United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R02-84/007
September 1984

EPA

Superfund Record of Decision:

Lone Pine Landfill, NJ

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA/ROD/R02-84/007	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE SUPERFUND RECORD OF DECISION: Lone Pine Landfill, NJ		5. REPORT DATE 09/24/84
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460		13. TYPE OF REPORT AND PERIOD COVERED Final ROD Report
		14. SPONSORING AGENCY CODE 800/00
15. SUPPLEMENTARY NOTES		

16. ABSTRACT

The 45-acre Lone Pine Landfill is situated on a 144-acre wooded parcel owned by the Lone Pine Corporation in Freehold Township, Monmouth County, New Jersey. The landfill is approximately 500 feet south of the headwaters of the Manasquan River and 1,000 feet south of the Turkey Swamp Fish and Wildlife Management area. The Lone Pine Landfill operated from 1959 until 1979 when it was ordered closed by the New Jersey Department of Environmental Protection. While it was open, wastes accepted at the landfill included municipal refuse and septage wastes, at least 17,000 drums and several million gallons of bulk liquid chemicals. The major class of contaminants being released from the landfill are volatile organic compounds, notably benzene, chlorobenzene, methyl chloride, toluene and vinyl chloride.

The cost-effective remedial alternative which was selected for this site includes installation of a slurry wall, approximately 30 feet through the Vincentown aquifer; a multi-layer surface seal over the 45-acre landfill; installation of ground water collection wells located within the contained zone; treatment of ground water collected from within the contained zone; and monitoring to determine the effectiveness of the remedy. The estimated present worth capital cost for this remedy is $10,642,050 and the annual O&M costs are $324,734.

(Key Words on attached page)

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision: Lone Pine Landfill, NJ Contaminated media: gw, sw, soil Key contaminants: VOCs, solvents, resins, pesticides, metals		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)* None	21. NO. OF PAGES 138
	20. SECURITY CLASS *(This page)* None	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

16. Abstract

Key Words: Ground Water Treatment, Slurry Wall, Source Control, PRP Alternative, Ground Water Contamination, Off-Site Plume Control

ROD ISSUES ABSTRACT

Site: Lone Pine Landfill, New Jersey

Region: II

AA, OSWER
Briefing: September 21, 1984

SITE DESCRIPTION

The 45-acre Lone Pine Landfill is situated on a 144-acre wooded parcel owned by the Lone Pine Corporation in Freehold Township, Monmouth County, New Jersey. The landfill is approximately 500 feet south of the headwaters of the Manasquan River and 1,000 feet south of the Turkey Swamp Fish and Wildlife Management area. The Lone Pine Landfill operated from 1959 until 1979 when it was ordered closed by the New Jersey Department of Environmental Protection. While it was open, wastes accepted at the landfill included municipal refuse and septage wastes, at least 17,000 drums and several million gallons of bulk liquid chemicals. The major class of contaminants being released from the landfill are volatile organic compounds, notably benzene, chlorobenzene, methyl chloride, toluene and vinyl chloride.

SELECTED ALTERNATIVE

The cost-effective remedial alternative which was selected for this site includes installation of a slurry wall, approximately 30 feet through the Vincentown aquifer; a multi-layer surface seal over the 45-acre landfill; installation of ground water collection wells located within the contained zone; treatment of ground water collected from within the contained zone; and monitoring to determine the effectiveness of the remedy. The estimated present worth capital cost for this remedy is $10,642,050 and the annual O&M costs are $324,734.

ISSUES AND RESOLUTION

1. The Potential Responsible Parties (PRPs) proposed capping the site and monitoring the ground water to determine the need for additional remediation (as a RCRA closure remedy). However, a slurry wall around the site and treatment of ground water inside the slurry wall is also necessary to prevent the migration of contaminated ground water into the Manasquan River, to reduce the potential for releases from areas of the landfill which remain below the ground water

KEY WORDS

- Ground Water Treatment
- Slurry Wall
- Source Control

Lone Pine Landfill, New Jersey
September 21, 1984
Continued

ISSUES AND RESOLUTION		KEY WORDS
	surface, and to prevent contamination of the State's 35 million gallon reservoir that will be constructed 16 miles downstream of the site.	
2.	The PRPs did not submit a formal remedial action plan or supporting documentation for their source control proposal justifying exclusion of the slurry wall. Therefore, EPA proceeded with remedial design and extended an opportunity to the PRPs to construct the selected remedial alternative.	. PRP Alternative
3.	An additional off-site hydrogeologic investigation will be performed to determine the extent of off-site ground water contamination and to assess ground water cleanup alternatives. A supplemental ROD will be prepared for off-site plume control once the hydrogeologic investigation is complete.	. Ground Water Contamination . Off-Site Plume Control

Record of Decision
Remedial Alternative Selection

Site:

Lone Pine Landfill site, Freehold Township, New Jersey.

