by the higher groundwater elevations of the shallow versus those of the deep wells. This indicates that the site is located in a groundwater recharge area. An exception to this is the lack of any gradient at the MW-1 cluster during the November, 1995 water level round (Refer to Table 3-6).

5.2.1.4 Soil Chemistry

The soil properties most affecting contaminant persistence and mobility include:

- redox potential (Eh);
- pH; and
- total organic carbon (TOC) content.

Redox potential of the subsurface affects the speciation of contaminants, and hence their mobility or persistence in the environment. Microbial activity and organic contaminants may create reducing conditions. The pH of soils and groundwater affects hydrolysis rates, equilibrium partitioning conditions, and contaminant solubility. The soil pH at the site varies between 6.2 and 8.9. High total organic carbon content in the site soil increases contaminant absorption and hinders the movement of contaminants through the soil. The TOC of the soil at the Forest Glen site is relatively high ranging from 14,000 mg/kg for the surface soils in the northern aspect to 90,000 mg/kg in the sediments of the wooded wetland. The natural soil type at the site is the Odessa silty clay loam, which is a poorly drained, moderately fine textured soil in which clay dominates. This corresponds to the relatively high TOC content of the soil samples and the existence of surface water bodies in depressed areas.

5.2.2 POTENTIAL CONTAMINANT TRANSPORT PATHWAYS

There are several potential contaminant transport pathways for contaminants identified at the site, including:

- Surface runoff to sediments in surface water bodies, through drainage channels and ultimately to East Gill Creek (Refer to Figure 3-1);

- The migration of chemical contaminants present in soil via surface runoff and windblown dusts;

- The volatilization of chemical contaminants present in surface soil into the ambient air;

- Discharge of contaminated groundwater to downgradient water bodies or vertically through soil/rock fractures

- Uptake of contaminants in soil by biota.

5.3 CHEMICAL AND PHYSICAL PROPERTIES OF CONTAMINANTS

To predict the persistence and potential migration of contaminants in soils and groundwater, it is necessary to identify which contaminants are likely to leach, degrade (biotically or abiotically), or volatilize. This depends on a given chemical's physical and chemical properties and the properties of the media through which it migrates. Table 5-2 presents the chemical and physical properties of the contaminants. The following sections describe the persistence and mobility of the identified contaminant groups, focusing on such properties as degradation, dissolution/precipitation, volatilization, biotransformation, adsorption, and bioaccumulation or bioconcentration.

5.3.1 CONTAMINANT PERSISTENCE (FATE)

Contaminant persistence describes the length of time that a contaminant will remain in its original chemical state in the environment. The chemicals that will persist in a given medium are those that form insoluble precipitates, or resist biodegradation, hydrolysis, and volatilization.

5.3.1.1 Processes that Affect Persistence

The major processes affecting the fate, or persistence, of each class of COCs in soils and groundwater are shown on the following table.

Contaminant Group	Fate Process
Pesticides/PCBs	Very, very slow biodegradation
PAHs, Targeted Organics	Very slow biodegradation
Phenols	Rapid biodegradation, dissolution/precipitation,
Metals	Dissolution/precipitation - pH dependent
Chlorinated VOCs	Biodegradation/biotransformation, hydrolysis

Degradation/transformation describes the process by which a chemical will degrade or change due to naturally occurring chemical and/or biological reactions. The chemical forms generated may

have significantly different environmental mobilities and toxicological properties relative to the original chemical.

Biodegradation is the degradation of chemicals by microbes in the soil or water, either under aerobic or anaerobic conditions. Chlorinated VOCs are very susceptible to biodegradation under anaerobic conditions. Phenols are very susceptible to biodegradation under aerobic and anaerobic conditions. Other organic compounds, such as pesticides/PCBs and PAHs are not very susceptible to biodegradation. Metals do not degrade.

Hydrolysis is the direct reaction of dissolved compounds with water molecules, and can be an important abiotic degradation process in groundwater systems. For example, hydrolysis of chlorinated hydrocarbons is significant because many chlorinated compounds are not readily degraded by reactions such as biodegradation. This hydrolysis of chlorinated compounds often yields an alcohol or an alkene.

Volatilization is an important transformation process in the unsaturated zone; its importance is determined by the area of contact between the compound and the unsaturated zone, the vapor pressures of the spilled compounds, and the rate at which the compound diffuses in the subsurface. The volatilization process is dependent upon physical properties of the chemical, the presence of modifying materials, and the physical and chemical properties of the environment. Movement of vapor away from residual spill material in the unsaturated zone is typically controlled by molecular diffusion (Refer to Section 5.3.2).

Dissolution and precipitation are processes by which the volume of a given metal in the environment may be reduced or increased. Redox conditions and pH govern the stability of metals and determine whether a metal will precipitate from solution and what ionic species of dissolved metals will be present.

For organic compounds, dissolution is the process by which chemical compounds penetrate from the unsaturated zone into the groundwater. When immiscible fluids reach the capillary fringe, their behavior is controlled by the fluid's density relative to water. Fluids less dense than water pool on the water table, while dense fluids penetrate into the groundwater. The dissolution process is an especially important mechanism in the fate and transport of the denser fluids.

5.3.1.2 COC Persistence

The chemical, physical, and biological factors that affect the persistence of each chemical group of contaminants are described in this section.

VOCs. The detected chlorinated solvents (i.e., TCA, TCE, DCA and DCE) are moderately persistent in the environment. They are resistant to chemical degradation, but moderately susceptible to biodegradation under anaerobic conditions as shown in Table 5-2. For example, TCE undergoes anaerobic degradation to produce DCE and other chlorinated species, like vinyl chloride, with significant toxicological concerns. One of the end products, vinyl chloride, is not

readily degraded and tends to accumulate. However, due to the high volatilization and mobility of vinyl chloride, it will not persist in the soil environment but will tend to leach to groundwater or volatize. The concentration of VOCs in the soil is expected to decrease gradually. The presence of vinyl chloride in the groundwater (ranging from 3 to 16 ug/l in Round 1 and from 44 to 220 ug/l in Round 2) confirms this.

PAHs. These compounds are relatively persistent in the environment. The degree of persistence generally increases with the molecular size of the compound. The relatively high octanol/water coefficients of PAHs indicate that they will be primarily detected in the suspended particulate fraction (unfiltered samples) in water. The larger PAHs such as benzo(a)anthracene (maximum concentration - 7700 mg/kg, and benzo(b)fluoranthene (maximum concentration 12,000 mg/kg)) found in the northern aspect, and some of the targeted organics such as N,N-diphenyl-1,4-benezenediamine and 2-anilinobenzothiazole are not volatile therefore, loss to the atmosphere is not expected to be significant. Biodegradation and biotransformation are the ultimate fate mechanisms affecting most PAHs. The smaller PAHs are readily biodegraded, with half-lives in soil measured in hours to weeks. The larger PAHs, such as the COCs, take significantly longer to biodegrade, with half-lives measured in weeks to months. The PAHs were detected at high concentrations as shown in the following AOCs: berm - benzo(a)pyrene (maximum concentration 3,800 ug/kg), northern aspect - benzo(b)fluoranthene (150 - 12,000 ug/kg), wooded wetlands - benzo(b)fluoranthene (ranging from 570 to 1400 ug/kg), Edgewood Drive - fluoranthene (56 to 130,000 ug/kg), and the subdivision-benzo(a)anthracene (ranging from 130 to 250,000 ug/kg). Based on the high concentrations present at the site and the persistence of PAHs they will remain sorbed to the organic matter in the soils.

Pesticides. Alpha-BHC, for example, which was detected in site soils, has a moderate solubility in water, low vapor pressure, low subsurface mobility, and little tendency to biodegrade. This pesticide, when released to surface water, will strongly adsorb to sediments. It may, however, volatilize very slowly. Alpha-BHC was found in all the sediment samples of the wooded wetland (ranging from 0.5 to 5.5 ug/kg) and at even lower concentrations in the surface water of East Gill Creek (ranging from 0.06 to 0.11 ug/l). Pesticide concentrations are therefore expected to decrease slowly over time. This could take place via adsorption to particulate material in surface runoff to surface waters of the creek which flows off site.

Phenols. These compounds show low to moderate adsorption to clay-type soils. Their adsorption indicates moderate soil mobility with possible leaching to groundwater through any available conduits. As noted previously, phenols have a high tendency to biodegrade. Thus, phenols are not expected to persist except where iron oxide and pH levels are high (Artola - Fortuny et al 1982).

PCBs. PCBs are highly immobile in the soil/groundwater environment because of their high affinity for sorption to soils and their very low solubility. The tendency of PCBs for adsorption increases with the degree of chlorination and with the organic content of the soil. These compounds also have a tendency to bioaccumulate.

Metals. The COC metals at the site are relatively soluble in water, except lead and mercury, and show high tendencies to dissolve into the water phase and move along with the water flow instead of sorbing to soil or organic matter in soil or suspended in aqueous media. Leaching of metal from areas of deposition into aqueous media will occur. The persistence will depend on the rates of leaching, amount of rainfall and individual metal properties. The persistence of metals is complicated by processes such as precipitation and dissolution which are dependent upon pH, the presence of certain ions or complexing agents and concentrations of the metals in solution. These factors are discussed further under mobility.

5.3.2 CONTAMINANT MOBILITY (TRANSPORT)

The major processes affecting the transport, or mobility, of each chemical type in soils and groundwater shown in the following table.

Contaminant Group	Transport Process
Chlorinated VOCs	Volatilization
Pesticides/PCBs	Sorption, bioaccumulation/bioconcentration
PAHs, Targeted Organics	Sorption, sedimentation
Phenols	Adsorption, volatilization, precipitation
Metals	Sorption, bioaccumulation, volatization (Hg)

Volatilization. This is the process whereby chemicals partition from a liquid or solid phase into the gas phase. The process is dependent on vapor pressure and temperature, water solubility, and molecular weight. It is important at the soil/air and water/air interface. Highly water soluble compounds generally have lower volatilization rates than water. Vapor pressure, a relative measure of the volatility of chemicals in their pure state, range from 0.001 to 760 millimeters (mm) Hg for liquids, with solids ranging down to 10^{-7} mm Hg. Henry's Law constant, which combines vapor pressure with solubility and molecular weight, is more appropriate for estimating releases to air from water. Compounds with Henry's Law constants in the range of 10^{-3} and larger, such as chlorinated VOCs, can be expected to rapidly volatilize from water. Chemicals with values ranging from 10^{-3} to 10^{-5}, such as phenols and mercury, are associated with possibly significant, but not rapid volatilization. Compounds with values less than 10^{-5}, such as PAHs, pesticides, and PCBs, will only volatilize slowly from water (Lyman et al., 1982).

Adsorption. The octanol-water partition coefficient (K_{ow}) and the organic carbon partition coefficient (K_{oc}) reflect the propensity of an organic compound to sorb to the organic matter found in soil. The normal range of K_{oc} values extends to 10^{+7}, with higher values indicating greater sorption potential.

Bioaccumulation/bioconcentration. Some chemicals, such as lead, pesticides and PCBs, tend to bioaccumulate/bioconcentrate in animal or plant tissue. In fact, plant uptake is sometimes used as a remedial strategy to remove these contaminants from soils and sediment.

Dissolution/precipitation. Whether a chemical is transported in a dissolved state in infiltrating rain water or groundwater or is precipitated out of solution depends on the solubility of that chemical relative to water. Highly soluble chemicals, such as chlorinated VOCs, are readily leached from wastes and soils into groundwater, where they continue to be highly mobile as dissolved contaminants. Chemicals with low solubility, such as pesticides, PCBs, and PAHs are not as easily leached from the soils. Most metals are relatively insoluble, but metal solubility is highly dependent upon redox conditions and pH.

5.3.2.1 Mobility of Organic Compounds

Chlorinated VOCs. Chlorinated VOCs are generally highly mobile in the environment. They are highly volatile, do not adsorb readily to soils, and have low retardation factors in groundwater, with their flow rates equal to approximately that of groundwater. Previous investigations found these compounds at higher levels in soils than were detected during the RI.

Past practices of illegal landfilling at the site may account for their presence in the soils in the northern portion of subdivision. A large fraction of the VOCs, when originally released, would have rapidly evaporated from the surface soil due to their high vapor pressure. Then, since these chlorinated solvents are moderately to highly soluble in water, and do not sorb to soils, the fraction remaining in the soil would readily infiltrate through the unsaturated zone by partitioning between the liquid phase (soil moisture) and the vapor phase and leaching into the groundwater. The contaminant transport pathway for VOC from the surface soils is therefore direct discharge to soils, leaching to groundwater, and migration with groundwater flow with only slight retardation.

PAHs and Targeted Organics. Site soils contained several SVOCs, predominantly the PAHs benzo(a)pyrene, benzo(b)fluoranthene, benzo(a)anthracene, dibenzo(a,h)anthracene, chrysene, benzo(k)fluoranthene and the targeted organics such as benzothiazole, 2-mercaptobenzothiazole and 2-anilinobenzothiazole. In general, the PAH compounds exhibit low mobility, low to moderate solubility, (naphthalene is moderate) and high organic partition coefficients. PAHs have a moderate to low mobility, with flow rates approximately one to three orders of magnitude slower than groundwater. The targeted organic compounds are mostly insoluble although a few show low solubility.

Consistent with these chemical properties, PAHs were detected only in the surface soil, subsurface soil and sediment samples. No PAHs were detected in the groundwater or surface water above the MCLs. The PAHs have primarily remained sorbed to the surface soil (0 - 2 ft) and subsurface soils (6 - 8 ft), near their apparent sources of release in the various AOCs.

