Tuxedo Waste Disposal Site

Also Known As

Sacco/Barone Dump
I.D. Number 336035

Record of Decision

February 1992

PREPARED BY:

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF HAZARDOUS WASTE REMEDIATION

RECORD OF DECISION

TUXEDO WASTE DISPOSAL SITE

ORANGE COUNTY, NEW YORK

ID NO. 336035

PREPARED BY

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

FEBRUARY 1992

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Tuxedo Waste Disposal Site
Tuxedo Park
Orange County, New York
Site Code: 336035
Funding Source: 1986 Environmental Quality Bond Act

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Tuxedo Waste Disposal Site in Orange County, New York. The selection was made in accordance with the New York State Environmental Conservation Law (ECL), and is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Oil and Hazardous Substances Pollution Contingency Plan ("NCP"). This decision document summarizes the factual and legal basis for selecting the remedy for this site.

Exhibit A identifies the documents that comprise the Administrative Record for the site. The documents in the Administrative Record are the basis for the proposed remedial action.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision ("ROD") may present an imminent and substantial threat to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The major elements of the selected remedy include:

- excavation of refuse (approximately 14,600 cubic yards) from the southeast corner of the site with consolidation into the main area and reclamation of the southeast corner;

- design and installation of an engineered final cover in accordance with applicable regulations and guidance including a gas collection layer (a pilot program will be carried out to aid in the design of the gas collection and treatment system);

- installation and operation of a passive gas collection and treatment system using activated carbon to remove hydrogen sulfide and volatile organic compounds;

- design and construction of a surface water diversion system to reduce surface run-on, infiltration, and the subsequent generation of leachate;

- site use restrictions to prevent any activities that could damage or compromise the integrity of the remedy; and

- environmental monitoring of groundwater, surface water, surface water sediments, and air emission sources to determine the effectiveness of the remedial program.

DECLARATION

The selected remedy is protective of human health and the environment, complies with State and Federal requirements that are legally applicable or relevant and appropriate to the remedial action to the extent practicable, and is cost effective. Waivers are justified for applicable or relevant and appropriate requirements that will not be met. This remedy utilizes permanent solutions and alternative treatment or resource recovery technologies, to the maximum extent practicable. However, because treatment of the principal threats of the site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element.

Because this remedy will not allow for unlimited use and unrestricted exposure within five years after commencement of remedial action, a five year policy review will be conducted. This evaluation will be conducted within five years after the commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

2/21/92
Date

Edward O. Sullivan
Deputy Commissioner
Office of Environmental Remediation
New York State Department of Environmental Conservation

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RECORD OF DECISION
TUXEDO WASTE DISPOSAL SITE (#336035)

I. SITE LOCATION AND DESCRIPTION

The Tuxedo Waste Disposal Site is located (latitude 41° 12' 36" N, longitude 74° 11' 02" W) in the Town of Tuxedo, Orange County, New York (see Figure 1). The site is approximately one mile north of Tuxedo Park, New York and lies between the east side of State Route 17 and an active passenger and freight rail line owned by Conrail. The Ramapo River lies immediately to the east of the rail line and the New York State Thruway lies another 500 feet to the east. The orientation of these major features, and the site itself, is predominantly north/south.

This 13 acre site contains approximately 500,000 cubic yards of wastes including construction and demolition (C&D) and non-C&D debris such as tires, railroad ties, auto parts, white goods, and building demolition debris. The "site" consists of wastes improperly deposited on portions of two privately owned parcels. The main parcel (12.2 acres owned jointly by R. Barone and S. Khourouzian; referred to below as the B/K parcel) is almost entirely covered with wastes and was formerly a sand and gravel mine. The approximate depth of the waste varies from three to perhaps seventy feet. The smaller parcel (7.9 acres owned by the Georgia Tech Foundation; see Figure 2) contains wastes in two locations. In the northwest corner of the Georgia Tech parcel is one-quarter acre of wastes that are connected with the main mass on the B/K parcel. In the northeast corner of the Georgia Tech parcel is one-half acre of wastes that are separate from the main mass and were placed in the final days of the disposal operation. This half-acre portion is uncovered whereas an interim cover exists over the wastes on the B/K parcel.

The topography of the site is characterized by three flat tiers of roughly equal area that drop off steeply along the eastern boundary of the site towards the rail line and the river (see Figure 3). The surface of the site is mostly open field covered with tall grasses along with some wooded areas along the eastern and western borders.

The nearest residences are approximately one-quarter mile south and southwest of the site. To the west, land rises approximately 300 feet along the Ramapo River valley wall. Buildings and residences comprising the Village of Tuxedo Park are approximately one-half mile west of the site.

Groundwater in the vicinity of the site travels from west to east and discharges into the Ramapo River. The nearest water supply well is associated with the antique shops directly to the north (sidegradient) but is not currently used as a source of drinking water. Drinking water for nearby residences comes from the local public water supply.

II. SITE HISTORY AND ENFORCEMENT STATUS

As described above, the "site" consists of two parcels. To avoid confusion, the discussion below generally addresses the site as a single unit even though some of the enforcement activities may technically apply to one or the other parcels due to the different owners involved.

Prior to being used for the improper disposal of solid and hazardous wastes, the site was a sand and gravel mine and included a bituminous concrete plant. In 1961, the Thruway Asphalt Company purchased what is now the B/K parcel and operated the asphalt plant in the southern end of the property. Aerial photographs of the region taken in 1948, 1968, and 1980 show the progression of activities at the site and document the removal of large amounts of overburden. The southern parcel, currently owned by the Georgia Tech Foundation, was deeded to the Foundation as a gift on December 12, 1977. The Foundation played no role in the disposal of hazardous waste at the site and is a "responsible party" solely by reason of its becoming an owner through a gift of land.

In 1985, the parcel was purchased by Messrs. Renard Barone and Sarkis Khourouzian who allowed a third party, Mr. Frank Sacco, to use the site purportedly as a construction and demolition debris landfill beginning in February 1987. Solid waste regulations in effect at that time allowed the disposal of inert, non-hazardous, nonputrescible construction and demolition debris at unpermitted sites for up to one year provided that certain conditions were met. Inspections beginning in March 1987 revealed that nonexempt wastes were being deposited at the site in violation of solid waste regulations. These wastes included auto parts, tires, plastics, paper, household garbage, railroad ties, hospital refuse, white goods, and other materials. Despite the issuance of multiple summonses, dumping continued leading the Department to refer the matter to the New York State Department of Law (NYSDOL) in the early fall of 1987. The Attorney General commenced a lawsuit against the owners and operators of the site in Orange County Supreme Court and obtained a temporary restraining order from the court on October 5, 1987. On October 7, 1987, Department law enforcement personnel arrested the site operator and halted activities. By that time, approximately 500,000 cubic yards of wastes were dumped at the site. Pursuant to the restraining order, cover material was placed on the site in an effort to control objectionable odors emanating from the site. Complaints of strong odors from local residents and travelers along Route 17 and the New York State Thruway began as early as April 1987. Subsequent analyses showed the the cover material, taken from an industrial site in Mahwah, New Jersey, was contaminated by low levels of polychlorinated biphenyls (PCBs).

Odors from the site are thought to result primarily from the decomposition of crushed wallboard (gypsum) resulting in the production of hydrogen sulfide with its characteristic "rotten eggs" odor.

In December 1987, the Department listed the site in the New York State Registry of Inactive Hazardous Waste Disposal Sites with a classification of "2a", indicating that the site was suspected of containing hazardous wastes and that further investigations were needed. The site owners were notified of this listing in January 1988. Between December 1987 and March 1988, various legal proceedings took place. The State Attorney General's Office pursued a preliminary and permanent injunction to continue the ban on further dumping, sought the assessment of civil penalties, and sought an order requiring the responsible parties to undertake investigations at the site and formulate a plan for remediation and closure of the site. A two-week hearing on these matters was conducted in late January and early February in the Orange County Supreme Court. In February 1988, the Attorney General's office commenced a lawsuit against the owners and operators of the illegal landfill operated on the Georgia Tech parcel.

In March 1988, the court maintained the prohibition on further dumping and ordered the placement of additional cover (clean) material. The court also found that a public nuisance existed at the site. In addition, the court directed that the Department commence additional investigations at the site. In April, the Department notified site owners that a state funded Phase II investigation of the site would be carried out. Although the Georgia Tech Foundation agreed to fund the investigation of its parcel, owners of the B/K parcel did not. Therefore, in May 1988, the Department contracted with Lawler, Matusky, and Skelly Engineers to plan and carry out the investigation of the B/K parcel. This Phase II Investigation began in June 1988 and the final report was submitted in March 1989.

In July 1988, the Orange County Supreme court issued a permanent injunction barring operation of the B/K landfill and requiring the posting of a $4.5 million dollar bond to cover closure costs. The decision was upheld on appeal. To date, the bond has not been posted. However, Barone and Khourouzian have agreed to a State lien on their assets pending the outcome of the RI/FS. In November 1988, the Supreme Court found the operators of the site in contempt for failure to post the bond and penalties of $1,000 per day continue to accumulate. The Attorney General's office has docketed judgments based upon these penalties and has retained New Jersey counsel to pursue execution of these judgments in that State. In December 1991, the Supreme court granted summary judgment to the State against Eli Neuhauser, an operator of the Georgia Tech site.

The investigation included geophysical and soil gas surveys, excavation and sampling of test pits and trenches, installation and sampling of groundwater monitoring wells, permeability studies, surface water and sediment analyses (from the Ramapo River), and ambient air surveys. A number of conclusions resulted from the investigation. Groundwater beneath the site was found to be contaminated above standards with arsenic, iron, manganese, and selenium. A sample of fill material was found to be a characteristic hazardous waste by virtue of its possessing concentrations of leachable lead to levels in excess of the applicable limit. Soil gas data indicated the presence of petroleum-related constituents in the fill throughout the site with highest levels found in the central and south-central portion of the site. The presence of solvent wastes (e.g., trichloroethene, tetrachloroethene, dichloroethene) was also indicated. Additionally, the existence of a hydraulic connection between the site and the Ramapo River results in the discharge of groundwater contaminated with heavy metals to the river. Examining the results of the analyses of river water and sediment samples indicated that the impacts upon the river were marginal but noticeable, especially for aluminum and iron. Notable by their absence were volatile and semi-volatile organic compounds in the groundwater and surface water.

Based upon the results of the Phase II investigation, the site was reclassified to a Class "2" site indicating that the presence of hazardous waste had been confirmed and that action was required to mitigate threats to human health and the environment. Site owners and other potentially responsible parties were notified of the change in classification and were given the opportunity to fund or participate in the funding of a remedial investigation and feasibility study (RI/FS) to further define the nature and extent of contamination at the site and identify the most feasible remedial alternative.

Other than the Georgia Tech Foundation, none of the potentially responsible parties consented to participating in the investigation or remediation of the site. In November of 1990, the Georgia Tech Foundation entered into a negotiated order on consent with the Department to satisfy its liability under the Environmental Conservation Law for contamination at the site. This included a nominal payment to help defray costs incurred by the Department in carrying out the investigations. Now that a remedy has been selected for the site, the potentially responsible parties will again be asked to participate in the process.

By August 1989, it was clear that the remaining responsible parties were unwilling or unable to participate in the RI/FS. Therefore, in November 1989, the Department tasked a standby consultant (Metcalf & Eddy of New York, Inc.) to plan and carry out the RI/FS. Scoping, work plan preparation, and contracting continued through the first half of 1990 and field work began in June of that year. The final RI/FS Report was completed in December 1991. The major elements of the RI/FS were as follows:

- installation of five additional groundwater monitoring wells to better define the horizontal and vertical distribution of contaminants;
- bedrock coring at seven locations along the eastern site perimeter to determine overburden and bedrock characteristics downgradient of the site;
- sampling and analysis of groundwater, river water, and river sediments;
- soil gas and ambient air sampling and analysis coupled with computer aided dispersion modelling to predict off-site concentrations of air contaminants released from the site;
- baseline risk assessment to identify the risks presented to human health by the site;
- identification and assessment of environmental habitat conditions in the vicinity of the site;
- performance of a number of interim remedial measures to improve site drainage and security; and
- performance of a feasibility study to develop a range of possible remedial alternatives for the site and identify the best option.

The results and conclusions of the RI/FS are summarized in the remainder of this decision document.

III. <u>HIGHLIGHTS OF COMMUNITY PARTICIPATION</u>

Throughout the course of the investigations, there has been a high degree of community involvement in the project. There have been a series of public meetings and additional meetings with officials of the Town of Tuxedo. The Town's Engineering Advisory Committee (EAC) has participated in the development of the various work plans and the review of the resultant reports. The following chronology summarizes these meetings:

April 28, 1988	Public meeting held to address concerns regarding health effects and describe the upcoming Phase II Investigation.
July 27, 1988	Meeting with Town EAC to discuss the status of the Phase II Investigation.
December 14, 1988	Meeting with Town Board to discuss project progress.
April 25, 1989	Public meeting to describe the results of the Phase II Investigation, the site reclassification, and the next steps in the program.
May 2, 1989	Meeting with Town EAC to discuss specifics of the Phase II Investigation results.
October 24, 1989	Meeting with Town EAC to discuss upcoming RI/FS.
January 30, 1989	Meeting with Town EAC to discuss scope of RI/FS.
February 9, 1990	Meeting with Town EAC to discuss RI/FS program.
March 21, 1990	Meeting with Town EAC to discuss RI/FS work plan.
May 10, 1990	Public meeting to describe RI/FS content and schedule.
August 6, 1991	Meeting with Town EAC to discuss results of RI and Phase I RI/FS Report.
August 8, 1991	Public meeting to present the results of the RI and the list of preliminary remedial alternatives under consideration.
November 6, 1991	Meeting with Town EAC to present conclusions of RI/FS.
January 21, 1992	Formal public meeting to present and receive comments on the Proposed Remedial Action Plan.

A Citizen Participation (CP) Plan was developed and implemented to provide concerned citizens and organizations with many opportunities to learn about and comment upon the investigations and studies. All major reports were placed in document repositories in the vicinity of the site and made available for public review. A public contact list was developed and used to distribute fact sheets and meeting announcements. Prior to each of the public meetings regarding the RI/FS program, a news release, legal notice, and fact sheets were issued to announce the meeting and its subject.

Additionally, mass mailings to approximately 1500 residences were sent out inviting all persons in the surrounding communities to the meetings.

Draft versions of the reports were provided to Town Officials who commented upon the documents. Several other meetings were held with representatives from over a dozen different local, county, state, and federal agencies during the development of a fire contingency plan. This plan is to be implemented if a fire were to occur at the site that was beyond the response capabilities of local agencies.

Inquiries and comments (written and verbal) were received and responded to throughout the course of the project from citizens, federal, state, county, and local officials, and special interest groups. Comments received regarding the Proposed Remedial Action Plan have been addressed and are documented in the Responsiveness Summary (Exhibit C).

IV. SCOPE AND ROLE OF RESPONSE ACTION

The remedial action selected in this decision document addresses the entire site and areas immediately surrounding the site. As discussed in more detail in Section V below, the media contaminated at the site include the disposed wastes and debris, soils, groundwater, surface water, sediments, and ambient air. Contaminants in the wastes leach into site soils and groundwater and volatilize into the air through the existing interim cover. Contaminated groundwater discharges into the adjacent Ramapo River where contaminants, primarily metals, are dispersed into the river water and sediments. The principal threat at the site is the contaminated debris which releases contaminants to the other media. Regarding threats to human health and the environment, volatilization of contaminants into the air and discharge of contaminated groundwater to the Ramapo River are the pathways of greatest concern.

Although it is not feasible to directly address the principal threat at the site, the remedy does address the pathways of greatest concern thereby mitigating the impacts of the principal threat. The installation of an engineered final cover system along with surface drainage improvements will significantly reduce the amount of water that infiltrates into the waste mass and eventually produces contaminated leachate. This should lessen the quantity of contaminated groundwater released which will then lessen the loadings to the Ramapo River. The inclusion of a landfill gas collection and treatment system will greatly reduce or eliminate the nuisance odor problem and will further reduce the emissions of volatile organic compounds.

V. SUMMARY OF SITE CHARACTERISTICS

The two main sources of descriptive information for the site are the Phase II Investigation Report and the RI/FS Report (see the Administrative Record, Exhibit A). A complete description of the site can be found in those documents.

As discussed above, the site has a footprint of 13 acres and contains approximately 500,000 cubic yards of mixed construction and demolition debris, municipal waste, and hazardous waste. The depth of the waste varies between three and 70 feet following the contours of the former gravel mine.

The following discussion addresses the characteristics of the site in terms of the major media of debris/soil, air/soil gas, groundwater, and surface water/sediments. Table 1 summarizes the contaminants of concern by media.

Debris/Soil

During the Phase II Investigation, five test pits and three test trenches were excavated to obtain information regarding the disposed wastes. The locations of the pits and trenches (see Figure 4) were selected to coincide with high concentrations of volatile organic compounds found during the soil gas survey (see Figure 5). Various wastes were observed during the excavations such as concrete, scrap metal, logs, auto parts, railroad ties, roofing, garbage, plastics, and white goods. Analyses of samples of the fill indicated the presence of elevated concentrations of semivolatile organic compounds and metals. Polycyclic aromatic hydrocarbons (PAHs) such as pyrene, fluorene, anthracene, benzo(a)pyrene, and chrysene were the most commonly encountered constituents. Total PAH concentrations ranged from 177,300 parts per billion (ppb) to 382,400 ppb. Examples of materials that contain PAHs are coal tars used to preserve railroad ties, roofing materials, and asphaltic wastes. Phthalate acid esters such as di-n-butylphthalate that are associated with plastic wastes were also found in relatively high concentrations (15,200 to 44,100 ppb). Total concentrations of semivolatile organic compounds were as high as 2,853,200 ppb.

In addition to searching for compounds on the so-called target compound list (TCL), attempts were made to identify the presence of other contaminants that could indicate the nature of the wastes. These tentatively identified compounds (TICs) ranged in concentration from 55,000 to 800,000 ppb and were present over large areas of the fill. A likely explanation for their presence is that these are petroleum related hydrocarbons associated with soils contaminated with fuel spills. Noting the presence of aromatic compounds (e.g., benzene, toluene, xylene) associated with gasoline that were found during soil gas surveys corroborates this hypothesis.

Tests to determine the presence of leachable metals in the wastes indicated the presence of arsenic, barium, chromium, and lead in most of the samples. One sample contained leachable lead at 8130 ppb which exceeds the limit of 5000 ppb used to classify a waste as a hazardous waste. The presence of lead may also be the result of the disposal of soil contaminated with leaded gasoline.

Volatile organic compounds (VOCs) were found in lower concentrations in the debris. The principal VOCs found were ketones (acetone, 2-butanone, and 4-methyl-2-pentanone), aromatics (benzene, toluene, ethylbenzene, and xylenes), and chlorinated ethenes (dichloroethene, trichloroethene, and tetrachloroethene). The total TCL VOC concentrations ranged from 588 to 2065 ppb with acetone found in the highest concentrations (up to 1700 ppb). A summary of the test pit analytical results is given in Table 2.

Polychlorinated biphenyls (PCBs) were found in low concentrations (670 to 1200 ppb) in the test pits. The pesticide dieldrin was found at very low concentrations (20-33 ppb). Tests for the family of compounds commonly referred to as dioxins showed insignificant levels of these contaminants.

The total concentration, expressed in terms of what is considered the most toxic congener (i.e., 2,3,7,8-tetrachlorodibenzo-para-dioxin), was 0.03 ppb.

Soil samples were taken during the Remedial Investigation (RI) along the eastern (downgradient) border of the site in conjunction with the bedrock boring program. Organic compounds were found at low levels. Total VOC concentrations were very low and ranged from 1.6 to 16.7 ppb. Total semi-volatile organic compound (SVOC) concentrations were low and ranged from 63 to 5412 ppb. These results reflect the low concentrations of VOCs in the debris and the lower mobility of the SVOCs. Except for one sample that contained a slightly elevated concentration of cadmium (5800 ppb at RIB-1), the concentrations of metals did not appear to be significantly higher than background. This reflects the low degree to which metals partition from groundwater onto soils where the soils have not been directly contaminated.

In summary, essentially all of the 500,000 cubic yards of disposed debris are considered to be contaminated with moderate to high levels of SVOCs, low levels of VOCs, and moderate levels of metals.

Air/Soil Gas

Air and soil gas are addressed as one media since soil gas is the source of the contaminants found in the ambient air. Chemicals present in the debris volatilize into the voids in the fill, are carried to the surface by diffusion and convection, and are released to the atmosphere. A variety of techniques have been used to characterize the identity and concentrations of contaminants.

Ambient air samples have been obtained and analyzed on at least five separate occasions. These episodes have focused on VOCs and/or hydrogen sulfide (H_2S). Typically, VOCs attributable to the site were found at very low levels or were not detected downwind of the site. H_2S was generally not detected off-site. When detected, the concentrations ranged from 1.91 to 2.88 $\mu g/m^3$ compared with the NYS standard of 13.9 $\mu g/m^3$. These values are not directly comparable since the samples were collected over eight hours in accordance with an ASTM sampling method and the standard is for one-hour periods.

Samples have also been taken at openings in the fill. These include cracks and fissures in the interim cover and at the ends of a drainage culvert that travels under the base of the site. A variety of VOCs (e.g., benzene, toluene, ethylbenzene, tetrachloroethene, trichloroethene, etc.) were found along with H_2S at these locations. Toluene was found in the highest concentrations (up to 16,000 $\mu g/m^3$). H_2S was found in concentrations up to approximately 300 parts per million (ppm) (equivalent to 416,000 $\mu g/m^3$). These results indicate that although there are some high strength sources, they are small enough that dilution results in very low or nondetectable concentrations off-site.

