LIST OF APPENDICES

APPENDIX #1

Superfund Proposed Plan

GLOBAL LANDFILL

Borough of Old Bridge, Middlesex County

February 1991

Introduction

This Proposed Plan presents the preferred option for addressing the first of two remedial actions, known as operable units, for the Global Landfill Superfund site. The Plan identifies the preferred alternative for the proper closure of the landfill which is located in Old Bridge Township, Middlesex County, New Jersey. The Plan also includes summaries of other alternatives considered for the area designated as Operable Unit One (OU 1). This document is issued by the New Jersey Department of Environmental Protection (NJDEP), the lead agency for site activities, and the United States Environmental Protection Agency (EPA), the support agency for this project. The EPA, in consultation with the NJDEP, will select a remedy for OU 1 at the site, only after the public comment period has ended and the information submitted during this time has been reviewed and considered.

This Proposed Plan is being issued in accordance with the public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). This document summarizes information that can be found in greater detail in the Feasibility Study (FS) report and other documents contained in the Administrative Record for this site. The NJDEP and the EPA encourage the public to review these other documents in order to gain a more comprehensive understanding of the site and Superfund activities that have been conducted to date.

The Administrative Record, which contains the information upon which the selection of this response action will be based, is available at:

Old Bridge Public Library
1 Old Bridge Plaza
Old Bridge, N.J. 08857
(908) 679-5622

Documents which support the Plan can also be obtained at the following public repositories:

Sayreville Public Library
1050 Washington Road
Parlin, N.J. 08859
(908) 727-0212

Middlesex County Health Dept.
Solid Waste Program
841 Georges Road
North Brunswick, N.J. 08902
(908) 745-4350

Old Bridge Township
Clerk's Office
1 Old Bridge Plaza
Old Bridge, N.J. 08857
(908) 721-5600

Sayreville Borough
Clerk's Office
167 Main Street
Sayreville, N.J. 08872
(908) 390-7022

Community Role in the Selection Process

The NJDEP and the EPA solicit input from the community on the cleanup methods proposed at each Superfund site. Public input is an important part of the remedy selection process. The NJDEP has set a public comment period from February 19, 1991 through March 21, 1991 to encourage public participation in the selection process. The comment period includes a public meeting at which the NJDEP, with the EPA, will present the FS report and the Proposed Plan, answer questions and accept both oral and written comments.

State of New Jersey
Department of Environmental Protection

The public meeting is scheduled for Tuesday, March 12, 1991 beginning at 7:00 pm in the Old Bridge Municipal Building. A public information session will be held on Wednesday, 13, 1991 from 11:00 am to 2:00 pm in the Old Bridge Municipal Building, to provide interested parties with an additional opportunity to discuss the Plan.

Comments on the Proposed Plan and the FS report will be welcomed through March 21, 1991 and will be summarized and responded to in the Responsiveness Summary section of the Record of Decision (ROD) for Global Landfill Operable Unit 1 (the ROD is the document that presents DEP/EPA's final selection of the cleanup).

Written comments should be submitted to:

Ms. Grace Singer, Chief
Bureau of Community Relations
New Jersey Department of Environmental Protection
CN 413, 401 East State Street, 6th Floor
Trenton, New Jersey 08625-0413

Site Background

Global Landfill was a municipal landfill located in Old BridgeTownship, Middlesex County, New Jersey (See Figure 1). It is bordered by wetlands to the northeast, southeast, and southwest, in the drainage basin of Cheesequake Creek. The site is bordered on the northwest by a former sand borrow pit. To the west, northwest, and north of the site, are residential areas of Old Bridge Township and the Borough of Sayreville. The residential areas are between 500 and 2400 feet from the site and include several apartment complexes as well as single family homes.

Global Landfill was in operation from 1968 until 1984. It is approximately 57.5 acres in size, and consists of two areas (See Figure 2). The first is a 51-acre mounded area which is 108 feet above mean sea level at its highest point; the second is a 6.5-acre area, adjacent to the northwest sideslope, which is 32 feet above mean sea level at its highest point. The areas are separated by a 42-inch underground gas pipeline owned by the Transcontinental Gas Pipe Line Company (Transco).

A New Jersey Administrative Order was issued to Global Landfill in May 1981 for violation of state regulations. Global was later ordered to establish an escrow account for closure of the landfill. The site was closed in April 1984 by the NJDEP, after the southeast sideslope of the landfill failed and slid into the adjacent wetlands. The sideslope failure was caused by two days of rain and excessive high tides in the surrounding wetlands.

A New Jersey court appointed Mr. Richard Sullivan of New Jersey First, Inc., as administrator for the closure fund. In 1986, Mr. Sullivan authorized the consulting firm of E.T. Killam Associates of Millburn, New Jersey, to conduct an investigation at the site. A subsequent slope stability study was performed which showed that the side slopes adjacent to the wetlands generally do not meet acceptable safety levels. Slope movement (creep) of the southeast sideslope is occurring. It is anticipated that this creep will continue until engineering controls are implemented.

The landfill was originally reported to contain municipal solid, bulky, vegetative and non-chemical industrial waste. Allegations that large numbers of drums containing hazardous industrial waste were buried at the landfill, led to an exploratory excavation of the 6.5-acre northeast tract in March 1988. Drums of hazardous waste were encountered during the preliminary investigation, confirming the allegations. This investigation was not extended to the main (51-acre) portion of the landfill. Investigation of the main landfill area, as well the groundwater and other natural resources at the site, will be conducted during an ongoing Remedial Investigation being conducted at Global Landfill.

The site was placed on the EPA National Priorities List (NPL) in March 1989 a[illegible]ecame eligible for action under CERCLA. Ki[illegible] Associates was authorized by the NJDEP a[illegible] Mr. Sullivan to prepare a Feasibility Study for on-site controls and closure of the landfill. The Proposed Plan is based on this FS report. Since the Feasibility Study investigated closure of the landfill, it provides only limited data on the nature and extent of contamination of ground water, surface water and air at the landfill.

There are two separate aquifers being monitored for contamination in connection with Global Landfill. The first is the upper, water table aquifer. This aquifer is contaminated because it is in direct contact with the landfill. The direction of ground water flow in this aquifer may be locally influenced by the mounding of contaminated ground water within the landfill, however, this has not yet been fully defined. The water [illegible]ble aquifer is not used for drinking water, but has a direct adverse impact on the natural resources of the Cheesequake Drainage Basin. The second aquifer affected by Global Landfill is the Old Bridge Sand aquifer, a confined aquifer located beneath the water table aquifer. This

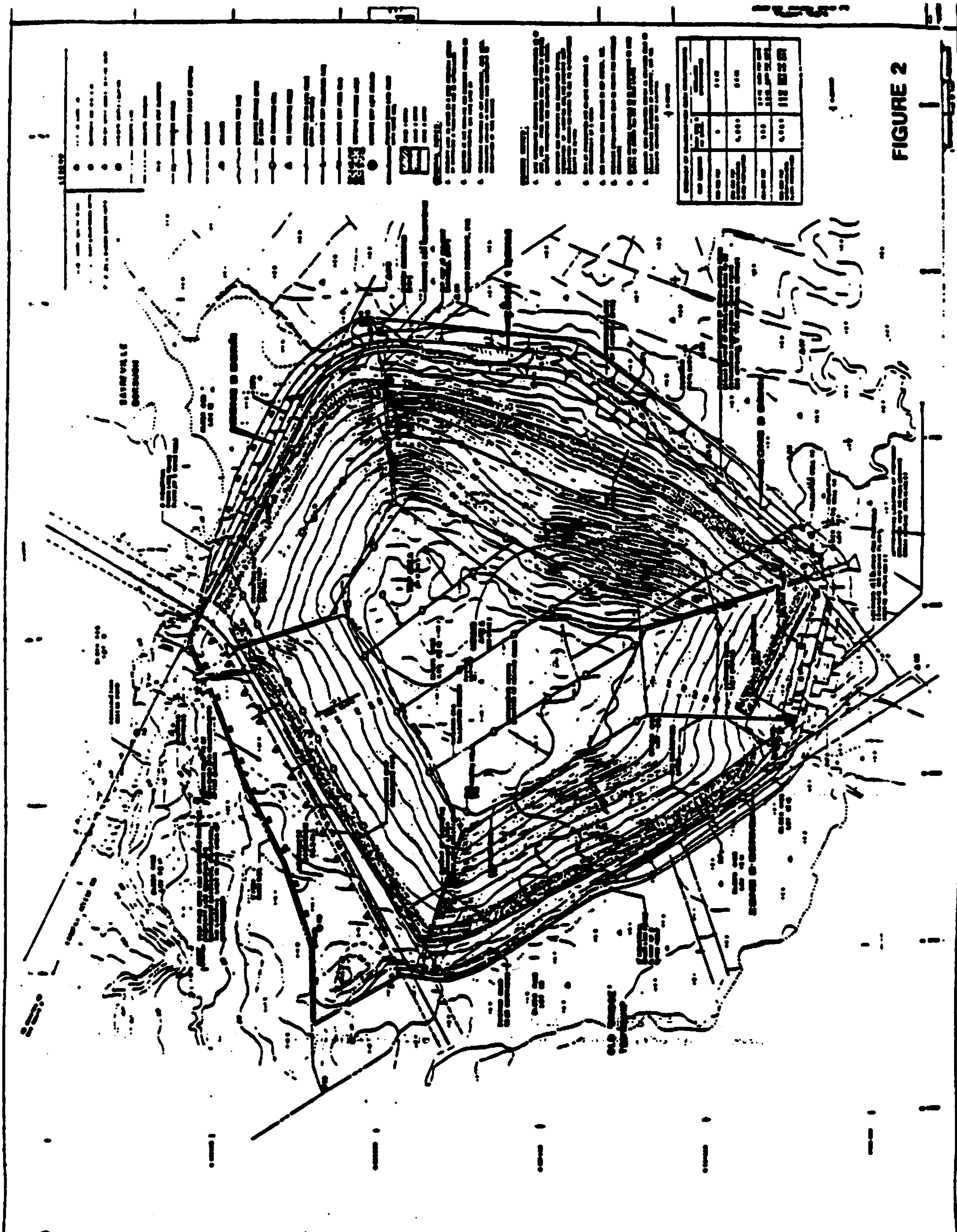
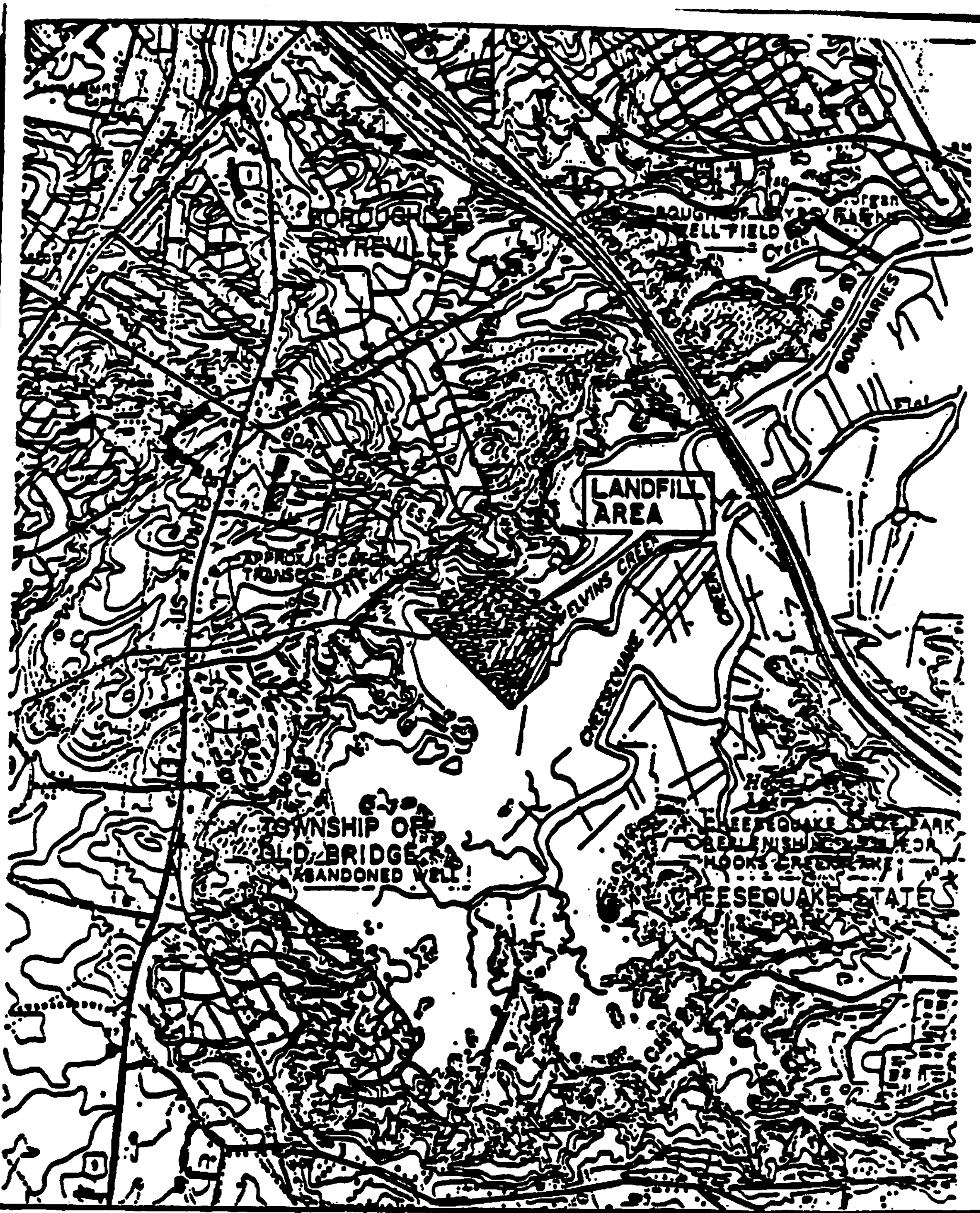


FIGURE 2



SOURCE: SOUTH AMBOY U.S.G.S
7.5 MIN. QUADRANGLE
PHOTO REVISED 1981

SCALE: 1" = 2000'

FIGURE 1

GLOBAL LANDFILL
OLD BRIDGE TOWNSHIP, N.J.

LOCATION MAP

aquifer is believed to be separated from the upper water table aquifer by a clay confining layer. The Old Bridge Sand aquifer is believed to flow in an easterly direction.

Liquid run-off from the landfill, known as leachate seepage, is visible over the landfill surface. These leachate seeps, along with contaminated soils, are washed by rain into the adjacent wetlands. Therefore, the local fauna are likely to be impacted by the migration of contaminants in the leachate.

Scope and Role of this Action

This is the first of two planned actions for this site. This action, Operable Unit 1 (OU 1) is an early response action that addresses the closure of the landfill. It consists of an impermeable cap, a gas collection and treatment system, and a leachate collection and treatment system. This action will be followed by Operable Unit 2 (OU 2) which will include the performance of a Remedial Investigation and Feasibility Study (RI/FS) that will focus on the remediation of groundwater and the natural resources at the site. The overall objective of OU 1 is to contain and limit contaminant concentrations at the site to levels protective of human health and the environment.

The purpose of the cap is to serve as an impermeable barrier to prevent the percolation of rainwater into the landfill, eliminate direct contact with the contaminated material, and restrict the escape of gasses. The cap consists of several layers, the most important of which is the impermeable layer. It is made either of a clay layer which retards the passage of water and thereby acts as a barrier, a plastic liner, or a composite (which is a clay layer overlain by a plastic liner). By preventing the passage of rainwater through the landfill, the spread of contaminants to the ground water and surface water is greatly curtailed. The rainwater is diverted through a storm water management system. Erosion control of the cap is achieved through the combination of a vegetative top layer, and diversion of the rainwater to the storm water management system.

The Transcontinental Gas Pipeline Corporation of Houston, owns a 42 inch natural gas pipeline which lies between the 6.5-acre area to the northwest of the site, and the main portion of the landfill. The pipeline is located approximately four feet beneath the original ground level, within a 75-foot easement which runs through the landfill proper. Approximately five to fifteen feet of refuse has been deposited on the Transco easement. Discussions are currently underway between representatives of Transco and the NJDEP regarding the feasibility of relocating the pipeline to an area beyond the extent of the proposed cap. This would have the desired effect of isolating the pipeline from the possible corrosive effects of contaminated ground water and leachate which may exist beneath the landfill. This action would also prevent post-construction damage to the cap, should repairs to the pipeline become necessary.

Also under consideration is the possible removal of the drums encountered during the exploratory drum excavation in the 6.5-acre tract of land north of the pipeline. The feasibility and cost-effectiveness of this option would be further evaluated during the design of the selected alternative for this operable unit.