The targeted organic compounds have behaved similarly. The high concentration of contaminants in the subsurface soil of the berm (phenothiazine - 4,600 ug/kg and 2-anilinobenzothiazole - 960,000 ug/kg) is explained by the excavation of surface soil from the northern aspect to create the berm to the west of the northern aspect. The remaining surface soil of the northern aspect is now relatively clean (2-anilinobenzothiazole - 80J). However, the northern aspect subsurface soil remains contaminated (phenothiazine - 470 ug/kg and 2-anilinobenzothiazole - 27,000 ug/kg) possibly because the soil excavation did not extend to the subsurface during preparation of the land for commercial development. In the subdivision, the slightly soluble and insoluble targeted organic compounds are highly concentrated in both the subsurface and the subsurface soils. This does not conform to the solubilities of these compounds. For example, benzothiazole's maximum concentration is 10,000 ug/kg in the surface soil and 16, 000 ug/kg in the subsurface soil; concentration of 2-mercaptobenzothiazole range from 200 to 50,000 ug/kg in the surface soil and 120 to 47,000 ug/kg in the subsurface soil. As these subsurface concentrations are exceedingly high, it is unlikely that the compounds reached the subsurface through any transport phenomena. The distribution pattern in the subdivision is consistent with deposition of contaminated fill material prior to development of the area for habitation. The surface and subsurface soils therefore represent one layer (vadose zone) and no true subsurface samples exists for the subdivision since the fill material extended down to eleven feet in some locations. There were only two detections of targeted organics in the groundwater, benzothiazole - 1J ug/kg, in wells MW4D and MW9D that are not considered significant due to the low estimated value. Based on the low solubilities and the relative absence in the groundwater, targeted organic compounds are not expected to migrate into the groundwater and will remain sorbed to soils and sediments. One exception is aniline which will sorb to colloidal organic matter and, though not detected in this groundwater investigation, may in the future leach to groundwater.

Pesticides/PCBs. Pesticides and PCBs also have low mobility in soils because their chemical properties are similar to PAHs. They were only detected in sediment and surface soils. Low concentrations of pesticides sorbed to suspended particles were found in the surface water of East Gill Creek (e.g. alpha-BHC, 0.02 ug/kg at GCSW03) versus the relatively higher concentration in the sediments of the wooded wetland (e.g. alpha-BHC, 5.5 ug/kg at WTSD03). The most probable contaminant transport pathway for the PAHs, pesticides, and PCBs detected is direct discharge and absorption to soils, surface runoff onto sediments, and uptake by biota.

Phenols. The phenols detected at the site are expected to show high soil mobility and relatively rapid mobilization from near surface soils. However, phenol will exist in a partially dissociated state in water and moist soils and, therefore, its transport and reactivity may be affected by pH. In 2-methyl phenol and 4-methyl phenol, hydrogen bonding interactions complicate the prediction of mobility from soil absorption. However, due to the high organic carbon content of the soil these hydrogen bonding interactions may be minimized resulting in moderate adsorption as

predicted from Table 5-4. The microbial populations in the fill could be destroyed by high phenol concentrations (Delfino, 1976). The high concentrations of phenol remaining in the fill areas (e.g. 4-methylphenol, 5,800 ug/kg at SS10) suggest that the microbial populations in the fill have been destroyed and thus the degradation process has been thwarted. Thus bonding interactions to the soil due to polarity of the phenol group and lack of microbes to aid the degradation process have resulted in reduced mobility of phenols at the site

5.3.2.2 Mobility of Metals

A variety of factors affect the mobility of metals in soil/water systems, including:

- the presence of water (soil moisture content);
- the presence of other complexing chemicals in solution
- the pH and oxidation/reduction potential, which affect the speciation of all metals and complexing agents;
- the temperature; and
- soil properties, such as cation exchange, the presence of hydrous oxides of iron and magnesium, and the presence of organic matter.

Because of the wide range of soil conditions in the environment and the resulting high variability of certain physical parameters, it is difficult to predict the mobility of metals. Soil sorption constants may vary over several orders of magnitude for a given metal in different soils and/or under different environmental conditions. Thus, there is no single sorption constant describing the binding of metals in solution to soils and no one mobility prediction holds for all environmental conditions.

In a study of metals retention in soils, the relative mobility of 11 metals in various soil types was assessed (EPA, 1978). The study concluded that chromium, mercury, and nickel are among the most mobile, while lead and copper are the least mobile. For the other metals studied, the mobility varied with the conditions, although the order of mobility was generally:

Most Mobile--As>V>Se>Cd>Zn>Be--Least Mobile

For this investigation, estimates of overall mobility were made for each metal COC, based on the anticipated speciation of the chemicals in fresh water, general solubility patterns, and general soil sorption patterns. General guidelines used to assign metals to a mobility group (high, medium, or low) were:

- metals whose predominant species in freshwater are anions (i.e., arsenic, and vanadium) which are only minimally retarded in soils, are among the most mobile;

- metals known to be fairly strongly sorbed to most soils under normal environmental conditions (i.e., pH 6 to 8 near neutral redox potential) are among the least mobile; and

- metals whose predominant freshwater species are cations, especially divalent heavy metals (i.e., copper, lead) which are subject to sorption via cation exchange, are among the least mobile.

The relative mobilities assigned to the metal contaminants are shown in Table 5-3 and described below.

Chromium. The mobility of chromium in soils depends on its oxidation state. It is most often found in the oxidation state Cr(III) and, to a lesser extent, Cr(VI). Chromium can be adsorbed or complexed to soil particles, metal oxides, or organic matter and is therefore rather immobile. Most of the Cr(III) found in soils is mixed Cr(III) and Fe(III) oxides or in the lattice of minerals, although Cr(III) complexed with organic ligands may stay in solution for over a year. Cr(III) is mobilized only in very acidic soil media. Cr(VI), by contrast, is easily mobilized, independent of the soil pH. The absorption of chromium onto clays is pH dependent; Cr(III) adsorption increases as pH increases, whereas Cr(VI) adsorption decreases as pH increases.

Lead. Lead is virtually immobile in all but sandy soils. Its predominant fate in the environment is sorption to soils and sediments. The adsorption of lead is pH dependent, increasing with increasing pH. Above pH 7, virtually all lead in soil is sorbed. In natural water, lead concentrations decrease over time; sorption of lead to both sediments and suspended particulates is the favored process with clay, hydrous metal oxides, and organic matter influencing this sorption.

Nickel. The metal appears to be only moderately retarded in its movement through soil. In studies of the migration of metal through soil, nickel was found to be evenly distributed throughout the column. Studies of sewage sludge and the leachability of metals, have found that nickel's mobility was similar to that of zinc and cadmium. Nickel concentrations are consistently greater in the deeper subsurface soils in the unsaturated zone (4-10 ft) than in the surface and shallow soils.

5.3.2.3 Mobility of Site Contaminants in Groundwater

To characterize the behavior of contaminants along the predicted flow path (through soils or in the water), their physical and chemical properties were used to establish a scheme of relative mobilities. A "retardation factor" was approximated for each chemical considered to be a COC at the site. These factors serve as estimates, within an order of magnitude, of the relative mobilities of each compound. This approach ignores the possible contribution of "facilitated transport", wherein the contaminant is transported along with mobile colloidal particles to which it is attached.

Retardation factors are based on four parameters: the bulk density of the subsurface material (1.57 kg/l); the fraction of organic matter in the subsurface material (f_{oc} = .0494); the effective porosity of the subsurface material (0.3); and an adsorption coefficient for each compound. The equation for calculating the retardation factor is:

$R_f = 1 + p K_d/n$
$= 1 + p K_{oc} f_{oc}/n$

R_f = retardation factor (dimensionless)
p = soil bulk density (kg/l)
k_d = sorption constant (l/kg)
k_{oc} = organic carbon normalized sorption constant (l/kg)
f_{oc} = weight fraction organic carbon in soil ($0 \leq f_{oc} \leq 1$) (dimensionless)
n = soil porosity ($0 \leq n \leq 1$) (dimensionless)

Estimates of the first three parameters were made based on saturated soil conditions. The fraction of organic carbon was estimated by averaging TOC concentrations over the entire saturated zone. The average TOC was calculated at 49,373 mg/kg, expressed as a fraction of 1 (i.e., 0.0494).

The fourth parameter, K_d is independent of position in the subsurface soils and is, instead, particular to each chemical. The adsorption coefficient reflects a compounds tendency to distribute itself as a solute dissolved in ground water or adsorbed to soil.

Using this equation, a retardation factor (Rf) was estimated for each compound in the saturated zone (Table 5-2). The range of retardation factors spans several orders of magnitude, indicating that different compounds move at different rates through the groundwater (Figures 5-2A and 5-2B).

Due to the low soil permeability and relatively high organic content of the soils, organic compounds would not be expected to be found in the groundwater, except for the moderate (lighter weight SVOCs) and highly mobile organics (VOCs). Groundwater sampling has confirmed that this is the case. VOCs such as, vinyl chloride (15 ug/l in MW5D) and 1,2 DCE total (13 ug/l in MW8S) were detected in the groundwater as well as TCE, DCA and xylenes (total). It is suspected that the pathway for these VOCs is volatization to the air from surface soils and vertical transport through breached areas of the clay. The moderately mobile organics (low molecular weight SVOCs) were also detected above screening criteria in the groundwater e.g. pentachlorophenol and hexachlorobutadiene.

Even though they are highly mobile, phenols were only detected in two groundwater samples (MW-6S, MW-6D) at concentrations that slightly exceeded drinking water standards. As explained previously, adsorption is enhanced by reduced degradation activity and hydrogen bonding. Any phenol transported through the subsurface and to the groundwater quickly attenuates. Phenol degradation is sufficiently rapid such that most groundwater is sufficiently free of this pollutant (Delfino, 1976).

The extensive clay layer beneath the surface causes the retention of water above the water table (perched water) in some areas of the site (subdivision and northern aspect). The highly mobile organics are therefore retained. However, illegal landfilling activities may have breached the clay layer which would have allowed contaminants to migrate into the underlying bedrock aquifers.

Additionally, VOCs were detected in the groundwater in areas where the clay depth is thinnest (MW5S). The highly retarded organics have remained in the soil.

5.4 SUMMARY OF CONTAMINANT FATE AND TRANSPORT

The majority of the chemicals of concern detected in the surface water, sediment, soils, and groundwater of the site can be grouped into three general categories that describe their persistence and mobility in the environment:

Group 1 Persistent, non-volatile, and very slowly degradable organic chemicals such as PCBs, Pesticides, PAHs and many of the targeted organics. These chemicals strongly sorb to soils and are relatively immobile. Concentrations present in soils will persist into the future, with very slow degradation of the organics. This group represents the majority of chemical contamination detected in soils and sediments during the remedial investigation. The PAHs and targeted organics will remain in the soil for years.

Group 2 Volatile, soluble, degradable contaminants such as volatile organic compounds. These chemicals do not sorb strongly to soils and are relatively mobile in groundwater. Their persistence will be determined by their rates of biodegradation, and their mobility by their retardation coefficients (Kd) and the velocity of groundwater. These chemicals, VOCs, are the constituents of concern in the groundwater. Although they reached the water table through releases to soils, very few traces of the VOCs remain in site soils that were sampled.

Group 3 Low volatility, soluble, degradable such as the phenols. These chemicals show low soil adsorption and are relatively mobile in soils. Phenols biodegrade quite rapidly in water and in soil. The high concentration of phenols (ranging to 9,700 ug/kg in the berm) still remaining in the subsurface soils suggest that microbial populations in the soil have been destroyed by high concentration spills. This has reduced or prevented the normally rapid degradation in soils. At the site, phenol has displayed abnormally moderate to high adsorption to the soils. It is expected however, that the phenols have and will continue to leach to groundwater due to their high solubilities (e.g. 2-methylphenol - 25,000 mg/l in water). They will not be detected in the groundwater in high concentrations since they degrade rapidly (hours to days). However, the concentrations in the soils are expected to decrease.

TABLE 5-1
SUMMARY OF CHEMICAL CLASSES OF COCS IN SITE MEDIA
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

MEDIA	AREA OF CONCERN	CONTAMINANT OF CONCERN GROUP
Surface water	4 - East Gill Creek	Pesticide and metals
Sediment	3 - Wooded wetland	Pesticide/PCB, PAH, Targeted organic and metals
	4 - East Gill Creek	Targeted organic and metals
Surface soil	2 - Northern Aspect	Targeted organic, PAH, and metals
	5 - Edgewood Drive	Targeted organic, PAH, and metals
	6 - Subdivision	Targeted organic, PAH, and metals
Subsurface soil	1 - Berm	Targeted organic, phenol, PAH, and metals
	2 - Northern Aspect	Targeted organic, phenol, PAH, and metals
	5 - Edgewood Drive	Targeted organic, PAH, and metals
	6 - Subdivision	Targeted organic, PAH, and metals
Groundwater	Sitewide	VOC and metals