Soil gas sampling and analyses were performed to help characterize the nature of the debris and to provide data needed to estimate emission rates of volatile compounds into the atmosphere. Soil gas samples taken during the Phase II Investigation were taken below the interim cover and indicate the presence of petroleum-related VOCs throughout the fill with high levels present in the central and south-central portion of the site. Ethene derivatives were found at relatively high levels in the south-central portion of the site (see Figure 5). H_2S was found throughout the site and in very high levels (>2000 ppm) in the south-central portion.

Soil gas surveys taken during the RI were designed to determine the effectiveness of the interim cover in inhibiting the release of these contaminants to the air. Therefore, samples were taken in the upper few feet of the cover and on the surface. Three techniques were used including extractive, sweep, and flux surveys. These techniques are described in the RI Report and were selected to provide different methods for obtaining estimates of the rate at which contaminants leave the surface (i.e., flux) and mix with the atmosphere.

Since soil gas is the source of contaminants released to the air, and soil gas concentrations are much more consistent than ambient air samples which are subject to a variety of meteorological conditions, soil gas data was used as the basis for estimating emission rates. Computerized dispersion models were then used to estimate off-site ambient concentrations. Conservative assumptions were made regarding the rate of gas generation in the fill and emission rates were calculated using the data sets showing the highest soil gas concentrations. The Industrial Source Complex (ISC) dispersion model was used to calculate the locations of the maximum and average off-site contaminant concentrations resulting from site emissions.

Results show that the only compound predicted to exceed an existing or proposed ambient air standard or guideline is hydrogen sulfide (H_2S). The maximum and average predicted off-site concentrations of H_2S were estimated to be 29.1 and 7.8 $\mu g/m^3$ respectively. The maximum value exceeds the one hour standard of 13.9 $\mu g/m^3$. The odor threshold for H_2S is reported to be approximately 7 $\mu g/m^3$. The three VOCs with the highest predicted ambient concentrations were toluene, xylenes, and 1,2-dichloroethene with maximum concentrations of 0.62, 0.56, and 1.5 $\mu g/m^3$ respectively. Since the contaminants are emitted at ground level, the highest ambient concentrations are found at the border of the site and decrease with distance from the site. The areal distribution of the air contaminants can be inferred from Figure 6.

Results also indicate that the predicted emission rates used in the dispersion modelling are very conservative. This can be seen by comparing the estimated rates with the actual surface flux emission rates found during the RI. This may not be true for hydrogen sulfide since the levels found in the fill exceeded the limits of the measuring techniques. There have been reports of H_2S odors in the community that indicate that the actual concentrations may be at or above those predicted by the model.

Groundwater

Twelve groundwater monitoring wells have been installed around the perimeter of the site. Six wells are screened in overburden, two at the overburden/bedrock interface, and four are screened in competent bedrock. Contaminated groundwater results when leachable contaminants in the debris come in contact with water, transfer into the water creating leachate, and the leachate percolates into groundwater. Water infiltrates into the site by three mechanisms: precipitation entering through the cover; surface run-on that seeps through the cover and sides of the fill; and groundwater recharge.

The mining of sand and gravel and the deposition of waste materials has significantly altered the natural hydrogeology of the site. Natural overburden material is characterized as glacial till predominated by sand and gravel. The average hydraulic conductivity was estimated from slug test data to be 3.7×10^{-2} cm/sec. Overburden overlies fractured and competent bedrock consisting of various forms of granitic gneiss. Figure 7 shows a geologic cross section along the eastern border of the site. Observations that combine this cross section, aerial photographs, topographic maps constructed before and after the emplacement of wastes, and other site records indicate the existence of a pronounced hydraulic connection between the base of the site and the Ramapo River in the vicinity of MW-6/RI-2. Groundwater elevation data indicates that all groundwater eventually discharges to the river but the pre-fill base of the site was essentially part of the river flood plain. As the river level fluctuates, water flows between the river and the base of the fill in that area. This hydraulic connection is the most likely reason why MW-6 shows the highest concentration of contaminants.

Over the course of the investigations, the predominant groundwater contaminants have been metals (see Figure 8). The concentrations and particular metals involved varies with time with no particular trends noted. Metals that consistently appear over State standards or guidelines are iron, sodium, manganese, magnesium, and lead. Others found above standards or background include aluminum, arsenic, barium, cadmium, calcium, chromium, copper, mercury, nickel, potassium, and zinc. Iron, lead, and mercury have been found in upgradient wells above standards on at least one occasion.

Low levels of VOCs and SVOCs were detected in 1990 and 1991 (see Figure 9). Compounds detected above standards or guidance levels include benzene, chloroform, phenol, naphthalene, acenapthene, and chrysene. Benzene was detected twice in MW-5 at a maximum concentration of 1.0 ppb. The SVOC present at the highest concentration was acenapthene at 28 ppb (this was detected in the second round only). The reported concentrations of some of these contaminants (e.g. chloroform) include the influence of common laboratory contaminants and are not clearly site related.

Data taken between 1988 and 1991 do not indicate any significant trends. The results of the RI and Phase II Investigation indicate that most of the wastes lie above the permanent water table. This indicates the need to minimize the amount of water infiltrating the site to help reduce leachate production and subsequent groundwater contamination. Elevated groundwater temperatures in downgradient monitoring wells indicate ongoing biological activity (waste decomposition) in the waste mass.

Given the illegal nature of the filling operations, there is the possibility that the site contains drum nests or other concentrations of hazardous wastes. There is evidence of waste pits installed at the base of the fill in the south end of the site and allegations of drum burials. Although excavations to 20 feet and geophysical prospecting did not reveal these wastes, this type of site always presents the possibility of future releases of unexpected contaminants or changes in contaminant concentrations.

Surface Water/Sediments

As discussed above, site contaminants that enter groundwater are eventually released to the Ramapo River. Although organic contaminants have not been detected in the water column, the metals aluminum, calcium, iron, lead, magnesium, and sodium were detected in marginally greater concentrations in samples alongside and downstream of the site. Although current discharges do not result in the exceedance of surface water standards or guidance values, the site is a source of metals to the river.

In the river sediments, 21 semi-volatile organic compounds were detected in concentrations that ranged from undetected to 6600 ppb (phenanthrene, found upstream). Most of the compounds are polycyclic aromatic hydrocarbons (PAHs). Four of these PAHs were present in sediments at levels above sediment guidelines but these occurred in samples taken upstream of the site. This may indicate contributions from runoff from the railroad and the highways. Based upon samples taken near where site groundwater is known to discharge to the river, there is evidence of PAH loadings to the river.

Five volatile organic compounds (VOCs: methylene chloride, acetone, 2-butanone, toluene, benzene) were detected in sediments but the concentrations found were influenced by common laboratory contaminants found in blank samples. Given the concentrations of VOCs found in groundwater, the impacts of VOCs from the site on the river appear insignificant.

VI. SUMMARY OF SITE RISKS

In accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR Part 300), a baseline risk assessment has been completed as one component of characterizing the site. The results of the baseline risk assessment are used to help identify potential remedial alternatives and select a remedy. The components of the baseline risk assessment for this site are as follows:

- a review of the site environmental setting;
- identification of site-related chemicals and media of concern;
- an evaluation of the toxicity of the contaminants of concern;
- identification of the possible exposure routes and pathways;
- incremental cancer risks and hazard indices for noncarcinogens; and
- an evaluation of the impacts of the site upon the environment.

Exposure routes are the mechanisms by which contaminants enter the body (e.g., inhalation, ingestion, absorption). Exposure pathways are the environmental media (e.g., soil, groundwater, air, etc.) through which contaminants are carried.

The risk assessment for this site (Chapter 7 of the Remedial Investigation Report) indicates that the most significant exposure mechanism is the inhalation of air containing contaminants that have volatilized from site wastes. To estimate emission rates, it was assumed that carbon dioxide and methane are generated in the fill at rates similar to those found in municipal landfills and that these gases carry site contaminants out of the fill into the air. Since the site consists predominantly of nondegradable C&D debris, this is a conservative assumption.

The site was divided into 10 sections and emission rates were estimated using data from field measurements that showed the highest concentration of contaminants for that subsection. The gaussian dispersion computer model called "Industrial Source Complex (ISC)" was used to calculate the dispersion coefficients and estimate contaminant concentrations at varying distances around the site. Contaminants were divided into the two categories of possible/probable carcinogens and those that may cause noncancer health effects (noncarcinogens or systemic toxicants). Toxicity data was obtained from the Integrated Risk Information (IRIS), Health Effects Assessment Summary Table (HEAST), and Risk Assessment Guidance for Superfund (RAGS).

The results of the assessment indicate that left unremediated, the maximum and average incremental risk of developing cancer as a result of exposure to site contaminants would be 3.0 and 2.4 per million respectively of exposed population. That is, if one million persons occupied the off-site locations that present the highest concentration of carcinogens for 24 hours/day over 70 years, a maximum of three of those persons would be predicted to develop some form of cancer (see Figure 6). The contaminants contributing the most to this risk are benzene and trichloroethene. Since contaminants are emitted at ground level, concentrations and risks are predicted to be greatest at the site borders and decrease with distance from the site.

The risks associated with exposure to noncarcinogenic contaminants are determined using the "Hazard Index" approach. A Hazard Index is the ratio of predicted exposure levels to acceptable exposure levels. A Hazard Index greater than one indicates that adverse noncarcinogenic effects may occur, while a value below one indicates that such effects are unlikely to occur. At this site, the total Hazard Index for exposure to noncarcinogenic related contaminants is much less than one, suggesting that adverse noncarcinogenic effects are not likely to occur.

There are a number of assumptions, uncertainties, and limitations associated with these estimates that are addressed in the Feasibility Study. In general, the main sources of uncertainty include:

- actual location and density of receptor population over time;
- VOC emission rates;
- modelling of exposure levels;
- accuracy of toxicological data; and
- the complex interaction of the uncertainty elements.

The mathematical models used to estimate the concentrations of contaminants at receptors contain many assumptions that can affect results. The measured data entered into the models (e.g. meteorological data) also have uncertainties that influence the final results. Much of the toxicological data used to estimate human impacts is extrapolated from animal studies. Often these studies are performed at high concentrations and produce results that may not occur at lower levels. Additionally, these and other uncertainty factors combine in ways that can increase the overall uncertainty of the results. These uncertainties are addressed by making conservative assumptions concerning risk and exposure parameters and emission rates throughout the assessment. As a result, the risk assessment provides upper bound estimates of the risks to populations around the Site, and is unlikely to underestimate actual risks related to the Site.

The results of the baseline risk assessment indicate a small increased risk of cancer due to exposure to site contaminants emitted to the atmosphere. It also predicts the likelihood for exceedances of the one-hour ambient air standard for hydrogen sulfide (a noncarcinogen). This in combination with concerns regarding exceedances of groundwater standards and impacts upon surface water indicate the need to implement a remedy to mitigate these concerns to the extent feasible. Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Groundwater beneath the site is contaminated with a variety of metals (predominantly iron, sodium, manganese, magnesium, and lead) at relatively high concentrations and organic compounds in low concentrations. Groundwater discharges to the Ramapo River but the concentrations and flow rates are evidently not high enough to cause exceedances of surface water standards. There is a possibility for a complete exposure pathway since there are drinking water supply wells near the banks of the Ramapo River downstream of the site. It is has been stated that some of these wells pump at rates high enough to induce flow from the river itself rather than drawing from the regional aquifer which discharges into the Ramapo. Since significant levels of contaminants were not found in the Ramapo River, the risk assessment focused mainly on the air pathway.

As part of the investigation of the site, an environmental assessment referred to as a Habitat Based Assessment (HBA) was completed. The objectives of the HBA included identifying any significant biological resources or habitats on or immediately adjacent to the site, evaluating the effects of past waste disposal activities on plant and animal life, and providing information needed for the evaluation of potential remedial alternatives. This was accomplished by completing field surveys of wildlife, preparing vegetation cover maps, reviewing available published information, and identifying any applicable or relevant and appropriate environmental standards. As a result of this review, it was determined that there was no evidence of threatened or endangered species or habitats in the area. A list of the observed vegetation and wildlife on and around the site is included in Appendix C of the Remedial Investigation Report.

VII. <u>DESCRIPTION OF THE REMEDIAL ALTERNATIVES</u>

To determine the most appropriate method for remediating the site, the feasibility study completed a process that took place in three parts. The first step identified and "screened" a large number of technologies that could be employed at the site to treat, contain, or dispose of the contaminants. Technologies that passed the initial screening phase were then grouped into different combinations to form remedial alternatives for further evaluation. After an initial analysis to identify the most promising alternatives, a detailed analysis was performed to serve as the basis for selecting a preferred alternative.

To identify technologies useful in addressing the contamination at the site, the three progressively more specific categories of "general response actions," "remedial technologies," and "process options" were identified. For example, regarding debris/soil, one of the general response actions considered was containment. This was then narrowed into the remedial technology of capping which was further subdivided into the process options of synthetic, asphaltic, and layered caps. A summary of the general response actions, remedial technologies, and process options considered is given in Table 3.

The initial screening process evaluates all of the identified process options against the single criterion of technical implementability. This also includes the evaluation of the "No Action" alternative which is carried through the entire process to demonstrate the need for remediation at the site and as a requirement of the NCP. A detailed discussion and evaluation of the initial screening process can be found in Section 4 of the Feasibility Study.

The remedial technologies and process options that passed the screening process were then assembled into different combinations or remedial alternatives. Theoretically, an immense number of combinations are possible but the NCP provides guidance (40 CFR 300.430(e)(3)) on how to assemble suitable technologies into alternative remedial actions for evaluation. Three sets of alternatives are described: (1) a range of alternatives that remove or destroy contaminants to the maximum extent feasible and eliminate or minimize to the degree possible, the need for long-term management; (2) "other alternatives which, at a minimum, treat the principal threats posed by the site but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed;" and (3) "one or more alternatives that involve little or no treatment, but provide protection of human health and the environment primarily by preventing or controlling exposure to ... contaminants, through engineering controls" and other methods to "assure continued effectiveness of the response action."

Since the wastes buried in the northeast corner of the Georgia Tech parcel are physically separated from the rest of the wastes, two groups of remedial alternatives were formulated. Seven alternatives were evaluated for the Barone/Khourouzian (B/K) parcel and four were evaluated for the wastes in the northeast corner of the Georgia Tech (GT) parcel. Each alternative is described in terms of the technologies proposed to address each of the four major media (i.e., debris/soil, soil gas/air, groundwater, and surface water/sediments). Since direct remediation of the Ramapo River and river sediments is not needed, each alternative includes a component for monitoring surface water/sediments.

The alternatives can be grouped into the three major categories of no action, containment, or excavation with treatment. The alternatives described below are numbered as they appear in the feasibility study. Present worth is the amount of money needed now (in 1991 dollars and assuming a discount rate of 5% before taxes and after inflation) to fund the construction, operation, and maintenance (O&M) of the alternative for 30 years. Capital cost mainly reflects initial construction costs and annual O&M reflects an average over 30 years of the money needed to operate and maintain the alternative for one year. Time to implement mainly refers to the time needed to construct the alternative. All costs and implementation times are estimates.

No Action Alternatives

B/K Alternative 1: No action + monitoring.

Present Worth:	**$1,972,000**	**Annual O&M:**	**$111,000**
Capital Cost:	**$ 39,000**	**Time to Implement:**	**Immediate**

The costs and activities associated with this alternative all deal with monitoring. Samples of groundwater, river water, sediments, soil gas, and ambient air would be taken on a quarterly basis for the first two years and annually thereafter. Groundwater, surface water, and sediments would be analyzed for volatiles, semi-volatiles, and metals. Groundwater wells that monitor discharges to the Ramapo River (MW-4 and MW-6) would be used to monitor for the full Target Compound List (TCL) of contaminants on an annual basis. Soil gas levels of H_2S, methane/nonmethane hydrocarbons, and combustible gases would be determined and ambient levels of volatile organic compounds and H_2S would be monitored.

Five perimeter soil gas monitoring wells would be installed to monitor the migration of landfill gases. The annual O&M cost estimate includes a provision for periodically replacing these monitoring wells over the 30 year monitoring period. The actual monitoring costs incurred will depend upon the number of wells routinely sampled, the analytical parameters selected, and the sampling frequencies. These parameters are affected by the variability of the contaminant concentration trends.

GT Alternative 1: No action.

Present Worth:	**$0**	**Annual O&M:**	**$0**
Capital Cost:	**$0**	**Time to Implement:**	**0 years**

Since the site monitoring provisions of B/K Alternative 1 would adequately address the needs for the GT parcel, no separate activities or costs are included in this alternative.

Containment Alternatives

B/K Alternative 2: Non-vented Cap + monitoring.

Present Worth:	**$5,917,000**	**Annual O&M:**	**$160,000**
Capital Cost:	**$3,040,000**	**Time to Implement:**	**1 year**

This alternative includes the installation of a final cover system that would minimize the infiltration of precipitation but would not provide for the collection or treatment of landfill gases. From top down, the design calls for a vegetated cover, a barrier protection layer, and the barrier. Eighteen perimeter passive gas monitoring points would also be installed so that subsurface migration of landfill gases could be monitored. Applicable New York State regulations (6 NYCRR 360-7) call for this type of design for the closure of construction and demolition debris landfills.

A surface water diversion program would be included to aid in the minimization of leachate production. Currently, a significant amount of run-off from a drainage area west of the site runs onto the site. Although a drain pipe runs under the site to carry this run-on to the Ramapo River, this pipe is damaged and allows an undetermined amount of water to enter the waste mass and potentially produce leachate. This water would be diverted to a newly installed 36 inch culvert to be installed under Route 17 south of the site and subsequently discharged to the Ramapo.

The environmental monitoring provisions of B/K Alternative 1 would also be included in this alternative. No provisions for groundwater collection or treatment are included.

<u>B/K Alternative 3:</u> Vented cap + passive gas collection and treatment + monitoring.

Present Worth:	**$8,168,000**	**Annual O&M:**	**$203,000**
Capital Cost:	**$4,604,000**	**Time to Implement:**	**1 year**

This would be the same as B/K Alternative 2 with the following exceptions: the final cover would include a gas collection layer; up to 19 interior passive gas vents/monitoring points would be installed; and up to 12 granular activated carbon (GAC) treatment units (3 canisters per unit) would be installed to treat gases from the perimeter and interior vents. The GAC would be used to remove H_2S and volatile organic compounds of concern (e.g., benzene, trichloroethene) so that they would not be emitted to the atmosphere.

B/K Alternative 3 would then include the installation of the following elements:

- o engineered final cover to minimize the amount of infiltration into the waste mass and the amount of leachate produced;
- o inclusion of a gas collection layer in the base of the cover connected to interior and perimeter gas vents;
- o passive collection of soil gas from interior and perimeter vents;
- o treatment of collected gases using granular activated carbon;
- o construction of a surface water diversion system to reduce surface run-on, infiltration, and the subsequent generation of leachate; and
- o environmental monitoring of groundwater, surface water, sediments, soil gas, and ambient air.

O&M activities would include maintenance of the cap, periodic replacement of the GAC, and periodic replacement of the gas vents. The environmental monitoring provisions of B/K Alternative 1 and the surface water diversion program of B/K Alternative 2 are also included. No provisions for groundwater collection or treatment are provided. A pilot program will be completed during the design phase of the remedy to confirm that passive gas collection and treatment will be adequate.

B/K Alternative 4: Vented cap + active gas collection and treatment + monitoring.

Present Worth:	**$8,914,000**	**Annual O & M:**	**$220,000**
Capital Cost:	**$5,069,000**	**Time to Implement:**	**1 year**

The difference between B/K Alternatives 3 and 4 is the method of gas collection. Alternative 4 would actively collect soil gas by connecting all of the interior vents to a blower which creates a vacuum over and inside the waste mass. Collected gases would then be treated before release to the atmosphere. This method would be preferable to passive collection and treatment if the site is found to generate high concentrations and large volumes of contaminants after the venting system is installed. The reason for this is that heavy contaminant loadings would necessitate an impractical replacement frequency for the carbon canisters envisioned for the passive system. O&M activities include maintaining the cap and the gas collection equipment, periodically replacing the GAC (or maintaining other gas treatment units if selected), and environmental monitoring. This option would not include groundwater collection or treatment.

B/K Alternative 5: Vented cap + active gas collection and treatment + downgradient vertical barrier + groundwater collection and treatment + monitoring.

Present Worth:	**$23,992,000**	**Annual O&M:**	**$583,000**
Capital Cost:	**$ 9,570,000**	**Time to Implement:**	**1 year**

This alternative includes all of the elements of B/K Alternative 4 plus a component to directly treat groundwater and indirectly treat surface water and sediments. As discussed above, contaminated groundwater beneath the site currently discharges into the Ramapo River. This could be minimized by installing vertical barriers between the ground surface and bedrock at the two locations where the bulk of site related groundwater discharges into the river. To prevent overtopping of the barriers, groundwater extraction wells would be installed behind the barriers. Collected groundwater would be treated and released to the river. This would essentially cut off the source of contamination from the site to the Ramapo and thereby indirectly address river contamination.

Three types of vertical barriers were evaluated in the feasibility study. The most promising of these is the so-called concrete diaphragm wall. Combined, the two walls would be approximately 1,000 feet long, two feet wide, and would average 50 feet deep. They would be installed on the eastern (downgradient) side of the site roughly between MW-3 and MW-4 and between MW-5 and RI-4.

It is estimated that four extraction wells would be needed to collect the estimated 21,000 gallons per day of water that would build up behind the walls. This water could be treated by an ion exchange system to remove metals. The low levels of organic compounds found in groundwater do not warrant treatment prior to release to the river.

O&M activities would include those listed under Alternative 4 plus those associated with the operation and maintenance of the groundwater extraction and treatment system. This includes periodic replacement of extraction wells, maintenance of pumps and piping, and purchase/disposal of regenerant chemicals and waste products.

GT Alternative 2: Excavation + deposition on B/K parcel + backfill.