After DEP/EPA selects the preferred alternative for OU 1, similar activities will be initiated to address the migration of contaminants from the site into nearby ground waters. Public comment will be solicited on the selection of a remedial alternative for this Operable Unit Two action at a later date.

Summary of Site Risks

The immediate problem at this site is the improperly closed landfill. When the landfill ceased operations in 1984, it was closed with only a thin soil cover. As a result of erosion by wind and rain, and the slope failure in 1984, large areas of refuse have been observed over the landfill surface. Also, due to the height and steepness of the landfill sideslopes and the weakness of the underlying soils, the landfill, in its current state, is marginally stable. Slope movement (creep) of the southeast sideslope continues to occur. It is anticipated that this creep will continue until engineering controls are implemented.

A total of 63 55-gallon drums were discovered during the drum excavation in March 1988, 18 of which were removed for sampling and analysis. The drums were generally in poor condition, having been previously crushed or corroded. Their contents included solids, sludges and liquids. Analysis indicated the presence of volatile organic compounds, base neutral extractable organic compounds and petroleum hydrocarbons.

Contaminants of concern at Global Landfill were evaluated as part of the Feasibility Study prepared by Killam Associates. Leachate seeps in the landfill were found to have much higher concentrations of contaminants, than in other media of concern at the site. Contaminants found in the leachate include:

metals, substituted alkane and alkene hydrocarbons, aldehydes, ketones, esters, ethers and aromatic hydrocarbons. Data obtained from analysis of the leachate seeps and during the drum excavation have been used to estimate concentrations typical of the entire landfill. Associated health risks are a result of these contaminants partially entering the ground water, volatilization into the air, or discharging into the wetlands.

Contaminants which were present in the leachate were also found in the upper water table aquifer beneath the site. Although this aquifer is not a potable water source for the area, it does discharge directly to the adjacent wetlands, and is therefore a potential threat to the surrounding natural resources. The major contaminants of concern in the upper aquifer are: chlorobenzene, naphthalene, xylene, ethylbenzene, benzene, methylene chloride, acenaphthene and acetone. These contaminants were found at elevated levels in excess of New Jersey Maximum Contaminant Levels (MCLs) for drinking water. Some metals were also detected at levels that exceeded New Jersey MCLs.

Beneath the upper water table aquifer lies the Old Bridge Sand aquifer, which is a regional potable water source. There were isolated instances where low levels of contamination, in excess of MCLs, were detected in this aquifer. Metals (cadmium, nickel, chromium and lead), volatile organic compounds (chlorobenzene, methylene chloride, tetrachloroethene, tetrachloroethane and vinyl chloride) and the pesticide, 4,4-DDT, were all detected in the Old Bridge Sand aquifer. Since the nearest potable wells are one mile upgradient of the site, there is little likelihood that they represent an immediate threat to public health. However, the presence of these contaminants poses a potential future threat to public health, and thereby justifies taking action at this site.

In addition to ground water, air is a medium of concern at the Global Landfill site. The detection of odors by residents surrounding the site, indicates that air is a pathway for gasses emanating from the landfill. Gasses are generated by the landfill due to the natural decomposition of organic matter. These gasses must be collected so as to avoid damage to the impermeable liner and infiltration into the air pathway. Because of the nature of the contaminants found at the landfill, it is expected that the gasses generated may include some hazardous materials. Therefore, treatment of these gasses will be necessary. Windblown particulates could also carry contaminants through the air. Dermal contact with site contaminants is another major pathway for site workers, visitors and trespassers. Although no specific toxic compounds have been identified in the air emissions from the landfill, there exists the potential of a public health risk via the air pathway. In any event, proper landfill closure requires that landfill gasses be collected and appropriately treated.

The natural resources of the Cheesequake Drainage Basin are also potentially threatened by the Global Landfill. All of the contaminants present in the upper aquifer can be expected to discharge directly into the adjacent wetlands. The wetlands are also subject to contamination from storm water runoff and leachate seeps. Limited surface water sampling shows high levels of fecal coliform bacteria and ammonia, which pose a potential threat to the local fauna. These and other contaminants were found in the surface waters which are in excess of New Jersey Surface Water Quality Standards. Other contaminants were found in the surface water at levels exceeding NJ Safe Drinking Water Act (NJSDWA) standards; these include pesticides (Lindane and DDT) and metals (cadmium, nickel, copper and zinc).

In addition, the landfill is situated on former wetlands. A berm is required at the toe of the landfill slope to support the selected cap and control the landfill movement resulting in unavoidable impact on wetlands. This impact, however, could be minimized by selecting the smallest and most effective berm possible. Mitigation of impacted wetlands would be in accordance with Section 404 of the Clean Water Act and New Jersey Coastal Wetland Act guidelines.

The nature and extent of contamination in the ground water, surface water, air and surrounding wetlands, will be fully characterized during the upcoming RI/FS.

Summary of Alternatives

In preparing the Feasibility Study, a wide range of remedial technologies were identified and initially screened for effectiveness, implementability and cost. Those alternatives which passed the initial screening are highlighted below. Under consideration is a No Action alternative and five closure alternatives which involve installation of a landfill cap. Detailed descriptions of all remedial alternatives considered for this operable unit are provided in the FS.

All alternatives considered, with the exception of the No Further Action Alternative, include the following common elements: a security fence around the perimeter of the landfill, a guard rail to prevent vehicular access, and a program to monitor movement (creep) of the landfill slope. In addition, a gas collection and treatment system, and one of three leachate collection and treatment system options will be selected. The costs for gas collection and treatment are included in the cost estimates for the capping alternatives. The costs for the leachate system options are not included in the cost estimates for the individual capping alternatives, but are listed separately. Each of the capping alternatives assume Operation and Maintenance (O&M) over a thirty year period of time. The estimated annual O&M costs, and the estimated capital construction costs, are listed at the end of each alternative, along with the calculated estimated present worth cost. Every capping alternative would require a period of approximately two years for the preparation of detailed engineering designs and specifications, followed by the construction time period shown.

Alternative 1: No Action

The National Contingency Plan (NCP) and CERCLA require the evaluation of a No Action alternative to serve as a point of comparison with other remedial action alternatives. The No Action alternative for OU 1 at the Global Landfill would require continuation of the New Jersey Pollution Discharge Elimination System (NJPDES) ground water monitoring program for 30 years. This program would consist of quarterly sampling of the 15 wells which surround the site. The samples would be analyzed for EPA priority pollutants plus water quality parameters. Also, the condition of wells would be inspected on a weekly basis. No other action is proposed under this alternative.

Estimated Capital Cost: $0
Estimated Annual O&M Cost: $210,000
Estimated Present Worth: $3,228,000

Alternative 2: NJDEP Solid Waste Cap

This alternative incorporates requirements for closure of a solid waste landfill, in accordance with the New Jersey Administrative Code (NJAC) 7:26-2A.9. It consists of a 12 inch clay layer with a permeability of 1 x 10-7 cm/sec, a drainage layer and a vegetative topsoil cover. The overall thickness of this cap is three feet.

Estimated Capital Cost: $16,915,000
Estimated Annual O&M Cost: $489,000
Estimated Present Worth: $23,722,000
Estimated Construction Period: 1 1/2 years

Alternative 3: NJDEP Hazardous Waste Cap

This alternative incorporates requirements for closure in compliance with New Jersey State Hazardous Waste Regulations (NJAC 7:26-11.4). This cap differs from the solid waste cap (Alternative 2) in that it utilizes four feet of clay (with a permeability of 1 x 10-7 cm/sec) instead of one. The overall thickness of this cap is six feet.

Estimated Capital Cost: $30,190,000
Estimated Annual O&M Cost: $581,900
Estimated Present Worth: $38,420,000
Estimated Construction Period: 2 1/2 years

Alternative 4: RCRA Hazardous Waste Cap

This alternative employs the requirements for landfill closure set forth in the Code of Federal Regulations (40 CFR 264.310) of the Resource Conversation and Recovery Act (RCRA). The RCRA cap consists of two feet of clay (with a permeability of 1 x 10-7 cm/sec), a synthetic geomembrane layer, a drainage layer and a vegetative topsoil layer. The overall thickness of this cap is five feet.

Estimated Capital Cost: $26,739,000
Estimated Annual O&M Cost: $554,000
Estimated Present Worth: $34,548,000
Estimated Construction Period: 2 1/2 years

Alternative 5: Bentonite Clay Cap

Bentonite is a clay material which is typically mixed with soil, or used alone, to form an impervious layer. This alternative would employ a layer of pure bentonite clay sandwiched between two geotextile layers. Upon contact with moisture, the 1/2 inch bentonite layer swells to a thickness of approximately two inches, to achieve a permeability of 1 x 10-9 cm/sec. This alternative would also include a drainage and vegetative layer. This cap would not meet NJDEP and RCRA hazardous waste closure requirements. The total thickness of this cover is 2.2 feet.

Estimated Capital Cost: $18,909,000
Estimated Annual O&M Cost: $504,000
Estimated Present Worth: $25,945,000
Estimated Construction Period: 1 1/2 years

Alternative 6: Modified NJDEP Hazardous Waste Cap

The Modified hazardous waste cap is a composite cap, which contains a 12 inch clay layer (with a permeability of 1 x 10-7 cm/sec) overlain by a synthetic geomembrane. This synthetic layer would consist of a non-woven geotextile spun from recycled plastic beverage bottles and bonded to a Hypalon-based containment membrane. This bonded membrane is designed to provide increased friction for landfills with steep slopes, such as the Global Landfill. As is the case with the two previous caps, this composite layer is also overlain by drainage and vegetative layers. This cap would comply with performance standards for RCRA hazardous waste landfill closure. The total thickness of this cap is three feet.

Estimated Capital Cost: $19,938,000
Estimated Annual O&M Cost: $512,000
Estimated Present Worth: $27,101,000
Estimated Construction Period: 2 years

Leachate System Options

The landfill is partially saturated with leachate due to the lack of an adequate cap. This leachate finds its way to the surface of the landfill in the form of leachate seeps, and needs to be collected. The leachate collection system would consist of a drainage blanket located beneath the impervious layer of the cap. Once collected, this leachate would be treated utilizing one of the three treatment options described below. In addition, the gas management system would generate condensate, which would also be collected and treated along with the leachate. Each treatment option would treat a flow rate that diminishes annually from approximately 20,000 gallons per day (gpd) to approximately 400 gpd after 15 years. There are three options for the leachate systems discussed below. The final option for leachate collection and treatment, however, would be selected during the design of this operable unit.

<u>Option 1: No On-Site Treatment With Discharge to an Industrial Waste Treatment Facility</u>

This option involves pumping the leachate and gas condensate c... harge to a storage tank on site. The effluent would then be transported by truck to an industrial waste treatment plant, which is a licensed hazardous waste treatment, storage and disposal facility (TSD). No pretreatment would be required for this option.

<u>Option 2: On-Site Pretreatment With Discharge to a Publicly Owned Treatment Works (POTW)</u>

This option involves pumping the leachate and gas condensate to an on-site holding tank for pretreatment. This option requires the construction of an on-site waste water pretreatment plant. The pretreated effluent would then be transported by truck, to a municipal waste water treatment facility (otherwise known as a publicly owned treatment works, or POTW). The waste from the pretreatment process would also be transported, by truck, to a TSD facility.

<u>Option 3: On-site Treatment With Discharge to Surface Water</u>

This option involves pumping the leachate and gas condensate to an on-site equalization tank, followed by full treatment and disinfection. The clean effluent would then be discharged directly to Cheesequake Creek. This option requires the construction of a complete waste water treatment plant on site. The treatment unit would be designed to produce an effluent which would meet NJPDES requirements for discharge to surface water. Like Option 2, the waste from the pretreatment process would also be transported, by truck, to a TSD facility.

Estimated Costs and Required Construction Time

<u>Option 1</u>
Capital Cost: $483,600
Annual O&M Cost: $1,394,700
Present Worth: $4,485,800
Construction Period:* 12 to 18 months

<u>Option 2</u>
Capital Cost: $1,051,700
Annual O&M Cost: $275,500
Present Worth: $2,797,700
Construction Period:* 24 to 27 months

<u>Option 3</u>
Capital Cost: $1,526,200
Annual O&M Cost: $253,100
Present Worth: $3,252,200
Construction Period:* 24 to 27 months

*The construction period of these leachate treatment options will run concurrently to the cap construction period.

Criteria for Evaluation

Nine criteria are used to evaluate the alternatives and to select the preferred alternative. This section discusses and compares the performance of the remedial alternatives under consideration against these criteria. In addition, the selected remedy for this operable unit will be consistent with the final remedy for the site, and will use treatment technologies to the maximum extent practicable. The nine criteria are described below:

Overall protection of human health and the environment addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering controls or institutional controls.

Compliance with potential ARARs addresses whether or not a remedy will meet all the applicable or relevant and appropriate requirements (ARARs) or Federal and State environmental statutes and/or provides a basis for a waiver.

Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

Reduction of toxicity, mobility or volume of contaminants addresses the anticipated performance of the remedy in terms of reducing the toxicity, mobility or volume of the contaminants of concern in the environment.

Short-term effectiveness addresses the period of time needed to achieve protection, and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

Implementability refers to the technical and administrative feasibility of implementing a remedy, including the availability of materials and services required to implement a particular option.

Cost includes estimated capital, and operation and maintenance costs of the remedy, and the net present worth of the alternatives.

State and support agency acceptance indicates whether, based on its review of the FS, the agencies involved concur with, oppose or have no comment on the preferred alternative for OU 1.

Community acceptance will be assessed in the Record of Decision following a review of the public comments received on the FS report and Proposed Plan.

Evaluation of Alternatives

The NJDEP and the EPA are required to select the remedial alternative which offers the best balance among the above nine criteria. The selected remedy must meet the first two criteria, protection of human health and the environment, and compliance with ARARs, unless a waiver for ARARs is granted. The manner in which the preferred alternative meets the criteria are addressed briefly below. After careful consideration of the remedial alternatives, the NJDEP and the EPA have preliminarily selected a Preferred Alternative. This alternative, which could change as a result of public comment, is described in the section below.

Analysis of Alternatives

The alternatives under consideration will be discussed below with respect to eight of the nine evaluation criteria. Community Acceptance will be evaluated upon completion of the public comment period and the preparation of the Responsiveness Summary.

Overall Protection

All closure alternatives, with the exception of the No Action alternative, offer protection of human health and the environment from windblown contaminants, and from direct contact with contaminated soil or leachate seeps. Alternatives 3 (NJDEP Hazardous Waste cap), 4 (RCRA cap) and 6 (Modified Hazardous Waste cap), offer the best protection of human health from gas emissions. In addition, these alternatives provide greater protection to the environment by reducing the production of leachate. However, Alternatives 3 and 4 would impact more wetland acreage because they would require larger berms. Alternative 5 (the Bentonite cap) offers less protection from gaseous emissions because the clay layer develops cracks when it is dry, allowing gasses to escape. Alternative 2 (NJDEP Solid Waste Cap) also has this problem. In addition, it has a lower impermeability to rainwater.

Alternative 6 offers the greatest overall protection of human health and the environment. This Modified NJDEP Hazardous Waste Cap alternative provides protection from leachate generation and exposure to contaminants. It is also lighter in weight and would provide a greater factor of safety for the unstable sideslopes. In addition, this alternative would require a smaller berm, thereby impacting less wetland acreage.

The landfill gasses emanating from the landfill would be collected and treated in a manner which would meet the appropriate air emissions standards, and assure protection of human health and the environment.

The No Action alternative offers little protection of human health and the environment. The risks would be exacerbated in the long term due to continual deterioration of the minimal on-site controls. This alternative will not be considered further in this document.

Compliance with ARARs

The Bentonite Clay cap (Alternative 5) and Modified Hazardous Waste cap (Alternative 6) are new capping designs and do not strictly comply with NJDEP or EPA capping guidelines. These were developed as lightweight caps to address the slope stability concerns specific to Global Landfill.

The NJDEP Solid Waste cap (Alternative 2), NJDEP Hazardous Waste cap (Alternative 3) and EPA RCRA cap (Alternative 4) are all in compliance with the appropriate requirements for landfill closure.

Hazardous waste landfill closure requirements are relevant and appropriate for closure of the Global Landfill. However, because of the instability of the steep landfill sideslopes, and the potential for another slope failure to occur, the appropriate hazardous waste cap may be technically impractical for this site. A waiver of this ARAR may be required for Alternatives 2, 4, 5, and 6.

Reduction of Toxicity, Mobility or Volume of Contaminants

None of the closure alternatives reduce the toxicity or volume of wastes present at Global Landfill, but do reduce waste mobility and provide for on-site containment of wastes. In addition, the collection and treatment of gasses would reduce the toxicity, mobility, and volume of contaminants released through the surface of the landfill.

All five closure alternatives provide for reduction in generated leachate quantity, and therefore reduce the mobility and toxicity of contaminants migrating into the ground water.