TABLE 5-2
FATE AND TRANSPORT PROPERTIES FOR FOREST GLEN SITE CONTAMINANTS

CONTAMINANT	Molec. Weight (g/mole)	Specific Density @20-25 C	Water Solubility @20-25 C (mg/l)*	Vapor Pressure @20-25 C (mm HG)	Henry's Law Constant @20-25 C (atm-m ^3/mol)	Koc (cc/gm)	log Kow	Kd (cc/gm)	Rf	Adsorption	Volatilization from Water	Mobility
TCL Volatile Organics												
Vinyl chloride	63	0.91	2.7E+03	2.7E+03	8.2E-02	2.5E+00	0.6	1.3E-01	4.9E+00	Low	High	High
Trichloroethene	131	1.46	1.1E+03	5.8E+02	9.1E-03	1.3E+02	2.5	6.3E+00	2.0E+02	High	High	Moderate
1,1,1-Trichloroethane	133	1.34	1.5E+03	1.2E+02	1.4E-02	1.5E+02	2.5	7.5E+00	2.4E+02	High	High	Moderate
1,1-Dichloroethane	99	1.18	5.5E+03	1.8E+02	4.3E-03	3.0E+01	1.8	1.5E+00	4.8E+01	Moderate	High	Moderate
1,2-Dichloroethene (cis)	97	1.27	3.5E+03	2.1E+02	7.6E-03	1.4E+02	1.9	7.0E+00	2.2E+02	High	High	Moderate
1,2-Dichloroethene (trans)	97	1.27	6.3E+03	3.2E+02	6.6E-03	1.8E+02	2.1	9.0E+00	2.8E+02	High	High	Moderate
Xylenes (Total)	106	0.88	2.0E+02	1.0E+01	7.0E-03	1.3E+02	3.2	6.5E+00	2.1E+02	High	High	Moderate
TCL Semi-Volatile Organics - 1												
Phenol	94	1.06	9E+04	2.0E-01	2.7E-07	2.7E+01	1.5	1.4E+00	4.3E+01	Moderate	Low	Moderate
2-Methylphenol	108	1.05	2.5E+04	2.4E-01	1.2E-06	2.2E+01	1.9	1.1E+00	3.6E+01	Moderate	Moderate	Moderate
4-Methylphenol	108	1.02	2.3E+04	1.3E-01	7.9E-07	4.9E+01	1.7	2.5E+00	7.8E+01	High	Moderate	Moderate
Pentachlorophenol	266	1.98	2.0E+01	1.7E-04	3.4E-06	8.9E+02	5.01	4.5E+01	1.4E+03	High	Moderate	Low
Hexachlorobutadiene	261	1.55	2.55	1.5E-01	1.3E-02	4.7E+03	4.9	2.3E+02	7.3E+03	High	High	Low
TCL Semi-Volatile Organics - 2 (PAH)												
Anthracene	178	1.28	1.3E+00	2.0E-04	6.5E-05	1.9E+04	4.3	9.5E+02	3.0E+04	High	Moderate	Low
Benzo(a)anthracene	228	1.27	9.0E-03	1.1E-07	8.0E-06	1.4E+06	5.9	7.0E+04	2.2E+06	High	Moderate	Low
Benzo(b)fluoranthene	252	ND	1.4E-02	5.0E-07	1.2E-05	5.5E+05	6.6	2.8E+04	8.6E+05	High	Moderate	Low
Benzo(a)pyrene	252	1.35	1.2E-03	5.6E-09	1.6E-06	4.0E+05	6.0	2.0E+04	6.3E+05	High	Moderate	Low
Benzo(g,h,i)perylene	276	ND	2.6E-04	1.0E-10	1.4E-07	7.8E+06	7.1	3.9E+05	1.2E+07	High	Moderate	Low
Benzo(k)fluoranthene	252	ND	5.5E-04	9.6E-11	1.0E-03	4.4E+06	6.9	2.2E+05	6.9E+06	High	Moderate	Low
Chrysene	228	1.27	6.0E-03	6.3E-09	7.3E-20	2.5E+05	5.6	1.2E+04	3.8E+05	High	Low	Low
Dibenz(a,h)anthracene	278	1.28	5.0E-04	1.0E-09	7.3E-09	1.7E+06	6.4	8.5E+04	2.7E+06	High	Low	Low
Dibenzofuran	168	1.09	1.0E+01	ND	ND	8.1E+03	4.2	4.1E+02	1.3E+04	High	-	Low
Fluoranthene	202	1.25	2.6E-01	1.0E-02	1.7E-02	4.2E+04	5.2	2.1E+03	6.6E+04	High	High	Low
Indeno(1,2,3-cd)pyrene	276	ND	6.2E-02	1.0E-09	3.0E-20	3.1E+07	6.0	1.6E+06	4.9E+07	High	Low	Low
Napthalene	128	1.16	3.1E+01	2.3E-01	4.6E-04	5.5E+02	3.4	2.8E+01	8.6E+02	High	Moderate	Moderate
Phenanthrene	178	1.18	8.2E-01	6.8E-04	3.9E-05	5.2E+03	4.6	2.6E+02	8.2E+03	High	Moderate	Low
Pyrene	202	1.27	1.6E-01	6.9E-07	1.1E-05	4.6E+04	4.9	2.3E+03	7.2E+04	High	Moderate	Low
Targeted Organics												
Aniline	93	1.00	3.6E+04	4.5E-01	1.9E-06	5.4E+01	0.9	2.7E+00	8.6E+01	High	Moderate	Moderate
2-Anilinobenzothiazole	226	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzothiazole	135	1.25	Slight	3.4E+01	NA	NA	NA	NA	NA	NA	NA	NA
Diphenylamine	169	1.20	5.8E+01	3.8E-05	1.5E-07	4.7E-07	3.6	2.4E-08	1.0E+00	Low	Moderate	High
N,N-diphenyl-1,4-benzenediamine	260	1.20	Slight	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Mercaptobenzothiazole	167	1.40	2.5E+03	NA	NA	NA	NA	NA	NA	NA	NA	NA
Perylene	252	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenothiazine	199	NA	Insoluble	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenylisothiocyanate	135	1.13	Insoluble	NA	NA	NA	NA	NA	NA	NA	NA	NA
TCL Pesticides/PCBs												
Aroclor 1254	327	1.51	1.2E-02	7.7E-05	2.7E-03	4.1E+05	6.5	2.1E+04	6.4E+05	High	High	Low
alpha-BHC	291	1.87	2.0E+00	2.5E-05	5.3E-06	1.9E+03	3.8	9.5E+01	3.0E+03	High	Moderate	Low

TABLE 5-2
FATE AND TRANSPORT PROPERTIES FOR FOREST GLEN SITE CONTAMINANTS

CONTAMINANT	Molec. Weight (g/mole)	Specific Density @20-25 C	Water Solubility @20-25 C (mg/l)*	Vapor Pressure @20-25 C (mm HG)	Henry's Law Constant @20-25 C (atm-m ^3/mol)	Koc (cc/gm)	log Kow	Kd (cc/gm)	Rf	Adsorption	Volatilization from Water	Mobility
TAL Inorganics												
Aluminium	27	2.70	Insoluble						1.0E+00			
Arsenic (+3)	75	4.70	Insoluble	-		NA	NA	3.0E+01	9.4E+02	High	NA	Moderate
Chromium (+6)	52	7.10	Insoluble	-		NA	NA	1.5E+01	4.7E+02	High	NA	Moderate
Cobalt	59	8.90	Insoluble						1.0E+00			
Lead	207	11.34	Insoluble						1.0E+00			
Mercury	201	13.55	Insoluble	2.0E-03		NA	322	NA	1.8E+02	5.7E+03	High	NA	Low
Nickel	59	8.90	Insoluble	0.0E+00		NA	NA	NA	7.9E+01	2.5E+03	High	NA	Low

VARIABLES

Fraction Organic Carbon, foc =	5.0%	
Soil Bulk Density, Rho_b =	1.57	gm/cc
Effective Porosity, Eta_e =	5%	

Adsorption is	"Low"	if Kd <	0.5
	"High"	if Kd >	2
	Moderate"	if Kd is in-between	
	Immobile"	if Kd >10	
Volatilization from Water is	"Low"	if H <	1.0E-07
	"High"	if H >	1.0E-03
	Moderate"	if H is in-between	
Mobility is	"High"	if Rf <	1.0E+01
	"Low"	if Rf >	1.0E+03
	Moderate"	if Rf is in-between	

NOTATION

Koc = Soil Organic Carbon/Water Partition Coefficient, cc/gm
Kow = n-Octanol/Water Partition Coefficient, dimensionless
Kd = Soil/Water Partition Coefficient [= Koc X foc for organics], cc/gm
Rf = Retardation Factor = 1 + (Rho_b X Kd / Eta_e), dimensionless
NA= Data is not available

NOTES

The Kd values for inorganics are based inf rmation provided in the EPA Soil Screening Guidance Document (EPA, 1994).
The Kd values for mercury, and nickel wer developed by EPA using an equilibrium
geochemical speciation model (MINTEQ2), ssuming a certain pore-water chemistry.
The values for arsenic, and chromium (6+), were based on empirical, pH-dependent relationships
developed by EPA. The Kd values used he e were adjusted for a site specific pH of 7.6.
However, for these values to be more site-s ecific, site-specific modeling would be required because, unlike
for organics, Kd values for inorganics are s gnificantly affected by a variety of soil conditions.
* For inorganics, solubility is based on "per 00 parts," i.e., units are [mg/(1.0E-04 l)].

Sources: 1 - Fate and Exposure Data by H ward, Philip H., Lewis Publishers
2 - Groundwater Chemicals Desk Referenc by John H. Montgomery and Linda M. Welko, Lewis Publishers
3 - Merck index, 11th Edition, Merck & Co. nc., Rahway, N.J., 1989.
4 - Dangerous Properties of Industrial Materials
5 - USEPA Superfund Public Health Evalua ion Manual, OSWER Directive 9285.4-1; October, 1986
6 - Koc value for Aniline, Soil Science Jour al, 1986, Citation 141:26; Bouchard, D; Mattice,J.; Lavy, T.L.
7 - Solubility of 2-Mercaptobenzothiazole, PA-560/2-76-006. Washington D.C: U.S. EPA. PP160, 1976. Investigation of selected potential environmental contaminants:
Mercaptobenzothiazoles. Santodonato, .; Davis,L.N.;Howard,P.H.;Saxena,J.
8 - Henry's Law value for Aniline: Syracus Research Corporation, 1988

TABLE 5-2A
SORTED RETARDATION FACTORS FOR DISSOLVED
FOREST GLEN SITE CONTAMINANTS IN THE SATURATED ZONE

TCL Organic Compound	Rf	log Rf	Comparison to Flow Rate
Diphenylamine	1.0E+00	0.00	▲
Vinyl chloride	4.9E+00	0.69	Flow rate one order
2-Methylphenol	3.6E+01	1.55	of magnitude slower
Phenol	4.3E+01	1.64	than water
1,1-Dichloroethane	4.8E+01	1.68	▼
4-Methylphenol	7.8E+01	1.89	
Aniline	8.6E+01	1.93	
Trichloroethene	2.0E+02	2.30	▲
Xylenes (Total)	2.1E+02	2.31	
1,2-Dichloroethene (cis)	2.2E+02	2.34	
1,1,1-Trichloroethane	2.4E+02	2.37	
1,2-Dichloroethene (trans)	2.8E+02	2.45	Flow rate two to four orders
Napthalene	8.6E+02	2.94	of magnitude slower
Pentachlorophenol	1.4E+03	3.15	than water
alpha-BHC	3.0E+03	3.47	
Hexachlorobutadiene	7.3E+03	3.87	▼
Phenanthrene	8.2E+03	3.91	
Dibenzofuran	1.3E+04	4.10	▲
Anthracene	3.0E+04	4.47	
Fluoranthene	6.6E+04	4.82	
Pyrene	7.2E+04	4.86	Flow rate four and more orders
Chrysene	3.8E+05	5.59	of magnitude slower
Benzo(a)pyrene	6.3E+05	5.80	than water
Aroclor 1254	6.4E+05	5.81	
Benzo(b)fluoranthene	8.6E+05	5.94	
Benzo(a)anthracene	2.2E+06	6.34	
Dibenz(a,h)anthracene	2.7E+06	6.43	
Benzo(k)fluoranthene	6.9E+06	6.84	
Benzo(g,h,i)perylene	1.2E+07	7.09	
Indeno(1,2,3-cd)pyrene	4.9E+07	7.69	▼

TABLE 5-2B
SORTED RETARDATION FACTORS FOR DISSOLVED
FOREST GLEN SITE CONTAMINANTS

TAL Inorganic Analyte	Rf	log Rf	Comparison to Flow Rate
Aluminum	1.0E+00	0.00	Flow rate two orders ▲
Lead	1.0E+00	0.00	of magnitude slower
Cobalt	1.0E+00	0.00	than water
Chromium (+6)	4.7E+02	2.67	▼
Arsenic (+3)	9.4E+02	2.97	▲
Nickel	2.5E+03	3.39	Flow rate three orders
Mercury	5.7E+03	3.75	of magnitude slower
Mercury	5.7E+03	3.75	than water ▼

TABLE 5-3
RELATIVE MOBILITIES OF INORGANIC COCS
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

HIGH	MEDIUM	LOW
Nickel	Aluminum	Cobalt
Vanadium	Arsenic	Zinc
	Cadmium	Vanadium
		Mercury

6.0 SUMMARY AND CONCLUSIONS

This section provides a summary of the major findings of the RI. The conclusions drawn from the various investigations that were conducted concerning the nature and extent of contamination in four environmental media, soil, surface water, sediment, and groundwater and the fate and transport of contaminants are discussed below. Recommendations for future work and remedial action objectives are also provided below. The site Endangerment Assessment (human health and ecological) was submitted as stand alone documents, therefore extensive explanation of their conclusions will not be incorporated into this report.

6.1 SOURCES OF CONTAMINATION

Historical records and aerial photographs indicate that the site was originally a forested wetland. Reports also indicate that the illegal landfilling of industrial fill material in many areas of the site occurred during the 1970s.

Analytical data collected during this RI, combined with historical data, suggest that the primary source of contamination is the fill material. Fill material was encountered in discrete areas of the northwest section of the northern aspect, the berm, the western edge of the Edgewood Drive lots, and the northern and central sections of the subdivision. Figure 6-1 presents the extent of fill material found at the site. The volume of contaminated material to be remediated will be determined in the FS.

6.2 NATURE AND EXTENT OF CONTAMINATION

A summary of the nature and extent of contamination found in four environmental media: soil, groundwater, surface water and sediment is provided in the following sections.

6.2.1 SOIL

The distribution of total targeted organic compounds is illustrated on Figure 6-2. Targeted organic compounds were detected in surface soil samples collected from all site AOCs. The highest detected concentrations, however, were found in the northern end of the subdivision where these contaminants had been historically detected. While elevated levels of the targeted organics were detected (40J ppb - 330,000 ppb) in the surface soil, contaminant concentrations were significantly less than what had been historically reported. It is possible that contaminant concentrations have been reduced by flooding conditions, that resulted from leaking pipes, and the subsequent surface water run off.