Present Worth:	**$367,000**	**Annual O&M**	**$0**
Capital Cost:	**$367,000**	**Time to Implement:**	**<1 year**

Since the wastes in the northeast corner of the Georgia Tech parcel are separate and distinct, they can be removed and combined with the main waste mass on the B/K parcel for subsequent treatment or disposal. Approximately 14,600 cubic yards of waste would be excavated and moved onto the B/K parcel. Clean fill would be imported to grade and revegetate the excavated area. The wastes in the northwestern corner of the GT parcel would be managed as part of the main waste mass on the B/K parcel.

Excavation with Treatment Alternatives

B/K Alternative 6: Excavation + off-site incineration + groundwater extraction and treatment and monitoring.

Present Worth:	**$1,049,256,000**	**Annual O&M:**	**$376,000**
Capital Cost:	**$ 991,592,000**	**Time to Implement:**	**7 years**

This alternative dramatically differs from those described above. In this case, all wastes would be completely removed from the parcel, transported to off-site permitted incinerators, and destroyed. The resulting ash would be land buried. Additionally, groundwater under the site would be extracted and treated until it met applicable standards.

Under this scenario, it is assumed that all of the 476,500 cubic yards of waste in the site would need to be removed from the site and incinerated (e.g., rotary kiln). This would take seven years. In a subset of this alternative, it was assumed that only 25% of the wastes would require off-site incineration and the rest could be decontaminated, placed back into the site, and properly covered for permanent closure. The present worth of this "sub-alternative" was estimated to be $295,971,000.

A groundwater extraction and treatment system would be installed and operated to remediate groundwater and prevent contaminant releases to the Ramapo River. It is assumed that 15 years would be needed to reduce concentrations in groundwater beneath the site to acceptable levels. Since a vertical barrier would not be included in this case, the amount of water collected and treated would significantly increase (perhaps double) due to the influence of the Ramapo River.

Surface water/sediments would be indirectly remediated by the groundwater program. Environmental monitoring of surface water/sediments and ambient air would occur to determine if the remedial action itself was not creating unacceptable damage or threats of damage.

After the completion of the excavation/treatment components, O&M activities associated with groundwater treatment and environmental monitoring are projected to continue until 30 years from the start of remediation.

B/K Alternative 7: Excavation + on-site incineration + groundwater extraction and treatment + monitoring.

Present Worth: $246,869,000 Annual O&M: $431,000
Capital Cost: $226,048,000 Time to Implement: 5 years

An optional permanent treatment/disposal method associated with excavation is on-site incineration. The advantages include no need for long distance transportation, dedicated incineration capacity, and reduced ash disposal costs. The disadvantages include the need for on-site residuals disposal, creation of local air emission sources, and concerns about effectiveness. Since metals are present at significant concentrations in the debris and incineration would not remove significant quantities from the resulting residuals, the ash would need to be stabilized to immobilize the metals. Uncertainties in the long-term effectiveness of this method raises the possibility of future contamination release problems.

The scenario analyzed in the feasibility study envisions the use of three on-site incinerators. In this case, it is projected to take five years to complete the treatment process and another 10 years to complete the groundwater treatment program. Using more or fewer incinerators would proportionately lessen or extend the time needed to complete the remedy.

As with B/K Alternative 6, the possibility that only 25% of the debris would need to be incinerated was investigated. The present worth of the remedy in this case was estimated to be $93,675,000. The remainder of the activities (i.e., groundwater extraction and treatment, environmental monitoring, etc.) would be similar to Alternative 6.

GT Alternative 3: Excavation + off-site incineration.

Present Worth: $41,544,000 Annual O&M: $0
Capital Cost: $41,544,000 Time to Implement: 1 year

In this case, the wastes deposited in the northeast corner of the GT parcel would be excavated and transported off-site for incineration. The resulting excavation would be graded and revegetated as in GT Alternative 2. Since all of the wastes would be removed, no O&M would be necessary. The wastes in the northwest corner would be managed as part of the B/K parcel.

GT Alternative 4: Excavation + on-site incineration.

Present Worth: $12,753,000 Annual O&M: $0
Capital Cost: $12,753,000 Time to Implement: 1 year

The difference between GT Alternatives 3 and 4 is that in Alternative 4, wastes would be incinerated on site in conjunction with B/K Alternative 7. As with GT Alternative 3, all of the wastes in the northeast corner would be removed so that O&M would not be needed after the construction was completed. Monitoring would be carried out in conjunction with the B/K parcel.

Refer to the discussion of B/K Alternative 7 above for more information about this alternative.

VIII. SUMMARY OF THE COMPARATIVE ANALYSIS OF THE ALTERNATIVES

The remedial alternatives developed for this site, and described above, have been grouped into three categories; (1) no action (B/K Alternative 1 and GT Alternative 1), (2) containment (B/K Alternatives 2, 3, 4, & 5 and GT Alternative 2), and (3) excavation and treatment (B/K Alternatives 6 & 7 and GT Alternatives 3 & 4). This comparative analysis will focus upon these three groups rather than address each individual alternative. Where specific differences between the alternatives are relevant, they are mentioned.

The site specific goals for remediating this site can be summarized in general as follows:

- prevent unacceptable health risks to exposed populations from airborne contaminants;
- prevent unacceptable environmental risks due to exposure to site related contaminants;
- close the site in conformance with applicable regulations;
- protect surface water and sediments from contamination which would adversely affect its uses;
- eliminate the odor nuisance emanating from the site.

The criteria used to compare the potential remedial alternatives are defined in the National Contingency Plan (40 CFR 300.430). For each of the criteria, a brief description is given followed by an evaluation of the alternatives against that criterion.

Threshold Criteria - The first two criteria must be satisfied in order for an alternative to be eligible for selection.

1. **Protection of Human Health and the Environment**--This criterion is an overall and final evaluation of the health and environmental impacts to assess whether each alternative is protective. This evaluation is based upon a composite of factors assessed under other criteria, especially short/long-term impacts and effectiveness and compliance with ARARs (see below).

If the no-action alternative were implemented, the threat to human health and the environment could be estimated from the results of the baseline risk assessment described above in Section VI. Although the risks are not large, it is prudent to determine what steps can be taken to minimize those risks to the extent practicable. As with other sites where the exact composition of the wastes is uncertain, the possibility of future releases of currently unidentified contaminants has also been considered.

The containment alternatives would provide protection by limiting the amount of contaminated groundwater generated and released, and in the case of alternatives with gas collection and control, would also limit the release of hazardous constituents to the atmosphere. By monitoring groundwater, surface water/sediments, and air releases, changes in the nature of the releases from the site would be detected and mitigating measures could be taken. By the addition of a vertical groundwater barrier and groundwater treatment, B/K Alternative 5 would directly prevent the release of contaminated groundwater to the river.

The excavation/treatment alternatives would provide protection by treating, and in the case of B/K Alternative 6, removing all of the hazardous wastes from the site. Wastes would be incinerated to destroy organic contaminants and chemically treated to immobilize the remaining heavy metals in the ash. The treated ash would be land buried either on or off-site. Groundwater would be collected and treated until the level of contamination was reduced to levels below standards.

Although the excavation/treatment alternatives would likely offer the highest overall protection of human health and the environment after completion of the action, there are factors that diminish the differences between the alternatives regarding this criterion. Specifically, the process of excavating and handling the wastes at the site would result in the release of potentially significant quantities of volatile contaminants to the atmosphere. Depending upon the effectiveness of engineering controls such as vapor suppression, the resulting exposures could be significant. The feasibility study estimates that the cancer risks to the community associated with excavating the site would be 17 times higher than for baseline conditions. Both sets of alternatives also implicitly contain the possibility that a subsurface fire could begin at the site resulting in the release of significant quantities of air contaminants. The risk of this occurring in conjunction with the containment alternatives is considered to be low. Because of their intrusive nature, the risk of fire may be greater with the excavation/treatment alternatives but these risks are difficult to quantify with any certainty.

2. **Compliance with Applicable or Relevant and Appropriate New York State and Federal Requirements (ARARs)**--ARARs are divided into the categories of chemical-specific (e.g. groundwater standards), action-specific (e.g. design of a landfill), and location-specific (e.g. protection of wetlands). Certain policies and guidance that do not have the status of ARARs that are considered to be important to the remedy selection process are identified as To-Be-Considered (TBC) criteria. A compilation of federal and state ARARs/TBCs are included in Table 4. If the implementation of a remedy results in one or more ARARs not being met, a waiver of the ARAR must be justifiable based upon one of the six reasons specified in the NCP (40 CFR 300.430(f)(1)(ii)(C)).

The key ARARs associated with this site are the requirements for site closure (i.e. installation of a final cover system) under the hazardous and solid waste regulations, ambient air standards, surface water quality standards, groundwater standards, and land disposal restrictions (40 CFR Part 268). Since the no-action alternative would not address these requirements and complete waivers could not be justified, no-action is not eligible for selection.

The containment alternatives that include gas collection and treatment would meet the key ARARs except regarding on-site groundwater standards. To meet these standards, the wastes themselves would have to be removed or treated so that they no longer served as a source of contaminants to the groundwater. If public monies are used to remediate the site, an applicable waiver of the on-site groundwater standard would be that taking the extraordinary steps needed to attain the ARAR would not provide a balance between the need for protection of human health and the environment at the site and the availability of public monies to respond to other sites that may present a threat to human health and the environment. Also, as discussed above, it is possible that the excavations needed to treat all of the wastes may result in the creation of a greater overall threat by resulting in the release of volatile chemicals.

The excavation/treatment alternatives would likely meet the key ARARs except for the possible exceedances of ambient air standards or guidelines during the five to seven years it would take to complete the remedy. Closure requirements would be met by removing the wastes or properly containing treated wastes on-site. Groundwater standards would be met by removing the source and treating groundwater until standards were met. In the long-term, ambient air standards and guidelines would be met by removing and destroying the volatile contaminants. Surface water quality standards will be maintained by reducing the release of contaminants to the Ramapo River.

Land disposal restrictions would prohibit the excavation and reburial of certain hazardous wastes without appropriate treatment. Incineration was evaluated as an appropriate treatment technology but the resulting ash may also require treatment (i.e., stabilization) before land burial would be permitted. Constructing a lined land burial facility may be impracticable.

<u>Primary Balancing Criteria</u> - The next five "primary balancing criteria" are used to weigh major trade-offs among the different hazardous waste management strategies.

3. **<u>Short-term Impacts and Effectiveness</u>**--The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment is evaluated. The length of time needed to achieve the remedial objectives is estimated and compared with other alternatives.

Because they are less intrusive, result in adequate protection, and can be implemented in a short amount of time (approximately one year), the containment alternatives are preferable to the excavation/treatment alternatives in regard to this criterion. Although less intrusive, the containment alternatives do involve a limited amount of waste excavation. This is necessary to achieve stable final slopes, to remove wastes deposited in the railroad right-of-way, and to consolidate the wastes in the northeast corner of the Georgia Tech parcel onto the B/K parcel. Engineering controls will be applied to minimize the release of volatile compounds. As described above, the excavation/treatment alternatives are predicted to result in greater risks than the no-action alternative.

4. **Long-term Effectiveness and Permanence**--If wastes or residuals will remain at the site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude and nature of the risk presented by the remaining wastes; 2) the adequacy of the controls intended to limit the risk to protective levels; and 3) the reliability of these controls.

It is generally preferable to implement remedies that will permanently eliminate any significant threats to human health or the environment, that will minimize or eliminate the need to manage residuals, and will minimize other operation and maintenance functions. The excavation/treatment alternatives provide these characteristics by treating all of the hazardous wastes at the site. They would not, however, provide the highest degree of permanence because unlike liquid wastes, significant quantities of residual wastes would remain in the form of stabilized ash. Wherever finally disposed, the ash would have the potential of eventually leaching out metals and producing contaminated groundwater.

Although only small amounts of the total waste mass would be treated, the containment alternatives would provide an adequate degree of long-term effectiveness and permanence. The magnitude and nature of the risks presented by the remaining wastes would be acceptable given the adequacy and reliability of the controls used to limit these risks. If the type or volume of contaminants released by the site were to significantly change over time, mitigative measures could be taken to address any new threats.

For example, if highly toxic compounds not currently detected at the site were found in groundwater that discharges to the Ramapo River, a groundwater collection and treatment system similar to that described in B/K Alternative 5 could be installed that would prevent the release of these contaminants. If the type or volume of gas emissions were to significantly change, modifications could be made to the gas collection/treatment system to address those problems. This could include conversion from a passive to an active collection system or the use of an alternate treatment system. Other technical and administrative solutions would also be available as described in the RI/FS Report.

5. **Reduction of Toxicity, Mobility, or Volume**--Preference is given to alternatives that permanently, and by treatment, significantly reduce the toxicity, mobility, or volume of the wastes at the site. This includes assessing the fate of the residues generated from treating the wastes at the site.

The excavation/treatment alternatives would significantly reduce the toxicity, mobility, and volume of the wastes whereas the containment alternatives would only reduce the mobility of the wastes. The excavation/treatment alternatives would reduce the toxicity of organic contaminants by thermal destruction. Mobility would be reduced by chemically treating the resulting ash to prevent the release of heavy metals. Volume would be reduced by segregating out non-hazardous wastes and incinerating the rest.

The containment alternatives would reduce the mobility of the wastes by minimizing the production of leachate and by collecting and treating landfill gases (except for B/K Alternative 2 which does not include a gas collection or treatment component). Both sets of alternatives would generate residues. Excavation/treatment would produce air emissions, treated ash, and groundwater treatment residues. The containment alternatives would generate gas and water treatment residues (e.g. spent activated carbon, metals sludges, depending on the actual method employed).

6. **Implementability**--The technical and administrative feasibility of implementing the alternative is evaluated. Technically, this includes the difficulties associated with the construction and operation of the alternative, the reliability of the technology, and the ability to effectively monitor the effectiveness of the remedy. Administratively, the availability of the necessary personnel and materiel is evaluated along with potential difficulties in obtaining special permits, rights-of-way for construction, etc.

Even though all of the potential alternatives are technically implementable, there are significant differences in the level of difficulty to construct and operate the remedies. Although the capping activities anticipated for the containment alternatives are well established, the physical nature of the wastes could present difficulties in establishing the final grades of the slopes. Minimizing the release of contaminants during these activities would require special attention. The installation of the gas extraction vents would be difficult due to the problems encountered when drilling through construction and demolition debris. The installation methods for a geomembrane as the impermeable component of the final cover are well established but requires special techniques and experienced personnel. The materials and personnel needed would be readily available.

The greatest challenges to implementing the excavation/treatment alternatives would be materials handling and the availability of incinerator capacity. Unlike liquids and some soils, the wastes at this site would need to be highly processed before they could be incinerated. Items such as reinforced concrete, railroad ties, structural steel, and white goods (e.g. refrigerators) would need to be either segregated and decontaminated or crushed into small pieces before being incinerated. Nearly all of the 500,000 cubic yards of waste would require some form of preparation. This process would exacerbate the release of volatile compounds.

The implementability of the on-site incineration/ash burial sub-alternative is uncertain since there is a good possibility that before redeposition, a liner system with leachate collection capabilities would need to be installed. Without removing all wastes from the site, the liner would have to be installed in small segments as the bottom of the site is exposed. This may not be feasible.

The very large quantities of waste to treat would monopolize scarce incinerator resources. If additional capacity was needed, a significant delay would be realized while the siting, design, construction, and permitting process was completed. The use of on-site incinerators could face administrative feasibility problems if projected air emissions were thought to be unacceptable or there was significant local resistance to the installation and operation of multiple incinerators in the community.

7. <u>Cost</u>--Capital and operation and maintenance costs are estimated for the alternatives and compared on a present worth basis. Although cost is the last criterion evaluated, where two or more alternatives have met the requirements of the remaining criteria, cost effectiveness can be used as the basis for final selection.

To simplify the presentation of the cost analysis, the B/K and GT alternatives are grouped into likely combinations and the resulting costs are added together. Each of the alternatives includes a monitoring component which is not stated explicitly in the following definitions. These alternatives are designated by Roman numerals and are defined below:

Estimated Costs (Present Worth) of Alternatives

Alt. I: No action = B/K 1 + GT 1..................................$1,972,000

Alt. II: Non-vented cap = B/K 2 + GT 2.............................$6,284,000

Alt. III: Vented cap + passive gas collection and treatment = B/K 3 + GT 2...$8,535,000

Alt. IV: Vented cap + active gas collection and treatment = B/K 4 + GT 2...$9,281,000

Alt. V: Vented cap + active gas collection and treatment + vertical groundwater barrier + groundwater collection and treatment = B/K 5 + GT 2............................$24,359,000

Alt. VI: Excavation + off-site incineration and disposal + groundwater collection and treatment = B/K 6 + GT 3..$1,040,080,000

Alt. VII: Excavation + on-site incineration and treatment + groundwater collection and treatment = B/K 7 + GT 4....$259,622,000

Modifying Criterion - This final criterion is taken into account after evaluating those above. It is focused upon after public comments on the proposed remedial action plan have been received.

8. **Community Acceptance**--Concerns of the community regarding the RI/FS Reports and the Proposed Remedial Action Plan are evaluated. The Responsiveness Summary (Exhibit C) for this project identifies those concerns and presents the Department's responses to those concerns.

IX. SELECTED REMEDY

The remedy selected for the site by the NYSDEC was developed in accordance with the New York State Environmental Conservation Law (ECL) and is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 USC Section 9601, <u>et. seq</u>., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

Based upon the results of the Remedial Investigation and Feasibility Study (RI/FS), and the criteria for selecting a remedy, the NYSDEC has selected a combination of B/K Alternative 3 and GT Alternative 2 to remediate the site (vented cap + passive gas collection and treatment + consolidation of GT wastes + monitoring). The estimated cost to implement the remedy (present worth) is $8,535,000. The cost to construct the remedy is estimated to be $4,971,000 and the average annual operation and maintenance cost is estimated to be $203,000.

The elements of the selected remedy are as follows (see also Figure 10):

1. A **remedial design program** to verify the components of the conceptual design and provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program. A **gas collection and treatment pilot study** will be carried out as part of the design program to verify the adequacy of the proposed gas collection and treatment system.

2. **Excavation and consolidation of wastes** to minimize the final size of the site. Wastes in the northeast corner of the Georgia Tech parcel will be excavated and used to grade the main site. Clean fill will be imported as necessary to stabilize and revegetate this corner. Wastes currently encroaching along the railroad right-of-way along the eastern border of the site will be removed and redeposited on the site.

3. Installation of a **vented final cover** to minimize the infiltration of precipitation and collect gases generated by the wastes. An adequate number of gas collection points will be installed around the perimeter and interior of the site to prevent the uncontrolled release of gases to the atmosphere. The major elements of the final cover will include vegetated top soil, a barrier protection layer, a drainage layer, a gas/water barrier (e.g. geomembrane), and a gas collection layer.

4. Installation and operation of a **passive gas collection and treatment system**. Gases collected in the final cover system will be conveyed through suitable piping to treatment modules containing regenerable activated carbon. Appropriate carbon will be selected so that both hydrogen sulfide and volatile organic compounds will be removed.

5. A **surface water diversion program** will be completed to reduce the run-on of precipitation to the extent feasible. This will help to reduce the amount of water that infiltrates the site and produces leachate. After an appropriate design program is completed, water currently running onto the southwestern portion of the site from the west side of State Route 17 will be diverted to the south and eventually to the Ramapo River. This will likely require the installation of an additional culvert under Route 17 to accommodate the increased flow. Additional improvements will be made as needed along the western and southern sides of the site to minimize the amount of run-on.

6. **Restrictions on the use of the site** will be put into place to ensure that the integrity of the remedy is not damaged or compromised. This will include restrictions on excavations into the cover or any other

activities that would reduce the effectiveness of the remedy (e.g. interfering with the gas collection/treatment system).

7. An **environmental monitoring program** to evaluate the performance of the remedial program.

The performance standards to be obtained by implementing the remedy include the following:

1. Prevent off-site exceedances of the one-hour ambient air standard for hydrogen sulfide of 0.01 parts per million (ppm).

2. Prevent off-site concentration exceedances of volatile organic compounds in ambient air that would result in an added risk of cancer of greater than one in one million or a hazard index greater than one (for noncarcinogens) at the nearest receptor.

3. Prevent the release of contaminated groundwater to the Ramapo River that would result in exceedances of surface water quality standards downstream of the site.

X. STATUTORY DETERMINATIONS

The following discussion describes how the remedy complies with the decision criteria in the laws and regulations.

1. Protection of Human Health and the Environment

The selected remedy will control risks to human health and the environment by reducing the release of contaminants to the groundwater, surface water, and air pathways. The combination of an impermeable cover along with the diversion of run-on will reduce the amount of water that infiltrates the site and subsequently produces contaminated groundwater. Since the release of contaminated groundwater is the mechanism for the contamination of surface water and sediments, reducing the release of groundwater will directly reduce the contaminant loadings to the river. The installation and operation of a passive gas collection and treatment system will reduce the release of contaminants to the air and the associated risks. No unacceptable short-term risks or cross-media impacts will be caused by implementation of the remedy.

2. Compliance with ARARs

The implementation of the selected remedy should result in compliance with all ARARs except for the attainment of on-site groundwater standards. The requirements for site closure will be met by the installation of an engineered final cover system as described above. Ambient air standards will be attained by the installation of a gas collection and treatment system. Surface water quality standards will be met by reducing the release of contaminants to the Ramapo River.

If public monies are used to remediate the site, an applicable waiver of the on-site groundwater standard would be that taking the extraordinary steps needed to attain the ARAR would not provide a balance between the need for protection of human health and the environment at the site and the availability of public monies to to respond to other sites that may present a threat to human health and the environment. Also, as discussed above, it is possible that the excavations needed to treat all of the wastes may result in the creation of a greater overall threat by resulting in the release of volatile chemicals.