All leachate collection and treatment options would be designed to collect 100 percent of the leachate seeps and gas condensate.

Short-Term Effectiveness

All five closure alternatives may cause potential short-term health and environmental impacts. These impacts are generally related to potential exposure to waste materials (on-site) or air emissions (on or off-site), typical construction related safety hazards, increased truck traffic, noise, and potential soil erosion. The short-term impacts, however, can be mitigated through proper design. In addition, health and safety plans would be developed for protection of local residents and on-site workers.

Wetlands would be impacted during construction of the stabilization berm. The impact would be greatest with capping Alternatives 3 and 4 because of the larger sizes of the berms required to support the weight of those caps.

Short-term health and environmental effects may be a concern during well drilling for the gas collection system. Protection of local residents and on-site workers can be achieved through air monitoring, minimizing the aerial extent of waste disturbance and by employing standard dust control measures. Construction of the leachate collection system will require similar measures.

Long-Term Effectiveness and Permanence

All five closure alternatives address this criteria by eliminating the potential risks associated with the direct (on-site) contact with wastes, and the off-site migration of contaminated dust or soil particles.

While capping the landfill is a typical closure action, some of the technologies proposed are relatively new. The long-term effectiveness of the Bentonite clay cap is not well documented. Textured geomembrane liners are gaining acceptance in the industry, but they have not been employed long enough to display longevity. Other site conditions would be addressed by any of the alternatives, i.e., slope stability, storm water and erosion controls and site access controls.

All the alternatives discussed above are expected to adequately control and manage the wastes remaining on site, and residuals generated after closure. The key to effective long-term performance is post-closure operation, maintenance, inspection and monitoring. Factors that will affect long-term performance include effects of differential settlement and sideslope creep (movement). Differential settlement can damage the wells and piping systems of the gas collection and leachate collection systems as well as the low permeability layer of the cap. Buildup of solids and biological growth on well screens and piping systems can also effect long-term operation. An appropriate operation and maintenance program would be implemented to minimize these potential problems.

Implementability

Alternative 6 is the most technically feasible for Global Landfill to assure the greatest factor of safety against sideslope failure. The weight of the caps proposed in Alternatives 3 and 4, due to the amount of clay required, would result in an unacceptable factor of safety. The Bentonite clay cap proposed in Alternative 5, and the textured geomembranes in the composite clay cap alternatives (3, 4 and 6) are presently available from a limited number of manufacturers, while natural clay is available from a number of sources. Alternatives 2, 3 and 4 employ technologies that are based on conventional construction procedures. The materials and techniques required to construct these alternatives have been used at other landfills and should not be difficult to implement.

The time required to construct Alternatives 2, 5 and 6 ranges from 1 1/2 to 2 years, while Alternatives 3 and 4 would require approximately 2 1/2 years to construct. No implementation difficulties are anticipated for the gas collection and treatment system. Implementation of all leachate collection and treatment options is technically feasible.

Cost

The Preferred Alternative (Alternative 6) is the most cost effective alternative, which would also be protective of public health and the environment.

Summary of the Preferred Alternative

Based on the results of the Operable Unit One Feasibility Study report, and after careful consideration of all reasonable alternatives, the NJDEP recommends Alternative 6 as the preferred choice for addressing source control management of the landfill. This alternative involves:

- Closure of the landfill with the Modified Hazardous Waste Cap (Alternative 6), including an active gas collection and treatment system;
- Implementation of a leachate collection and treatment system to prevent migration of contaminants into ground water and surrounding wetlands;
- Installation of a guard rail to prevent vehicular access, and a perimeter security fence to restrict access to the site; and,
- Implementation of a program to monitor movement of the landfill sideslopes.

The preferred leachate collection and treatment system is Option 3 (on-site treatment with discharge to surface water). However, a contingency system, which would include off-site disposal, may be used during this phase of the remedial action. This would provide sufficient time to evaluate whether a single treatment plant could be designed and constructed to address both the landfill leachate and underlying groundwater.

The estimated present worth of the preferred alternative with Leachate Option 3 is $30,353,200 million. The capitol cost is estimated to be $21,464,200 million with an annual operation and maintenance cost of approximately $765,100.

Rationale for Preference

The NJDEP believes that the preferred alternative provides the best balance among the alternatives according to the evaluation criteria. Alternative 6 provides a high level of protection of human health and reduces the threat to the environment by containing the landfill refuse and reducing the risk of contaminant migration from the landfill. In addition, this alternative is lighter in weight and would address the slope stability concerns of Global Landfill. The landfill capping and long-term monitoring will comply with all provisions of RCRA hazardous waste landfill closure regulations which are relevant and appropriate to the landfill.

This proposed alternative would also eliminate site risks due to gaseous and windblown contaminants by capping the landfill and installing an active gas collection and treatment system. By capping the landfill now, further degradation of the ground water and surrounding wetlands can be minimized. The wetlands and surface waters will also be protected from the discharge of leachate by reducing infiltration into the landfill, and by collecting the leachate for treatment. Furthermore, the spread of contamination in the water table aquifer, which affects the wetlands and possibly the Old Bridge Sand aquifer, would be greatly reduced. Based on the information available at this time, the NJDEP believes the preferred alternative would be protective of human health and the environment, would comply with ARARs, would be cost effective, and would utilize permanent solutions and alternative treatment technologies to the maximum extent possible.

Bureau of Community Relations
Division of Hazardous Site Mitigation
New Jersey Department of Environmental Protection
CN 413
Trenton, N.J. 08625-0413

APPENDIX #2

COMMUNITY ENVIRONMENTAL INVESTIGATION SERVICES
REPORT OF FINDINGS

For The

GLOBAL LANDFILL TASK GROUP
OLD BRIDGE TOWNSHIP HEALTH DEPARTMENT
AND
NEW JERSEY DEPARTMENT OF HEALTH

Prepared Jointly By

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February 9, 1990

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APPENDICES

SECTION 1 - INTRODUCTION

On August 10, 1988, Eikon Planning and Design Corp. (Eikon) and Enseco, Inc. (Enseco) jointly submitted a Scope of Work to the Global Landfill Task Group (Task Group) outlining proposed environmental investigatory services required to address health concerns of Old Bridge residents living in the area of the Global Landfill and Sommers Brothers Landfill sites. Said proposal was drafted based upon scope of work and project objectives (namely, Objective 1) outlined in the Global Landfill Task Group Community Investigation Health Service Grant Application. The purpose of Objective 1 was as follows:

1. To determine whether the residences in the immediate vicinity of Global and Sommers Brothers Landfills were built upon a former sanitary landfill.

2. To identify the composition of in-situ soils, including the presence, if any, of contaminants.

The full Health Service Grant is included in Appendix I; a listing of Task Group Members (revised January, 1990) is outlined in Appendix II.

Subsequent discussions and amendments between New Jersey Department of Health (NJDOH), New Jersey Department of Environmental Protection (NJDEP), Old Bridge Township and Citizens Helping Environmental Cleanup (CHEC) personnel, both within and outside the Task Group, resulted in the full Scope of Work Document dated November 7, 1988. Said document was accepted through resolution by the Old Bridge Township Council on January 18, 1989. Field work was initiated in March, 1989.

Environmental investigatory work was to be conducted in three phases:

- Phase I - Soil Vapor Study in Target Areas
- Phase II - Investigatory Soil Boring Study in Target Areas - Based Upon Phase I Data
- Phase III - Laboratory Analysis of Phase II Soil Boring Samples

Enclosed herein are the findings of Phase I through Phase III activities.

SECTION 2 - GENERAL SITE DESCRIPTION

Outlined below is a brief description of the Global Landfill, Sommers Brothers and adjacent apartment complex areas. The general site layout is depicted on Figure I.

Global Landfill:

Global Landfill is an approximately 50 acre inactive facility located in a salt marsh area off Ernston Road, between New Jersey State Route 9 and the New Jersey Garden State Parkway in Old Bridge Township. The landfill had reportedly been in operation since the late 1960's, and was active until April 1984, when, due to a slope failure, it was ordered to cease operations and prepare a proper closure plan by the State of New Jersey.

A history of engineering design and operating violations were recorded at the landfill during its approximately 20 years of operation. Global Landfill was placed upon the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund) National Priorities List (NPL) in March, 1989 (NPL rank No. 260).

Sommers Brothers Landfill:

The Sommers Brothers site consists of approximately 234 acres, east of Route 9 and north of Route 34, in Old Bridge Township. Global Landfill abuts the site to the north. Approximately 20-30 acres of the property were used as a municipal landfill by Old Bridge Township between 1900 and 1968. Localized dumping reportedly occurred throughout the remainder of the site.

In 1986, the NJDEP Division of Hazardous Waste Management (DHWM) discovered in excess of 200 labeled and unlabeled drums deposited in eight or more locations throughout the site. Limited drum removal activities were undertaken in 1986; additional NJDEP supervised investigatory and/or remedial activities will likely continue on the site.

Subject Apartment Complexes:

The subject apartment complexes, namely London Terrace (approximately 962 units), Parkwood Village (approximately 500 units), Skytop (approximately 840 units) and Nieuw Amsterdam (approximately 480 units) were erected in an area between Global Landfill, Sommers Brothers Landfill and Route 9. Skytop and Nieuw Amsterdam were completed between 1959 and 1966; London Terrace and Parkwood Village were completed in the late 1960's/early 1970's. Additional information regarding prior site use in the areas presently occupied by said apartments is included in the aerial photographic review portion of Section 3.

SECTION 3 - PHASE I SOIL VAPOR STUDY

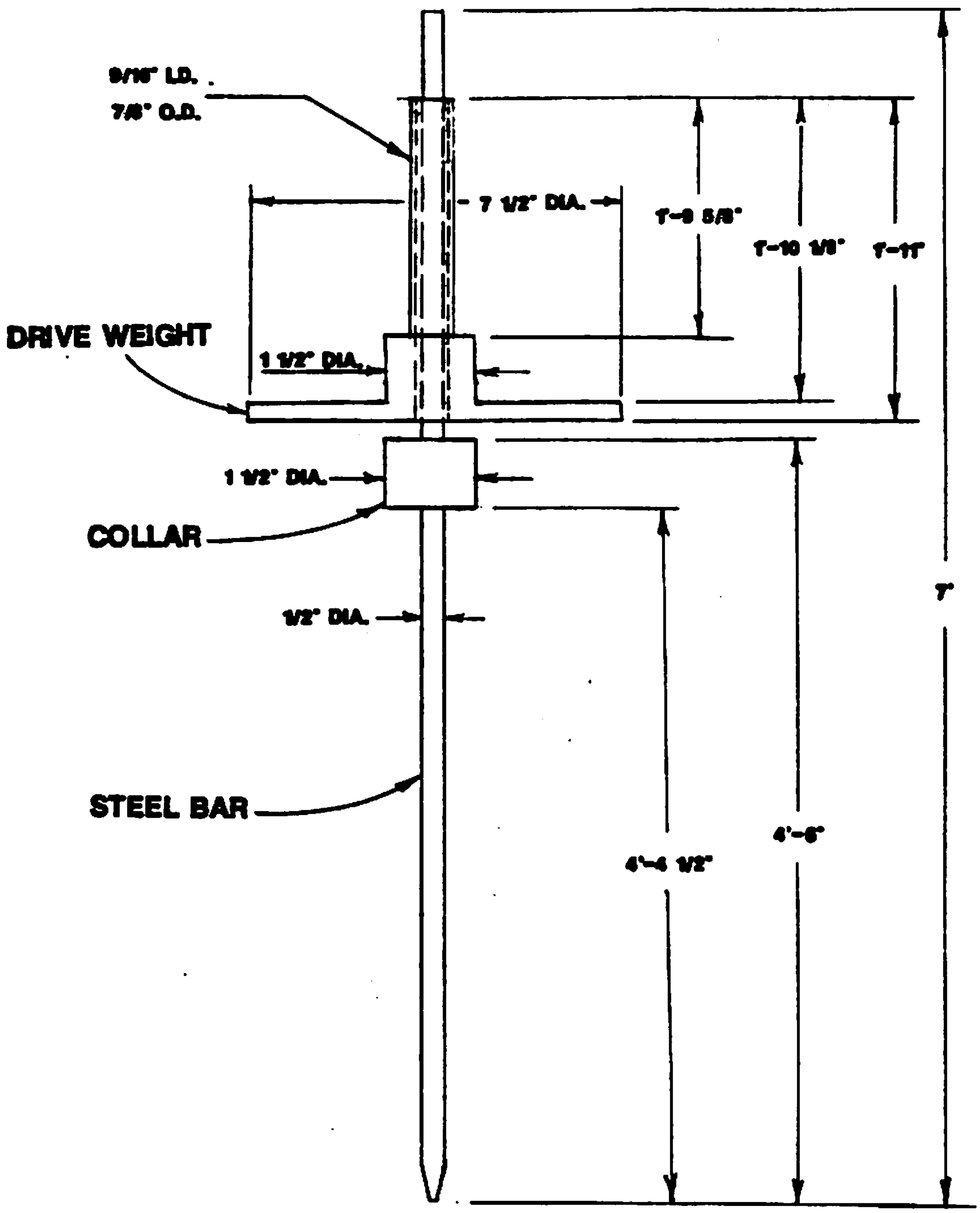
Preparation for Phase I soil vapor activities began in March, 1989. Public underground utility marking services were notified of scheduled field work; extended efforts to locate municipal and private water and sewer lines, however, were largely unsuccessful (i.e., due to nonresponse from private parties or nonexistence of as-built utility drawings).

An approximately 200 ft. by 200 ft. grid was marked over the proposed Phase I target area (see Figure II - Proposed Phase I Soil Vapor Boring Plan). Upon notification to NJDEP and Task Group personnel, field activities commenced on March 31, 1989.

Utilizing a power auger and a bar hole maker (approximately one half inch diameter steel rod with an attached driving weight - refer to Figure III), soil vapor test borings were advanced at previously marked grid node locations. Ambient organic compound air concentrations were recorded at each sampling point prior to boring advancement utilizing a flame ionization detector (FID) manufactured by the Foxboro Company (OVA 128 Century organic vapor analyzer) and a photoionization detector (PID) manufactured by the HNU Corporation (HNU Model PI101).

Depending upon in-situ soil conditions (e.g., density, gradation) soil vapor test borings were advanced between 36" and 56" below grade. Soil cuttings were observed to qualify the composition of in-situ soils.

A remote soil vapor sampling device (Teflon tubing, encased within a rigid PVC casing, with a glass and Teflon head - refer to Figure IV) was lowered into the vapor boring; the boring was subsequently sealed and purged based upon the calculated hole volume. The hole remained undisturbed for approximately 5 - 15 minutes to allow for soil gas to enter the boring. A PID reading was recorded; the hole equilibrated for another 5 - 15 minutes and a FID reading was recorded. The remote sampling device was removed and the hole was backfilled to grade. This method of soil gas sample collection allowed direct subsurface monitoring with a minimal amount of disturbance to the test areas.