Semivolatile PAHs were ubiquitous, with surface soil detections noted throughout the site (Figure 6-3). However, the highest PAH concentrations were noted in the western ends of both Edgewood Drive wooded lots. Benzo(a)pyrene and dibenzo(a,h)anthracene were observed at concentrations that exceeded NYS TAGM soil cleanup objectives by more than 1400 and 1000

times, respectively. Observed PAH concentration in surface soil in the Edgewood Drive wooded lots ranged from 40J to 130,000 ppb. Elevated PAH levels (60J to 7,2000D ppb) were also observed in the subdivision surface soil. However, the observed subdivision concentrations were significantly lower than the contaminant levels noted in the surface soil of the Edgewood Drive wooded lots.

As with the organic contaminants, the highest inorganic COC concentrations were associated with the fill. Generally, the highest inorganic concentrations, detections between nine and ten times above background screening criteria, were observed in the subdivision surface soils. Figures 6-4 and 6-5 illustrate the distribution of sitewide lead and nickel concentrations that were above background criteria.

Subsurface soil contamination was also associated with the fill material present in much of the site. Site wide, the fill material was observed to depths of 14.00 feet BGS, with variations of thickness noted throughout the AOCs.

In the berm, northern aspect, and subdivision, the fill material was generally associated with elevated levels of the targeted organic compounds. The highest concentrations of the compound were detected in the fill samples collected from the berm. Detected concentration of the targeted organics ranged up to 1,100,000 ppb (2-mercaptobenzothiazole). Semivolatile organics, PAH compounds and phenol, were also detected in the berm and northern aspect fill areas at concentrations that exceeded NYS TAGM cleanup objectives ranging to more than 300 times (phenol). Figures 6-6 and 6-7 illustrate the distribution of subsurface targeted organics and total PAHs, respectively.

In the Edgewood Drive lots and in the eastern area of the subdivision, the subsurface fill material was associated with elevated levels of PAH compounds. In the Edgewood Drive lots, contaminant concentrations decreased in the subsurface soil, however detected concentrations exceeded the NYS TAGM levels by more than 680 times (benzo(a)pyrene). In the eastern section of the subdivision, subsurface PAH concentrations exceeded NYS TAGM criteria over 2700 times (benzo(a)pyrene). Additionally, benzo(a)pyrene was detected in the perched water well which was installed in this fill area.

As with the organic contamination, subsurface inorganic contamination was generally associated with the fill material. The highest inorganic concentrations were generally found in the subdivision at levels that exceeded background criteria by up to nine times. Chromium, nickel, and lead, consistently detected in the subsurface soil samples at levels above background criteria, were also detected in groundwater samples at concentrations above State and Federal MCLs. Figures 6-8, 6-9, and 6-10 illustrate the subsurface distribution of chromium, lead, and nickel concentrations that were above background screening criteria.

Generally, the frequency of contaminant detections and contaminant concentrations decreased with depth. However, contaminant concentrations in some fill material samples were higher than in

corresponding surface soil samples. Contaminant concentrations, if detected at all, were significantly lower in samples collected below the fill layer.

6.2.2 SURFACE WATER

East Gill Creek surface water is contaminated with pesticides and inorganics at or above NYSDEC screening criteria. Both pesticides detected in the surface water, alpha-BHC and beta-BHC were commonly observed in the wooded wetland sediment. It is suspected that an intermittent stream located in the wooded wetland, which seasonally flows into East Gill Creek, could be transporting these contaminants into the creek. Several of the inorganics detected in the surface water were also present, at higher concentrations, in the upstream, background sample. This could suggest a potential offsite source of the contamination.

6.2.3 SEDIMENT

Sediment quality in the wooded wetland was characterized by PAHs, pesticide and PCB contamination. Generally, the highest levels of contamination were detected in samples collected from the center of the wetland area. While several inorganic analytes were detected in the wetland sediment sample, most of the detections were below background criteria.

As subdivision storm water and surface water runoff discharges into East Gill Creek, surface soil contaminants are suspected to be transported into the creek. This was confirmed by the presence of elevated targeted organic and semivolatile organic concentrations in the downstream and offsite (GCSD6), sediment samples. Targeted organic concentrations ranged from 90J ppb to 81,000 ppb in the downstream sediment samples.

As site specific organic contaminants were detected in the offsite sample location, it appears that East Gill Creek is acting as transport mechanism that is allowing the offsite migration of organic contamination. Inorganic analytes were detected in the majority of the East Gill Creek sediments; however, most observed detections were at concentrations below background screening criteria.

6.2.4 GROUNDWATER

Site soil contamination has appeared to have migrated vertically to the underlying groundwater. This suggests the overburden clay layer, found throughout the site, may have been breached during illegal landfilling activities.

In both sampling rounds, volatile organic compounds, including vinyl chloride, 1,2-DCE, 1,1-DCA, and TCE were consistently detected in the wells downgradient of the fill areas. While volatile organic compounds were not commonly detected in soil samples collected during the RI field investigation, their presence in the site soils and fill materials was documented during previous site investigations. Generally, the highest volatile organic compounds detections were noted in well MW-5S. As discussed in Chapter 3, shallow groundwater flows from all directions toward a slight bedrock depression in the vicinity of MW-5S. This flows regime could be

responsible for transporting groundwater contamination from throughout the site to the MW-5S area, explaining the elevated levels of volatile organic compounds detected in the well. Additionally, volatile organic concentrations increased in Round 2, when groundwater elevations were three to four feet higher than in Round 1.

Semivolatile organic compounds detections and standard exceedances in the groundwater were generally limited to two wells, MW-6D and MW3-PW. Pentachlorophenol and hexachlorobutadiene, at concentrations above State or Federal MCLs, were noted in well MW-6D which is downgradient of the Edgewood Drive and subdivision fill areas. Semivolatile PAHs, and one standard exceedance of benzo(a)pyrene, were generally noted in MW-3PW the perched water well. The MW-3 well cluster was installed in a fill area that was delineated during drive point boring activities.

Inorganic analytes were widely detected in both rounds of groundwater sampling. Chromium, nickel, and lead, however, were the only analytes with concentrations that exceeded State and Federal drinking water standards. All three analytes were widely detected in the site surface and subsurface soils, with the highest analytes concentrations noted in the fill material. Accordingly, the highest inorganic concentrations were generally detected in samples collected from source area wells, MW-3OB and MW-3S, and wells downgradient of the subdivision and Edgewood Drive fill area, MW-4S, MW-4D, and MW-5D. The presence of these analytes, commonly detected in the subsurface fill material, in the deep monitoring wells suggests that inorganic contamination has migrated vertically.

Volatile organic compounds and inorganic analytes were noted in the offsite well MW-8S at concentrations that exceeded State and Federal drinking water standards. Since the same contaminants were detected in onsite wells at higher concentrations, it appears that contamination is migrating offsite.

6.2.4.1 Variability Between Sampling Rounds

Inorganic detections were noted to decrease in the second round. Elevated concentrations of inorganics were detected in sample MW-30B in Round 1 but not Round 2. As discussed in Section 2, due to the low water levels in MW-30B at the time of Round 1 sampling, the standing water in the well was collected and submitted for metals analysis. Water levels were significantly higher in Round 2 and which allowed well MW-30B to be purged according to standard protocol. It is possible, due to the purging/sampling method employed, that Round 1 inorganic concentrations may not be indicative of aquifer conditions at the MW3 cluster.

With the exception of MW-30B, all other wells were sampled according to the procedure outlined in the POP. The well data sheets (Appendix I) indicate that monitoring well purge water ranged in description from clear to very turbid and brown (MW-4S). However, the purge water descriptions were consistent over both sampling rounds. Therefore, it is difficult to assign the increase or decrease in inorganic contamination to turbidity or suspended solids in the groundwater samples.

Volatile organic compound concentrations also varied significantly between the two rounds. Volatile organic compound concentrations were noted to increase in some instances by an order of magnitude in the second sampling round. As stated above, Round 2 water levels were up to two feet higher than the Round 1 measurements. It is possible that the increase of precipitation prior to the second sample event, which is responsible for the increase of water levels, was also responsible for an increased migration of fill-related contaminants.

None of the above theories are definitive. Therefore, it is recommended that an additional round of groundwater samples be collected to confirm contaminant concentrations.

6.2.5 RELATIONSHIP BETWEEN SOIL AND GROUNDWATER CONTAMINATION

Contaminants identified in the groundwater are very similar to those identified in the site soils, especially the more soluble volatile organics. The primary VOCs in the groundwater include vinyl chloride, 1,2-dichloroethene, 1,1-dichloroethane, trichloroethene, and xylene. The same compounds were identified in sampling by NUS in 1987 and 1988.

A similar comparison of groundwater and soil sampling results for semivolatile compounds in the subdivision and Edgewood Drive wooded lots indicate that these compounds do not migrate as readily from soils to the groundwater. Only a few semivolatile compounds were detected in the groundwater, while many were detected in soils. The semivolatile compounds are generally significantly less soluble than VOCs and are not expected to migrate into the groundwater.

Numerous inorganic analytes have been detected in subdivision soils and fill material. These same inorganics have also been detected in the groundwater, with chromium, nickel, and lead exceeding State and Federal drinking water standards.

6.3 SUMMARY OF CONTAMINANT FATE AND TRANSPORT

The majority of the chemicals of concern detected in the surface water, sediment, soils, and groundwater of the site can be grouped into three general categories that describe their persistence and mobility in the environment:

Group 1 Persistent, non-volatile, and very slowly degradable organic chemicals such as PCBs, Pesticides, PAHs and many of the targeted organics. These chemicals strongly sorb to soils and are relatively immobile. Concentrations present in soils will persist into the future, with very slow degradation of the organics. This group represents the majority of chemical contamination detected in soils and sediments during the remedial investigation.

Group 2 Volatile, soluble, degradable contaminants such as volatile organic compounds. These chemicals do not sorb strongly to soils and are relatively mobile in groundwater. Their persistence will be determined by their rates of biodegradation, and their mobility by their retardation coefficients (Kd) and the velocity of

groundwater. These chemicals, VOCs, are the constituents of concern in the groundwater. Although they reached the water table through releases to soils, very few traces of the VOCs remain in site soils that were sampled.

Group 3 Low volatility, soluble, degradable such as the phenols. These chemicals show low soil adsorption and are relatively mobile in soils. Phenols biodegrade quite rapidly in water and in soil. The high concentration of phenols (up to 9700 ug/kg in AOC 1) still remaining in the subsurface soils suggest that microbial populations in the soil have been destroyed by high concentration spills. Due to the relatively high mobility of phenols, it is expected to leach to groundwater.

6.4 CONCLUSIONS

The significant findings of the RI investigation are as follows:

- Analytical data collected during this RI, combined with historical data, suggest that the primary source of contamination is the fill material. Fill material was encountered in discrete areas of the northwest section of the northern aspect, the berm, the western edge of the Edgewood Drive lots, and the northern and central sections of the subdivision.

- Surface soils of the subdivision and Edgewood Drive wooded lots contain elevated levels of targeted organic compounds, PAH semivolatiles, phenol, and inorganics.

- Subsurface soils of the berm, northern aspect, Edgewood Drive wooded lots, and the subdivision contain elevated levels of targeted organic compounds, PAH semivolatiles, phenol and inorganics.

- Contaminant concentrations, if detected at all, were significantly lower in analytical samples collected below the fill layer.

- Sediment in the wooded wetland area contain PAHs, pesticides and PCBs at concentrations above sediment screening criteria.

- Downstream sediment samples in East Gill Creek contain elevated levels of the site-specific targeted organic compounds. It appears that East Gill Creek is acting as a transport mechanism which is permitting the offsite migration of organic contaminants.

- Site groundwater contains elevated levels of volatile organics and inorganics. Similar analytes were detected in the soil, during this investigation or historically, in the site soils. This suggests that soil contamination has migrated vertically to the underlying groundwater. It is possible that the overburden clay layer, found throughout the site, may have been breached during the landfilling activities.

- Volatile organic compounds and inorganic analytes were noted in the offsite well (MW-8S) at concentrations that exceeded State and Federal drinking water standards. Since the same contaminants were detected in onsite wells at higher concentrations, it appears that contamination may migrating offsite.

6.5 DATA LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORK

6.5.1 DATA LIMITATIONS

Samples collected during the RI from each of the four environmental media (soil, groundwater, surface water, and sediment) were analyzed by EPA's contract laboratory program (CLP) and H2M Laboratory, under subcontract to CDM Federal. Samples for TCL/TAL analysis were analyzed by the CLP laboratory and validated by EPA Region II staff. All other analyses were performed by H2M Laboratory and validation by CDM Federal EPA Region II-certified data validators. All data was validated in accordance with EPA Region II validation procedures. In some instances, the analytical results were used in conjunction with interpretation of other data to develop conceptual models illustrating contaminant distribution in the soil. As subsurface environments are constantly changing; delineated boundaries and contour intervals should not be considered fixed points. Since the characterization of subsurface environments requires some interpolation of data, figures in this chapter are provided for data presentation only.

6.5.2 RECOMMENDATIONS FOR FUTURE WORK

The following recommendations for future work are identified based on the RI investigation:

- **Wooded Wetland Sediment**

  Further characterization of the wooded wetland area may be required. Samples collected from this area during the RI were limited to the intermittent streambed. Upland samples would provide data on the areal extent of contamination.