3. Cost-Effectiveness

Of the alternatives that can achieve the remedial goals and meet the threshold evaluation criteria, the selected remedy has the lowest cost.

4. Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable.

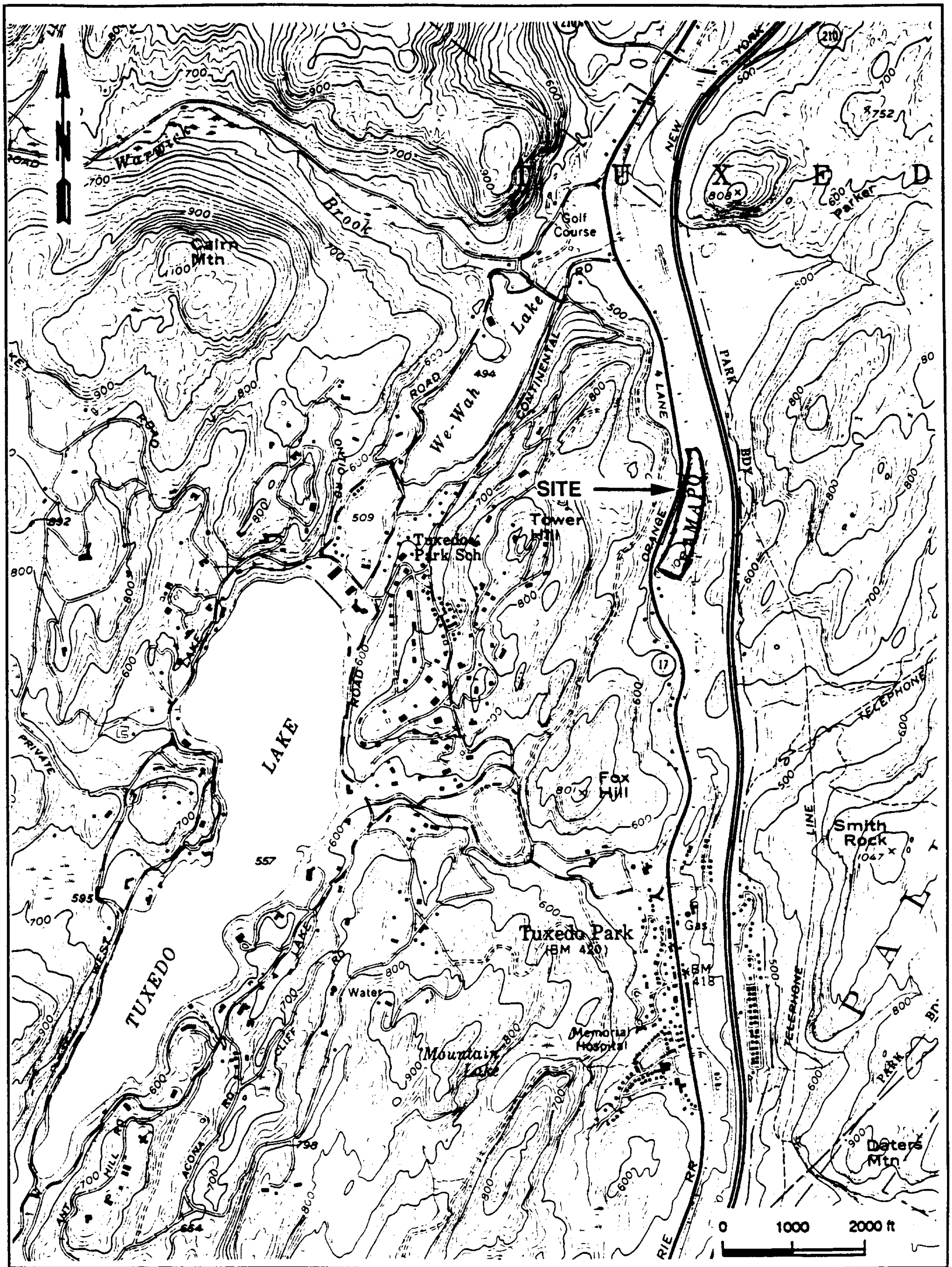
The NYSDEC has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the State has determined that this remedy provides the best balance of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume, short-term impacts and effectiveness, implementability, and cost, also considering the statutory preference for treatment as a principal element.

While the selected remedy does not offer as high a degree of long-term effectiveness and permanence as the excavation/treatment alternatives, it will significantly reduce the inherent hazards posed by the release of air and groundwater contaminants. Additionally, the incineration options, while resulting in fewer residuals requiring long-term management, would nonetheless require land burial of the metal contaminated ash. The selected remedy can be implemented more quickly, with less difficulty and at less cost than the excavation/treatment alternatives and provides the best balance and versatility among the containment alternatives. Therefore, the selected remedy is determined to be the most appropriate solution for the site.

5. Preference for Treatment as a Principal Element

Although the overall amount of contaminants released by the site is reduced and soil gases released by the site are treated using regenerable activated carbon, the principal element of the remedy is containment, not treatment. Therefore, the statutory preference for remedies that employ treatment as a principal element is not completely satisfied. However, in accordance with the analysis given above, it has been determined that this preference has been satisfied to the extent practicable given the conditions at the site and the extraordinary measures needed to incorporate treatment as a principal element.

FIGURES



Metcalf & Eddy of New York, Inc.

TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY, NEW YORK

FIGURE 1
SITE LOCATION MAP

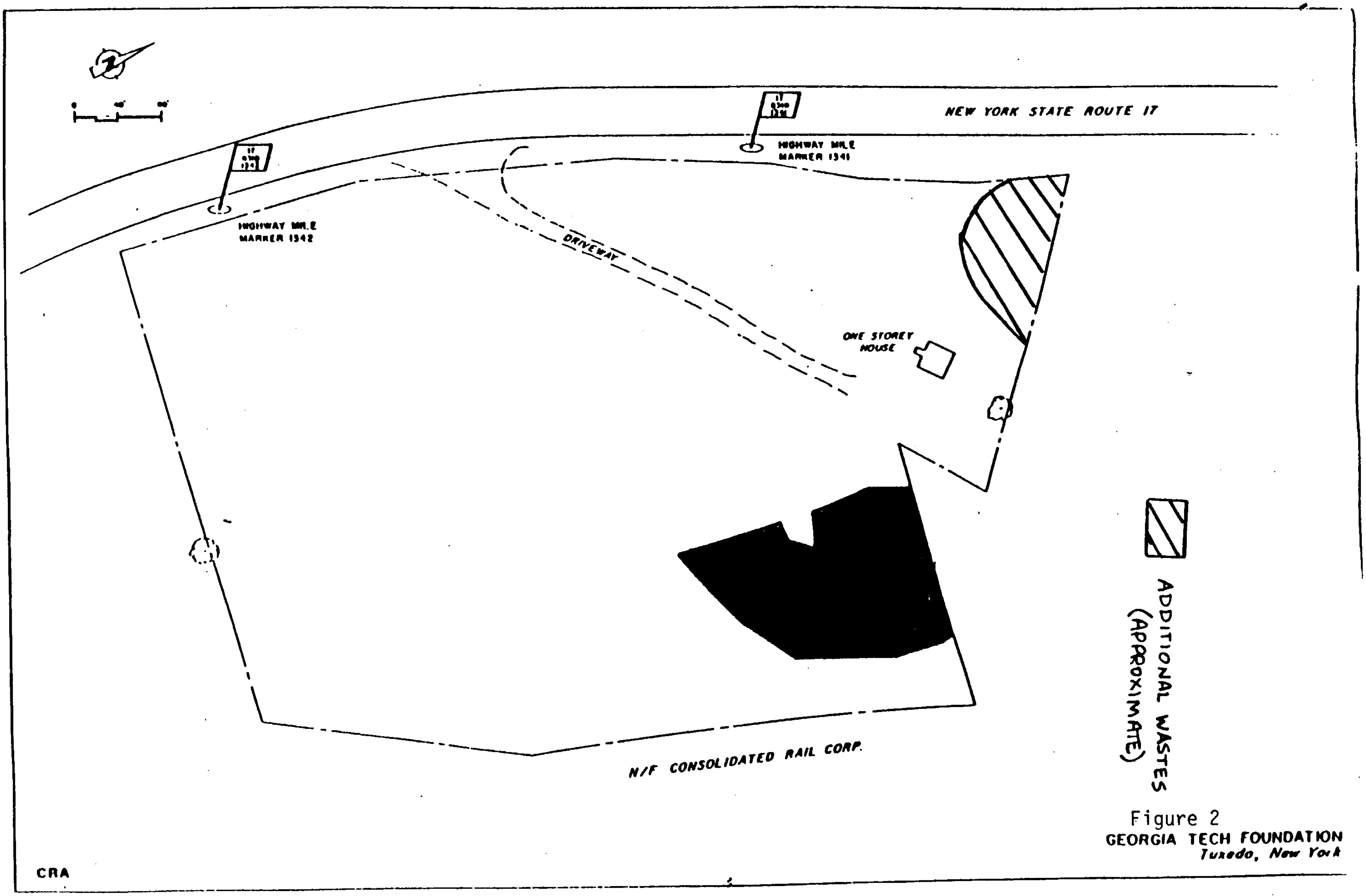
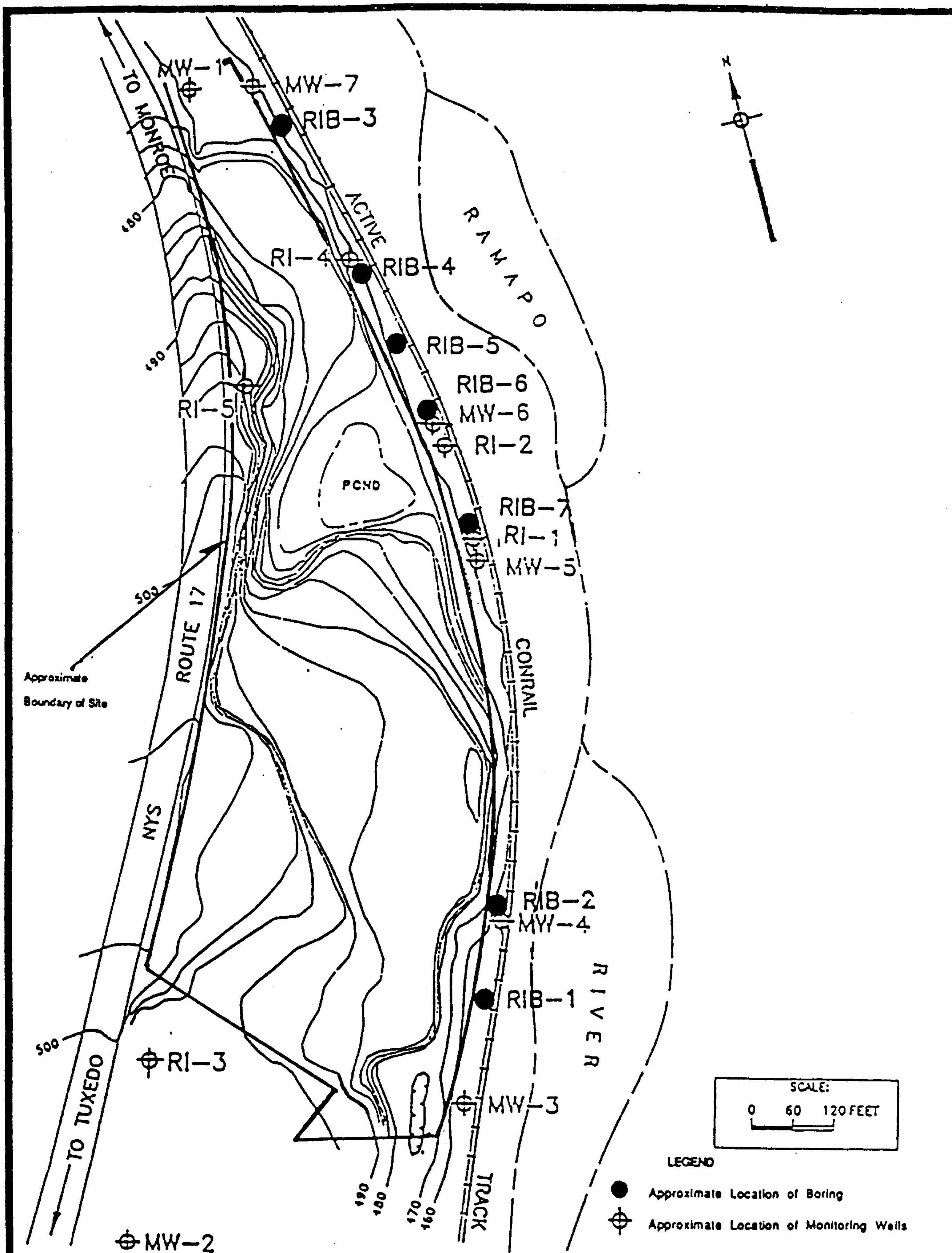


Figure 2
GEORGIA TECH FOUNDATION
Tuxedo, New York



M&E Metcalf & Eddy	TUXEDO WASTE DISPOSAL SITE ORANGE COUNTY, NEW YORK	FIGURE 3 SOIL BORING AND MONITORING WELL LOCATION MAP

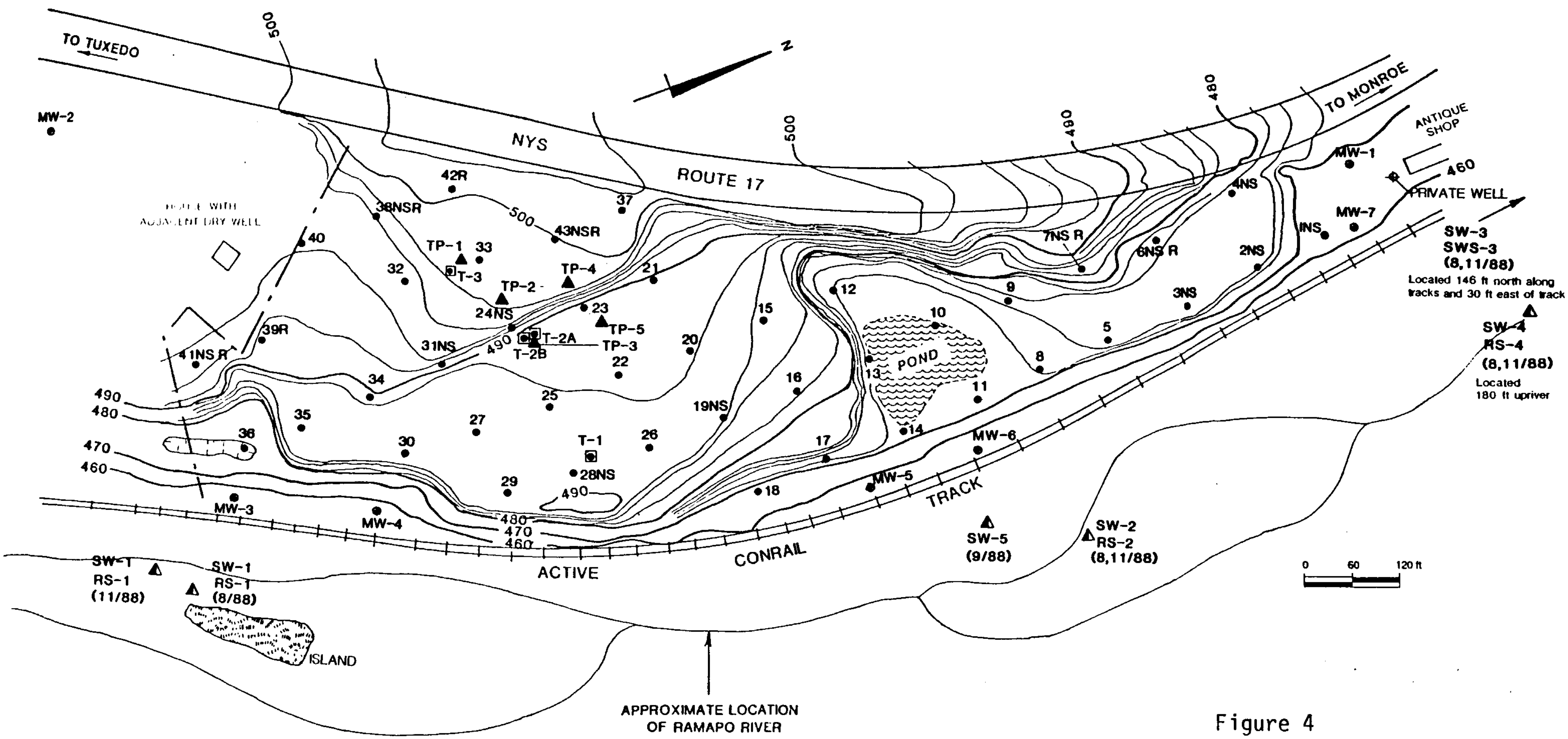


Figure 4

LEGEND	
● Soil survey point	▲ Surface water sediment
⊡ Trench location	NS Not surveyed (location approx.)
● Monitoring well	R Refusal, point could not be installed
▲ Test pit	

SOIL GAS, TRENCH, TEST PIT, MONITORING WELL, SURFACE WATER, AND SEDIMENT LOCATION MAP

Tuxedo Waste Disposal Site
NYSDEC I.D. No. 336035
1988 NYSDEC PHASE II INVESTIGATION

LAWLER, MATUSKY & SKELLY ENGINEERS
Pearl River, New York

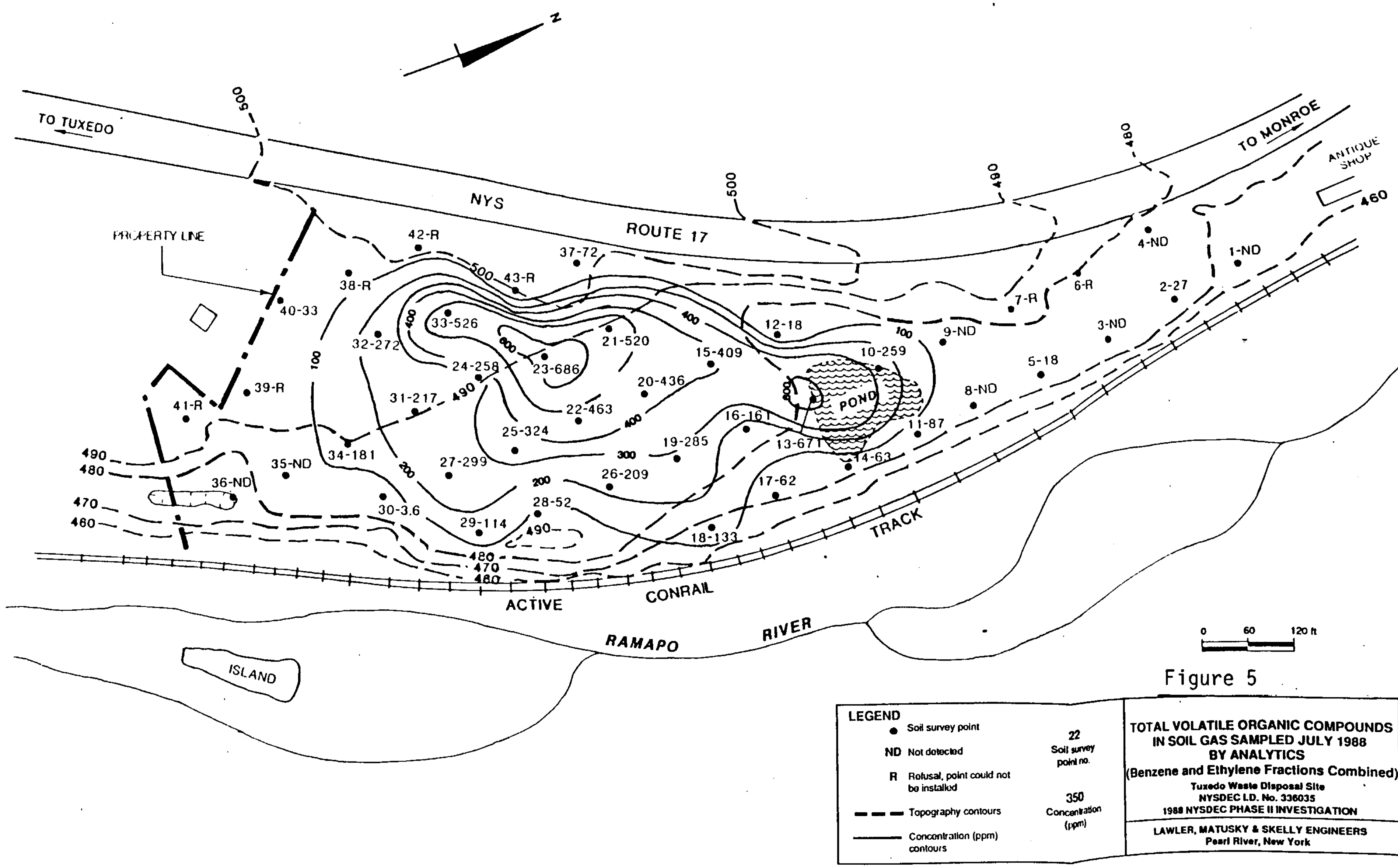
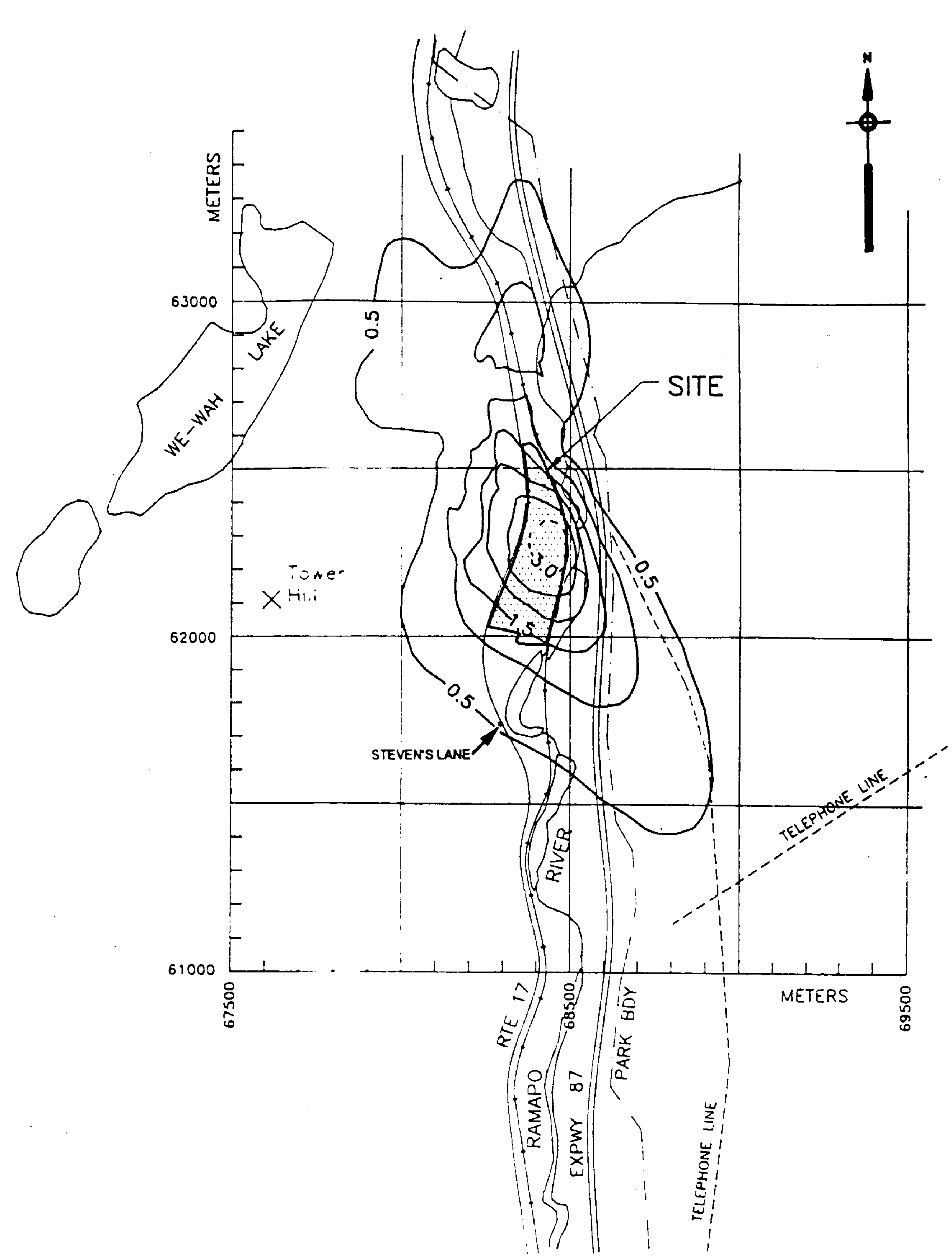