BAR HOLE MAKER DETAIL

FIGURE III

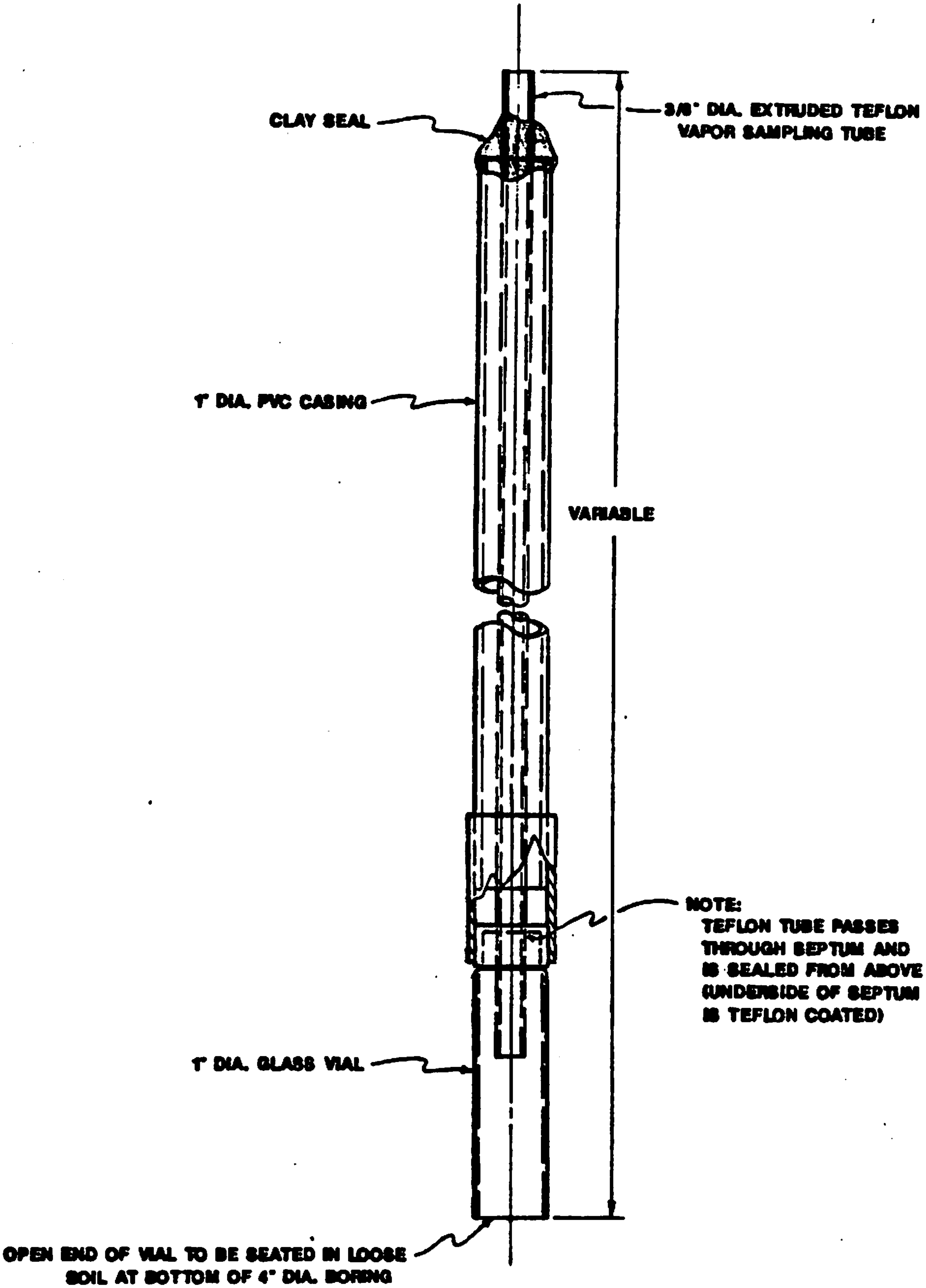


FIGURE IV

REMOTE SOIL VAPOR SAMPLING DEVICE

SCALE: 1/2" = 1" DATE: 7-11-89

Between soil vapor borings, sampling equipment was cleaned with nonphosphate soap and a distilled water rinse. In addition, Teflon tubing within the remote sampling device was checked between borings to ensure that organic vapor readings returned to background levels (i.e., the Teflon tubing was not contaminated).

Soil vapor borings SV1 through SV23 were initially advanced in Parkwood Village, London Terrace and an open (vacant) lot adjacent to London Terrace as per the unbiased soil vapor sampling plan (completed soil vapor boring installation locations are depicted on Figure V). General field data for vapor borings SV1 through SV23 is outlined in Table I.

On April 4, 1989, Phase I soil vapor field activities were temporarily halted due to subsurface work indemnification clauses required by the owners of the London Terrace apartment complex.

During the referenced interruption to Phase I field work, the Task Group decided to review historical aerial photographs of the target study areas to augment soil vapor boring placement activities (said 9 inch x 9 inch nonstereo contact prints are included in Appendix III).

Based upon a preliminary aerial review, it was recommended that the photographs be enlarged to further qualify area conditions; said recommendation was approved by the Task Group and Phase I activities were amended as follows:

1. Phase I soil vapor installation activities would be augmented with an aerial photographic review.

2. Select soil vapor boring installation points would be sited with respect to suspected landfill ingress/egress points, or landfill space itself, as noted during the aerial photographic review.

TABLE I

Phase I Soil Vapor Boring Field Data SV1 Through SV23

Soil Vapor Boring ID	Location - General	Approximate Depth
SV 1	Vacant Lot	48"
SV 2	Parkwood Village	44"
SV 3	Parkwood Village	40"
SV 4	Parkwood Village	47 1/2"
SV 5	Parkwood Village	42"
SV 6	Parkwood Village	49"
SV 7	Parkwood Village	50 1/2"
SV 8	Vacant Lot	46"
SV 9	London Terrace	49"
SV 10	Parkwood Village	48"
SV 11	Parkwood Village	46 1/2"
SV 12	Parkwood Village	48 1/2
SV 13	Parkwood Village	44 1/2"
SV 14	Parkwood Village	43"
SV 15	London Terrace	52"
SV 16	London Terrace	52"
SV 17	London Terrace	52"
SV 18	London Terrace	51"
SV 19	London Terrace	48"
SV 20	London Terrace	49"
SV 21	London Terrace	48"
SV 22	London Terrace	38"
SV 23	London Terrace	39"

3. Unbiased (random) and biased (based upon Task Group input and the aforementioned aerial review) soil vapor boring installation points would be combined to further quantify Phase II soil boring locations.

Aerial photographs were obtained and reviewed for the following years: 1959, 1966, 1967, 1976 and 1984. Information observed during said review is outlined below.

<u>March 29, 1959</u>:

Numerous unimproved roads were noted throughout the primarily wooded property now occupied by the London Terrace Apartments. It appeared that said roads loosely connected a potato farm, Route 9, Sommers Brothers, a munitions testing facility and an offsite excavation pit (presently occupied by Sky Top Apartments). Several of the referenced roads appeared to dead end in wooded areas.

Sommers Brothers appeared to be active, and two trucks appeared to be present in a cul-de-sac on the western portion of the landfill. The potato farm, munitions testing facility and excavation pit also appeared active. Global Landfill, it's main access road, and the subject apartment complexes in question did not exist as of this date.

<u>December 4, 1966</u>:

The northern portion (closest to Global) of Sommers Brothers appeared to be more active (i.e., new dumping was observed), and adjacent unimproved access roads were more heavily traveled. The Skytop and Nieuw Amsterdam Apartment complexes were completed at this time, the former was built upon a portion of the aforementioned excavation pit, the latter built upon farm fields, presumably part of the adjacent potato farm (the potato farm appeared inactive or minimally operative).

Although it was difficult to ascertain whether dumping had begun at Global, initial clearing and filling for the landfill base had commenced (the former munitions testing facility was not visible, presumably razed during Skytop and/or Global access road construction activities).

Furrows or "short roads" appeared to be cut into the rear portion of what is now London Terrace property, immediately off the unimproved road connecting the Sommers Brothers and Global areas. In addition, an extensive soil removal operation had apparently begun adjacent to Global Landfill's main access road, in the area closest to London Terrace. Several of the unimproved access roads through wooded areas observed in the 1959 aerial (in the present London Terrace Apartment complex area) were more heavily traveled at this point in time. Most roads were directed towards Global Landfill; other roads still appeared to dead end into wooded areas.

<u>February 7, 1969</u>:

Sommers Brothers appeared to have new activity (i.e., dumping) in the northeastern section of the landfill. The potato farm appeared inactive.

The entire wooded area presently occupied by London Terrace and Parkwood Village was cleared; all 1959 and 1966 access roads through said wooded area were obliterated. It appeared that between 1966 and 1969 an extensive soil removal project had been undertaken on the subject apartment complex property (first noted in the 1966 aerial); approximately ten to thirty feet of material appeared to have been removed (presumably for road base material construction of Route 9, according to area citizens and select Task Group personnel).

Global Landfill was active and varied truck traffic was observed. In addition, the construction of London Terrace was in progress (approximately one third complete).

March 20, 1976:

Global Landfill was active and had greatly expanded since 1969 (what appeared to be several construction trailers/offices, dump trucks and a tanker truck were noted on the landfill). In addition, there appeared to have been vehicles and other debris disposed along the rear bank of the London Terrace Apartment complex; said bank appeared steep and heavily eroded.

All the subject apartment complexes (i.e., the remainder of London Terrace and all of Parkwood Village) were built as of this time. The undeveloped (vacant) lot adjacent to London Terrace and Parkwood Village (adjacent to northbound Route 9) exhibited localized underbrush (low vegetation); remaining areas appeared to be bare soil. Erosion and unimproved roads/paths were observed throughout the lot.

April 11, 1984:

Global Landfill increased in size from the 1976 aerial, further encroaching upon existing salt marshes and/or wetland areas. The April 1984 slope failure was visible, as well as resultant displaced wetland areas. Active truck traffic was observed on Global Landfill's main access road; construction trailers/offices were also evident. Sommers Brothers Landfill appeared less active.

Unpaved roads/paths in the vacant lot adjacent to London Terrace and Parkwood Village appeared more heavily traveled (possibly for recreational use and/or apartment complex ingress/egress). The subject apartment complexes remained relatively unchanged.

Based upon information derived from the aerial photographic review presented above, in conjunction with transparency overlays of present apartment complexes locations with respect to former access road intersections/locations, (noted on the 1959 and 1966 aerials), biased soil vapor sample locations were proposed (former unimproved access road locations are included on Figure V). In addition, two offsite control soil vapor boring locations were proposed by the Task Group, adjacent to the municipal water tower, off of northbound Route 34. After review and comment by NJDEP and Task Group personnel, said biased and control sampling locations were confirmed.

The apartment complex indemnification concern was resolved and Phase I field work resumed by May 31, 1989. On June 9, 1989, Phase I soil vapor installation activities were completed; an additional thirteen locations were screened (SV24 through SV34, and two off-site control points). General field data for all soil vapor borings are outlined in Table II; soil vapor boring locations are depicted on Figure V.

Based upon recorded data, eight soil vapor borings exhibited elevated organic vapor readings (SV8, SV20, SV21, SV22, SV26, SV27, SV29 and Control 2); said data is outlined in Table III.

Boring SV8 was located in the vacant lot; SV20, SV21, SV22, SV26, SV27 and SV29 were located in London Terrace; Control 2 was located adjacent to the municipal water tower off northbound Route 34. No elevated vapor boring readings were detected in Parkwood Village. Except for SV27, SV29 and Control 2, all vapor borings were in relatively close proximity to Westminster Boulevard. In addition, SV8, SV20, SV26, SV27 and SV29 were located adjacent to former unimproved access roads noted in the 1959 and 1966 aerial photographs (SV21 and SV22 were located between two former access roads).

Based upon the data presented above, seven proposed onsite boring locations were chosen for Task Group review. Said borings were located adjacent to elevated vapor boring locations and/or adjacent to access road intersections (or more heavily utilized access roads, as presumed based upon the aerial photographic review). Task Group and NJDEP input resulted in two additional proposed areas in Parkwood Village and Nieuw Amsterdam, respectively. Proposed boring locations are outlined in Table IV. After review and discussion, six Phase II boring locations were selected by the Task Group; said locations are outlined in Table V and depicted on Figure VI.

SECTION 4 - PHASE II INVESTIGATORY SOIL BORINGS

The scope of work called for Phase II soil boring depths to be based upon field conditions (to a maximum of 40 feet). In order to eliminate delays in acquiring permission from the property owners for state drilling permits (soil borings greater than 25 feet in depth or borings to groundwater require a permit from the NJDEP Division of Water Allocation), and given the site generally appeared to have been stripped of soil, a maximum boring depth of 20-25 feet was chosen. Phase II drilling activities commenced on June 14, 1989; the last sample boring was completed on June 20, 1989.

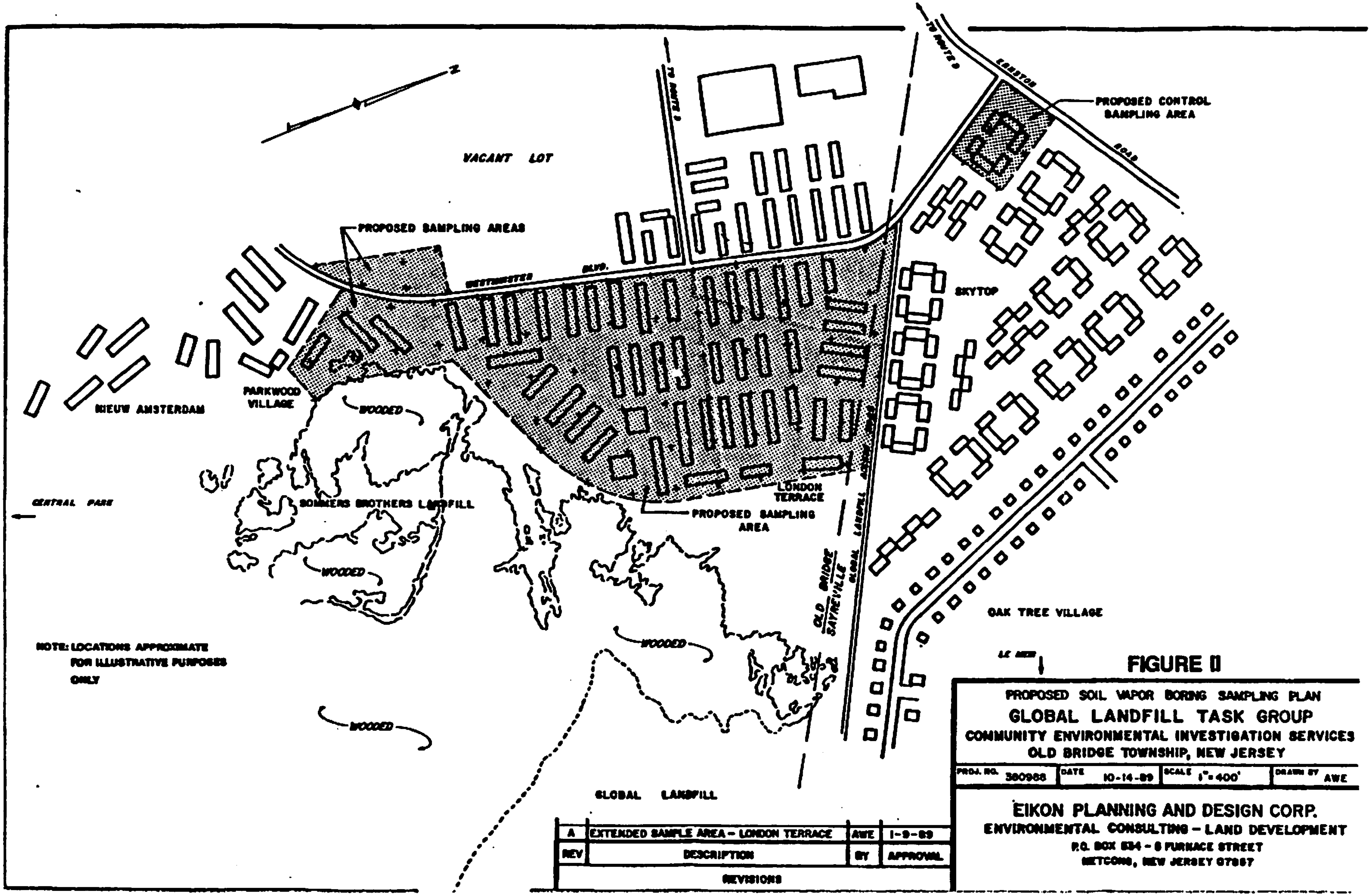
Utilizing a hollow stem auger drill rig, borings were advanced in numerical order as outlined in Table V. Drilling equipment was steam cleaned prior to site mobilization and between borings; sampling equipment was decontaminated following general NJDEP protocol, namely:

- Nonphosphate detergent and tap water wash.
- Tap water rinse.
- Distilled/deionized water rinse.
- 10% nitric acid rinse.