- **Groundwater**

  Shallow Bedrock Groundwater Flow

  Water level measurements indicate that shallow groundwater flows along the top of bedrock toward a small bedrock depression beneath the MW-5 cluster. However, accessing which shallow bedrock groundwater zone wells are downgradient from the site is difficult due to these local anomalies. It was expected that MW-7 and MW-8 would be considered downgradient of the site. The groundwater elevation data reveals that MW-8S may be downgradient of the site and that much of the site's shallow bedrock zone groundwater flow is toward MW-5S. Some of the flow at MW-5S may be directed vertically downward as indicated in the vertical head differences at the MW-5 cluster (Table 3-6). The horizontal component of flow from MW-5S is not obvious from the data collected during the RI. The

area between and south of MW-5S, MW-6S and MW-8S needs further investigation in order to evaluate the shallow bedrock groundwater flow from the site. It is also important to characterize groundwater flow in the vicinity of MW-7S. At least one additional shallow bedrock well is recommended in the subdivision to verify the groundwater flow direction.

Northern Aspect

Although there were anecdotal reports regarding contamination in the northern aspect, this area was not considered a source area during project planning. The drive-point soil boring investigation performed during the initial site characterization did not reveal areas of fill. Therefore, the RI did not include a groundwater investigation in the northern aspect. Since high levels of organic and inorganic contamination were found in the fill material in the berm and the adjacent test pits during field data collection activities, this area should be considered a source area. During the leveling of the ground surface in the northern aspect and the construction of the berm, the clay layer may have been breached, potentially allowing contaminants to migrate into the groundwater. An investigation is recommended to determine the groundwater quality downgradient of the northern aspect.

Groundwater Analytical Results

Volatile organic compound concentrations were noted to increase in some instances by an order of magnitude in the second round. Inorganic detections were noted to decrease in the second round. Therefore, an additional sampling round is recommended to confirm contaminant concentrations. Samples should be collected using the EPA-recommended low-flow protocol. The turbidity of groundwater should also be closely monitored.

6.6 REMEDIAL ACTION ALTERNATIVES

The RI has shown that several site media including soil, groundwater, and sediments are contaminated. Based on this data the following preliminary remedial action objectives are discussed below. Remedial action objectives will be further developed in the FS which will use the results of the human health and ecological risk assessment.

The surface and subsurface soils, sediments, surface water and groundwater have been shown to be contaminated significantly above the screening criteria (ARARs, TBCs and site background) identified in Section 4.1.1. The human health risk assessment determined that quantifiable human health risks, above target levels established for Superfund sites, exist at the Forest Glen site based on several future land use scenarios for residents. The ecological risk assessment found that unacceptable risks to ecological receptors exist from acute and chronic exposure to chemical in the site's terrestrial and aquatic habitats. Therefore, several remedial action objectives have been identified to mitigate the potential present and/or future risks associated with Forest Glen. These remedial action objectives are to:

- Restore the presently abandoned site to beneficial use as a residential property.

- Prevent/minimize human exposure including ingestion, inhalation and dermal contact for future residents and construction workers and environmental exposure to contaminants present in the surface and subsurface soils, sediments, surface water and groundwater.

- Prevent/minimize the uptake of contaminants present in soils, sediments, surface water and groundwater by biota.

- Prevent/minimize migration of contaminants present in surface soils via surface runoff and windblown dusts.

- Prevent/minimize the downgradient and offsite migration of contaminated groundwater.

FIGURE 6-1
SITEWIDE EXTENT OF FILL MATERIAL
FOREST GLEN SITE - NIAGARA FALLS, NEW YORK

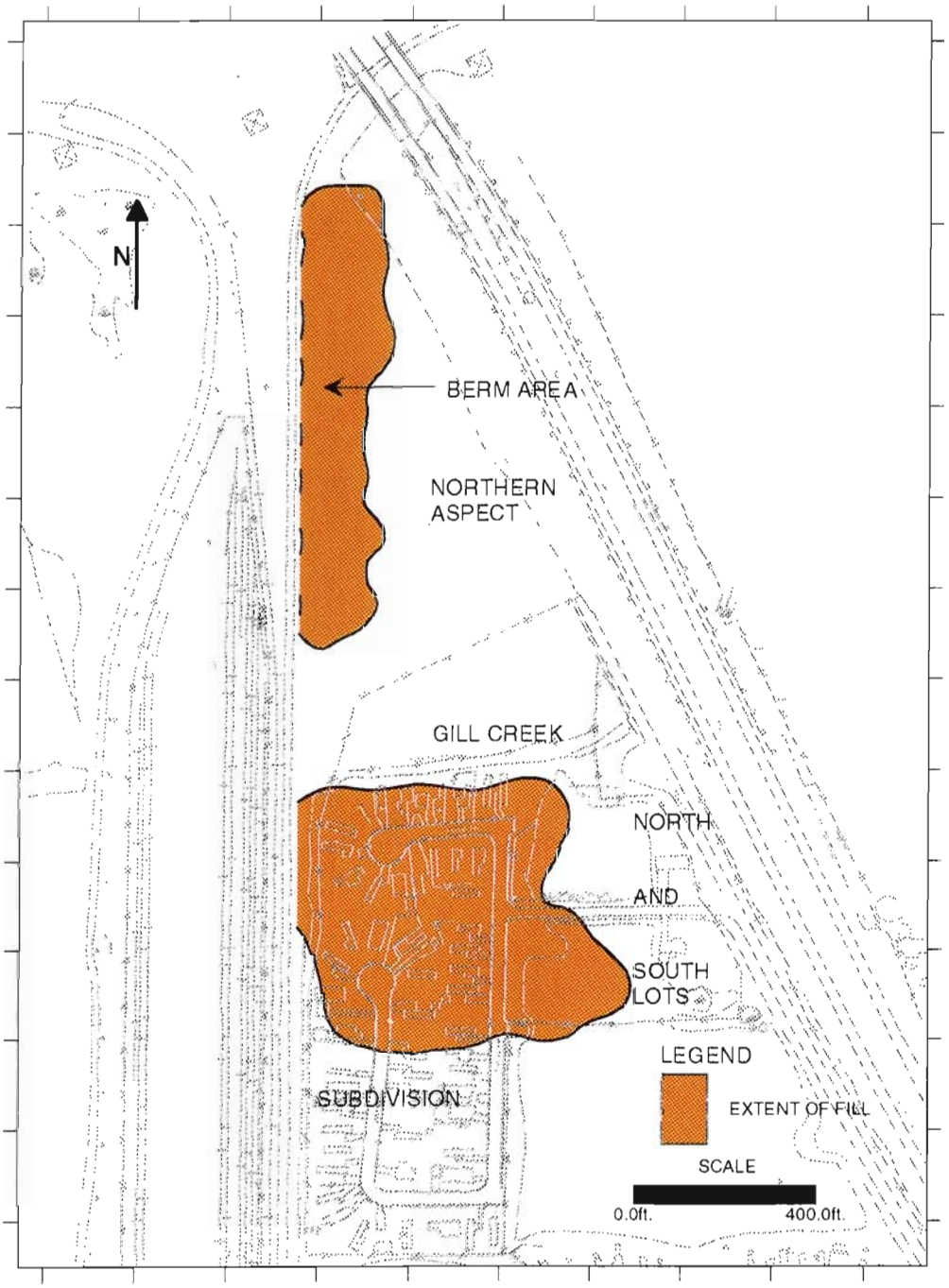


FIGURE 6-2
TOTAL TARGETED SVOCs - SURFACE SOIL
FOREST GLEN SITE - NIAGARA FALLS, NEW YORK

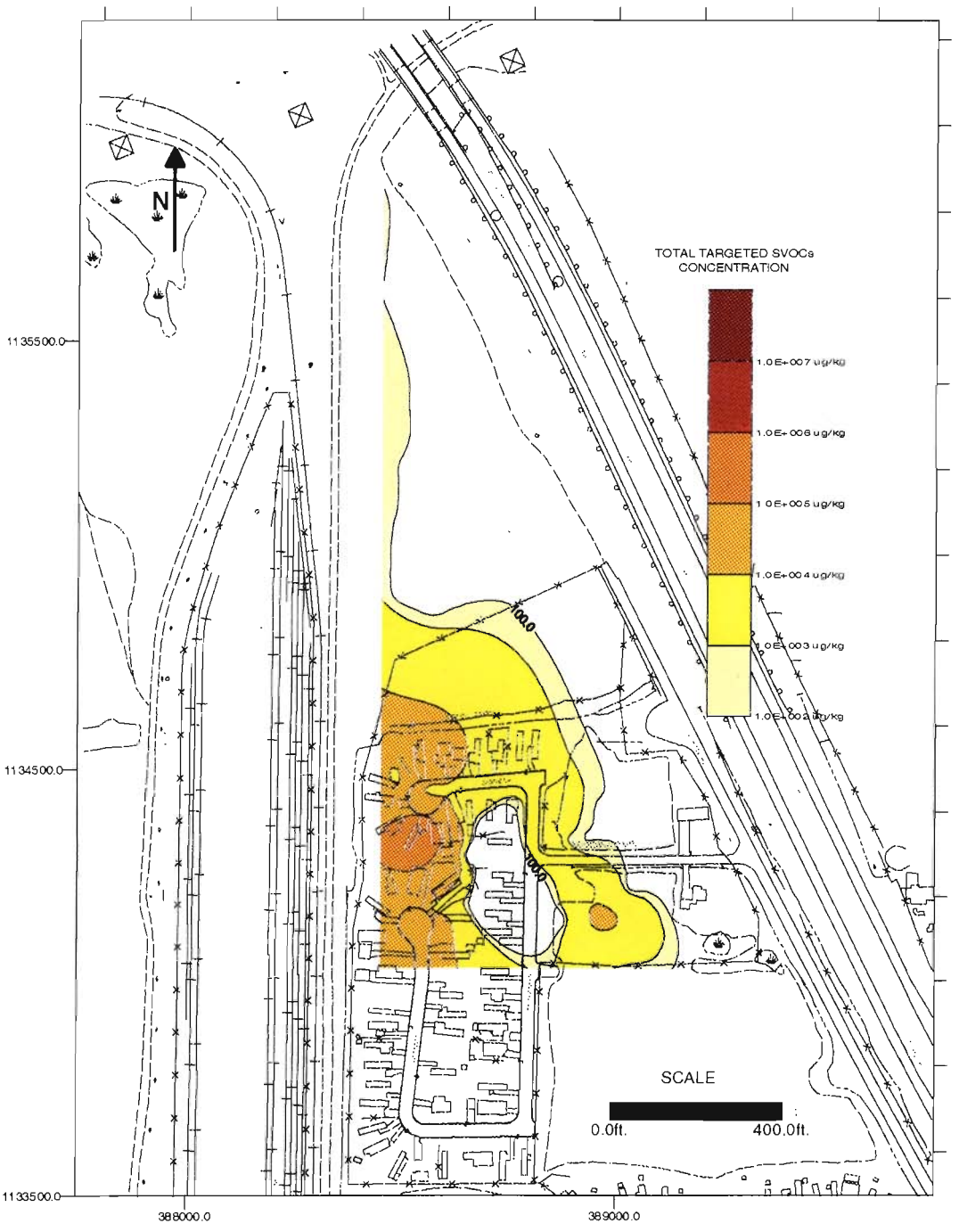


FIGURE 6-3
TOTAL PAHs OF CONCERN - SURFACE SOIL
FOREST GLEN SITE - NIAGARA FALLS, NEW YORK

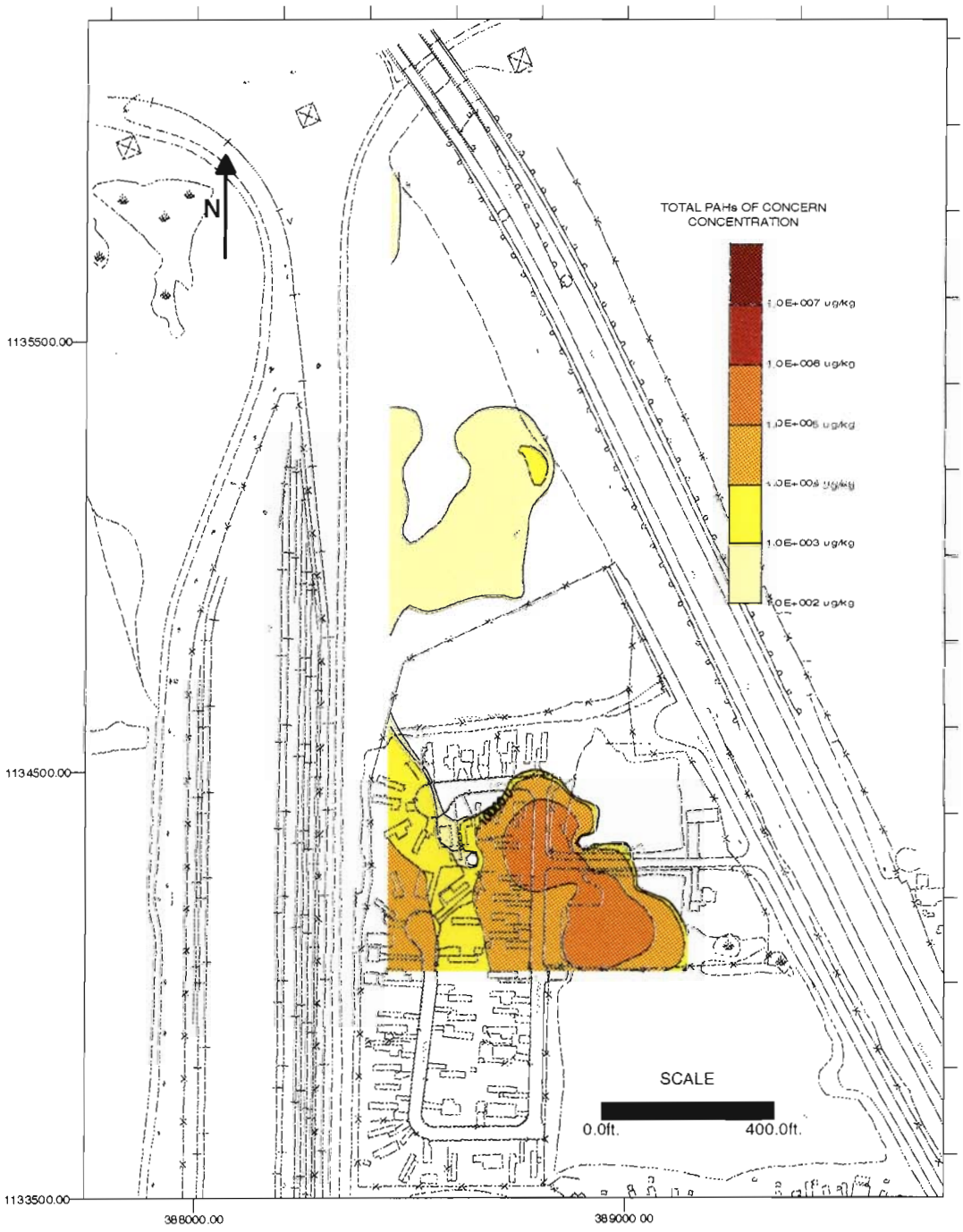


FIGURE 6-4
LEAD CONCENTRATIONS IN EXCEEDANCE OF BACKGROUND SCREENING CRITERIA
SURFACE SOIL
FOREST GLEN SITE - NIAGARA FALLS, NEW YORK