N
TO TUXEDO
TO MONROE
NYS
ROUTE 17
ANTIQUE SHOP
PROPERTY LINE
POND
ACTIVE
CONRAIL
TRACK
RAMAPO
RIVER
ISLAND
500
490
480
470
460
100
200
300
400
600
1-ND
2-27
3-ND
4-ND
5-18
6-R
7-R
8-ND
9-ND
10-259
11-87
12-18
13-671
14-63
15-409
16-161
17-62
18-133
19-285
20-436
21-520
22-463
23-686
24-258
25-324
26-209
27-299
28-52
29-114
30-3.6
31-217
32-272
33-526
34-181
35-ND
36-ND
37-72
38-R
39-R
40-33
41-R
42-R
43-R
0
60
120 ft
LEGEND
Soil survey point
ND Not detected
R Refusal, point could not be installed
Topography contours
Concentration (ppm) contours
22 Soil survey point no.
350 Concentration (ppm)
TOTAL VOLATILE ORGANIC COMPOUNDS IN SOIL GAS SAMPLED JULY 1988 BY ANALYTICS
(Benzene and Ethylene Fractions Combined)
Tuxedo Waste Disposal Site
NYSDEC I.D. No. 336035
1988 NYSDEC PHASE II INVESTIGATION
LAWLER, MATUSKY & SKELLY ENGINEERS
Pearl River, New York

Figure 5



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TUXEDO WASTE DISPOSAL SITE
ORANGE COUNTY NEW YORK

FIGURE 6
AIR EXPOSURE MODEL MAXIMUM
POTENTIAL CANCER PER MILLION

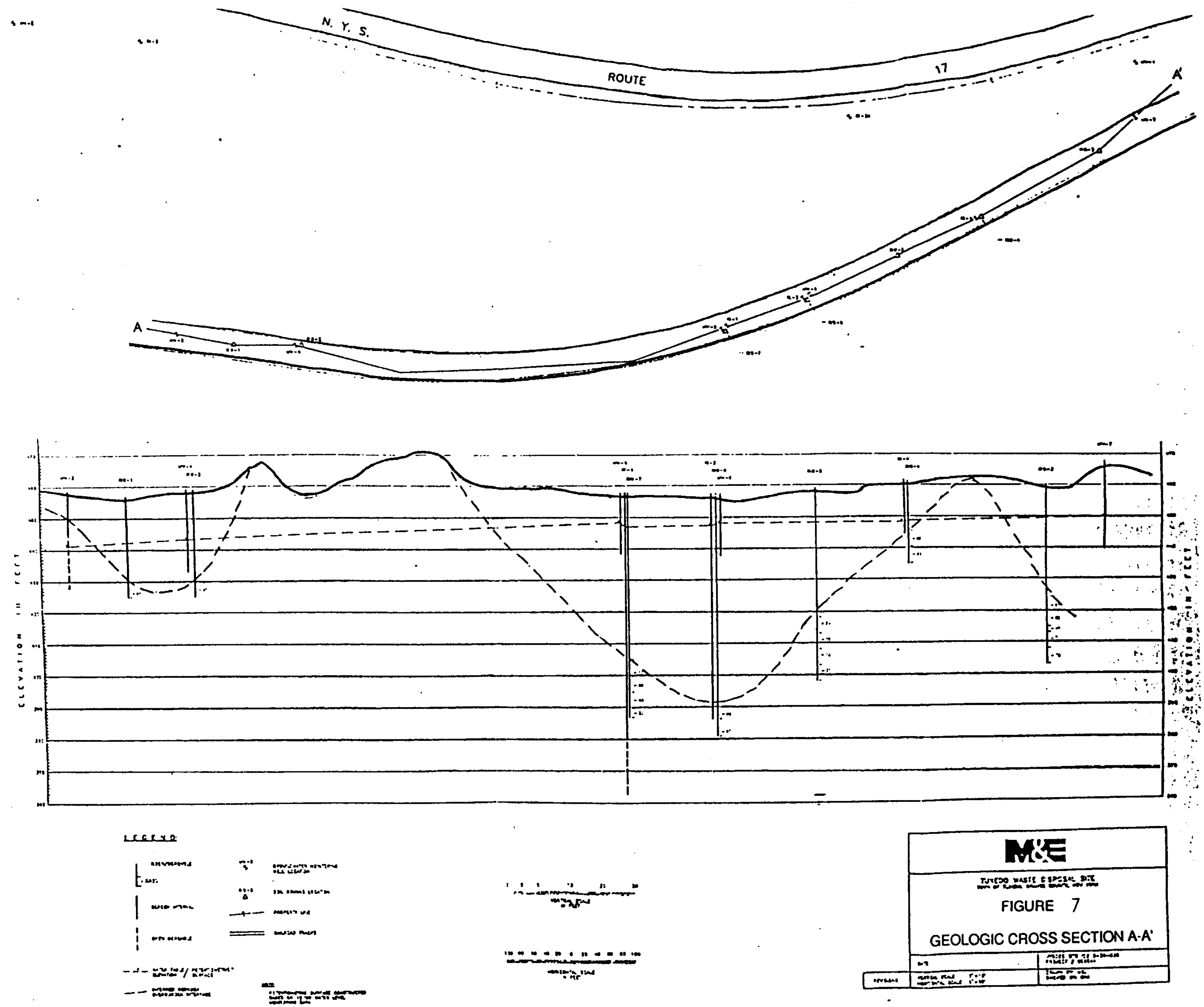

FIGURE 7

GEOLOGIC CROSS SECTION A-A'

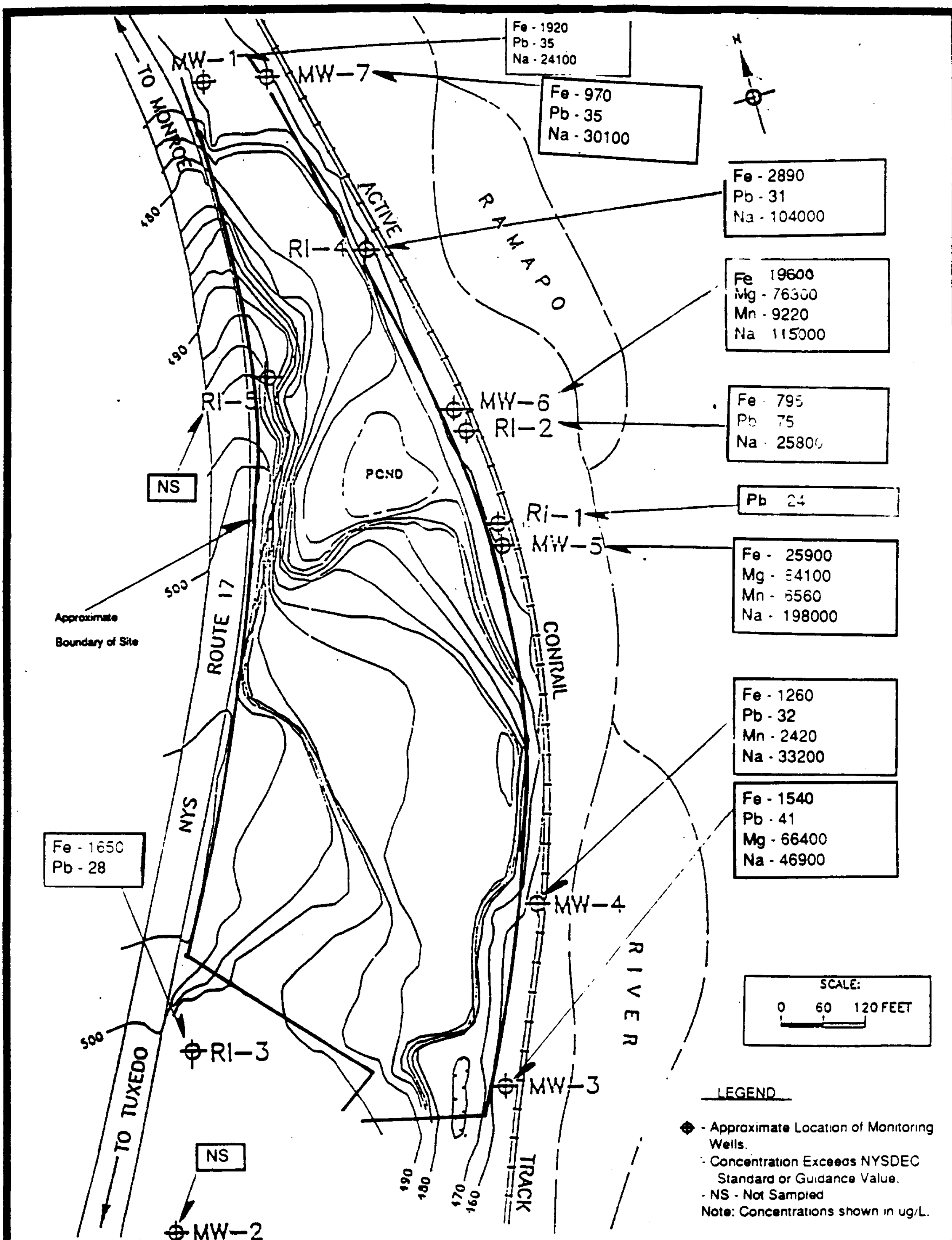

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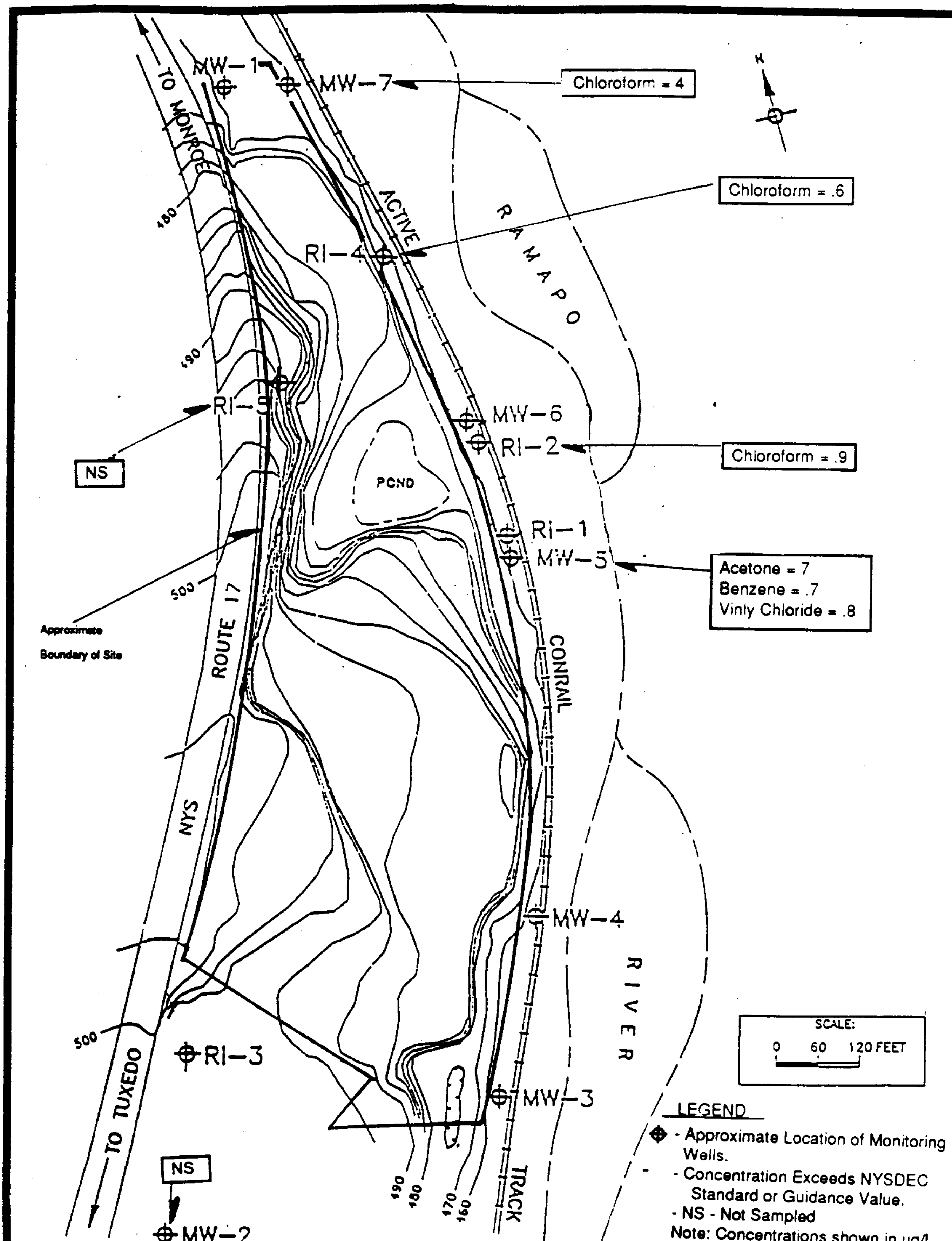
FIGURE 8
WELLS CONTAINING METAL CONCENTRATIONS EXCEEDING NEW YORK STATE STANDARDS AND GUIDANCE VALUES (1991)



Metcalf & Eddy of New York, Inc.

FIGURE 9
ORGANIC COMPOUNDS DETECTED IN MONITORING WELLS (1991)

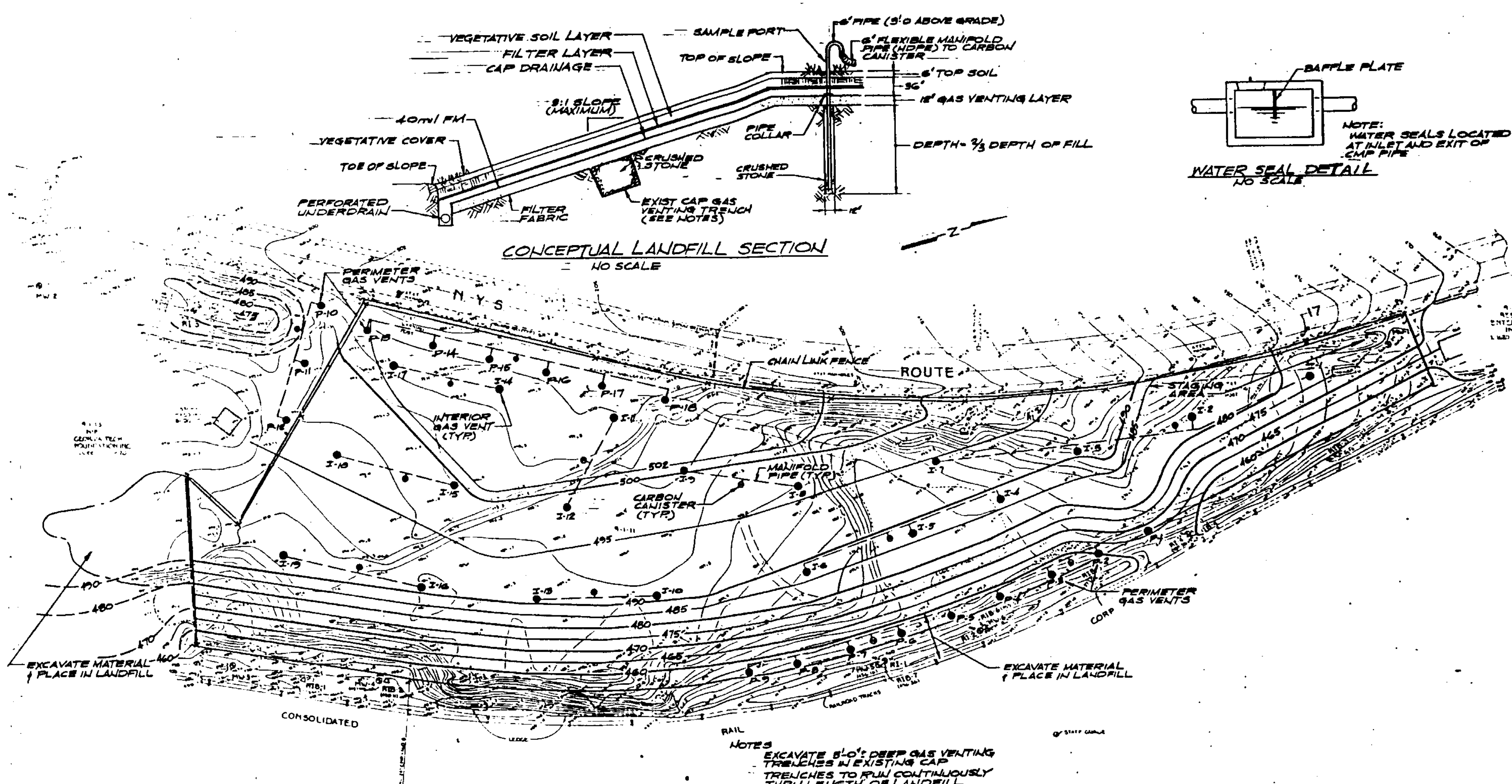


Figure 10

CONCEPTUAL LANDFILL CLOSURE PLAN
TUXEDO WASTE DISPOSAL SITE, ORANGE CO. N.Y.

M&E
Metcalf & Eddy

TABLES

TABLE 1

MEDIA AND CONTAMINANTS OF CONCERN
TUXEDO WASTE DISPOSAL SITE

Contaminants of Concern	Media				
	Air/ Soil Gas	Soil	Groundwater	Surface Water	Surface Water Sediment
Hydrogen Sulfide	X				
Methane	X				
Volatile Organic Compounds	X	X	X		
Semi-Volatile Organic Compounds		X	X	X	X
Metals		X	X	X	X
PCBs		X			

Volatile Organic Compounds:

Toluene
Trichloroethylene
Carbon tetrachloride*
1-2 dichloroethane
Xylene
Benzene
Ethyl benzene
Freon 113
Chloroform

Semi-Volatile Organic Compounds:

Fluoranthene
Pyrene*
Chrysene
Phenols
Naphthalene
2-methylnaphthalene
Acenapthene
Dibenzofuran
Fluorene
Phenanthrene
Bis (2-ethylhexyl)phthalate
Benzo(a) anthracene
Benzo(b) fluoranthene
Benzo(a) pyrene

Metals:

Aluminum
Arsenic
Cadmium
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Sodium
Selenium*
Silver
Zinc

* Listed based on prior investigations. The M&E Remedial Investigation did not find contaminant at levels of concern.