TABLE II

Phase I Soil Vapor Boring Field Data - Complete

Soil Vapor Boring ID	Location - General	Approximate Depth
SV 1	Vacant Lot	48"
SV 2	Parkwood Village	44"
SV 3	Parkwood Village	40"
SV 4	Parkwood Village	47 1/2"
SV 5	Parkwood Village	42"
SV 6	Parkwood Village	49"
SV 7	Parkwood Village	50 1/2"
SV 8	Vacant Lot	46"
SV 9	London Terrace	49"
SV 10	Parkwood Village	48"
SV 11	Parkwood Village	46 1/2"
SV 12	Parkwood Village	48 1/2
SV 13	Parkwood Village	44 1/2"
SV 14	Parkwood Village	43"
SV 15	London Terrace	52"
SV 16	London Terrace	52"
SV 17	London Terrace	52"
SV 18	London Terrace	51"
SV 19	London Terrace	48"
SV 20	London Terrace	49"
SV 21	London Terrace	48"
SV 22	London Terrace	38"
SV 23	London Terrace	39"



N
VACANT LOT
PROPOSED SAMPLING AREAS
TO ROUTE 9
WESTMINSTER BLVD.
PROPOSED CONTROL SAMPLING AREA
ROAD
SKYTOP
PARKWOOD VILLAGE
NIEUW AMSTERDAM
WOODED
CENTRAL PARK
SOMMERS BROTHERS LANDFILL
LONDON TERRACE
PROPOSED SAMPLING AREA
OLD BRIDGE
SAYREVILLE
GLOBAL LANDFILL ACCESS ROAD
OAK TREE VILLAGE
NOTE: LOCATIONS APPROXIMATE FOR ILLUSTRATIVE PURPOSES ONLY
GLOBAL LANDFILL
FIGURE II
PROPOSED SOIL VAPOR BORING SAMPLING PLAN
GLOBAL LANDFILL TASK GROUP
COMMUNITY ENVIRONMENTAL INVESTIGATION SERVICES
OLD BRIDGE TOWNSHIP, NEW JERSEY
PROJ. NO. 380988
DATE 10-14-89
SCALE 1"=400'
DRAWN BY AWE
EIKON PLANNING AND DESIGN CORP.
ENVIRONMENTAL CONSULTING – LAND DEVELOPMENT
P.O. BOX 534 - 8 FURNACE STREET
NETCONG, NEW JERSEY 07857
A
EXTENDED SAMPLE AREA – LONDON TERRACE
AWE
1-9-89
REV
DESCRIPTION
BY
APPROVAL
REVISIONS

TABLE II

Phase I Soil Vapor Boring Field Data - Complete
(Continued)

Soil Vapor Boring ID	Location - General	Approximate Depth
SV 24	London Terrace	36"
SV 25	London Terrace	46"
SV 26	London Terrace	45"
SV 27	London Terrace	48"
SV 28	London Terrace	49"
SV 29	London Terrace	56"
SV 30	London Terrace	46"
SV 31	London Terrace	40"
SV 32	London Terrace	49"
SV 33	London Terrace	48"
SV 34	London Terrace	48"
Control 1	Municipal Water Tower Adjacent to Route 34 North	47"
Control 2	Municipal Water Tower Adjacent to Route 34 North	48"

TABLE III

Phase I Soil Vapor Boring Field Data - Elevated Readings

Soil Vapor Boring ID	Readings Over Background OVA (ppm)	HNU (ppm)	Remarks
SV8	360 (peak) 240 (constant)	0	Sampled in vacant lot along Westminster Blvd. (across the street from London Terrace Bldg. No. 10). Water observed in boring at approximately 20" below grade; refusal at approximately 46" (unknown object); adjacent to a former unimproved access road (1959/1966 aerials); water, sanitary sewer and storm sewer utilities run along Westminster Blvd.
SV20	5 (peak) 1 (constant)	0	Sampled in London Terrace along Westminster Blvd. near Bldg. No. 11; adjacent to a former unimproved access road (1959/1966 aerials); water, sanitary sewer and storm sewer utilities run along Westminster Blvd.
SV21	0	1 (peak) 0.1 (constant)	Sampled in London Terrace along Westminster Blvd. adjacent to Bldg. No. 12; between two former unimproved access roads (1959/1966 aerials); water, sanitary sewer and storm sewer utilities run along Westminster Blvd.
SV22	1000+ (peak) 50-60 (constant)	0	Sampled in London Terrace along Westminster Blvd. adjacent to Bldg. No. 13; refusal at approximately 38" (unknown object); between former unimproved access roads (1959/1966 aerials); water, sanitary sewer and storm sewer utilities run along Westminster Blvd.

TABLE III

Phase I Soil Vapor Boring Field Data - Elevated Readings
Page 2

Soil Vapor Boring ID	Readings Over Background OVA (ppm)	HNU (ppm)	Remarks
SV26	0	11 (peak) 8.5 (constant)	Sampled in London Terrace along Westminster Blvd. in center median between Bldg. No. 18 and No. 19; adjacent to a former unimproved access road (1959/1966 aerials); water, sanitary sewer and storm sewer utilities run along Westminster Blvd.
SV27	1000+	1.8 (peak) 1.0 (constant)	Sampled in London Terrace between Bldg. No. 14 and No. 15; soil cuttings had sweet/aromatic odor beginning at approximately 30"-34" below grade; adjacent to a former unimproved access road (1959/1966 aerials).
SV29	5 (peak) 5 (constant)	0	Sampled in London Terrace off corner of Bldg. No. 52; adjacent to a former unimproved access road (1959/1966 aerials).
Control 2	120 (peak) 60-80 (constant)	0	Grassy area adjacent to municipal water tower (approximately 75 ft. from water tower); reddish brown sandy loam soil matrix; undetected PID and FID readings were recorded at Control 1 approximately 70 ft. away.

TABLE IV

Phase II - Proposed Soil Boring Locations

Location	Remarks
London Terrace between Bldg. No. 14 and No. 15 (adjacent to SV27)	Elevated soil vapor readings; adjacent to former unimproved access road; soil vapor boring cuttings had sweet/aromatic odor.
London Terrace; along Westminster Blvd. near Bldg. No. 13 (adjacent to SV22)	Elevated soil vapor readings; situated between two former unimproved access roads.
London Terrace; along Westminster Blvd. in center median between Bldgs. No. 18 and No. 19 (adjacent to SV26)	Elevated soil vapor readings; adjacent to former unimproved access road.
London Terrace; adjacent to Bldg. No. 52 along back of apartment complex - abutting Global Landfill (adjacent to SV29)	Elevated soil vapor reading; adjacent to former unimproved access road and in proximity to intersection of several former access roads.
London Terrace; between two existing apartment bldgs. east of Bldg. No. 15	Location of former unimproved access roads; possible off-road and road intersection activity (activity appeared somewhat heavier than majority of roads observed) as per enlarged aerial photographic review.
London Terrace; along Westminster Blvd. near Bldg. No. 11 (adjacent to SV20)	Elevated soil vapor reading; adjacent to former unimproved access road.
Vacant lot; along Westminster Blvd. across Blvd. from Bldg. No. 10 (adjacent to SV8)	Elevated soil vapor reading; adjacent to former unimproved access road.
Parkwood Village; in area including and north of Bldg. No. 12	Potential location as proposed by select Task Group and NJDEP personnel

TABLE IV

Phase II - Proposed Soil Boring Locations
Page 2

Location	Remarks
Nieuw Amsterdam; along back of apartment complex abutting Sommers Brothers Landfill property	Potential location as proposed by select Task Group personnel; location of former access road servicing Sommers Brothers Landfill.
Municipal Water Tower off of northbound Rt. 34 (adjacent to Control 1 and Control 2)	Proposed off-site control boring location consistent with Task Group selection of off-site soil vapor control locations.

TABLE V

Phase II Soil Boring Locations - Approved

Soil Boring	Location
SB - 1	London Terrace between Bldg. No. 14 and No. 15 (adjacent to SV27)
SB - 2	London Terrace; along Westminster Blvd. near Bldg. No. 13 (adjacent to SV22)
SB - 3	London Terrace; along Westminster Blvd. in center median between Bldgs. No. 18 and No. 19 (adjacent to SV26)
SB - 4	London Terrace; adjacent to Bldg.No. 52 along back of apartment complex - abutting Global Landfill (adjacent to SV29)
SB - 5	Nieuw Amsterdam; along back of apartment complex abutting Sommers Brothers Land-fill property
SB - 6	Municipal Water Tower off of northbound Rt. 34 (adjacent to Control 1 and Control 2

- Distilled/deionized water rinse.
- Solvent (pesticide grade) rinse.
- Total air dry.
- Distilled/deionized water rinse.

Glassware, distilled/deionized water, solvent rinse and nitric acid rinse was supplied by Enseco.

Each boring was advanced to a depth of 20 ft; split spoon samples were collected at 5 ft. intervals from grade. Spoon samples were examined in the field (both visually and with portable organic vapor analyzing equipment) for indications of contamination and strata changes (refer to boring logs in Appendix IV). Based upon field observations, soil sampling intervals were chosen for each boring location. If field observations provided no apparent indications of environmental concern in a particular boring, sampling consistent with prior boring collection depths and end of boring (20 - 22 ft.) depths were chosen.

In addition, daily field blanks were collected for target parameters; daily trip blanks were analyzed for volatile organic compounds. Duplicate samples and laboratory analytical QA/QC samples were provided as outlined under Phase III activities. Soil samples were relinquished to Enseco at the end of each day's sampling activity. As per Scope of Work guidelines, split spoon soil samples collected at 5 ft. intervals were placed in driller's sample core jars for cold storage at Enseco.

A summary of soil boring data is outlined in Table VI.

TABLE VI

Phase II Soil Boring Data Summary

Sample ID	Location	Date	Depth	Environmental Observations
SB-1	SV27	06/13/89	0'-2'	Light brown clayey sand, trace gravel; variable odor (pungent/ashen, other areas swee /aromatic); HNU at 0.2 ppm over background in split spoon; sample retained in drilling core jar at Enseco until release by New Jersey Department of Health.
			5'-7'	Similar in composition to 0'-2'sample; distinc dark brown apparent organic layer at approximately 5' 3" - 5' 6" depth; variable odor in apparent organic layer (odor similar to 0'-2' sample) and HNU at 0.2-0.4 ppm over backgrounc sample retained in drilling core jar at Ensecc until release by New Jersey Department of Health.
			10'-12'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health.
			15'-17'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health.
			20'-22'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health. Sample SB-1 20'-22' collected and analyzed at Enseco.
SB-1A	SV27	06/13/89	5'-7'	Similar in composition to SB-1 5'-7'. Dark brown apparent organic layer at approximately 5'4" to 5'6" depth; within dark layer, solid material was captured in split spoon which appeared to resemble burnt fibrous rubber/

TABLE VI

Phase II Soil Boring Data Summary
Page 2

Sample ID	Location	Date	Depth	Environmental Observations
				synthetic material and/or compressed organic material (e.g., wood); undeterminable composition; strong ashen, pungent odor. Sample retained in drilling core jar at Enseco until release by New Jersey Department of Health. Sample SB-1A 5'-7' collected and analyzed at Enseco.
SB-2	SV22	06/14/89 - 06/15/89	0'-2'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health.
			5'-7'	Material similar in composition to SB-1 5'-7' and SB-1A 5'-7'; variable odor (pungent/ashen) noted; HNU at 20-50 ppm over background. Sample retained in drilling core jar at Enseco until release by New Jersey Department of Health. SB-2 5'-7' collected and analyzed at Enseco.
			10'-12'	No apparent environmental concern noted; sample retained in drilling core jar at Enseco until release by New Jersey Department of Health.
			15'-17'	No apparent environmental concerns noted; sample retained in drilling core jar at Ensecc until release by New Jersey Department of Health.
			20'-22'	No apparent environmental concern noted; sample retained in drilling core jar at Enseco until release by New Jersey Department of

TABLE VI

Phase II Soil Boring Data Summary
Page 3

Sample ID	Location	Date	Depth	Environmental Observations
				Health. SB-2 20'-22' collected and analyzed a Enseco.
SB-3	SV26	06/15/89	0'-2'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health.
			5'-7'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health. SB-3 5'-7' collected and analyzed at Enseco.
			10'-12'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health.
			15'-17'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health.
			20'-22'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health. SB-3 20'-22' collected and analyzed at Enseco.
SB-4	SV29	06/16/89	0'-2'	No apparent environmental concern noted; HNU at approximately 0.25 ppm over background. Sample retained in drilling core jar at Ensecc until release by New Jersey Department of Health.
			5'-7'	No apparent environmental concern noted; samp. retained in drilling core jar at Enseco until release by New Jersey Department of Health. SB-4 5'-7' collected and analyzed at Enseco.

TABLE VI

Phase II Soil Boring Data Summary
Page 4

Sample ID	Location	Date	Depth	Environmental Observations
			10'-12'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health.
			15'-17'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health.
			20'-22'	No apparent environmental concern noted; sampl retained in drilling core jar at Enseco until release by New Jersey Department of Health. SB-4 20'-22' collected and analyzed at Enseco.
SB-7	Duplicate of SB4	06/16/89	5'-7'	SB-7 5'-7' collected and analyzed at Enseco.
SB-5	Nieuw Am-sterdam - adjacent to former Sommers Bros. Landfill Access Road	06/19/89	0'-2'	No apparent environmental concern noted; neart material surface staging was observed (roofinc and construction materials, starter fluid, etc.); sample retained in drilling core jar at Enseco until release by New Jersey Department of Health.
			5'-7'	No apparent environmental concern noted; sampl retained in drilling core jar until release by New Jersey Department of Health. SB-5 5'-7' collected and analyzed at Enseco.
			10'-12'	No apparent environmental concern noted; sampl retained in drilling core jar until release by New Jersey Department of Health.

TABLE VI

Phase II Soil Boring Data Summary
Page 5

Sample ID	Location	Date	Depth	Environmental Observations
			15'-17'	No apparent environmental concern noted; sampl retained in drilling core jar until release by New Jersey Department of Health.
			20'-22'	No apparent environmental concern noted; sampl retained in drilling core jar until release by New Jersey Department of Health. SB-5 20'-22' collected and analyzed at Enseco.
SB-6	Off-Site Control Pt. adjacent to municipal water tower off Rt. 34 N.	06/19/89 - 06/20/89	0'-2'	No apparent environmental concern noted; sampl retained in drilling core jar until release by New Jersey Department of Health.
			5'-7'	No apparent environmental concern noted; sampl retained in drilling core jar until release by New Jersey Department of Health. SB-6 5'-7' collected and analyzed at Enseco.
		06/20/89	10'-12'	No apparent environmental concern noted; sampl retained in drilling core jar until release by New Jersey Department of Health.
			15'-17'	No apparent environmental concern noted; sampl retained in drilling core jar until release by New Jersey Department of Health.
			20'-22'	No apparent environmental concern noted; sampl retained in drilling core jar until release by New Jersey Department of Health. SB-6 20'-22' collected and analyzed at Enseco.

SECTION 5 - PHASE III LABORATORY ANALYSIS

As per Phase III objectives, two select samples in each of the six borings installed under Phase II were collected and submitted to Enseco for analysis. Said samples were analyzed for priority pollutant +40 compounds (PP+40) utilizing EPA Method SW846 Guidelines (PP target compounds are included as Table VII). Remaining split spoon soil samples collected in drilling core jars were stored at Enseco. In addition, based upon discussions between Old Bridge Township, Eikon, Enseco and Task Group personnel during initial scope of work revisions, a Quality Assurance/Quality Control (QA/QC) plan was included as part of Phase III activities. The QA/QC plan implemented is included as Table VIII.

Soil boring samples were submitted to Enseco between June 14, 1989 and June 20, 1989; results were received on or about the week of July 20, 1989. Analytical summary data is included in Appendix V. Said analytical data summary package was presented to the Task Group and select NJDEP personnel in October, 1989; a complete set of Phase III analytical data and supporting documentation was presented to said personnel in November, 1989.

Based upon a review of Phase III analytical data, it was noted that sample receipt temperatures at Enseco were recorded above 4° Celsius. Phase II boring samples were delivered to Enseco within 1 - 6 1/2 hours from collection, and were staged in coolers with ice packs during handling. Immediately upon log-in at Enseco, all samples were transferred to and stored in refrigerated rooms ($4^{\circ}C$) until analysis. Given the short sample handling periods, sample handling and transport methods and laboratory sample preservation protocol, analytical data presented in Phase III is believed to accurately reflect in-situ conditions in borings SB-1 through SB-6.

A review of analytical data from SB1 through SB6 revealed several samples with detectable compound levels (outlined below). A summary of detected levels is outlined in Table IX.

SB-1:

SB-1 was located adjacent to SV27 in London Terrace, between Bldg. No. 14 and No. 15.

5'-7': A total of 25.1 parts per billion (ppb) volatile organic compounds (VOCs) were detected, consisting of 1,1,1, trichloroethane (1,1,1 TCA), toluene (below the laboratory method detection limit [MDL]), and one unknown tentatively identified compound (TIC). 1,1,1 TCA and toluene are common commercial/industrial solvents utilized for a variety of purposes.

Acetone was present in both the sample and the trip blank, and was therefore suspect.

A total of 6,794 ppb semi-volatile organic compounds (SVOC) were detected, consisting of fluoranthene (reported below the MDL) and ten TICs (Sulfur, Mol. [S8], three hydrocarbons and six unknowns). Fluoranthene is a tetracyclic hydrocarbon derived from coal tar. Sulfur is a nonmetalic element utilized in a variety of manufacturing processes, including but not limited to, pulp and paper, rubber vulcanization, petroleum refining, pharmaceuticals, explosives, fertilizers, and road asphalt, among others.

A total of seven heavy metals were detected at low concentrations, consisting of beryllium (Be), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), zinc (Zn) and arsenic (As). Total cyanides were reported at 0.7 parts per million (ppm); phenolics were reported at 11 ppm. Trace amounts of Cu, Pb and phenolics were detected in the field blank.