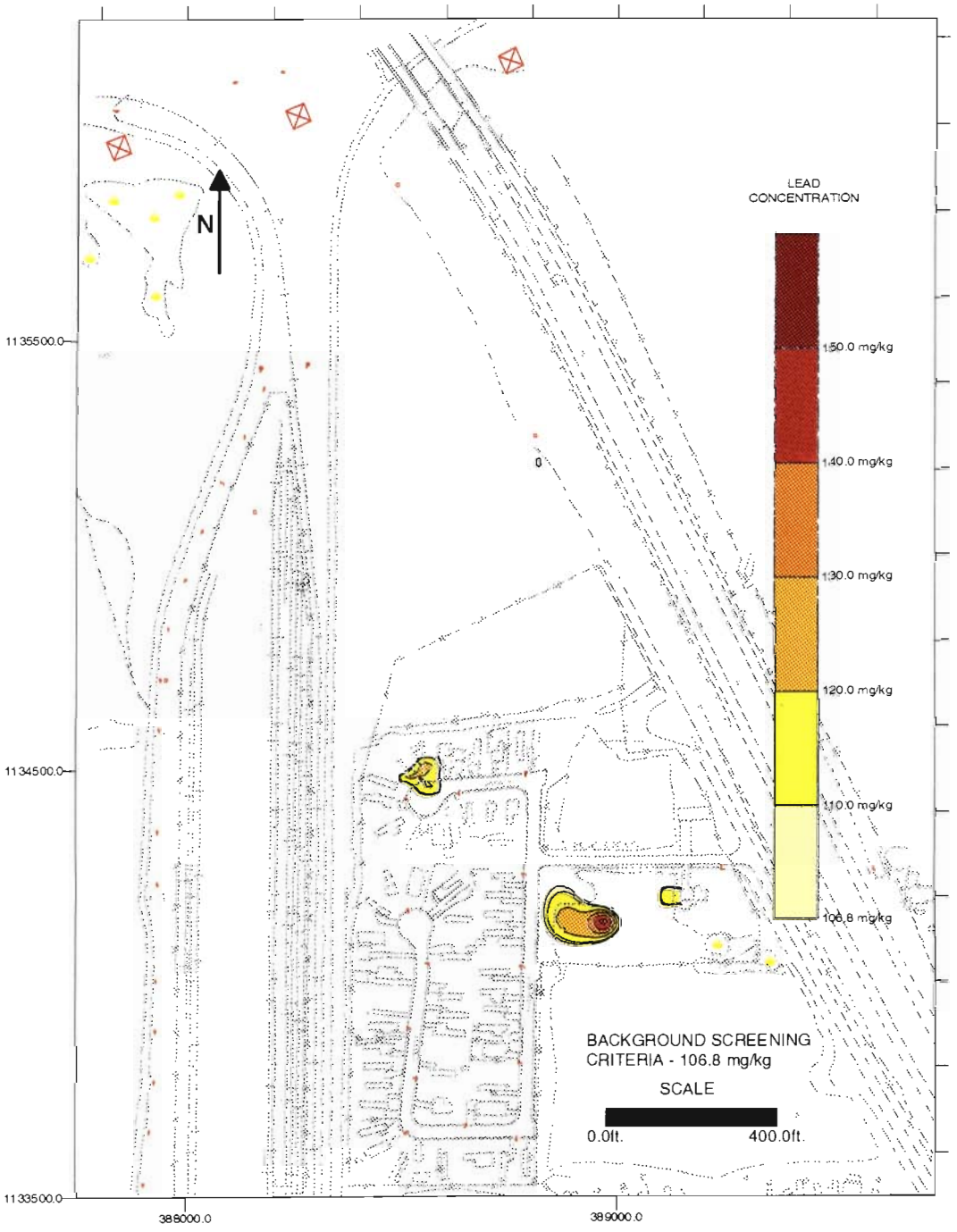


FIGURE 6-5
NICKEL CONCENTRATIONS IN EXCEEDANCE OF BACKGROUND SCREENING CRITERIA
SURFACE SOIL
FOREST GLEN SITE - NIAGARA FALLS, NEW YORK