TABLE 2 (Page 1 of 7)

TUXEDO PHASE II TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	1A	1B	2A	2B	3A		3B
LABORATORY	ENSECO	VERSAR	ENSECO	VERSAR	ENSECO	ENSECO	VERSAR
NYSDEC SAMPLE I.D. No.	SH336035-26	SH336035-36	SH336035-27	SH336035-37	SH336035-28	SH336035-28DL	SH336035-38
PARAMETER							
TCL Volatiles (ug/kg or ppb)							
Methylene chloride	32B	95	9J	77	44	NR	110
Acetone	1,300E	870	190	570B	63	NR	1,400E
Carbon disulfide	42	37J	20	ND	66	NR	41
1,2-Dichloroethene (total)	ND	ND	10J	ND	10J	NR	ND
2-Butanone	240	320	45	110	ND	NR	280
Trichloroethene	ND	ND	18	ND	8J	NR	ND
Benzene	ND	ND	6J	ND	ND	NR	ND
4-Methyl-2-pentanone	51J	ND	29	ND	21J	NR	ND
Tetrachloroethene	ND	ND	ND	ND	13J	NR	ND
Toluene	77	110	110	35	78	NR	49
Ethylbenzene	40	60	86	20J	55	NR	35
Total xylenes	150	260	310	64	230	NR	150
Volatile TICs (ug/kg)							
C10H16 Isomer	860J (3)	ND	990J (3)	ND	1,240J (3)	NR	ND
Unknown	ND	1,250J (3)	ND	263J (2)	ND	NR	915J (3)
TCL Semivolatiles (ug/kg)							
Phenol	ND	ND	390J	ND	ND	ND	ND
Benzyl alcohol	ND	ND	370J	ND	ND	ND	ND
4-Methylphenol	5,500J	ND	370J	ND	4200J	ND	3400
Naphthalene	2,2000	3200	5900	17000	270000E	ND	23000
2-Methylnaphthalene	6,100J	ND	2400J	3700	42000	27000JD	8300
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	1,400J	ND	1600J	ND	2400J	3000JD	ND
Acenaphthene	9200	ND	2000J	2400	46000	41000D	16000
Dibenzofuran	6,000J	ND	2200J	1700	40000	39000D	13000
Diethylphthalate	ND	ND	ND	ND	ND	ND	ND
Fluorene	10000	ND	4000	2800	52000	48000D	17000
Phenanthrene	56000	9700	26000	18000	220000	200000D	53000E
Anthracene	12000	2000	5200	3800	42000	40000D	15000
Di-n-butylphthalate	ND	2400	ND	ND	ND	9600JB	2400
Fluoranthene	59000	13000	25000	24000	140000	160000D	50000E
Pyrene	44000	11000	22000	19000	120000	87000D	42000E
Butylbenzylphthalate	5700J	31000	5200	2200	67000	58000D	3200
Benzo(a)anthracene	25000	5500	9400	8900	34000	34000D	15000
Bis(2-ethylhexyl)phthalate	52000	28000B	20000	55000BE	21000	18000JD	22000B
Chrysene	22000	5100	10000	8200	33000	35000D	16000
Benzo(b)fluoranthene	20000	4800	16000X	6400	34000X	43000X	11000
Benzo(k)fluoranthene	21000	3200	16000X	6000	34000X	43000X	8000

Numbers in parentheses indicate number of identified compounds.

ND - Not detected.
NR - Not run.
B - Compound present in blank.

J - Estimated concentration; compound below detection limit.
X - Coeluted.
D - Compound detected in diluted sample.

TABLE 2 (Page 2 of 7)

TUXEDO PHASE II TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	1A	1B	2A	2B	3A	3A	3B
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NYSDEC SAMPLE I.D. No.	SH336035-26	SH336035-36	SH336035-27	SH336035-37	SH336035-28	SH336035-28DL	SH336035-38
PARAMETER							
TCL Semivolatiles (ug/kg or ppb) (Cont.)							
Benzo(a)pyrene	19000	4500	9400	6600	16000	18000JD	8400
Indeno(1,2,3-cd)pyrene	14000	2400	5600	3100X	11000J	5000JD	3400
Dibenzo(a,h)anthracene	ND	ND	1900J	ND	ND	ND	ND
Benzo(g,h,i)perylene	13000	2400	4600	3000X	9700J	3600JD	2800X
Di-n-octylphthalate	ND	1900	ND	1700	ND	ND	830J
Semivolatile TICs (ug/kg)							
C10H16 Isomer	23000J	ND	6600J	ND	60000J	45000JD	ND
C10H16 Isomer	13000J	ND	ND	ND	ND	27000JD	ND
Benzene proprionic acid	92000J	ND	ND	ND	ND	ND	ND
C12H1602 Isomer	11000J	ND	ND	ND	ND	ND	ND
4H-Cyclopenta[def] phenanthrene	8700J	ND	5900J	ND	34000J	32000JD	ND
Hexadecanoic acid	24000J	ND	ND	ND	ND	ND	ND
Sulfur, mol. (S8)	460000J	ND	26000J	ND	400000J	290000JD	ND
Unknowns	14000J (2)	29800J (10)	ND	34000J (6)	279000J (5)	666000JD (6)	51900J (7)
Unknown alkanoic acid	11000J	ND	ND	ND	ND	ND	ND
Unknown branched alkane	9600J	ND	ND	ND	ND	ND	ND
C17H12 Aromatic isomer	20600J (2)	ND	11000J (2)	ND	28000J	ND	ND
Unknown alkane	79000J (4)	5900J (3)	35100J (4)	ND	87000J (4)	151000JD (4)	7600J (3)
Unknown phthalate	71000J	ND	8600J	ND	ND	ND	ND
Benzo(j)fluoranthene	9200J	ND	ND	ND	ND	ND	ND
Benzo(e)pyrene	14000J	ND	4300J	ND	ND	ND	ND
1-Methyl-1-(methylethyl) benzene	ND	ND	3000J	ND	ND	20000JD	ND
C11H24 Isomer	ND	ND	41000J	ND	ND	ND	ND
C10H18 Isomer	ND	ND	3000J	ND	ND	ND	ND
Methylphenanthrene/anthracene	ND	ND	3500J	ND	ND	ND	ND
Docosane	ND	ND	7100J	ND	ND	ND	ND
Tetracosane	ND	ND	13000J	ND	ND	ND	ND
C18H12 & C18H10 Aromatic isomers	ND	ND	15000J	ND	ND	20000JD	ND
Pentacosane	ND	ND	17000J	58000J (3)	28000J	23000JD	ND
Hexacosane	ND	ND	ND	ND	42000J	25000JD	ND
Unknown adipate	ND	ND	ND	ND	56000J	ND	ND
Benzo(b)thiophene	ND	ND	ND	ND	20000J	ND	ND
1-Methylnaphthalene	ND	ND	ND	ND	23000J	21000JD	ND
C11H24 Isomer	ND	ND	ND	ND	60000J	ND	ND
Bicyclo[2.2.1]heptan-2-one, trimethyl isomer	ND	ND	ND	1900J	ND	20000JD	ND

Numbers in parentheses indicate number of identified compounds.

ND - Not detected.
NR - Not run.
B - Compound present in blank.

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D - Compound detected in diluted sample.

TABLE 2 (Page 3 of 7)

TUXEDO PHASE II TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	1A	1B	2A	2B	3A		3B
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NYSDEC SAMPLE I.D. No.	SH336035-26	SH336035-36	SH336035-27	SH336035-37	SH336035-28	SH336035-28DL	SH336035-38
PARAMETER							
Semivolatile TICs (ug/kg or ppb) (Cont.)							
Dibenzothiophene	ND	ND	ND	ND	ND	ND	ND
9H-Carbazole	ND	ND	ND	ND	ND	ND	ND
Benzo[B]naphtho[2,3-D]furan	ND	ND	ND	ND	ND	ND	ND
9H-Fluorene-carbonitrile isomer and unknown alkane	ND	ND	ND	ND	ND	ND	ND
C12H9N Isomer	ND	ND	ND	ND	ND	ND	ND
2-Phenylnaphthalene	ND	ND	ND	ND	ND	ND	ND
Octanoic acid	ND	ND	ND	ND	ND	ND	ND
Unknown hydrocarbon	ND	10400J (2)	ND	73600J (9)	ND	ND	55400J (4)
Unknown ketone	ND	13200J (2)	ND	ND	ND	ND	12200J (2)
Unknown PAH	ND	6000J (2)	ND	ND	ND	ND	39800J (2)
Unknown substituted benzene	ND	1400J	ND	ND	ND	ND	11000J
5-Hexen-2-one, 5-methyl	ND	ND	ND	9300J	ND	ND	ND
3-Heptanone,2,4-dimethyl	ND	ND	ND	2600J	ND	ND	ND
Limonene	ND	ND	ND	1300J	ND	ND	ND
1,2-Ethanediol, monoacetate	ND	ND	ND	1300J	ND	ND	ND
1,4-Methanonapthalene, 1,4-	ND	ND	ND	2000J	ND	ND	ND
Heptadecane, 2,6-dimethyl	ND	ND	ND	3200J	ND	ND	ND
Pentatriacontane	ND	ND	ND	20000J	ND	ND	ND
Heptadecane, 2,6-dimethyl	ND	ND	ND	12000J	ND	ND	ND
Pesticides/PCBs ug/kg							
Dieldrin	ND	ND	ND	NR	ND	ND	20
Aroclor 1242	ND	1000	ND	970	ND	ND	640
Aroclor 1260	ND	200	ND	350	ND	ND	500

Numbers in parentheses indicate number of identified compounds.

ND - Not detected.
NR - Not run.
B - Compound present in blank.

J - Estimated concentration; compound below detection limit.
X - Coeluted.
D - Compound detected in diluted sample.

TABLE 2 (Page 4 of 7)

TUXEDO PHASE II TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	4A		4B	5A	5B	1A		1B	
LABORATORY	ENSECO	ENSECO	VERSAR	ENSECO	VERSAR	ENSECO	ENSECO	VERSAR	VERSAR
NYSDEC SAMPLE I.D. No.	SH336035-29	SH336035-29DL	SH336035-39	SH336035-30	SH336035-40	SH336035-26MS	SH336035-26MSD	SH3360-36MS	SH3360-36MSD
PARAMETER									
TCL Volatiles (ug/kg or ppb)									
Methylene chloride	15	ND	140	10J	220	91B	84B	99	110
Acetone	320	ND	730B	360	1300B	1100	1700E	930	970
Carbon disulfide	14	ND	ND	ND	ND	10J	14J	ND	ND
1,2-Dichloroethene (total)	9J	ND	ND	11J	ND	ND	ND	ND	ND
2-Butanone	110	ND	91	130	ND	220	320	390	400
Trichloroethene	8J	ND	ND	10J	ND	ND	ND	ND	ND
Benzene	7J	ND	ND	7J	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	76	ND	ND	68	ND	46J	62	ND	ND
Tetrachloroethene	5J	ND	ND	3J	ND	ND	ND	ND	ND
Toluene	160	ND	57	160	64	ND	ND	ND	ND
Ethylbenzene	62	ND	23J	55	54	26J	28J	42J	41J
Total xylenes	190	ND	78	180	190	110	120	210	220
Volatile TICs (ug/kg)									
C10H16 Isomer	710J (3)	ND	ND	650J (3)	ND	NA	NA		
Unknown	ND	ND	50J	ND	530J (2)	ND	ND	NA	NA
TCL Semivolatiles (ug/kg)									
Phenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzyl alcohol	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	3500	7600J	5200J	2600	5000
Naphthalene	15000	13000JD	4400	1800	12000	32000	18000	5300	7000
2-Methylnaphthalene	7200J	4800JD	2000	4400	3500	14000	7100J	ND	2300
Dimethylphthalate	ND	ND	ND	ND	ND	1000J	1200J	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	4900J	1600J	ND	ND
Acenaphthene	24000	21000JD	2700	1900J	2200	ND	ND	ND	ND
Dibenzofuran	20000	16000JD	2600	960J	1600	22000	9200	1600X	2500X
Diethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	35000	290000	3700	1100J	ND	29000	14000	2200	3600
Phenanthrene	300000E	2300000	17000	5600	4500	26000E	85000	1300	26000
Anthracene	60000	480000	2500	1900J	ND	54000	21000	2700	4900
Di-n-butylphthalate	ND	98000JDB	990J	ND	1100	ND	2500J	4300	4100
Fluoranthene	360000E	3000000	23000	11000	6600	28000E	90000	16000	37000E
Benzoic acid	ND	ND			1400JX			ND	ND

Numbers in parentheses indicate number of identified compounds.

ND - Not detected.
NR - Not run.
B - Compound present in blank.

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X - Coeluted.
D - Compound detected in diluted sample.

TABLE 2 (Page 5 of 7)

TUXEDO PHASE II TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	4A		4B	5A	5B	1A		1B	
LABORATORY	ENSECO	ENSECO	VERSAR	ENSECO	VERSAR	ENSECO	ENSECO	VERSAR	VERSAR
NYSDEC SAMPLE I.D. No.	SH336035-29	SH336035-29DL	SH336035-39	SH336035-30	SH336035-40	SH336035-26MS	SH336035-26MSD	SH3360-36MS	SH3360-36MSD
PARAMETER									
TCL Semivolatiles (ug/kg or ppb) (Cont.)									
Pyrene	330000E	2000000	26000	9800	6000	ND	ND	Y	Y
Butylbenzylphthalate	200000	140000D	2600	5400	2700	4300J	5400J	20000	17000
Benzo(a)anthracene	130000	110000D	12000	4400	3300	100000	33000	6600	18000
Bis(2-ethylhexyl)phthalate	50000	350000	43000BE	13000	46000BE	13000	18000	87000BE	160000BE
Chrysene	140000	110000D	11000	5000	3300	93000	30000	6500	17000
Benzo(b)fluoranthene	200000X	200000XD	12000	6900X	3700	150000X	46000X	6500	17000
Benzo(k)fluoranthene	200000X	200000XD	7300	6900X	2600	150000X	46000X	3800	11000
Benzo(a)pyrene	120000	990000	9100	4600	3200	83000	27000	5500	15000
Indeno(1,2,3-cd)pyrene	29000	310000	4200	ND	1500	26000	13000	2700	6700
Dibenzo(a,h)anthracene	11000J	9000JD	ND	ND	ND	6500J	3400J	ND	2300
Benzo(g,h,i)perylene	22000	230000	3600	ND	1700	20000	11000	2700	5800
Di-n-octylphthalate	ND	ND	1800	ND	2400	ND	ND	7400	3600
Semivolatile TICs (ug/kg)									
C10H16 Isomer	ND	19000JD	ND	5500J	ND	NA	NA	NA	NA
C10H16 Isomer	ND	ND	ND	ND	ND	NA	NA	NA	NA
Benzene proprionic acid	ND	ND	ND	ND	ND	NA	NA	NA	NA
C12H1602 Isomer	ND	ND	ND	ND	ND	NA	NA	NA	NA
4H-Cyclopenta[def] phenanthrene	36000J	30000JD	ND	ND	ND	NA	NA	NA	NA
Hexadecanoic acid	ND	ND	ND	ND	ND	NA	NA	NA	NA
Sulfur, mol. (S8)	200000J	110000JD	ND	382700J (2)	ND	NA	NA	NA	NA
Unknowns	38000J (2)	450000JD (4)	25680J (8)	22900J (6)	72200J (9)	NA	NA	NA	NA
Unknown alkanoic acid	ND	ND	ND	12300J (2)	ND	NA	NA	NA	NA
Unknown branched alkane	ND	ND	ND	ND	ND	NA	NA	NA	NA
C17H12 Aromatic isomer	ND	78000JD (3)	ND	ND	ND	NA	NA	NA	NA
Unknown alkane	130000J (4)	48000JD (3)	8100J (4)	16100J (5)	4800J (2)	NA	NA	NA	NA
Unknown phthalate	ND	ND	ND	11600J (2)	ND	NA	NA	NA	NA
Benzo(j)fluoranthene	15000J	ND	ND	ND	ND	NA	NA	NA	NA
Benzo(e)pyrene	41000J	ND	ND	ND	ND	NA	NA	NA	NA
1-Methyl-1-(methylethyl) benzene	ND	ND	ND	ND	ND	NA	NA	NA	NA
C11H24 Isomer	ND	ND	ND	ND	ND	NA	NA	NA	NA
C10H18 Isomer	ND	ND	ND	ND	ND	NA	NA	NA	NA
Methyl phenanthrene/ anthracene	32000J (2)	15000JD	ND	ND	ND	NA	NA	NA	NA
Docosane	ND	ND	ND	ND	ND	NA	NA	NA	NA

Numbers in parentheses indicate number of identified compounds.

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D - Compound detected in diluted sample.

TABLE 2 (Page 6 of 7)

TUXEDO PHASE II TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	4A		4B	5A	5B	1A		1B	
LABORATORY	ENSECO	ENSECO	VERSAR	ENSECO	VERSAR	ENSECO	ENSECO	VERSAR	VERSAR
NYSDEC SAMPLE I.D. No.	SH336035-29	SH336035-29DL	SH336035-39	SH336035-30	SH336035-40	SH336035-26MS	SH336035-26MSD	SH3360-36MS	SH3360-36MSD
PARAMETER									
Semivolatile TICs (ug/kg or ppb) (Cont.)									
Tetracosane	ND	ND		ND		NA	NA	NA	NA
C18H12 & C18H10 Aromatic isomers	27000J	22000JD		ND		NA	NA	NA	NA
Pentacosane	ND	ND	ND	ND	ND	NA	NA	NA	NA
Hexacosane	ND	ND		ND		NA	NA	NA	NA
Unknown adipate	ND	ND		ND		NA	NA	NA	NA
Benzo(b)thiophene	ND	ND		ND		NA	NA	NA	NA
1-Methylnaphthalene	ND	ND		2100J		NA	NA	NA	NA
C11H24 Isomer	ND	ND		ND		NA	NA	NA	NA
Bicyclo[2.2.1]heptan-2-one, trimethyl isomer									
Dibenzothiophene	14000J	ND	ND	ND	ND	NA	NA	NA	NA
9H-Carbazole	25000J	ND		ND		NA	NA	NA	NA
Benzo[B]naphtho[2,3-D]furan	19000J	40000JD		ND		NA	NA	NA	NA
9H-Fluorene-carbonitrile isomer and unknown alkane	23000J	ND		ND		NA	NA	NA	NA
C12H9N Isomer	ND	21000JD		ND		NA	NA	NA	NA
2-Phenylnaphthalene	ND	15000JD		ND		NA	NA	NA	NA
Octanoic acid	ND	ND		3500J		NA	NA	NA	NA
Unknown hydrocarbon	ND	ND	13100J (5)	ND	336000J (9)	ND	ND	NA	NA
Unknown ketone	ND	ND	12800J (3)	ND	8300J (2)	ND	ND	NA	NA
Unknown PAH	ND	ND	7500J (2)	ND	1700J	ND	ND	NA	NA
Unknown substituted benzene	ND	ND	ND	ND	ND	ND	ND	NA	NA
5-Hexen-2-one, 5-methyl	ND	ND	ND	ND	NDL	ND	ND	NA	NA
3-Heptanone, 2,4-dimethyl	ND	ND	ND	ND	ND	ND	ND	NA	NA
Limonene	ND	ND	ND	ND	ND	ND	ND	NA	NA
1,2-Ethanediol, monoacetate	ND	ND	ND	ND	ND	ND	ND	NA	NA
1,4-Methanonapthalene, 1,4-	ND	ND	ND	ND	ND	ND	ND	NA	NA
Heptadecane 2,6-dimethyl	ND	ND	ND	ND	ND	ND	ND	NA	NA
Pesticides/PCBs (ug/kg)									
Dieldrin	ND	ND	28F	ND	33	ND	ND	ND	ND
Aroclor 1242	ND	ND	550	ND	500	ND	ND	3300	3000
Aroclor 1260	ND	ND	240	ND	170	ND	ND	740	1100

Numbers in parentheses indicate number of identified compounds.

ND - Not detected.
NR - Not run.
B - Compound present in blank.

J - Estimated concentration; compound below detection limit.
X - Coeluted.
D - Compound detected in diluted sample.

TABLE 2 (Page 7 of 7)

TUXEDO PHASE II TEST PIT DATA SUMMARY

Tuxedo WD Site NYSDEC I.D. No. 336035

SAMPLE LOCATION (TEST PIT No.)	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B
LABORATORY	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO	ENSECO
NYSDEC SAMPLE I.D. No.	SH336035-11	SH336035-12	SH336035-13	SH336035-14	SH336035-15	SH336035-16	SH336035-17	SH336035-18	SH336035-19	SH336035-20
PARAMETER										
TCL Metals (ug/kg or ppb)										
Aluminum	6480000	8920000	6000000	6400000	7920	7750000	6670000	5510000	9450000	7530000
Antimony	9100AN	NDN	11800AN	11000AN	13600AN	11100AN	18800N	16300AN	10100AN	16700AN
Arsenic	4200	4300	3900+	11400	6700	8500	18500	4600	4200S	9000S
Barium	741000*	575000*	571000*	684000*	2200000*	311000*	486000*	1700000*	532000*	1120000*
Beryllium	340A	360A	400A	310A	490A	430A	420A	310A	490A	430A
Cadmium	ND	6100*	4600*	1600*	1500*	1700*	2600*	3000*	5300*	4900*
Calcium	49600000	34000000	91700000	54500000	87900000	48900000	80200000	86900000	34600000	57000000
Chromium	42900	46800	25900	37800	29100	27200	23500	30900	83800	49000
Cobalt	8000A	14200	5100A	7500A	6600A	8200A	5500A	5900A	12800	11300A
Copper	1520000*	239000*	44700*	175000*	629000*	106000*	66400*	87900*	236000*	304000*
Iron	18500000	31800000	14100000	27400000	17200000	21900000	16600000	13700000	39800000	35600000
Lead	582000*	868000*	523000*	2160000*	697000*	722000*	511000*	714000*	857000*	1710000*
Magnesium	7230000	7550000	6460000	6640000	8740000	5720000	9340000	8650000	5520000	7850000
Manganese	335000*N	512000*N	295000*N	266000*N	312000N*	336000N*	432000N*	256000N*	704000N*	434000N*
Mercury	1000	2200	700	1100	900	1000	800	700	1600	1900
Nickel	39100	63200	18000	23300	24500	26600	18200	18900	76800	94500
Potassium	1280000	1070000A	1240000A	1230000A	1650000	1200000A	1440000	1440000	784000A	1420000A
Selenium	ND	ND	ND	610A	ND	ND	ND	ND	ND	NDW
Silver	2300A	1300A	8200	1100A	1500A	ND	1600A	1300A	1200A	4400
Sodium	705000A	962000A	326000A	309000A	758000A	410000A	647000A	848000A	368000A	1160000A
Vanadium	29600	43900	56100	32300	33600	22700	32400	21400	48300	55200
Zinc	890000E*	1410000E*	531000E*	1450000E*	1560000E*	534000E*	738000E*	1180000E*	210000E*	3440000E*
Cyanide	1500	ND	ND	ND	1800	1300	680	ND	2000	2100
Total Solids %	78.9	84.4	73.0	76.0	74.4	77.7	73.9	72.2	79.6	70.1
Dioxins (ug/kg or ppb)	[SH336035-21]		[SH336035-22]							
1,2,3,4,6,7,8HCDD	1.5	NR	ND	NR	NR	NR	NR	NR	NR	NR
HCDD	3.1	NR	ND	NR	NR	NR	NR	NR	NR	NR
OCDD	27.0	NR	9.1	NR	NR	NR	NR	NR	NR	NR

ND - Not detected.
A - Below contract required detection limits.
N - Spiked sample recovery not within limits.
E - Reported value is an estimate because of the presence of an interference.
W - Spike for furnace AA not within limits.
S - Value determined by method of standard additions (MSA).
* - Duplicate analyses not within control limits for all values.
+ - Correlation for MSA is less than 0.995.
NR - Not run.