TABLE VII

USEPA Priority Pollutant Target Compounds

Priority Pollutants

PURGEABLE ORGANICS (31 COMPOUNDS)

Acrolein	1, 2 Dichloropropane
Acrylonitrile	1, 3 Dichloropropene
Benzene	Methylene chloride
Toluene	Methyl chloride
Ethylbenzene	Methyl bromide
Carbon tetrachloride	Bromoform
Chlorobenzene	Dichlorobromomethane
1, 2-Dichloroethane	Trichlorofluoromethane
1, 1, 1-Trichloroethane	Dichlorodifluoromethane
1, 1-Dichloroethane	Chlorodibromomethane
1, 1-Dichloroethylene	Tetrachloroethylene
1, 1, 2-Trichloroethane	Trichloroethylene
1, 1, 2, 2-Tetrachloroethane	Vinyl chloride
Chloroethane	1, 2 trans-Dichloroethylene
2-Chloroethyl vinyl ether	bis (Chloromethyl) ether
Chloroform	

BASE/NEUTRAL EXTRACTABLE ORGANICS (46 COMPOUNDS)

1, 2-Dichlorobenzene	Fluorene
1, 3-Dichlorobenzene	Fluoranthene
1, 4-Dichlorobenzene	Chrysene
Hexachloroethane	Pyrene
Hexachlorobutadiene	Phenanthrene
Hexachlorobenzene	Anthracene
1, 2, 4-Trichlorobenzene	Benzo (a) anthracene
bis (2-Chloroethoxy) methane	Benzo (b) fluoranthene
Naphthalene	Benzo (k) fluoranthene
2-Chloronaphthalene	Benzo (a) pyrene
Isophorone	Indeno (1, 2, 3-c, d) pyrene
Nitrobenzene	Dibenzo (a, h) anthracene
2, 4-Dinitrotoluene	Benzo (g, h, i) perylene
2, 6-Dinitrotoluene	4-Chlorophenyl phenyl ether
4-Bromophenyl phenyl ether	3, 3'-Dichlorobenzidine
bis (2-Ethylhexyl) phthalate	Benzidine
Di-*n*-octyl phthalate	bis (2-Chloroethyl) ether
Dimethyl phthalate	1, 2-Diphenylhydrazine
Diethyl phthalate	Hexachlorocyclopentadiene
Di-*n*-butyl phthalate	N-Nitrosodiphenylamine
Acenaphthylene	N-Nitrosodimethylamine
Acenaphthene	N-Nitrosodi-*n*-propylamine
Butyl benzyl phthalate	bis (2-Chloroisopropyl) ether

ACID EXTRACTABLE ORGANICS (11 COMPOUNDS)

Phenol	*p*-Chloro-*m*-cresol
2-Nitrophenol	2-Chlorophenol
4-Nitrophenol	2, 4-Dichlorophenol
2, 4-Dinitrophenol	2, 4, 6-Trichlorophenol
4, 6-Dinitro-*o*-cresol	2, 4-Dimethylphenol
Pentachlorophenol	

PESTICIDES/PCB'S (26 COMPOUNDS)

α-Endosulfan	Heptachlor
β-Endosulfan	Heptachlor epoxide
Endosulfan sulfate	Chlordane
α-BHC	Toxaphene
β-BHC	Aroclor 1016
δ-BHC	Aroclor 1221
γ-BHC	Aroclor 1232
Aldrin	Aroclor 1242
Dieldrin	Aroclor 1248
4, 4'-DDE	Aroclor 1254
4, 4'-DDD	Aroclor 1260
4, 4'-DDT	2, 3, 7, 8-Tetrachlorodibenzo-*p*-dioxin (TCDD)
Endrin	
Endrin aldehyde	

METALS (13 ELEMENTS)

Antimony	Mercury
Arsenic	Nickel
Beryllium	Selenium
Cadmium	Silver
Chromium	Thallium
Copper	Zinc
Lead	

MISCELLANEOUS (3 ANALYTES)

Total Cyanides
Total Phenols

TABLE VIII

Phase III Quality Assurance/Quality Control Plan

QA/QC Type	Analysis	Testing Frequency
Trip Blank(s)	Volatile Organics (with Library Search [LS])	one/day
Field Blank(s)	Priority Pollutant +40	one/day (field cleaning)
Method Blank(s)	Volatiles + Library Search, Semi-Volatiles (BN/AF) + LS	one/20 Sample Batch
Matrix Spike	Volatiles + Library Search, Semi-Volatiles (BN/AF) + LS	one/20 Sample Batch
Sample Matrix Spike	Volatiles + Library Search, Semi-Volatiles (BN/AF) + LS	one one
Duplicate Samples	Priority Pollutant +40	one

TABLE IX

Phase III Laboratory Analysis Summary - Detected Compounds

Soil Boring ID/ Detected PP+40 Compounds	Result	MDL	Qualifier
SB-1(A) 5'-7' (06/14/89):			
VOLATILE ORGANICS			
1,1,1 Trichloroethane	16 ppb	5.6 ppb	
Toluene	1.8 ppb	5.6 ppb	J
TICs			
Acetone	81 ppb		B
Unknown	7.3 ppb		
SEMI-VOLATILE ORGANICS			
Fluoranthene	14 ppb	370 ppb	J
TICs			
Unknown	230 ppb		
Unknown	260 ppb		
Unknown	330 ppb		
Sulfur, Mol. (S8)	3900 ppb		
Unknown	340 ppb		
Hydrocarbon	280 ppb		
Hydrocarbon	450 ppb		
Hydrocarbon	490 ppb		
Unknown	320 ppb		
Unknown	180 ppb		
METALS			
Beryllium	0.6 ppm	0.1 ppm	
Chromium	12 ppm	1 ppm	
Copper	16 ppm	1 ppm	
Lead	15 ppm	6 ppm	
Nickel	10 ppm	4 ppm	
Zinc	28 ppm	1 ppm	
Arsenic	3.7 ppm	0.3 ppm	
PHENOLICS	11 ppm	0.1 ppm	
CYANIDE, TOTAL	0.7 ppm	0.6 ppm	
SB-1 20'-22' (06/14/89):			
VOLATILE ORGANICS			
TICs			
Acetone	12 ppb		B

TABLE IX

Phase III Laboratory Analysis Summary - Detected Compounds
Page 2

Soil Boring ID/ Detected PP+40 Compounds	Result	MDL	Qualifier
SB-1 20'-22' (06/14/89): (Continued)			
METALS			
Beryllium	0.8 ppm	0.1 ppm	
Chromium	5 ppm	1 ppm	
Copper	2 ppm	1 ppm	
Nickel	5 ppm	5 ppm	
Zinc	19 ppm	1 ppm	
Arsenic	5.7 ppm	0.3 ppm	
PHENOLICS	11 ppm	0.1 ppm	
SB-2 5'-7' (06/14/89):			
VOLATILE ORGANICS			
1,1,1 Trichloroethane	27 ppb	5.5 ppb	
Toluene	2.0 ppb	5.5 ppb	J
TICs			
Acetone	140 ppb		B
2-Butanone	6.6 ppb		
SEMI-VOLATILE ORGANICS			
TICs			
C-10 H-16 O Isomer	210 ppb		
TID Compound 2	870 ppb		
Sulfur, Mol. (S8)	3700 ppb		
Unknown	410 ppb		
Hydrocarbon	170 ppb		
Hydrocarbon	590 ppb		
Hydrocarbon	480 ppb		
Unknown	340 ppb		
Unknown	2400 ppb		
Unknown	380 ppb		
METALS			
Beryllium	0.6 ppm	0.1 ppm	
Chromium	16 ppm	1 ppm	
Copper	13 ppm	1 ppm	
Lead	14 ppm	6 ppm	
Nickel	13 ppm	4 ppm	
Zinc	34 ppm	1 ppm	
Arsenic	0.7 ppm	0.3 ppm	

TABLE IX

Phase III Laboratory Analysis Summary - Detected Compounds
Page 3

Soil Boring ID/ Detected PP+40 Compounds	Result	MDL	Qualifier
SB-2 5'-7' (06/14/89): (Continued)			
PHENOLICS	12 ppm	0.1 ppm	
CYANIDE, TOTAL	2.0 ppm	0.6 ppm	
Trip Blank (06/14/89)			
VOLATILE ORGANICS			
Acetone	6.1 ppb		
Field Blank (06/14/89):			
VOLATILE ORGANICS			
TICs			
1,1,2 Trichloro-2,2,1 Trifluoro-ethane	5.3 ppb		
METALS			
Copper	0.01 ppm	0.01 ppm	
Lead	0.002 ppm	0.002 ppm	
PHENOLICS	0.18 ppm	0.01 ppm	
SB-2 20'-22' (06/15/89):			
VOLATILE ORGANICS			
TICs			
Acetone	21 ppb		B
METALS			
Beryllium	0.7 ppm	0.1 ppm	
Chromium	3 ppm	1 ppm	
Copper	2.3 ppm	0.7 ppm	
Zinc	12 ppm	1 ppm	
PHENOLICS	1.3 ppm	0.1 ppm	

TABLE IX

Phase III Laboratory Analysis Summary - Detected Compounds
Page 4

Soil Boring ID/ Detected PP+40 Compounds	Result	MDL	Qualifier
SB-3 5'-7' (06/15/89):			
VOLATILE ORGANICS			
TICs			
Acetone	29 ppb		B
METALS			
Beryllium	0.7 ppm	0.1 ppm	
Chromium	7 ppm	1 ppm	
Copper	6.5 ppm	0.7 ppm	
Nickel	11 ppm	5 ppm	
Zinc	30 ppm	1 ppm	
Arsenic	6.6 ppm	0.3 ppm	
PHENOLICS	1.3 ppm	0.1 ppm	
SB-3 20'-22' (06/15/89):			
VOLATILE ORGANICS			
TICs			
Acetone	39 ppm		B
METALS			
Beryllium	1.1 ppm	0.1 ppm	
Chromium	9 ppm	1 ppm	
Copper	3.8 ppm	0.7 ppm	
Zinc	24 ppm	1 ppm	
Arsenic	5.8 ppm	0.3 ppm	
PHENOLICS	7.0 ppm	0.1 ppm	
Trip Blank (06/15/89):			
VOLATILE ORGANICS			
Acetone	13 ppb		
Field Blank (06/15/89):			
SEMI-VOLATILE ORGANICS			
bis(2-ethylhexyl)phthalate	26 ppb	10 ppb	

TABLE IX

Phase III Laboratory Analysis Summary - Detected Compounds
Page 5

Soil Boring ID/ Detected PP+40 Compounds	Result	MDL	Qualifier
SB-4 5'-7' (06/16/89):			
SEMI-VOLATILE ORGANICS			
Unknown	5700 ppb		
Unknown	1200 ppb		
METALS			
Beryllium	0.5 ppm	0.1 ppm	
Chromium	2 ppm	1 ppm	
Copper	2.7 ppm	0.6 ppm	
Lead	7 ppm	5 ppm	
Silver	0.9 ppm	0.5 ppm	
Zinc	13 ppm	1 ppm	
Arsenic	0.8 ppm	0.3 ppm	
PHENOLICS	1.5 ppm	1.1 ppm	
SB-7 5'-7' (Duplicate of SB-4 5'-7') (06/16/89):			
VOLATILE ORGANICS			
TICs			
Acetone	13 ppb		
SEMI-VOLATILE ORGANICS			
Unknown	5900 ppb		
Unknown	1100 ppb		
METALS			
Beryllium	0.4 ppm	0.1 ppm	
Chromium	2 ppm	1 ppm	
Copper	2.4 ppm	0.6 ppm	
Lead	9 ppm	5 ppm	
Nickel	4 ppm	4 ppm	
Silver	0.5 ppm	0.5 ppm	
Zinc	12 ppm	1 ppm	
Arsenic	0.5 ppm	0.3 ppm	
PHENOLICS	12 ppm	0.1 ppm	

TABLE IX

Phase III Laboratory Analysis Summary - Detected Compounds

Soil Boring ID/ Detected PP+40 Compounds	Result	MDL	Qualifier
SB-4 20'-22' (06/16/89):			
VOLATILE ORGANICS			
1,1,1 Trichloroethane	3.0 ppb	5.3 ppb	J
TICs			
Acetone	15 ppb		
SEMI-VOLATILE ORGANICS			
TIC			
Unknown	1100 ppb		
METALS			
Beryllium	0.6 ppm	0.1 ppm	
Chromium	2 ppm	1 ppm	
Copper	2.8 ppm	0.6 ppm	
Lead	5 ppm	5 ppm	
Nickel	4 ppm	4 ppm	
Zinc	14 ppm	1 ppm	
Arsenic	0.6 ppm	0.3 ppm	
PHENOLICS	1.9 ppm	0.1 ppm	
SB-5 5'-7' (06/19/89):			
VOLATILE ORGANICS			
TICs			
Acetone	94 ppb		B
METALS			
Beryllium	0.2 ppm	0.1 ppm	
Chromium	10 ppm	1 ppm	
Copper	4.1 ppm	0.7 ppm	
Zinc	11 ppm	1 ppm	
Arsenic	8 ppm	0.3 ppm	
PHENOLICS	0.9 ppm	0.1 ppm	

TABLE IX

Phase III Laboratory Analysis Summary - Detected Compounds
Page 7

Soil Boring ID/ Detected PP+40 Compounds	Result	MDL	Qualifier
SB-5 20'- 22' (06/19/89):			
VOLATILE ORGANICS			
1,1,1 Trichloroethane	5.8 ppb	5.3 ppb	
TICs			
Acetone	130 ppb		B
METALS			
Chromium	5 ppm	1 ppm	
Copper	2.4 ppm	0.6 ppm	
Lead	7 ppm	5 ppm	
Zinc	4 ppm	1 ppm	
Arsenic	0.6 ppm	0.3 ppm	
PHENOLICS	2.1 ppm	0.1 ppm	
SB-6 5'-7' (06/19/89):			
VOLATILE ORGANICS			
1,1,1 Trichloroethane	1.8 ppb	5.6 ppb	J
TICs			
Acetone	16 ppb		B
METALS			
Beryllium	0.3 ppm	0.1 ppm	
Chromium	16 ppm	1 ppm	
Copper	3.2 ppm	0.7 ppm	
Lead	12 ppm	6 ppm	
Zinc	16 ppm	1 ppm	
Arsenic	7 ppm	0.3 ppm	
Field Blank (06/19/89):			
VOLATILE ORGANICS			
TICs			
Acetone	93 ppb		

TABLE IX

Phase III Laboratory Analysis Summary - Detected Compounds
Page 8

Soil Boring ID/ Detected PP+40 Compounds	Result	MDL	Qualifier
SB-6 20'- 22' (06/20/89):			
VOLATILE ORGANICS			
1,1,1 Trichloroethane	2.6 ppb	6.6 ppb	J
METALS			
Chromium	7 ppm	1 ppm	
Copper	4.7 ppm	0.8 ppm	
Selenium	0.3 ppm	0.3 ppm	
Zinc	7 ppm	1 ppm	
Arsenic	6.1 ppm	0.4 ppm	
PHENOLICS	11 ppm	0.1 ppm	

Pesticides and polychlorinated biphenyls (PCBs) were not detected.

20'-22': In the VOC run, one TIC (acetone) was identified at 12 ppb. However, said compound was also present in the trip blank, and was therefore suspect.

A total of six heavy metals were detected at low concentrations, consisting of Be, Cr, Cu, Ni, Zn and As. Phenolics were reported at 11 ppm. Trace amounts of Cu, Pb and phenolics were detected in the field blank.

SVOCs, total cyanides, pesticides and PCBs were not detected.

SB-2:

SB-2 was located adjacent to SV22 in London Terrace, adjacent to Bldg. No. 13 and Westminster Blvd.

5'-7': A total of 35.6 ppb VOCs were detected, consisting of 1,1,1 TCA, toluene (reported below the MDL) and one TIC (2-butanone). Acetone was present in both the sample and the trip blank, and therefore was suspect. 1,1,1 TCA, toluene and 2-butanone (also known as methyl ethyl ketone) are common commercial/industrial solvents utilized for a variety of purposes.

A total of 9,550 ppb SVOCs were detected, consisting of eight TICs (sulfur, Mol. [S8], C-10 H-16 O Isomer, three hydrocarbons and four unknowns). Sulfur is a nonmetalic element utilized in a variety of manufacturing processes, including but not limited to, pulp and paper, rubber vulcanization, petroleum refining, pharmaceuticals, explosives, fertilizers and road asphalt, among others.

A total of seven heavy metals were detected at low concentrations, consisting of Be, Cr, Cu, Pb, Ni, Zn and As. Total cyanides were reported at 2.0 ppm; phenolics were reported at 12 ppm. Trace amounts of Cu, Pb and phenolics were detected in the field blank.

Pesticides and PCBs were not detected.

20'-22': In the VOC run, one TIC (acetone) was identified at 21 ppb. However, said compound was also present in the trip blank, and was therefore suspect.

A total of four heavy metals were detected at low concentrations, consisting of Be, Cr, Cu and Zn. Phenolics were reported at 1.3 ppm.