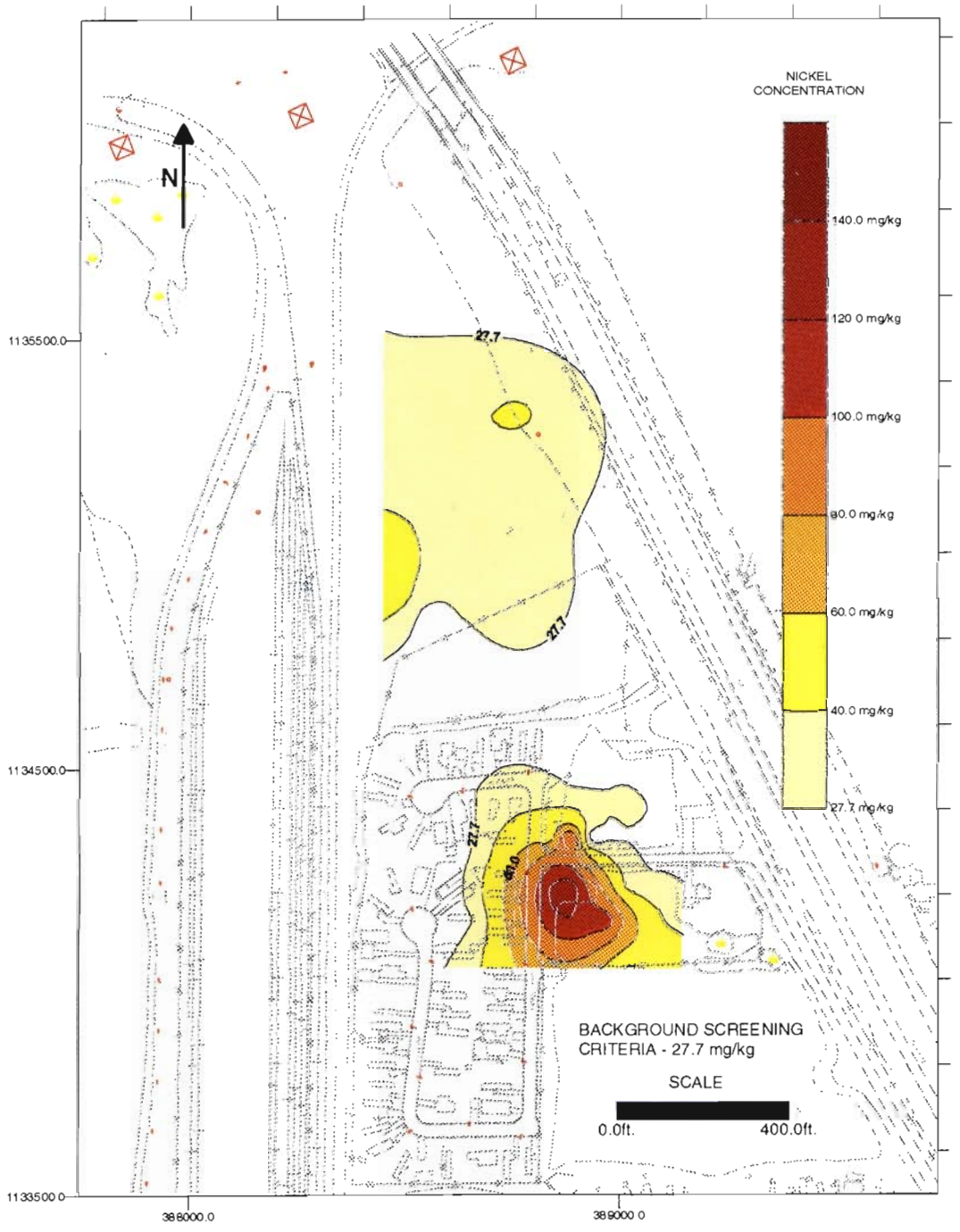


FIGURE 6-6
TOTAL TARGETED SVOCs - SUBSURFACE SOIL
FOREST GLEN SITE - NIAGARA FALLS, NEW YORK

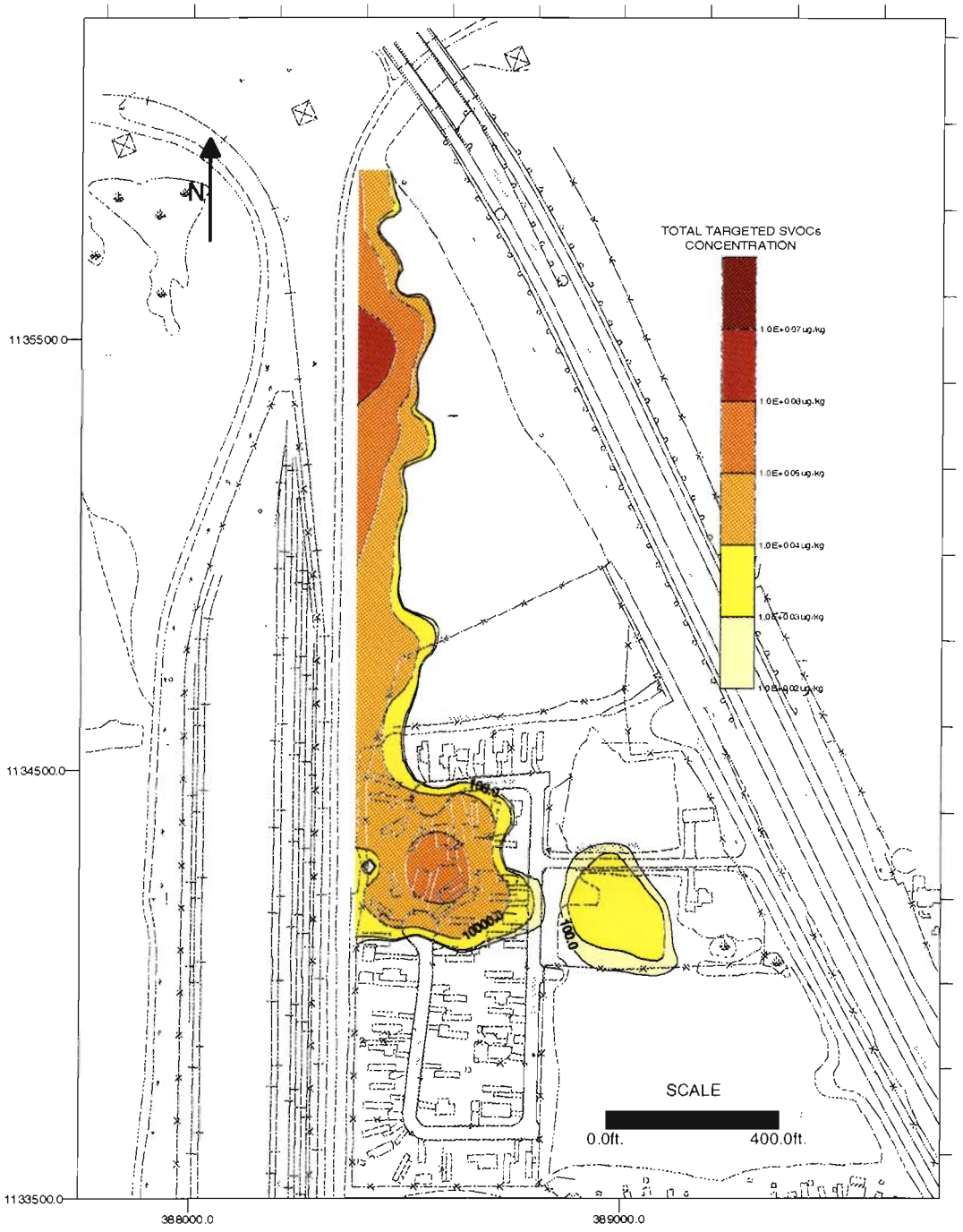


FIGURE 6-7
TOTAL PAHs OF CONCERN - SUBSURFACE SOIL
FOREST GLEN SITE
NIAGARA FALLS, NEW YORK

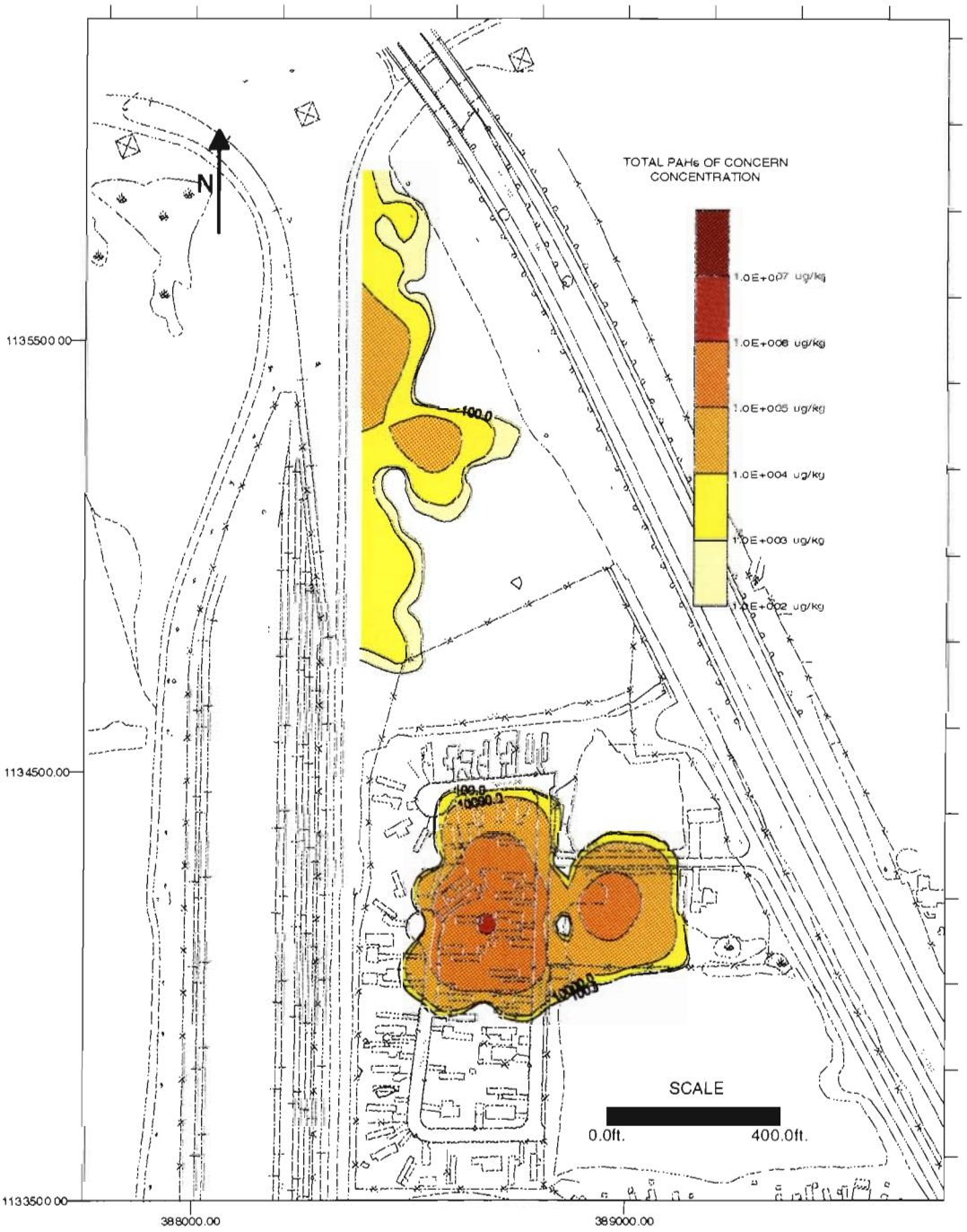


FIGURE 6-8
CHROMIUM CONCENTRATIONS IN EXCEEDANCE OF BACKGROUND SCREENING CRITERIA
SUBSURFACE SOIL
FOREST GLEN SITE - NIAGARA FALLS, NEW YORK

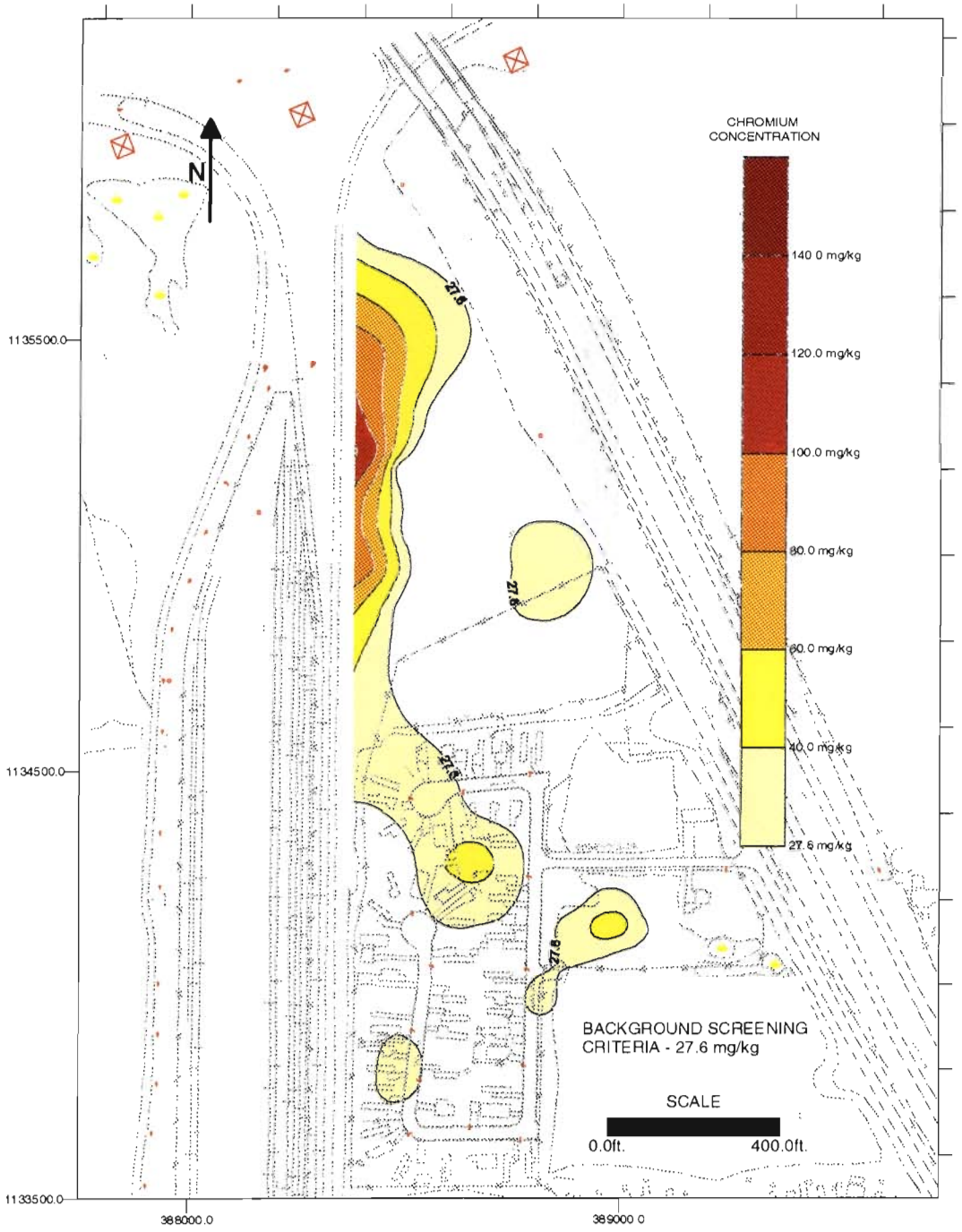


FIGURE 6-9
LEAD CONCENTRATIONS IN EXCEEDANCE OF BACKGROUND SCREENING CRITERIA
SUBSURFACE SOIL
FOREST GLEN SITE - NIAGARA FALLS, NEW YORK

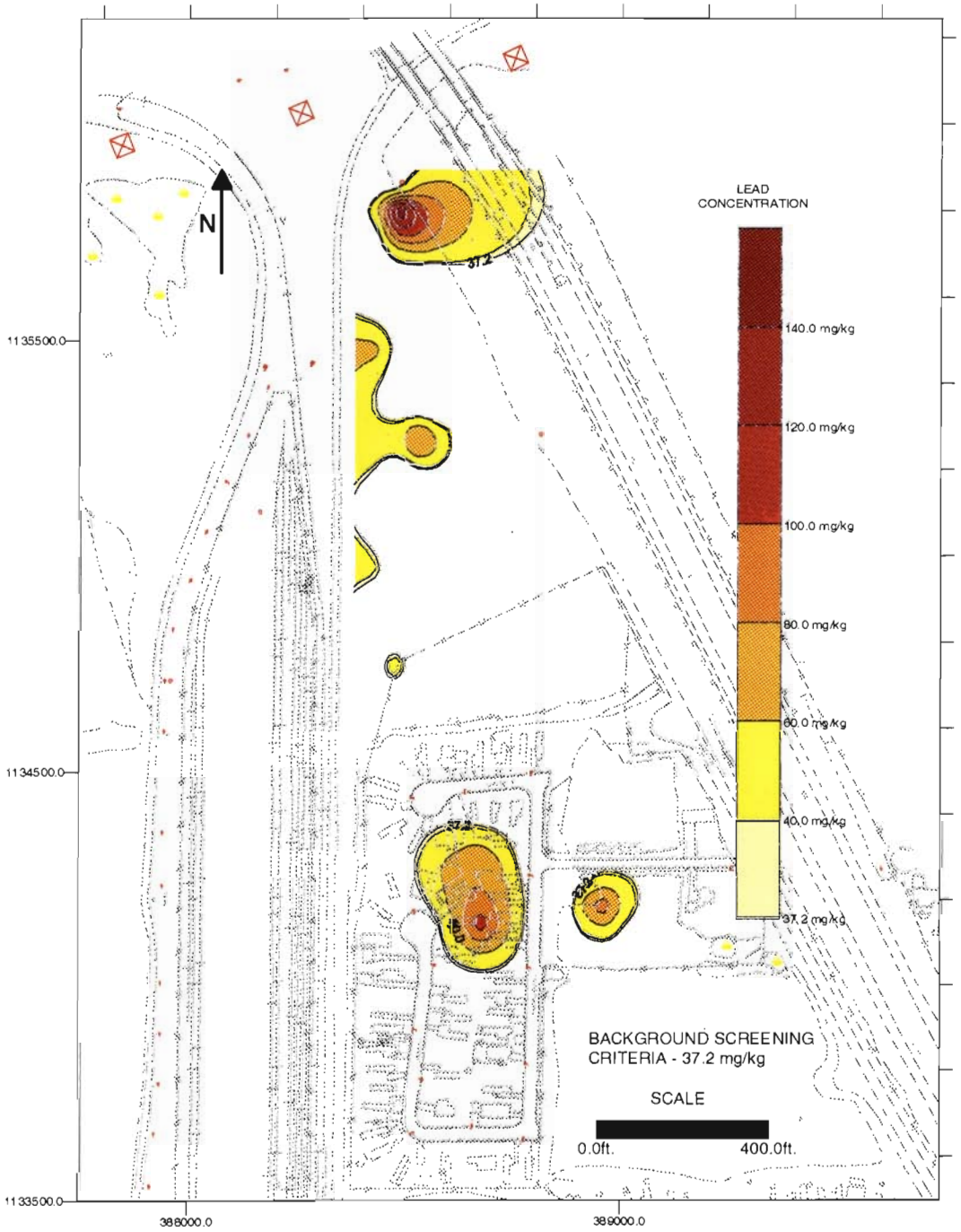
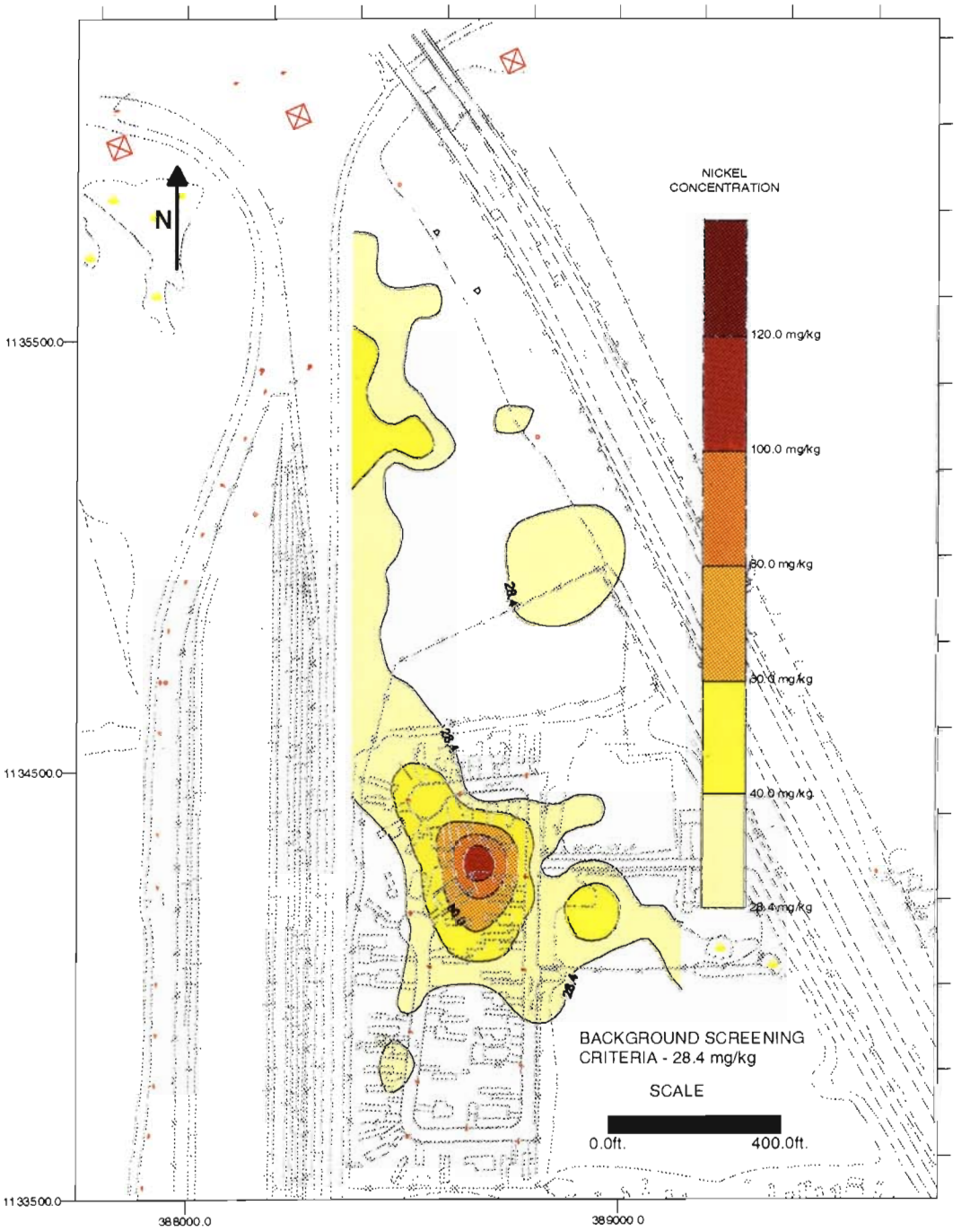


FIGURE 6-10
NICKEL CONCENTRATIONS IN EXCEEDANCE OF BACKGROUND SCREENING CRITERIA
SUBSURFACE SOIL
FOREST GLEN SITE - NIAGARA FALLS, NEW YORK



7.0 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). 1989. Preliminary Health Assessment for Forest Glen Mobile Home Park, Niagara Falls, Niagara County, New York. July 21, 1989.