TABLE 3

PRELIMINARY SCREENING
FILL WASTE/SOIL TREATMENT ALTERNATIVES

Response Media	General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability
Fill Waste/Soil (Tuxedo Site)	Institutional	None	Not applicable	May not achieve remedial action objectives.	None related to specific GRA
		Access Restriction	Fencing	Effective in restricting access to exposed areas of contamination. May not achieve remedial action objectives.	Readily implementable using locally available materials and equipment. Susceptible to vandalism. Requires maintenance and monitoring.
		Land Use Restrictions	Deed restrictions	Effectiveness dependant upon continued future implementation. Does not reduce contamination.	Dependent upon legal requirements and authority. Difficult to implement. Requires owner's consent.
	Containment	Surface Cap	Layered soil	Effective in providing a physical barrier between fill waste and surface when properly maintained and implemented in conjunction with institutional GRAs. Least susceptible to cracking. May not meet remedial action objectives alone.	Readily implementable using conventional construction requirements. Materials and equipment available.
			Asphalt	Effective in providing a physical barrier between fill waste and surface when properly maintained. Susceptible to cracking. May not meet remedial action objectives alone.	Implementability dependant upon availability of materials. Soil gas collection system may be needed.
			Synthetic material	Effective in providing a low permeability barrier between fill waste and surface. Increased effectiveness when implemented in conjunction with alternate process options. May not meet remedial action objectives alone. Does not reduce volume or toxicity of waste alone.	Readily implementable. Soil gas collection system probably necessary.

TABLE 3 (continued)

PRELIMINARY SCREENING
FILL WASTE/SOIL TREATMENT ALTERNATIVES

Response Media	General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability
Fill Waste/Soil (Tuxedo Site) Continued	Removal	Excavation	Excavation/Transportation/ Disposal	Effective in removing source of contamination. Short-term exposure risks high. May achieve remedial action objectives. Massive potential risks if accident occurs while transporting untreated material off-site. Does not reduce volume or toxicity of waste alone.	Questionable implementability made difficult by presence of combustible gases, unknowns within the landfill, off site exposure hazards and active railway. Requires on-site treatment prior to disposal or identification of suitable TSD facility for disposal of fill waste/soil.
			Excavation/ Treatment/Disposal (Transportation - if off-site treatment)	Same as above with treatment options. See "Off-site Incineration" below.	Similar potential operational hazards as above.
	Treatment	Thermal	Incineration (on-site)	Effective in removal and destruction of certain contaminants. Reduction of volume through incineration of fill waste. Increase in metals toxicity through concentration in ash residue.	Implementability moderately difficult. May need prior crushing and grinding. Disposal of incinerator bottom and fly ash required. Permits may be required and difficult to meet limits. Requires construction of processing unit and staging areas on site. Disposal of ash may be a problem due to metals content
			Incineration (off site)	Same as above with transportation to TSD facility.	Difficult to implement due to off-site facility's ability to take this type of material with these types and levels of contaminants. May need prior crushing and grinding.
		Stabilization (on site)	Various	Effective in reducing mobility of certain contaminants by combining with stabilizing agents. Large increase in volume of waste through addition of stabilizing agent. May not be suitable for certain types of waste.	Moderate implementability. Need to construct processing and staging areas on site. May need prior crushing and grinding. Volume of treated material may not be landfilled due to lack of landfill space.

TABLE 3 (continued)

PRELIMINARY SCREENING
FILL WASTE/SOIL TREATMENT ALTERNATIVES

Response Media	General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability
Georgia Tech Fill Waste	No action	None	Not applicable	Does not achieve remedial action objective.	Readily implementable
	Institutional	Access/Land Use Restrictions	Fencing/deed restriction	See "Institutional GRA" under fill waste/soil response media.	See "Institutional GRA" under fill waste/soil response media.
	Containment	Surface Cap	Layered soil asphalt synthetic material	See "Containment GRA" under fill/waste soil response media.	Difficult to implement due to slope problems, proximity of property to rail line, and drainage problems.
	Relocation	Excavation	Conventional construction	Effective in relocating fill waste from Georgia Tech property to Tuxedo Site fill waste area.	Readily implementable but may require special equipment to excavate materials.
	Removal	Excavation	Excavation/ Transportation/ Disposal	See "Removal GRA" under fill waste/soil response media. However, short-term risk is lower than B/K Parcel.	Smaller volumes involved may make landfill disposal feasible.
	Treatment	Thermal	Incineration (Off-Site)	See "Treatment GRA" under fill waste/soil response media.	Smaller volumes involved may make off-site incineration more feasible.
			Incineration (On-Site)	See "Treatment GRA" under fill waste/soil response media.	Practical only if performed together with Tuxedo fill waste.
		Stabilization	Various (On-Site)	See "Treatment GRA" under fill waste/soil response media.	Most practical if performed together with Tuxedo fill waste, but could be done separately.

TABLE 4

ARARS ASSOCIATED WITH THE TUXEDO WASTE DISPOSAL SITE

Statute, Regulation, or Program	Pertinence	Specificity
CERCLA/NCP/SARA	Applicable to remedial actions taken at CERCLA sites. While the site is not an EPA-designated CERCLA site, applicable regulations will be applied.	• Action-specific
RCRA Subtitle C/HSWA/NY HW Mgmt. Regs.	Applicable to the treatment, storage, transportation and disposal of hazardous wastes and wastes per 40 CFR 260-264 and 6 NYCRR Part 370-373.2. These regulations are applicable to the site's remedial actions. Certain RCRA regulations have been delegated to NYS.	• Action-specific
RCRA Subtitle D/ NY Solid Waste Mgmt. Regs.	Pertains to the management and disposal of solid wastes. The site contains RCRA Subtitle D construction and demolition waste. 6 NYCRR Part 360 is relevant and appropriate. Regulations regarding site closure will be applied. Certain RCRA regulations have been delegated to NYS.	• Action-specific
TSCA	Applicable to disposal of PCB-contaminated items. The bottom layer of the site's cover has low levels of PCB contamination.	• Action-specific • Contaminant-specific
SDWA	Applicable to surface water and area wells which may be utilized for public drinking water. One known private well is in the vicinity of the site. An adjacent water body, the Ramapo River, is a public water supply in New Jersey.	• Contaminant-specific • Action-specific • Location-specific
CAA	Applicable where remedial activities will impact the ambient air quality. Remedial activity options may impact air quality.	• Action-specific • Contaminant-specific

TABLE 4 (Continued)

ARARS ASSOCIATED WITH THE TUXEDO WASTE SITE

Statute, Regulation, or Program	Pertinence	Specificity
CWA	Applicable for alternatives involving all treatment with point-source discharges to surface water.	• Action-specific
OSHA	Applicable to workers and the work place throughout implementation of remedial measures.	• Action-specific • Location-specific
Haz. Materials Transportation	Applicable to the off-site transport of hazardous materials.	• Action-specific
Fish & Wildlife Coordination Act	Applicable to fish and wildlife in the vicinity of any proposed remedial actions, particularly on-site.	• Location-specific
NY Water Quality Regulations	Applicable to sources of potable water supply and for alternatives involving treatment with point source discharges to the waters of NY.	• Action-specific
NY Uniform Procedures Act	Applicable to projects needing an SPDES permit and to the construction/operation of hazardous waste treatment facilities. The site will not require a SPDES permit but will need to comply with the substantive requirements thereof.	• Action-specific

EXHIBITS

EXHIBIT A
ADMINISTRATIVE RECORD
TUXEDO WASTE DISPOSAL SITE (#336035)

A. Reports and Work Plans:

1. "Record of Decision; Tuxedo Waste Disposal Site; Orange County, New York; ID No. 336035," prepared by the New York State Department of Environmental Conservation, dated February 1992.

2. "Proposed Remedial Action Plan; Tuxedo Waste Disposal Site; AKA Barone/Sacco Dump," prepared by the New York State Department of Environmental Conservation, dated January 1992.

3. "Remedial Investigation and Feasibility Study Report; Tuxedo Waste Disposal Site; Site ID No. 3-36-035," three volumes, prepared by Metcalf & Eddy of NY, Inc.

   Volume I: Remedial Investigation Report, dated November 1991.
   Volume II: Remedial Investigation Report Appendices, dated November 1991.
   Volume III: Feasibility Study Report, dated December 1991.

4. "Fire Contingency Plan; Tuxedo Waste Disposal Site; Town of Tuxedo, Orange County, New York; NYSDEC Site ID No. 3-36-035; Standby Contract Work Assignment No. D002406," prepared by Metcalf & Eddy of NY, Inc., dated, May 1991.

5. Remedial Investigation/Feasibility Study Work Plan (seven volumes): prepared by Metcalf & Eddy of NY, Inc.

   Volume 1: Memorandum Report on Health and Safety Reconnaissance; dated April 1990.
   Volume 2: Summary NYSDEC Phase II Report and Related Information; dated April 1990.
   Volume 3: Summary Analysis Potential Remedial Alternatives; dated April 1990.
   Volume 4: Final Work Plan; dated June 1990.
   Volume 5: Field Activities Plan: Appendix I; dated April 1990.
   Volume 6: Health and Safety Plan: Appendix II; dated April 1990.
   Volume 7: Quality Assurance Project Plan: Appendix III; dated April 1990.

6. Modifications to RI/FS Work Plan:

   Letter dated July 24, 1990 from A. English (NYSDEC) to M. Kittinger (M&E of NY, Inc.) Re: changes to IRMs;
   Letter dated September 14, 1990 from A. English (NYSDEC) to M. Kittinger (M&E of NY, Inc.) Re: changes to sampling procedures;
   Letter dated December 13, 1990 from A. English (NYSDEC) to M. Kittinger (M&E of NY, Inc.) Re: cancellation of pump tests;

7. Data Validation Reports; prepared by NYTEST Environmental, Inc:

   June 3, 1991: SDG046;
   June 1, 1990: SDG043, SDG044;

April 19, 1991:	SDG046;
April 15, 1991:	SDG043, SDG044;
March 13, 1991:	SDG040, SDG041, SDG042;
February 25, 1991:	SDG040, SDG041, SDG042;
January 22, 1991:	SDG045;
November 27, 1990:	SDG042;
November 5, 1990:	SDG040, SDG041.

8. "Phase II Investigation Report; Tuxedo Waste Disposal Site No. 336035," four volumes, prepared by Lawler, Matusky & Skelly Engineers, dated March 1989.

B. Court Orders and Miscellaneous:

1. Temporary Restraining Order; dated October 5, 1987.

2. Preliminary Injunction; dated March 21, 1988.

3. Permanent Injunction; dated July 22, 1988.

4. Result of Appeal; dated October 19, 1989.

5. NYSDEC Reclassification Document determining that the site presents a significant threat to human health or the environment, dated March 27, 1989.

6. Letters from W. Reiss (NYSDEC) to Potentially Responsible Parties requesting commitments to perform needed investigations and remedies, all dated March 30, 1989.

   Recipients: R. Barone, F. Sacco, S. Khourouzian, L. Sacco, Material Transport Services - Dart Construction Company, Inc., E. Neuhauser.

7. Order on Consent between the NYSDEC and the Georgia Tech Foundation, Index # C3-0001-90-04, dated November 19, 1990.

8. Work Assignment to Metcalf & Eddy of NY, Inc. directing the performance of a Remedial Investigation/Feasibility Study at the Tuxedo Waste Disposal Site; letter dated October 30, 1989 to C. Velsor (M&E) from P. D. Smith (NYSDEC).

C. Correspondence:

1. Letter dated January 31, 1992 from William R. Sovak (Village of Sloatsburg) to Mr. Andrew English (NYSDEC), Re. inadequacy of proposed remedy.

2. Letter dated January 28, 1992 from Commissioner T. Jorling (NYSDEC) to Congressman B. Gilman, Re. response to December 4, 1991 request for information.

3. Letter dated January 21, 1992 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. comments on draft final RI/FS Report.

4. Letter dated January 19, 1992 from H.E. Nimke (Town of Tuxedo) to A. English (NYSDEC), Re. comments on draft final FS Report and Proposed Remedial Action Plan.

5. Memorandum dated January 18, 1992 from E.L. Huston (Town of Tuxedo Engineering Advisory Committee) to J. Hofmann (Town of Tuxedo EAC) copied to A. English (NYSDEC), Re. comments on draft final FS Report.

6. Letter dated January 11, 1992 from I.H. Conloy to NYSDEC, Re. alternative remedy.

7. Letter dated December 4, 1991 from Congressman B. Gilman to Commissioner T. Jorling (NYSDEC), Re. request for information.

8. Letter dated November 19, 1991 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. concerns about preferred remedial alternative.

9. Letter dated August 14, 1991 from A. English (NYSDEC) to A. Dorozynski (Town of Tuxedo), Re. Phase I RI/FS Report.

10. Letter dated August 8, 1991 from A. English (NYSDEC) to R. Murphy (Orange County Legislator), Re. progress and status of investigations.

11. Letter dated July 21, 1991 from R. Murphy (Orange County Legislator) to A. English (NYSDEC), Re. progress and status of investigations.

12. Letter dated July 18, 1991 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. Phase I RI/FS Report.

13. Letter dated July 7, 1991 from H. E. Nimke (Town of Tuxedo) to A. English (NYSDEC), Re. Phase I RI/FS Report.

14. Letter dated June 6, 1990 from A. English (NYSDEC) to A. Dorozynski (Town of Tuxedo), Re. RI/FS Work Plan.

15. Letter dated April 17, 1990 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. RI/FS Work Plan.

16. Letter dated March 16, 1989 from M. Komoroske (NYSDEC) to H. E. Nimke (Town of Tuxedo), Re. Phase II Investigation Report.

17. Letter dated January 9, 1989 from H. E. Nimke (Town of Tuxedo) to M. Komoroske (NYSDEC), Re. Phase II Investigation Report.

18. Letter dated July 11, 1988 from E. L. Huston (Tuxedo EAC) to A. Dorozynski (Town of Tuxedo), Re. Phase II Investigation Work Plan.

19. Letter dated July 28, 1988 from M. Chen (NYSDEC) to A. Dorozynski (Town of Tuxedo), Re. Phase II Investigation Work Plan.

20. Letter dated December 26, 1987 from H. E. Nimke (Town of Tuxedo) to J. Proudfit (NYS Department of Law), Re. Site status.

21. Letter dated November 13, 1987 from H. E. Nimke (Town of Tuxedo) to T. Jorling (NYSDEC), Re. Site status.

D. **Public Participation Documents:**

1. "Citizen Participation Plan; Tuxedo Waste Disposal Site," prepared by the New York State Department of Environmental Conservation, updated July 1990.

2. Public meeting transcript; meeting date - January 21, 1992.

3. Public Notice for January 21, 1992 public meeting to present the Proposed Remedial Action Plan.

4. Public Notice for August 8, 1991 public meeting to present the results of the Remedial Investigation and Phase I of the feasibility study.

5. Public Notice for May 10, 1990 public meeting to present the proposed RI/FS work plan.

6. Information Sheet: Tuxedo Waste Disposal Site; Remedial Investigation and Feasibility Study, prepared by the NYSDEC, dated May 1990.

7. Fact Sheet: Tuxedo Landfill Update; prepared by the NYS Department of Health (NYSDOH); dated May 1990.

8. Public Notice for the April 25, 1989 public meeting to present the results of the Phase II Investigation.

9. Information Sheet: Tuxedo Waste Disposal Site; prepared by the NYSDEC, dated April 1989.

10. Fact Sheet: Tuxedo Park; prepared by the NYS Department of Health (NYSDOH); dated April 1988.

EXHIBIT B

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF HAZARDOUS WASTE REMEDIATION
INACTIVE HAZARDOUS WASTE DISPOSAL REPORT

CLASSIFICATION CODE: 2 REGION: 3 SITE CODE: 336035
EPA ID: NYD982531832

NAME OF SITE : Tuxedo Waste Disposal Site
STREET ADDRESS: Route 17
TOWN/CITY: Tuxedo COUNTY: Orange ZIP: 10987

SITE TYPE: Open Dump-X Structure- Lagoon- Landfill- Treatment Pond-
ESTIMATED SIZE: 12+ Acres

SITE OWNER/OPERATOR INFORMATION:
CURRENT OWNER NAME....: ** Multi - Owner Site **
CURRENT OWNER ADDRESS.: * * * * *
OWNER(S) DURING USE...: Multiple owners during use
OPERATOR DURING USE...: Material Transport Service
OPERATOR ADDRESS......: 1025 Saw Mill River Road, Yonkers, NY
PERIOD ASSOCIATED WITH HAZARDOUS WASTE: From 3/87 To 10/87

SITE DESCRIPTION:
The site lies east of NYS Route 17 and west of the Ramapo River, separated by an active Conrail track. Construction and demolition material mixed with hazardous waste were dumped into this former gravel mine in 1987. Air releases have caused community complaints.
There are approximately 500,000 cubic yards of fill material with depths ranging to 70 feet. Based on the findings of the completed Phase II investigation, the presence of hazardous waste in the fill has been confirmed. The source can be attributed to the dump operators most likely accepting waste contaminated with petroleum products and industrial solvents.
The Ramapo River is a Class A stream at this location and a direct hydraulic connection exists between the dump and the Ramapo River and groundwater releases threaten the river.
A State Superfund RI/FS is in progress. The NYSDEC will be pursuing a full remedial program.

HAZARDOUS WASTE DISPOSED: Confirmed-X Suspected-

TYPE	QUANTITY (units)
PCBs	Unknown
Benzene	Unknown
Toluene	Unknown
Xylene	Unknown
Solvents	Unknown
Lead contaminated waste	Unknown

ANALYTICAL DATA AVAILABLE:
Air-X Surface Water-X Groundwater-X Soil-X Sediment-X

CONTRAVENTION OF STANDARDS:
Groundwater-X Drinking Water-X Surface Water- Air-

LEGAL ACTION:

TYPE..: Consent Order State- X Federal-
STATUS: Negotiation in Progress- X Order Signed-

REMEDIAL ACTION:

Proposed- Under design- In Progress- Completed-
NATURE OF ACTION:

GEOTECHNICAL INFORMATION:
SOIL TYPE: Gneiss Bedrock overlain by unconsolidated Glacial dep.
GROUNDWATER DEPTH: 9.5 - 19.5 feet in the overburden

ASSESSMENT OF ENVIRONMENTAL PROBLEMS:

Metals leaching from the fill material have been documented to violate class GA drinking water standards. Based on Ramapo River water and sediment sampling, there is a slight heavy metal contamination attributed to the dump. The site is within 2.5 miles of a mapped primary aquifer.

ASSESSMENT OF HEALTH PROBLEMS:

EXHIBIT C
RESPONSIVENESS SUMMARY
PROPOSED REMEDIAL ACTION PLAN
TUXEDO WASTE DISPOSAL SITE - ID NO. 336035
AKA SACCO/BARONE DUMP SITE

The issues addressed below were raised during a public meeting held on January 21, 1992 at the George F. Baker High School in Tuxedo Park, New York and in various letters received from commentors. The purpose of the meeting was to present the Proposed Remedial Action Plan (PRAP) for the site and receive comments on the PRAP for consideration during the final selection of a remedy. The transcript from the meeting and copies of the written comments are included in the administrative record for the site (Appendix A) and is available for public review. The public comment period for the PRAP extended from January 3, 1992 to February 3, 1992.

The following written comments were received regarding the proposed remedy:

1. Letter dated January 31, 1992 from William R. Sovak (Village of Sloatsburg) to Mr. Andrew English (NYSDEC), Re. inadequacy of proposed remedy.

2. Letter dated January 21, 1992 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. comments on draft final RI/FS Report.

3. Letter dated January 19, 1992 from H.E. Nimke (Town of Tuxedo) to A. English (NYSDEC), Re. comments on draft final FS Report and Proposed Remedial Action Plan.

4. Memorandum dated January 18, 1991 from E.L. Huston (Town of Tuxedo Engineering Advisory Committee) to J. Hofmann (Town of Tuxedo EAC) copied to A. English (NYSDEC), Re. comments on draft final FS Report.

5. Letter dated January 11, 1992 from I.H. Conloy to NYSDEC, Re. alternative remedy.

6. Letter dated December 4, 1991 from Congressman B. Gilman to Commissioner T. Jorling (NYSDEC), Re. request for information.