SVOCs, total cyanides, pesticides and PCBs were not detected.

SB-3:

SB-3 was located adjacent to SV26 in London Terrace, between Bldg. No. 18 and No. 19 (along Westminster Blvd.).

5'-7': In the VOC run, one TIC (acetone) was identified at 29 ppb. However, said compound was also present in the trip blank, and was therefore suspect.

A total of six heavy metals were detected at low concentrations, consisting of Be, Cr, Cu, Ni, Zn and As. Phenolics were reported at 1.3 ppm.

SVOCs, total cyanides, pesticides and PCBs were not detected.

20'-22': In the VOC run, one TIC (acetone) was identified at 39 ppb. However, said compound was also present in the trip blank, and was therefore suspect.

A total of five heavy metals were detected at low concentrations, consisting of Be, Cr, Cu, Zn and As. Phenolics were reported at 7 ppm.

SVOCs, total cyanides, pesticides and PCBs were not detected.

<u>SB-4</u>:

SB-4 was located adjacent to SV29 in London Terrace, near Bldg. No. 52.

<u>5'-7'</u>: In the VOC run, no detectable compounds were identified in SB-4, however, 13 ppb of acetone was reported in the duplicate sample (SB-7).

A total of 6,900 ppb SVOCs were detected in SB-4, consisting of two unknown TICs; 7,000 ppb SVOCs were detected in the duplicate, SB-7, also consisting of two unknown TICs.

A total of seven heavy metals were detected at low concentrations in SB-4, consisting of Be, Cr, Cu, Pb, silver (Ag), Zn and As. Eight heavy metals were detected in low concentrations in the duplicate, SB-7 (same seven metals as SB-4, with the addition of Nickel [Ni] reported at the MDL). Phenolics were reported at 1.5 ppm in SB-4, and at 12 ppm in SB-7.

Total cyanides, pesticides and PCBs were not detected in SB-4 or SB-7.

SB-7 duplicate results, except for the acetone and phenolic data, generally corresponded well with SB-4 results.

<u>20'-22'</u>: A total of 18 ppm VOCs were detected, consisting of 1,1,1 TCA (reported below the MDL) and acetone. 1,1,1 TCA and

acetone are common commercial/industrial solvents utilized for a variety of purposes.

A total of 1,100 ppb SVOCs were detected, consisting of one unknown TIC.

A total of seven heavy metals were detected at low concentrations, consisting of Be, Cr, Cu, Pb, Ni, Zn and As. Phenolics were reported at 1.9 ppm.

Total cyanides, pesticides and PCBs were not detected.

SB-5:

SB-5 was located adjacent to a former Sommers Bros. Landfill access road in the rear of the Nieuw Amsterdam apartment complex.

5'-7': In the VOC run, one TIC (acetone) was identified at 94 ppm. However, said compound was also present in the trip blank, and was therefore suspect.

A total of five heavy metals were detected at low concentrations, consisting of Be, Cr, Cu, Zn and As. Phenolics were reported at 0.9 ppm.

SVOCs, total cyanides, pesticides and PCBs were not detected.

20'-22': A total of 5.8 ppb VOCs were detected, consisting of 1,1,1 TCA (below the reported MDL). Acetone was present in both the sample and the field blank, and therefore was suspect. 1,1,1 TCA is a common commercial/industrial solvent utilized for a variety of purposes.

A total of five heavy metals were detected at low concentrations, consisting of Cr, Cu, Pb, Zn and As. Phenolics were reported at 2.1 ppm.

SVOCs, total cyanides, pesticides and PCBs were not detected.

SB-6:

SB-6 was located off-site, adjacent to the municipal water tower in the control area selected for Phase I soil vapor borings.

5'-7': A total of 1.8 ppb VOCs were detected, consisting of 1,1,1 TCA (reported below the MDL). Acetone was present in both the sample and the field blank, and therefore was suspect. 1,1,1 TCA is a common commercial/industrial solvent utilized for a variety of purposes.

A total of six heavy metals were detected at low concentrations, consisting of Be, Cr, Cu, Pb, Zn and As.

SVOCs, phenolics, total cyanides, pesticides and PCBs were not detected.

20'-22': A total of 2.6 ppb VOCs were detected, consisting of 1,1,1 TCA (reported below the MDL). 1,1,1 TCA is a common commercial/industrial solvent utilized for a variety of purposes.

A total of five heavy metals were detected at low concentrations, consisting of Cr, Cu, Zn, As and selenium (Se); selenium was reported at the MDL. Phenolics were reported at 11 ppm.

SVOCs, total cyanides, pesticides and PCBs were not detected.

Based upon the analytical results presented above, and in conjunction with Phase I and Phase II data, project conclusions and recommendations are presented in Section 6.

SECTION 6 - CONCLUSIONS AND RECOMMENDATIONS

The original objective (i.e. Objective 1) of the Health Service Grant was to undertake an environmental study which addressed the following points:

1. To determine whether the residences in the immediate vicinity of Global and Sommers Brothers Landfills were built upon a former sanitary landfill.

2. To identify the composition of in-situ soils, including the presence, if any, of contaminants.

Each point is addressed below:

1. Based upon Phase I and Phase II findings (i.e., aerial photographs, soil boring data and historical information provided by Task Group personnel), it appears that the property presently occupied by the London Terrace apartments was not utilized for landfilling activities, but rather had undergone a major vegetative clearing and soil removal process (approximately ten to thirty feet of soil across a major portion of the property from the mid 1960's to the mid 1970's). A stereoscopic review of the 1966 and 1969 aerials and/or locating additional aerials between 1966/1969 and 1969/1976 would further confirm this point.

   Prior to clearing activities, the London Terrace area was wooded and exhibited a network of unimproved access roads, apparently linking Sommers Brothers and Global Landfills, a former munitions facility, an excavation pit, a potato farm and Route 9. Offshoot roads emanating from said access roads appeared to dead end in the woods. It is possible that localized disposal of unauthorized materials occurred along and adjacent to the referenced accessways, especially due to the relative proximity of landfill areas and the secluded nature of the site (i.e., wooded). It is also possible that construction debris was disposed in target areas during apartment construction activities.

2. Based upon Phase I soil vapor data, no elevated organic concentrations were recorded in Parkwood Village. Elevated readings in London Terrace and the adjacent vacant lot were largely recorded along Westminster Blvd. and/or former unimproved access roads (the highest concentrations were recorded in the vicinity of Bldgs. No. 10 through No. 15 in London Terrace). Elevated readings were also recorded in one off-site control point (Control 2); the origin of said control reading was uncertain (Control 1 soil vapor boring, approximately 70' away, revealed no detectable readings). Said Phase I data was largely utilized to select Phase II boring locations.

   Phase II data revealed trace concentrations of volatile organic compounds, namely, 1,1,1 TCA and toluene in borings SB-1A (5'-7'), SB-2 (5'-7'), SB-4 (20'-22'), SB-5 (20'-22') and the off-site control SB-6 (5'-7' and 20'-22'). An unknown TIC compound was also recorded in SB-1A (5'-7') and 2-butanone (TIC) was recorded in SB-2 (5'-7'), both in low concentrations.

   Although recorded volatile organic concentrations were not excessive for industrial/commercial sites, said concentrations are not typically found in undisturbed soils utilized for residential purposes. Given the fact that 1,1,1 TCA and toluene were detected or estimated in low concentrations in five of the six borings installed (including the off-site control), it is possible that said compounds originated from a common location (possibly from the adjacent landfills). Existing and/or proposed soil vapor or perimeter soil studies at both Global and Sommers Brothers landfills should be reviewed to quantify if subsurface transport path data is available, and/or if 1,1,1 TCA, toluene or the other reported analytes (all common multi-use solvents) are targeted compounds.

Elevated Phase II semi-volatile organic compound concentrations in borings SB-1A (5'-7'), SB-2 (5'-7') and SB-4 (5'-7' and 20'-22') were recorded; all three locations were adjacent to former access road locations. In addition, soil boring data for SB-1A and SB-2 revealed unidentifiable apparently foreign material at the 5'-7' depth.

Although recorded semi-volatile concentrations were not excessive (ranging from 1,100 to 9,550 ppb) for industrial/commercial sites, said levels are not typically found in undisturbed soils utilized for residential purposes. The elevated readings in SB-1A, SB-2 and SB-4 at the 5'-7' depth are possibly due to localized material disposal along former access roads prior to the completion of London Terrace, or from building/construction material disposal during apartment erection (several of the identified and estimated compounds are constituents of common building materials, such as roofing, insulation, paints, waterproofing, pipe coatings, mortars and asphalt additives, among others). The origin of the unknown TIC compound in SB-4 at a depth of 20'-22' is uncertain. Specific analytical testing on unidentifiable fibrous material observed in SB-1A (5'-7') may be beneficial to further quantify in-situ materials, and further investigatory borings in the vicinity of London Terrace Bldgs. No. 13 and No. 15 may be warranted to quantify the horizontal extent of said material.

Given the fact that sanitary sewer and storm sewer utilities reportedly run along Westminster Blvd., it is possible that certain elevated organic vapor readings recorded during Phase I testing were due to pipeline degradation. As-built plans in conjunction with localized excavation activities in select utility areas may be beneficial to confirm this assumption.

In conclusion, compounds identified during project activities may be attributable to one or a combination of the following:

- Common off-site compound soil vapors (e.g., originating at Global or Sommers Brothers Landfills).
- Degradation of utility lines (i.e., sanitary sewer and/or storm sewer pipes) along Westminster Blvd. in the vicinity of London Terrace.
- Localized unauthorized material disposal along former access roads and/or during apartment erection activities.

The possible sources outlined above should be reviewed concurrent with areas of documented resident health concerns to further qualify contaminant origins and transport paths.

Questions or comments relating to the environmental findings report outlined herein can be directed to Mr. Glenn P. Brukardt at Eikon Planning and Design Corp.'s Netcong, New Jersey office at (201) 347-2272.

APPENDIX #3

ENVIRONMENTAL COMMISSION
(201) 721-5600

MIDDLESEX COUNTY, N.J.

TOWNSHIP OF OLD BRIDGE

Memo to: Council
From: Blanche D. Hoffman (Global Health Task Force)
Date: April 26, 1989
RE: Soil Tasks

You recall that the Global Health Task Force was formed to investigate the health concerns in answer to questions relative to alleged health problems stemming from living near Global Landfill and the Summer Bros. sites.

An important data collection phase has been halted due to an indemnification problem with the soil boring task. The grant which expires June 30, 1989 is in jeapordy.

Old Bridge has two options -

(1) negotiate the indemnification problem

or

(2) delay action until after June 30 and nothing can be done.

It is extremely urgent for Old Bridge to negotiate the indemnification problem before May 5th for the following reasons:

(1) Future State grants will be denied to any agency with a history of problems in administering grant funds.

(2) It is critical for the Township to demonstrate visibly at this time their concern for protecting the health of its citizens.

(3) Action is consistent with a legislative mandate. In response to the public concerns, Assemblyman Joann Smith succeeded in having the New Jersey legislature provide $75,000 for the soil task and other activities in connection with this investigation.

The Old Bridge Health Officer and the Global Task Force feel committed to the goals of these activities. It is our responsibility to inform the Council of the options and likely results as a result of this indemnification problem which is caused by the contractor's refusal to accept the risk for his own work.

ONE OLD BRIDGE PLAZA • OLD BRIDGE, N.J. 08857 • (201) 721-5600

Memo to: Council
Page 2
April 26, 1989

In November, the Council took positive action in passing a resolution which documented their concern for the health of the citizens living near the landfill. Only the Council with swift action can make this effort a reality.

cc Mayor Haney
Joseph Leo
Ronald Reisner, Esq.
Thomas Sikorski, Health Officer
Assemblywoman Joann Smith
Assemblyman Joseph Kyrillos
Senator Richard Van Wagner
Jacqueline Solomon, NJ DOH

APPENDIX #4

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF HAZARDOUS SITE MITIGATION
CN 413, Trenton, N.J. 08625-0413
(609) 984-2902
Fax # (609) 633-2360

JUN 29 3 08 PM '90
ENVIRONMENTAL HEALTH PROGRAM

Anthony J. Farro
Director

JUN 28 1990

M E M O R A N D U M

TO: JACQUELINE SOLOMON, EHS COORDINATOR
COMMUNITY INVESTIGATION UNIT, NJDOH

FROM: PETER LATIMER, SITE MANAGER/GLOBAL LANDFILL
BUREAU OF SITE MANAGEMENT, NJDEP

SUBJECT: QUALITY ASSURANCE DATA REVIEW FOR GLOBAL LANDFILL TASK GROUP: RESULTS OF SOIL DATA PREPARED BY EIKON AND ENESCO

A review of the soil data by Dr. Winnie Chu, Hazardous Mitigation Specialist II, Bureau of Environmental Measurements and Quality Assurance, has produced the following conclusions:

The most consequential irregularity with the data was that the sample temperature when received by the laboratory. These temperatures ranged from 12° to 26° C while the maximum temperature allowable by NJDEP protocol is 4° C. The elevated temperatures introduced significant bias to the volatile fraction and an unknown degree of bias to the semi-volatile fraction. Data must be considered bias low and the Department cannot make any health related claims based on this data.

Acetone was found in all the samples but due to its existence in the blank its presence in 13 of the 15 samples can be disregarded.

Chain of custody forms were not provided. This points to a possible procedural shortcoming although it does not point to any wrong doing without further evidence to that end.

Some fractions of the Priority Pollutant target compounds were not on the calibration list. Although these few compounds registered as ND, since they were not included in the calibration, they must be considered estimates.

Generally, there were some transcription problems and some unreadable documentation. These problems, however, are not believed to be of great significance. The major shortcoming, therefore, seems to be the temperature of the samples.

HS329:dfg

A P P E N D I X # 5

State of New Jersey
DEPARTMENT OF HEALTH
CN 360
TRENTON, N.J. 08625-0360

FRANCES J. DUNSTON, M.D., M.P.H.
STATE COMMISSIONER OF HEALTH

September 25, 1990

Dear

As you may already be aware, legislation passed by the State of New Jersey resulted in an investigation of the health concerns of those residents of Old Bridge and Sayreville who live near the Global Landfill and the Somners Brothers property.

Conducting physical examinations of children is one of the ways in which the New Jersey Department of Health can address concerns about the health of children living near Global Landfill and the adjoining property. However, the information from the health evaluation does not offer a certain or direct link between the landfill and your child's health.

Your child, , participated in the health evaluation done at the Old Bridge Department of Health. The evaluation included a complete medical history, physical exam and several laboratory tests routinely ordered by doctors for comprehensive medical examinations: complete blood count, blood chemistries, blood lead levels, and urinalysis.

The results of your child's laboratory tests were normal. During the physical examination we discussed the middle ear infection that your child had at the time. We recommended that you see your child's physician as soon as possible to follow up this problem. A middle ear infection is a very common problem and we have no reason to believe that is related to living near the Global Landfill. Other than the middle ear infection, there were no abnormalities found on physical examination.

Your child's blood lead level was 11 mcg/dl. The laboratory does not consider this abnormal but we would recommend that you inform your child's physician because he/she may wish to repeat the test.

If you identified your family physician on the consent form signed at the time of the examination, we will be notifying him or her of the examination and laboratory results. If you did not indicate that you would like to have sent, please write to me at the address above indicating this and be sure to include the physician's full name and address. I will be happy to make sure that the results are sent to the physician.

If you have any questions regarding these laboratory findings, please call me at the NJDOH at (609) 633-2043.

Sincerely,

Marilyn Howarth

Marilyn V. Howarth, M.D.
Division of Occupational and
Environmental Health

A P P E N D I X #6

S U M M A R Y R E P O R T
P E D I A T R I C H E A L T H E X A M I N A T I O N S

Prepared By:

Division of General Pediatrics
University of Medicine and Dentistry of New Jersey

INTRODUCTION

Residents of Old Bridge, NJ have raised concern about possible health effects of exposure to materials dumped in the Global landfill and in two other landfills nearby. The New Jersey Department of Health responded with a comprehensive evaluation of this potential problem, which included health screenings of children living and playing near these areas. The Division of General Pediatrics of the University of Medicine and Dentistry of New Jersey in New Brunswick was asked to assist with developing and implementing these health screenings. We met with representatives of the Department of Health (DOH) during 1988 and 1989 to plan our approach to these screenings.