Air Weather Service (AWS). 1987. Climatic Brief for the Niagara Falls, New York International Airport Station.

AWS Climatic Brief, Niagara Falls, New York, October 1987.

Barcelona, M.J., Gibb, J.P., and Miller, R.A., 1983. A guide to the Selection of Materials for Monitoring Well Construction and Ground-Water Sampling. Illinois State Water Survey Contract Report 327.

Beech, J. 1996. Personal communication. Information received on January 18, 1996 from James Beech, Water Quality Management, New York State Department of Environmental Conservation.

Benson, R.C., R.A. Glaccum, and M.R. Noel, 1982, Geophysical Techniques for Sensing Buried Wastes and Waste Migration, United States Environmental Protection Agency, Contract No. 68-03-3050.

Bouchard, D; Mattice, J.; Lavy, T.L. Koc value for Aniline, Soil Science Journal, 1986, Citation 141:26.

Burt, W.H. and R.P. Grossenheider. 1980. A Field Guide to the Mammals, North America north of Mexico. 3rd Edition. Houghton Mifflin Company, Boston, MA.

Chapman, J.A. and G.A. Feldhamer, editors. 1982. Wild Mammals of North America, Biology, Management, and Economics. The Johns Hopkins University Press, Baltimore, MD.

Dobrin, M.B., and C.H. Savit, 1988. Introduction to Geophysical Prospecting, 4th Ed., New York, McGraw-Hill Book Co.

Federal Interagency Committee for Wetland Delineation. (1989). Federal Manual for Identifying and Delineating Jurisdictional Wetlands. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and USDA Soil Conservation Service. Washington, DC. Cooperative technical publication.

Geonics, 1991. EM34-3 Operating Instructions, Geonics Limited, 1745 Meyerside Dr., Unit 8, Mississauga, Ontario, Canada. L5T 1C6.

Geonics, 1992. EM31 Operating Manual for Models with Two Digital Meters, Geonics Limited, 1745 Meyerside Dr., Unit 8, Mississauga, Ontario, Canada, L5T 1C6.

Geometrics, 1993. StrataView™ Exploration Seismograph Operators Manual, Geometrics, Inc., 395 Java Drive, Sunnyvale, California.

Hazardous Substances Databank (HSDB). 1993. On-line database supported by the National Library of Medicine and the Agency for Toxic Substances and Disease Registry.

Howard, P.H. 1990. Fate and Exposure Data for Organic Chemicals, Lewis Publishers, Chelsea, Michigan.

Johnston, R.H., 1964 "Groundwater in the Niagara Falls near New York with emphasis on the water-bearing characteristics of the bedrock." New York State Conservation Department Bulletin GW-53.

Lewis, R.J. 1992. SAX's Dangerous Properties of Industrial Materials - Eight Edition, Van Nostrand Reinhold, New York, New York.

Lyman, W.J., W.F. Reehl, and D.H. Rosenblatt, Handbook of Chemical Property Estimation Methods: Environmental Behavior of Organic Compounds (New York: McGraw-Hill, Inc., 1982)

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American Wildlife & Plants. Dover Publications, Inc., New York, NY.

Maslia, M.L. and Johnson, R.H. Simulation of groundwater flow in the vicinity of Hyde Park Landfill, Niagara Falls, New York. USGS Open File Report 82-159.

McNeill, J.D., 1980a. Electrical Conductivity of Soils and Rocks, Geonics Limited, Technical Note TN-5.

McNeill, J.D., 1980b. Electrical Terrain Conductivity Measurement of Low Inductionh Numbers, Geonics Limited, Technical Note TN-6.

McNeill, J.D., 1983. EM 34-3 Survey Interpretation Techniques: Geonics Limited, Mississauga, Ontario, Technical Note TN-8.

Merck Index. 1989. An Encyclopedia of Chemicals Drugs, and Biologicals. Eleventh Edition. Es. S. Budavari, Merck and Co., Inc. Rahway, NJ.

Miller, Todd S. And Kappel, William M., 1987, "Effect of Niagara Power Project on Groundwater flow in the Upper Part of the Lockport Dolomite, Niagara Falls Area, New York: U.S. Geological Survey", Water-Resources Investigations Report 86-4130, Ithaca, New York.

Montgomery, John H. and Welkom, Linda M., Groundwater Chemical Desk Reference Lewis Publishers.

Natural Heritage Program (NHP). 1996. Biological and Conservation Data System - Element Occurrence Report 06, February 1996, accompanied by a letter from Nicholas Conrad of the New York State Department of Environmental Conservation Wildlife Resources Center, to Nancy Zygmont, dated February 6, 1994.

National Oceanic and Atmospheric Administration (NOAA). 1992. Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1961-90, New York. NOAA, National Climatic Data Center, Asheville, NC. January 1992.

New York State Department of Environmental Conservation (NYSDEC). 1988. Background Concentrations of 20 Elements in Soils with Special Regard for New York Stat. Prepared by E. Carol McGovern.

NUS Corporation Superfund Division, August 3, 1989, Final Draft Site Inspection Report - Forest Glen Subdivision Niagara Falls, New York.

Polhlmann, K.F. and Hess, J.W., 1988. Generalized Ground-Water Sampling Device Matrix. Water Resources Center, Desert Research Institute, Las Vegas, NV.

Shacklette, H.T., and J.G. Boerngen, 1984. Elemental Concentrations in Soils and Other Surficial Materials of the Conterminous United States. U.S. Geological Survey Professional Paper 1270. Washington, D.C.

Solubility of 2-Mercaptobenzothiazole, PA-560/2-76-006. Washington D.C.: U.S. EPA, PP160, 1976. Investigation of selected potential environmental contaminants: Mercaptonbenzothiazoles. Santodonato, .: Davis, L.N.,:Howard, Ph.H.; Saxena, J.

Tepper, D.H., Goodman, W.M., Gross, M.R., Kappel, W.M. and Yager, R.M., 1990. Stratigraphy, Structural Geology and Hydrogeology of the Lockport Group: Niagara Falls Area, New York, in Lash, G.G., ed., New York State Geological Association 62nd Annual Meeting September 1990 Field Trip Guidebook: Western New York and Ontario: New York, Fredonia State University College, p. Sun. B1-B25.

Tesmer, I.H., 1981. Colossal Cataract - The Geologic History of Niagara Falls. The State University of New York Press, Albany.

United States Department of Agriculture. (1972). Soil Survey of Niagara County, New York. Soil Conservation Service in cooperation with Cornell University Agricultural Experiment Station.

United States Environmental Protection Agency. (1989a). Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. Office of Water. Washington, DC. EPA/440/4-89/001.

United States Environmental Protection Agency. (1990). Biological Criteria, National Program Guidance for Surface Waters, Office of Water Regulations Standards. Washington, DC. EPA/440/5-90/004.

United States Environmental Protection Agency. (1991). RFI/CMS Ecological Assessment Guidance Document. Hazardous Waste Management Division.

U.S. DOA, 1972. Soil Survey of Niagara County, New York. U.S. Government Printing Office, Washington, D.C.

U.S. Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund. Office of Emergency and Remedial Response. EPA/504/1-89/002.

U.S. Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund. Office of Emergency and Remedial Response. EPA/504/1-89/002.

U.S. Environmental Protection Agency (USEPA). 1991. Exposure Point Concentrations in Groundwater. Office of Superfund. Hazardous Waste Management. EPA/504/1-89/002.

U.S. Environmental Protection Agency (USEPA). 1986. Public Health Evaluation Manual, Office of Superfund, OSWE2 Directive 9285.4-1.

U.S. Environmental Protection Agency (USEPA). 1993. Risk-based Concentration Table, First Quarter 1993.

U.S. Environmental Protection Agency (USEPA). 1993. Integrated Risk Information System (IRIS).

U.S. Environmental Protection Agency (USEPA). 1993. Integrated Risk Information System (IRIS).

U.S. Environmental Protection Agency (USEPA). 1995. Information provided on October 31, 1995. U.S. EPA LANDVIEW II. GIS system.

U.S. Fish and Wildlife Service (USFWS). 1996. Letter from Sherry W. Morgan, Field Supervisor, USFWS to Ms. Nancy Zygmont, CDM Federal Programs Corporation, dated February 16, 1996.

Washington State Department of Ecology, 1991. Summary of Criteria and Guidelines for Contaminated Freshwater Sediments. Environmental Investigations and Laboratory Services. Washington State Department of Ecology.

Woodward-Clyde Consultants, 1988. Geologic report, Necco Park, Niagara Falls, New York Technical report prepared on behalf of E.I. DuPont de Nemours and Company, Niagara Falls, New York.

Yager, R.M. and W.K. Kappel, 1987, "Detection of Characterization of Fractures and their Relation to Groundwater Movement in the Lockport Dolomite, Niagara County, New York", U.S. Geological Survey, Water Resources Division.

Zenger, D.H., 1965, "Stratigraphy of the Lockport Formation (Middle Silurian) in New York State", New York State Museum and Science Service - Geological Survey, Bulletin 404.

GLOSSARY OF ABBREVIATIONS

AMSL	Above Mean Sea Level
AOC	Area of Concern
ACOE	Army Corps of Engineers
ARARs	Applicable or Relevant and Appropriate Requirements
ARCS	Alternative Remedial Contracting Strategy
ATSDR	Agency for Toxic Substances and Disease Registry
ASTM	American Standard Testing Methods
BNA	Base-Neutral/Acid Extractables
BOD	Biochemical Oxygen Demand
BGS	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CLP	Contract Laboratory Program
COC	Chain of Custody
COCs	Contaminants of Concern
COD	Chemical Oxygen Demand
CRDL	Contract Required Detection Limit
DQO	Data Quality Objective
1,1-DCA	1,1-Dichloroethane
1,2-DCE	1,2-Dichloroethene (total)
EPA	United States Environmental Protection Agency
Eh	Redox Potential

GLOSSARY OF ABBREVIATIONS (Continued)

ERT	Environmental Response Team
FIT	Field Investigation Team
FEMA	Federal Emergency Management
FFS	Focused Feasibility Study
FS	Feasibility Study
GIS	Geographical Information System
GPS	Global Positioning System
HCL	Hydrochloric Acid
HSP	Health and Safety Plan
HSL	Hazardous Substance List
ID	Inner Diameter
LEL	Lowest Effect Level
MCLs	Maximum Contaminant Levels
MCLGs	Maximum Contaminant Level Goals
MSL	Mean Sea Level
NAAQS	National Ambient Air Quality Standards
NCHD	Niagara County Health Department
NCP	National Contingency Plan
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHP	New York Natural Heritage Program
NPDES	National Pollution Discharge Elimination Systems
NPL	National Priorities List

GLOSSARY OF ABBREVIATIONS (Continued)

NYCRR	New York Code of Rules and Regulations
NUS	NUS Corporation
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OSHA	Occupational Health and Safety Act
OSWER	Office of Solid Waste and Emergency Response
OVA	Organic Vapor Analyzer
PAHs	Polyaromatic hydrocarbons
PASNY	Power Authority for the State of New York
PCBs	Polychlorinated Biphenyls
PID	Photoionizer Detector
POP	Project Operations Plan
PPB	Parts Per Billion
PRAP	Proposed Remedial Action Plan
PRP	Potentially Responsible Party
PSI	Pounds Per Square Inch
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
RA	Risk Assessment
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation

GLOSSARY OF ABBREVIATIONS (Continued)

RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RQAC	Regional Quality Assurance Coordinator
SAP	Field Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SAS	Special Analytical Services
SDG	Sample Delivery Group
SDWA	Safe Drinking Water Act
SEL	Severe Effect Level
SJB	SJB Services, Inc.
SMO	Site Management Office
SOP	Standard Operating Procedures
SOW	Statement of Work
SVOC	Semivolatile Organic Compounds
TAGM	Technical Administrative Guidance Memorandum
TAL	Target Analyte List
TAT	Technical Assistance Team
1,1,1-TCA	1,1,1-Trichloroethane
TCE	Tetrachloroethene
TBC	"To Be Considered" Guidance Values
TCL	Target Compound List
TDS	Total Dissolved Solids

GLOSSARY OF ABBREVIATIONS (Continued)

TICs	Tentatively Identified Compounds
TKN	Total Kjelhald Nitrogen
TOC	Total Organic Carbon
TOG	Technical Operating Guidance
TVGA	TVGA Engineering Services
TSCA	Toxic Substance Control Act
UNFN	United States Fish and Wildlife Service
USC	United State Code
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WACR	Work Assignment Close-Out Report
WAM	Work Assignment Manager