7. Letter dated November 19, 1991 from A. Dorozynski (Town of Tuxedo) to A. English (NYSDEC), Re. concerns about preferred remedial alternative.

Where the same or similar issues were raised either in writing or verbally during the public meeting, they have been grouped together and are addressed once. The remaining issues are addressed individually. The issues raised have been grouped into the following general categories: (I) Comments in Opposition to the Proposed Remedy; (II) Comments in Support of the Proposed Remedy; and (III) Miscellaneous. Of the three general response actions considered (i.e., no action, containment, and excavation/treatment), the vast majority of the comments received opposed the proposed remedy (containment) and preferred a remedy involving the complete excavation and removal of wastes from the site.

I. <u>Comments in Opposition to the Proposed Remedy:</u>

Issue #1: The proposed containment remedy should not be selected because it would maintain an intolerable financial liability upon the Town of Tuxedo.

Response: The Town of Tuxedo is neither an owner or an operator of the site, therefore, it is unclear what liability needs to be addressed by the Town. In addition, it has not been stated or suggested that the Town risks liability exposure under the Environmental Conservation Law, or any other authority, as a potentially responsible party (PRP) for the site. However, even if the Town were considered a PRP, or was found to be liable in any way for the site, the State is constitutionally prohibited from giving a gift or loaning the "credit of the State" to any public corporation or association (N.Y. Const. art. VII, § 8). The State would violate that constitutional prohibition if it were to grant the Town unlimited indemnification for some unknown liability the Town may face in the future. Therefore, the State cannot indemnify or hold harmless the Town of Tuxedo for future financial liability of the site.

Issue #2: The proposed remedy does not adequately address the long-term potential for adverse impacts to the Ramapo River.

Response: The commentors correctly observe that the Ramapo River is important not only for its status as a Class (A) trout stream but primarily as an indirect source of water for users in both New York and New Jersey. A number of water supply wells exist in aquifers influenced by the river and in some cases, water withdrawal rates exceed aquifer discharge flows into the river. In these wells, it is asserted that up to 50% of the extracted water comes indirectly from the river. Since groundwater contaminated by the site clearly discharges into the Ramapo, the need to protect the water supply from site impacts is obvious. The Department completely acknowledges and supports the goal of protecting the state's water supplies. In fact, a great deal of the Department's regulatory structure and initiatives primarily boil down to water resource protection, development, and restoration.

Achieving this goal on a statewide basis clearly calls for a rational, reasoned approach that balances available resources, available technology, the problem to be faced, and the needs of the citizens of New York State and citizens of other states where they are influenced by actions taken in New York. The alternative to taking a balanced approach is irresponsibility and ineffective stewardship.

Issue #2 can be rephrased to express the concern that there is a good chance that sometime in the future, significant quantities of toxic contaminants will be released from the site into the river where they will cause serious impacts upon downstream users of the river. The short response to this issue is that the evidence indicates that this is relatively unlikely. Nevertheless, if significant releases of contaminants were to occur, feasible, reasonable actions can be taken to prevent significant impacts. Also, removing the wastes would present increased health risks and would divert funding from tens or hundreds of sites in the state that present similar or greater threats. These negative consequences are essentially intolerable.

A more complete response takes into account the issues and questions addressed in the RI/FS. Six major questions are identified: 1) What is the **nature** and **extent** of the known threat? 2) What are the **effects** of the threat? 3) What are the available **remedies**? 4) What are the **advantages** and **disadvantages** of implementing the remedies? 5) What is the **likelihood** that there will be significant new releases in the future? and 6) What are the **options/consequences** for addressing this possibility? Any rational analysis must be based upon an understanding of actual conditions. The potential consequences of unknown but conceivable hazards can then be considered and addressed in terms of risk management.

These questions have been considered and addressed for all site related exposure pathways but the issue raised specifically addresses the surface water (i.e., Ramapo River) pathway. The **nature** of the threat is that groundwater contaminated with metals (particularly iron, sodium, manganese, magnesium, and lead) and very low levels of organic compounds (benzene, phenol, naphthalene, acenapthene, and chrysene) discharges into the river. The concentrations of the metals and the release rate is not high enough to cause any significant impact upon the river. The presence of the discharge and a marginal influence can, however, be detected in the major discharge area adjacent to the site. Therefore, the **extent** of the known threat is limited to the portion of the river alongside the site. Although conditions in the river have the potential for being quite variable, the characteristics of the source of the discharge, that is site groundwater, has been found to be relatively consistent.

The **effects** of the actual threat are essentially nil since impacts on the river downstream of the site are not detectable. Therefore, conducting a baseline risk assessment to assess the affects on site contamination or downstream users would be entirely speculative.

Since we have determined that the existing threat is marginal to nil, then no action would be an appropriate response to the threat posed to the Ramapo River. Evaluating other pathways and legal requirements (i.e., the air pathway and closure requirements), however, led to the conclusion that action is necessary. Fortuitously, this action (site containment), benefits the river by reducing already low releases.

The potentially **available remedies** fall into the three categories of no action, containment, and excavation/treatment. Three levels of analysis of the available remedies have been performed (i.e. screening, detailed, and comparative). Detailed analyses were performed of potential remedies that would influence the interactions between the site and the river. While the potential remedies focused upon the site as the source of the threat, technologies that focused upon the river were also screened. These included in-situ processes such as sediment excavation, treatment (e.g., bubbler aeration), and treatment at withdrawal points.

The **advantages** and **disadvantages** of the potential remedies are addressed in the detailed and comparative analyses in the Feasibility Study. The selected remedy (containment) was found to be the best solution because it adequately addresses the threat, can be completed relatively quickly, and is cost effective (see the response to Issue #5 for a discussion of time and cost considerations). The excavation/treatment remedies would address the threat but would take much longer, present greater risk from the air pathway, and has no realistically available funding source. Dedicating the money needed to fund this option would necessitate ignoring tens or hundreds of other sites across the state that present similar or greater risks.

Determining the **likelihood** of significant new releases in the future is more difficult to address because there is no basis for formulating a reasonable exposure scenario in terms of contaminants, concentrations, release durations, or other factors needed to assess risk. In lieu of a quantitative assessment, the approach selected was to envision a scenario where currently undetected compounds of high toxicity were released into the river and remained in the river at concentrations that would adversely impact downstream users.

Although conceivable, this scenario is considered very unlikely because of the way the site was constructed. Considering the hydraulics of the site, it is likely that if significant quantities of toxic materials were present at the base of the site, at least traces would be detectable after four years with little to no restrictions on water infiltration. The site is completely unlined and little to no care was taken during waste emplacement that would lengthen the lifetime of containers. The most plausible scenario includes toxic wastes buried at the base of the dump, some of which is only slightly above (or perhaps below) the water table. Multiple excavations in the upper 20 feet of the dump where soil gas concentrations were highest also yielded no evidence of this type of disposal.

Even so, if the worst were to occur, what could be done (**options**)? The first and most direct step would be to treat extracted water at the affected withdrawal point(s). This is a common practice across the state, is easily implemented, and is reliable. After an adequate understanding of the situation was achieved, a decision could be made to upgrade the remedy at the site to prevent releases from the site to the river. This could include the installation of a vertical groundwater barrier and a groundwater extraction and treatment system. This was evaluated as B/K Alternative #5 in the feasibility study. Technical difficulties would be encountered in implementing this process option but it is feasible with existing technology.

The remaining concern is whether or not the monitoring network would serve as an adequate alarm system. The proposed monitoring program takes into account release points, release rates, quantities of saturated waste, time scales (of leachate generation, groundwater contamination, and groundwater release), the likelihood of release, and existing requirements for routine sampling/analysis at withdrawal points. Further details of the monitoring program are discussed in response to Issue #9F.

The proposed containment remedy, therefore, goes beyond what is needed to properly address the known threat and adequately takes into account the possibility of future releases by having identified and evaluated contingencies that could be implemented. The proposed remedy and the contingencies, which are protective of human health and the environment, can be implemented in less time, with less risk, and at a small fraction of the cost of even the least expensive excavation/treatment alternative.

Issue #3: The entire contents of the site should be excavated and removed from the site because of the uncertainties associated with the health effects resulting from chronic exposures to low concentrations of contaminants.

Response: The comment reflects the concern that what we <u>don't</u> know about the wastes in the site and the health effects of long-term exposure may be more significant than what we <u>do</u> know. The commentor cites a newspaper article that summarizes the conclusions of a National Research Council (NRC) report that discusses this and other issues. The point appears to be that billions of dollars may be wasted in cleanup programs across the country by either not doing enough or overreacting due to an inadequate understanding of the hazards presented by these sites to the public. The article notes that millions of dollars are being spent in research to increase our understanding of these problems and interactions.Acknowledging that these uncertainties exist, the Department is faced with the task of making reasonable decisions based upon existing knowledge and understanding balanced by a realistic assessment of the consequences of making incorrect assumptions. This process led to the selection of the remedy for this site.

The concern raised in this issue focuses on what the health risk is from exposure to site related contaminants, both identified and unidentified. The key to assessing this risk is the concept of an exposure pathway. An exposure pathway refers to the environmental media (i.e., air, water, soil) through which contaminants travel to a receptor. Exposure routes are the ways that contaminants enter the receptor (e.g., inhalation, ingestion, dermal absorption, injection). To create a health effect, there must be a complete exposure pathway and a complete exposure route (which also implies the existence of a receptor).

The RI/FS process showed that this site presents two exposure pathways of concern. These include the air pathway and the groundwater/surface water pathways. For the air pathway, the exposure route of concern is inhalation. For the water pathway, the route of concern is ingestion. As discussed in the response to Issue #2, the proposed remedy adequately addresses the water pathway.

The results of the air pathway analysis suggested that the cancer and non-cancer health impacts on the community are also marginal. The most significant problem appears to be presented by hydrogen sulfide which causes a nuisance odor. It is predicted that the concentration of hydrogen sulfide will occasionally exceed the one-hour ambient air standard for the compound near the site. Even so, an argument could be made for selecting the no-action alternative to address the air pathway. This would result in a remedial action that did not include a landfill gas collection/treatment component.

New York State, however, takes the position that risks should be minimized to the extent feasible. After evaluating the criteria used to determine feasibility, gas collection/treatment is shown to be feasible, beneficial, and effective. Also, the uncertainties regarding the analysis of the air pathway are greater than the water pathway creating the need to be especially conservative even if it results in being significantly overprotective.

The question is raised, is complete waste removal the only option available for achieving this protectiveness? Since gas collection/treatment cuts off the air pathway thereby essentially eliminating that exposure, then waste removal is not the only possible solution. To the contrary, the high concentrations of contaminants that would be released by the excavation/treatment/ removal process is predicted to present a greater overall risk to the community than doing nothing at all. This is contrary to intuition but shows how high concentrations over a short period can be more significant than low concentrations over a long period. The legal requirement that the actions taken by the Department must be commensurate with the threat presented makes the decision even clearer.

Finally, the need for additional study must always be balanced by the need to take responsible action in a timely manner. Recognizing that much needs to be learned about contaminant behavior and health effects, we cannot succumb to the "paralysis of analysis" and not act in the hope of gaining new information in the future.

Issue #4: The data and analysis methods used to produce conclusions about the site are inadequate. The remedy selection process, therefore, if flawed and the conclusions cannot be supported.

Response: This is an understandable concern that results from differing perceptions of the quantity and quality of information that is needed for making decisions. This dilemma is faced each time a remedial investigation/feasibility study is designed and carried out. In this case, two particular criticisms were noted regarding the baseline risk assessment performed for the site. The first comment stated that the distribution of the atmospheric stability classes assumed during the dispersion modelling was too optimistic. The second concern was that a cancer potency factor for a particular compound was ignored.

The approach taken by the Department to respond to these issues was to first evaluate the validity of the concerns and then to evaluate how changing the conditions or assumptions would affect the selection of a remedy. In both cases, the issues were found to be arguable but making changes would not affect the remedy selection process. Since making the changes would have resulted in delays and increased costs, a decision was made to not revise the reports in this case.

If, however, the Department had concluded that a no-action remedy was appropriate for the site, then these issues could have been critical and would have received more scrutiny.

Issue #5: The estimates of how much it would cost and how long it would take to completely remove and redispose of site wastes are unrealistic.

Response: Since no information or data was submitted to contradict the cost estimates in the feasibility study, this issue appears to be a matter of perception. Unsupported statements assert that the site operator earned approximately $3 million (gross or net profit?) by dumping wastes at the site over a seven month period. Intuition has it that removing the wastes should be commensurate in terms of costs and time. This ignores, however, the realities of the situation. Unfortunately, the Department was ineffective in adequately communicating these realities.

There are many factors that result in final cost and time estimates. These are listed in Appendix A of the Feasibility Study Report and are described in the body of the report. In summary, the major factors that result in cost estimates that range from approximately $100 million to $1 billion include: 1) a prohibition on hazardous waste excavation and redisposal off-site without treatment to certain levels; 2) the limited number of feasible treatment technologies applicable to site wastes; 3) immense materials handling and waste preparation problems that would be faced before the wastes could be treated; 4) the scale of the task would strain current national treatment capacity necessitating additional time; 5) capacities of existing secure disposal facilities are limited; 6) siting new land burial facilities is extremely difficult and time consuming; 7) the process of excavating the dump would necessitate the imposition of worker/community protection measures that are costly and time consuming; 8) transportation costs would be significant; 9) various types of approvals and authorizations would be needed from many public and private agencies that could present significant delays; and 10) waste segregation and analysis would be difficult and expensive.

The goal for the accuracy of these estimates was that they be within +50 percent and -30 percent of what would be the actual cost of implementing the remedy. For example, if the actual cost of a remedy was $10 million, the initial cost estimates should be no higher than $15 million and no less than $7 million. It is preferable to initially overestimate costs rather than underestimate them. Reasonable people could certainly argue about the estimates selected but the point is that the cost of excavation/treatment would be astronomical in comparison to the problem and the available resources. It is also important to understand that the containment principles incorporated into the selected remedy apply to all materials in the site, whether they are all identified or not.

Issue #6: The wastes in the northeast corner of the Georgia Tech parcel should not be consolidated onto the main part of the site.

Response: The stated basis for this issue is that the consolidation would be prohibited. In general, restricted hazardous wastes cannot be land buried without appropriate treatment nor can the be disposed in an unacceptable facility. This is why site wastes could not be removed and dumped somewhere else or placed in a secure facility without treatment. In this case, the "site" consists of both the Barone/Khourouzian parcel and the Georgia Tech parcel. Therefore the movement of wastes would be a consolidation and not off-site disposal. The USEPA has ruled (OSWER Directive 9347.1, "Policy for Superfund

Compliance With RCRA Land Disposal Restrictions," (4/17/89)) that consolidation without treatment does not constitute "placement."

Also, it would be very difficult and expensive to cover these wastes in their current location due to the proximity to the railroad and the slopes involved. Consolidation is clearly the best solution to this problem and brings the added benefit of providing material that can be used to grade the main part of the site.

Issue #7: It is unrealistic to think that the threats posed by the site will go away in 30 years.

Response: No attempt has been made to imply that the wastes will disappear in 30 years. The costs to operate and maintain the potential remedial alternatives for 30 years are evaluated for comparison purposes and to comply with regulatory requirements for such evaluations. It is important to note that if properly designed, constructed, and maintained, the cover system could last for hundreds of years. Unlike a liner system, if defects develop in a cover system, they can be repaired.

Issue #8: The removal option was not adequately investigated or given an honest appraisal. Also, the proposed remedy ignores the concept of the Environmental Conservation Law (ECL) 27-1313 relative to returning a dump site to its "original state."

Response: This language does not appear in ECL 27-1313. The comment may be a reference to ECL 27-1313(5)(d) which says, "[t]he goal of any such remedial program shall be a complete cleanup of the site through the elimination of the significant threat to the environment posed by the disposal of hazardous wastes at the site..." Therefore the goal is not to return all dumps to their "original state" (even if that could be adequately defined), but is to eliminate significant threats. The ECL also says (27-1313(5)(c)) that, "[t]he costs incurred by the department in developing and implementing such a program shall be in an amount <u>commensurate</u> with the actions the department deems <u>necessary</u> to eliminate such danger" (emphasis added). The law continues on to give criteria for determining if a remedy is cost effective including whether "limited actions" would eliminate the danger and the "extent to which the actions would reduce such danger to human health or the environment." These criteria were addressed in the RI/FS process.

The goals of remedial actions are further discussed and defined in the "Draft Cleanup Policy and Guidelines" report prepared by the Department (dated October 1991) and currently under public review. This document states, "[t]he Department's goal for any remedial activity is to achieve pre-release conditions or environmental media standards and criteria, whichever are more stringent." It goes on to state that "[i]t is recognized that the goal of cleanup to pre-release conditions may not always be feasible." The example used to illustrate this case is the closure of landfills. The third category of remedial actions given in the report is "Regulation Closure for Landfills." This concept acknowledges that except for very small landfills, remedial programs for these sites consist mainly of containment technologies. The focus of RI/FS investigations can then be on determining if limited excavations make sense and what types of containment components are needed to eliminate the significant threat.

The assertion that the entire contents of the site must be removed to eliminate the significant threat posed by the site is contrary to the actual mandate of the law because it does not consider the consequences of the action or consider whether other more cost effective alternatives are available. Given the actual conditions at the site and the likelihood that those conditions will significantly change over time, implementing a removal remedy would be gross overkill. Removal would likely expose the community to greater risk, take five to seven times longer, and cost 10 to 100 times more than the proposed remedy. It would also deplete limited financial resources needed to address similar or greater threats at hundreds of other sites across the state. The selected remedy is protective, implementable, and cost effective.

As with Issue #4, there are differing perceptions of how much information is needed to make informed, responsible decisions. In the feasibility study, the same level of analysis (if not greater) was devoted to considering the excavation/removal options as the containment and no-action alternatives. Since there were no comments from the public requesting a more thorough analysis of the no-action alternative, the implication is that the commentors are dissatisfied with the results of the process rather than the process itself. This makes it difficult to respond because evidently no response would be adequate except to respond with a proposal to remove the wastes from the site regardless of the consequences, logic, statutory compliance, or feasibility of the action.

II. Comments in Support of the Proposed Remedy:

Issue #9: The proposed remedy will adequately insure the health and safety of Tuxedo residents and should be implemented without delay.

This commentor modified the supporting comment with statements that are best addressed as sub-issues.

Issue #9A: Land ownership and consequent liabilities must remain exclusively with the current owners.

Response: Although the State cannot force a land owner to retain a parcel if they desire and are able to sell it, the State has no intention of obtaining ownership of the parcels.

Issue #9B: Benefits from any future land use must be used to reduce remediation costs without diminishing responsibility for potential future liabilities.

Response: The ECL gives the Department authority to recover costs from responsible parties (including landowners) as well as money damages and penalties. With the assistance of the Department of Law, the DEC will seek to have responsible parties fund the remedy to the extent possible and recover already incurred costs.

Issue #9C: The residential use of either parcel should be prohibited.

Response: Where there are wastes on either parcel, this is prudent. Where a structure would not interfere with remedy, this should be evaluated on a case-by-case basis.

Issue #9D: DEC must also guarantee that should air or groundwater tests show a trend of increasing contamination, additional remedial measures will be taken expeditiously.

Response: If monitoring indicates the occurrence of releases that could cause adverse impacts, the DEC's response would be to determine the cause of the problem, identify the best solution, and implement the solution expeditiously.

Issue #9E: The 30-year monitoring period must be viewed as only a basis for comparisons among the alternatives.

Response: Agreed, see response to Issue #7.

Issue #9F: Monitoring should continue on a quarterly basis until one year after a declining trend for each and every target compound is established.

Response: The Department agrees that the monitoring program must serve as an adequate "alarm system." The proposed remedy contains a conceptual design for a monitoring system which in actual practice will be flexible. If unusual events or trends are noted, sampling/analysis frequencies will be increased. Since the target compound list (TCL) contains well over one hundred compounds and less than two dozen are of concern at this site, it would not be cost effective to analyze for the full TCL on a quarterly basis. Rather, select compounds will be searched for quarterly and the TCL used on perhaps an annual basis. Since some compounds exist naturally at levels above standards (e.g., iron), a declining trend will never be observed for all compounds.

Issue #9G: Monitoring should continue on an annual basis until the concentration of each and every target compound falls two orders of magnitude below the Standard and Guidance values. Monitoring should thereafter be conducted on a five year basis indefinitely. Exceptions should be made for floods, earthquakes, or other conditions which could reasonably be expected to alter the site. Monitoring should then occur within three months of such an event.

Response: A monitoring program based upon a one hundred fold decline would not be practicable. Limitations in analytical detection limits, background concentrations, and natural variance would make it impossible to ever achieve this criterion. Indefinite monitoring is likely, however, but the actual frequency is uncertain at this time. A five year cycle seems reasonable. The monitoring program will be flexible enough to respond to site altering conditions.

Issue #9H: Local and county government must be held harmless from liabilities created by the existence of the site.

Response: See response to Issue #1.

III. Miscellaneous:

Issue #10: Releases from the site have already resulted in intolerable health effects in the community.

Response: Health studies have been performed around several sites in the Hudson Valley area that are similar to the Tuxedo site. These studies have found a correlation between emissions from the dumps and health effects such as respiratory irritation and other effects, and nausea. These effects have been reported around the Tuxedo site. Health effects beyond these have not been documented. (Response provided by the NYS Health Department.)

Issue #11: The responsible parties should be forced to pay for the cleanup. Specific potentially responsible parties were mentioned.

Response: As discussed in the response to Issue #9B, the DEC will recover costs to the extent possible.

Issue #12: The DEC is lying.

Response: The commentor did not substantiate the accusation or suggest what possible motivation DEC staff would have to "lie" to the public.

Issue #13: Site wastes should be processed in a recycling plant funded by the responsible parties rather than containing the site.

Response: Unfortunately, very little of the waste in the site is recyclable. Also, the problems with excavation and redisposal discussed above would be encountered.