We reviewed medical literature regarding evaluation of health effects resulting from exposure to hazardous waste sites, for example the well-known Love Canal area in New York State. Ill-health effects are presumed to result from human exposure through skin contact, ingestion (such as of contaminated ground water) or inhalation (such as of fumes or dust from the landfill). These will then cause short-term or longer-term health problems. Some of the short-term problems which have been noted include respiratory problems (such as asthma exacerbations, bronchitis, chronic cough), skin problems (such as rashes, skin discolorations, unusual acne), narcotic symptoms (such as headaches, dizziness, balance problems), and mood disorders (such as irritability and insomnia). Longer-term problems may include reproductive abnormalities, developmental and learning problems, chronic diseases and cancer. There are a variety of factors which make valid determination of any relationship between exposure and health effects difficult at best. These include relatively small numbers of people with significant exposure, exposures to hazards in daily life (air pollution, smoking, drugs, alcohol, occupational hazards, etc.), mobility of families, genetic predispositions, and socioeconomic factors. In addition, many of the potential health problems are difficult to identify as related to exposure because they are rare (e.g. certain reproductive abnormalities), they take many years to develop (e.g. most cancers), or their prevalence in the general population is not well-known (e.g. bronchitis and headaches).

With this background in mind, we felt that the most effective way to identify any relationship between exposure to the landfills and health problems would be through a comprehensive questionnaire that included demographic and hazardous exposure data, as well as a thorough review of perceived symptoms and problems. We tried to minimize reporter bias by eliciting information about which perceived problems had been evaluated and/or treated by a physician. The next component of the evaluation was a complete physical examination, particularly looking for physical signs that would confirm health concerns. Finally, we obtained some screening laboratory tests to try to identify occult problems. We hypothesized that if health problems were resulting from exposure to the landfill, that they would be more prevalent in those individuals with the greatest exposure. The health screenings were restricted to children under 18 years of age as the initial target group.

MATERIALS AND METHODS

The health screening program was conducted at the Old Bridge Health Department offices. Parents enrolled their children in the program in response to information circulated regarding the screenings in area schools and newspapers. At the time of the screening, each parent was asked a long series of questions about their family. These included an extensive family and social history regarding family profile, family health problems, family's residences for the preceding 15 years, and household exposures (including cigarette smoke, wood, kerosene, or oil-burning heaters, and materials used in hobbies and recreational activities). We asked for a list of places their children played and for a list of household members with known or suspected chemical exposure and the circumstances of the exposure. We also asked about certain risk factors for health problems such as alcohol use and about family history of reproductive abnormalities. The remainder of the questionnaire addressed a comprehensive review of systems. Information was elicited regarding heart problems and chest pain. We asked about gastrointestinal problems including abdominal pain, gastric disturbances and changes in bowel habits. We addressed kidney and bladder problems and asked a series of questions about skin problems. We asked about respiratory problems including coughing, wheezing, asthma, bronchitis, allergies and upper respiratory infections. We addressed hematopoietic problems such as bruising, nosebleeds, anemia, lead poisoning, leukemia, immune problems and other cancers. We asked about mood disturbances, headaches, insomnia, behavior and learning problems, coordination problems, "blackouts", and seizures. We then proceeded to a complete physical examination. Laboratory analysis included complete blood count, urinalysis, erythrocyte protoporphyrin, lead level, and serum chemistries including liver function tests (SMA-12).

Following completion of the health screenings, the data were compiled and were analyzed using the Epidemiological Graphics, Estimation and Testing (EGRET) package. Outcome variables were compared with exposure level based on proximity of the child's residence or play areas to the landfills.

RESULTS

There were 175 children enrolled in the health screening program between August, 1989 and February, 1990. The ages of the children ranged from 12 months to 18 years. There were 90 boys and 85 girls. The racial and ethnic distribution reflected that of the community. The vast majority of the physical examinations were completely within normal limits and therefore our data analysis focused on relationships between reported health problems from the questionnaires and proximity of the child's residence and play areas to the landfills.

There were no significant heart problems identified. However, we asked about "frequent, pounding headaches" in our cardiac review of symptoms and 37 children (21.1%) were reported to have these. There was a significant correlation between problems with headaches and living or playing near the landfill ($p=0.025$ for proximity of residence and $p=0.015$ for proximity of play area).

With respect to gastrointestinal problems, there was no significant correlation found. Abdominal pain was reported to be a problem in 27 children (15.4%), however presence of abdominal pain was no more likely for children living close to the landfill ($p>0.1$). Nausea, vomiting, diarrhea and constipation were not found to be significant problems.

There were 39 children (22.3%) who were reported to have problems with rashes. Most of these were likely eczema or atopic dermatitis by description. There was no significant risk for such rashes, however, from living or playing near the landfill ($p>0.1$).

There were a variety of respiratory problems reported. Fifty-four of the children (30.9%) had problems with frequent coughing, wheezing or asthma, and the likelihood of such problems increased with proximity of residence ($p=0.018$) to the landfill. The correlation of these to play area was of questionable significance ($p=0.062$). In further analyzing this group of symptoms, 24 children (13.7%) had "hay fever", 29 (16.6%) had "respiratory allergies", 21 had been diagnosed with pneumonia (12%) and 18 had recurrent "bronchitis" (10.3%). There was no significant relationship of any of these problems to proximity to the landfill. Forty-one of the children were reported to have throat infections more than three times per year (23.4%) and 39 have had ear infections more than three times per year (22.3%). Again, risk for these problems did not increase with proximity to the landfill ($p>0.10$). There were 23 children (13.1%) with asthma and proximity of residence to the landfill was a significant risk factor for this problem ($p=0.047$). Risk for this from playing near the landfill was not significant ($p=0.15$). Conjunctivitis was grouped with "upper respiratory infections" and had been recurrent in 52 children (29.7%). However, it was no more likely for children living or playing nearest the landfill ($p>0.2$).

There were no significant hematopoietic problems identified, such as easy bruising, nosebleeds, lead poisoning, or other blood diseases. There were a few children who had iron deficiency anemia as toddlers, but no other significant anemias. There were no cases of leukemia, other cancers, or immune deficiency in any study children or their siblings.

There were no significant problems with emotional or psychiatric disturbances. However, there were 21 children (12%) with sleeping problems (not significant, p=0.4). Twenty-nine children (16.6%) had been evaluated for learning problems and about half of these were in special education (again not significant, p>0.1). There were significant problems with headaches as discussed earlier. There were no significant problems with balance, coordination or seizures.

In analyzing the laboratory data, there were no significant cases of anemia identified. There were 8 children with mild anemia, all of which appeared related to mild iron deficiency. The blood counts were otherwise all completely within normal limits. There were 35 children with lead levels between 11 and 15, 3 with levels between 16 and 20 and one child with a level of 23 (all venous samples). While none of these children have true "lead poisoning", there has been concern raised lately among experts that these mild lead burdens may have significant adverse effects, for example on learning. Such lead burdens are probably fairly common in urban dwellers, and there was no significant correlation with exposure to the landfill in the children studied. There were no significant urinary abnormalities identified. Most of the serum chemistries were normal, however there were some children with mildly elevated liver function tests. Thirty-eight children had aspartate aminotransferase (AST) levels above 40 (maximum = 75), 8 had alkaline phosphatase levels above 400 (maximum = 553), and two children had mild elevation of both. AST elevation was not correlated with landfill exposure, but alkaline phosphatase elevation was (p=0.03), and the two children with mild elevation of both values are residents of one of the closest developments, the Parkwood Apartments. Neither of these children had any significant health problems except headaches.

DISCUSSION

The health screening program revealed that there are some relatively minor health problems which seem related to exposure to the landfills. The types of health effects seen - headaches, respiratory problems (such as asthma), and mild elevation of liver enzymes - are ones which have been associated with low-dose exposure situations. These were likely primarily inhalation exposures and a number of families commented on the frequent fumes and foul odors they detected from the landfill. There may also be some contribution of ingestion of (e.g. via ground water) and direct contact with the landfill, however the health effects seen are less compatible with these routes.

Headaches and other central nervous system manifestations of toxic exposure have primarily been reported related to exposure to organic chemicals (such as alcohols, aromatic hydrocarbons, solvents and insecticides) and heavy metals (such as lead, mercury and arsenic). While such compounds have been evaluated extensively for the past several years in an ongoing monitoring system of the Global landfill site, the interpretation of results of the sampling/monitoring is beyond the scope of this portion of the analysis. It may be that the problem with headaches in many of the children studied is related to exposure to one or more of these compounds. We screened lead levels to look for indication of significant heavy metal exposure, but the lead levels were within normal limits. Therefore, it would be more likely that if the landfill is contributing to headaches in nearby residents, they are more related to organic chemical exposure (e.g. fumes).

Respiratory problems have been reported to be related to a number of different toxins. These include organic chemicals (such as anhydrides, formaldehydes, methane and ethane), inorganic chemicals (such as ammonia, hydrogen sulfide, sulfur oxides, and halogenated compounds), metals (e.g. cobalt and cadmium), and minerals (e.g. asbestos and silica). Many of these compounds are also included in the routine, ongoing analysis of the landfills and their leachates. As the direct contacts with the landfills are very limited in area residents, it is most likely that any related respiratory symptoms are the result of inhalation exposure to organic or inorganic chemicals.

Mild liver abnormalities have been associated with exposure to organic chemicals (such as halogenated compounds, insecticides, and carbon tetrachloride), inorganics like phosphorus compounds, and metals like arsenic. Again, such compounds are part of the routine monitoring.

It is difficult, if not impossible, to assess the true relationship between health problems experienced by residents around the Global landfill and exposure to toxins from it. Although our health screening project provided some indication that there may be related mild health problems, all studies of hazardous waste sites to date have been plagued by a number of technical and human problems in trying to establish cause and effect relationships. First, the study populations tend to be small (as ours is) so the range and significance of effects tends to be limited. The people in the study tend to have a variety of demographic and exposure factors which may also be contributing to their health problems (as in this study). Exposures to toxins in the general population, especially in urban areas, are poorly defined and this study attempts to evaluate children living in a very industrialized, urban area with significant air and water pollution problems. There is very limited data regarding the prevalence of common health problems (such as headaches and coughing) in the general population, let alone in children. There was a report in Pediatrics in January, 1988 regarding a national survey of prevalence of asthma in 3-17 year old children and the overall prevalence was found to be 6.7% with a prevalence in urban areas of 7.1%. Therefore, the prevalence of asthma in our study of 13.1% may be higher than the national norm, but we don't know how it compares to prevalence in the New York City metropolitan area or other very industrial, polluted areas. Some health effects possibly related to toxic exposures are rare or have a long latency period, so we don't know if we've missed a small, but significant increased risk of reproductive abnormalities or cancer. Finally, publicity and speculation often introduce or accentuate reporting biases regarding adverse health effects making waste site studies especially difficult.

In conclusion, this health screening study seems to identify several minor health effects in children living and playing near the Global landfill in Old Bridge, NJ. The study has recognized limitations and should be interpreted with considerable caution. The health effects identified are similar to those found in other studies evaluating health effects from hazardous waste sites, and are probably related to low level inhalation exposure for the most part. Any proposed cause and effect relationship must be considered speculative given the difficulties of studies such as this one. Nonetheless, it would likely be in the best interest of area residents to minimize or eliminate toxic exposures from this landfill as much as possible and in a timely fashion.

Sally M. Smith, M.D.
All Children's Hospital
St. Petersburg, FL
(formerly with UMDNJ-RWJMS
New Brunswick, NJ)

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APPENDIX #7

MIDDLESEX COUNTY, N.J.

TOWNSHIP OF OLD BRIDGE

Dear Old Bridge and Sayreville Parents:

As you may already be aware, recent legislation enacted by the State of New Jersey has resulted in a study of the health concerns of the residents of Old Bridge and Sayreville living in close proximity to the Global Landfill. The study is being administered by the Global Task Group made up of representatives of the Old Bridge Health Department, State Department of Health, Old Bridge Environmental Commission, Sayreville Environmental Commission and Citizens Helping Environmental Clean-up (CHEC).

One of the ways inwhich we plan to address your concerns is by conducting physical examinations of pre-school and school age children. The examinations will be conducted at the Old Bridge Health Department by pediatricians affiliated with Robert Wood Johnson Medical Center, the University of Medicine and Dentistry of New Jersey. Our intention is to conduct the examinations during the latter part of the summer and early into the fall. If you feel that you would or may be interested in having your child examined, please complete the lower portion of this letter and return it to school before the end of the school year.

If you should have any questions, you can call: Thomas Sikorski, Health Officer, Old Bridge Township, at 201-679-4800; Jacqueline Solomon or Barbara Giudici, New Jersey State Department of Health, at 609-633-2043; or Debbie Cahill, CHEC member, at 201-727-0648.

- -

NAME: ____________________ NUMBER OF CHILDREN: ____________________

ADDRESS: ____________________ NAMES AND AGES OF CHILDREN: ____________

____________________ ____________________

PHONE #: ____________________ ____________________

Please check one: INTERESTED IN SCREENING ____

NOT INTERESTED ____

ONE OLD BRIDGE PLAZA • OLD BRIDGE, N.J. 08857 • (201) 721-5600

A P P E N D I X #8

The Old Bridge Township Health Department
in conjunction with
The New Jersey State Dept. of Health and the University of Medicine & Dentistry - Robert Wood Johnson (UMDNJ-RWJ)

*** CONSENT FORM ***

For Pediatric Health Screenings as part of the Global Landfill Investigation

I, THE UNDERSIGNED, hereby agree to participate in the Global Landfill Investigation Pediatric Health Screening provided by the OBHD, NJDOH and UMDNJ-RWJ. I understand that:

1. This screening is attempting to evaluate the health status of children living in the areas surrounding the Global Landfill site. No guarantees or assurances have been made to me or my child as to results that may be obtained from these tests. The data derived from such examination/tests is to be considered as a preliminary screening only, and offers no direct link between the Global landfill and an individual's health status.

2. The screening will include the following:
   - completing a medical history questionnaire,
   - discussion of this information with a nurse,
   - physical examinations by a physician of UMDNJ-RWJ and,
   - laboratory tests to include: blood chemistries, (blood leads and SMA-12) and a urinalysis.

3. These tests are "screening tests" and DO NOT replace regular medical care. Rather, the tests are to be an aid to me and my child's personal physician.

4. The doctors who are performing these tests cannot provide ongoing medical treatment if an abnormality is observed, but I will be referred for follow-up to my child's regular physician.

5. I hereby release the Old Bridge Township Health Department, its agent and employees, the University of Medicine and Dentistry of NJ Robert Wood Johnson University Hospital, and the New Jersey State Department of Health from any responsibility or liability that may arise from these tests or from the data received from them.

6. I can refuse participation in the screening at any time.

7. The results of the testing will be given to me and if requested to my child's regular physician. I would like the results of the testing sent to the regular medical care provider.

   ______ YES ______ NO

   If YES, Please provide the Name and Address of provider:

   Physician Name: ______________________________

   Address: ______________________________

   Phone: ______________________________

8. I have read and fully understand the implications of this consent form. If I have any questions regarding this testing I can contact the Old Bridge Township Health Dept. at (201) 679-4800.

PRINT NAME: ______________________ DATE: ______________

SIGNATURE: ______________________________

ADDRESS: ______________________________

APPENDIX #9

State of New Jersey
DEPARTMENT OF HEALTH
CN 360, TRENTON, N.J. 08625-0360

MOLLY JOEL COYE, M.D., M.P.H.
COMMISSIONER

September 25, 1989

Dear Community Member:

As you may be aware, recent legislation, passed in the State of New Jersey, has called-for an investigation of health concerns of residents of Old Bridge and Sayreville. This investigation is to take place in selected areas near Global Landfill and Sommer Brothers property sites. The State Department of Health, together with the Old Bridge Health Department and Citizens Helping Environmental Cleanup (C.H.E.C.), will be investigating these health concerns.

Part of the investigation is a health survey of your neighborhood which is continuing during October in households chosen at random. An Interviewer may knock on your door to ask you if you would agree to answer some questions about specific concerns you may have about the landfill's effect upon your family's health. These Interviewers will show you identification from the Old Bridge Health Department and ask your permission to ask questions. The interview takes about 15-20 minutes. You do not have to answer any question you don't want to. All the information you provide will be kept strictly confidential and your identity will not be disclosed.

Responding to this questionnaire is totally voluntary. However, your help is very important to the success of this investigation. The information from all completed interviews will be collected to identify the community's specific health concerns and possible ways to address them. For scientific reasons, a random sample of homes are being asked to complete the interview.

If you have any questions, you can call Thomas Sikorski, Health Officer, Old Bridge Health Department at 201-679-4800 and Jacqueline Solomon, M.P.H., or Barbara Giudici, R.N., New Jersey State Department of Health, Environmental Health Service at (609) 633-2043.

Thank you for your help and cooperation.

Sincerely,

Diana L. Kiel

Diana L. Kiel, M.P.H.
Acting Director,
Environmental Health Service

TASK GROUP ON GLOBAL LANDFILL
AND SOMMERS BROTHERS PROPERTY
Contact List - March 1992

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FYI CONTACTS:
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LOCAL LIBRARIES

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Old Bridge Plaza
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