Documents Reviewed:

I am basing my decision primarily on the following documents describing the analysis of the cost-effectiveness of remedial alternatives at the Lone Pine Landfill site:

- Geophysical Investigation for Buried Drums at the Lone Pine Landfill, Technos, Inc., August 1981.

- Lone Pine Landfill Final Report Excavation and Sampling Fred C. Hart, January 1982.

- Lone Pine Landfill Hydrogeological Investigation, Fred C. Hart, April 1982.

- Lone Pine Landfill Preliminary Aquifer Testing, Fred C. Hart, July 1982.

- Lone Pine Landfill Analytical Results for Samples Collected September 1982, Camp Dresser and McKee, February 1983.

- Draft Feasibility Study - Lone Pine Landfill, Camp Dresser and McKee, June 1983.

- Draft Environmental Information Document for Remedial Actions at the Lone Pine Landfill, Camp Dresser and McKee, June 1983.

- Summary of Organic Chemical Concentrations in Water and Sediment Samples, Camp Dresser and McKee, August 1983.

- Evaluation of Analytical Chemical Data from Lone Pine Landfill, NUS Corporation, September 1983.

- Evaluation of Analytical Chemical Data from Lone Pine Landfill, NUS Corporation, February 1984.

- Presentation of Analytical Chemical Data and Groundwater Evaluations from Lone Pine Landfill, NUS Corporation, March and May 1984.

- Supplemental Feasibility Study for the Lone Pine Landfill Site, Camp Dresser and McKee, May 1984.

- Lone Pine Landfill Air Investigation Report, Camp Dresser and McKee, September 1984.

- Responsiveness Summary, including documents prepared and presented by the Generators Steering Committee, Freehold Township, Howell Township, and Monmouth County (see Attachment 5).

- Staff summaries, memoranda, letters, and recommendations.

- Summary of Remedial Action Alternative Selection - Lone Pine Landfill.

Description of Selected Remedy:

- Installation of a shallow groundwater cut-off wall and surface seal over the 45-acre landfill.

- Installation of groundwater collection wells located within the contained zone.

- Treatment of the groundwater collected from within the groundwater cut-off wall and discharge to the Manasquan or Metedeconk River, or alternately, to a sanitary sewer interceptor for treatment at the Ocean County wastewater treatment plant. (The specific treatment scheme will be designated upon completion of the ongoing treatability studies.)

Declarations:

Consistent with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), and the National Contingency Plan (40 CFR Part 300), I have determined that the selected containment and treatment strategy for the Lone Pine Landfill site is a cost-effective remedy, and that it effectively mitigates and minimizes existing and potential damage to, and provides adequate protection of public health, welfare and the environment.

I have also determined that the action being taken is appropriate when balanced against the availability of Trust Fund monies for use at other sites.

The action will require future operation and maintenance activities to ensure the continued effectiveness of the remedy. These activities will be considered part of the approved action and eligible for Trust Fund monies for a period of one year.

EPA will undertake an additional field investigation to further delineate the extent of off-site groundwater contamination. If additional remedial action is determined to be necessary to address off-site contamination, a supplemental Record of Decision will be prepared for approval of the additional action. Also, a treatability study has been initiated to study groundwater treatment methods. The results of this treatability study will be incorporated into the design phase of the remedial project.

The Region has consulted with the State of New Jersey in selecting the recommended remedial action for this site. The State concurs that containment is the most appropriate source control measure for the Lone Pine Landfill.

9/28/84
Date

Lee M. Thomas
Assistant Administrator
Office of Solid Waste and Emergency Response

NOTE:

The original feasibility study evaluated nine alternatives that addressed both source control and off-site plume control. And the supplemental feasibility study evaluated five additional alternatives. Because of the need to perform additional field investigation to further evaluate the plume, this Record of Decision (ROD) only addresses the nine source control remedial alternatives from both studies. Upon completion of the additional field ivestigation, if plume control is determined to be necessary, a supplemental ROD will be prepared. Because of the alterations in the original presentation in the feasibility study, the alternative numbering sequence has been changed as follows:

ALTERNATIVE NO.

Current	Previous
1	1 (no action)
2	4A
3	4
4	3B
5	2A
6	5
7	6A
8	6C
9	7

Briefing for the Assistant Administrator
Record of Decision
Lone Pine Landfill

Purpose:

The purpose of this Record of Decision is to select the appropriate remedial actions for the Lone Pine Landfill site that re consistent with the requirements of CERCLA and the NCP. The ssistant Administrator has been delegated the authority for that pproval.

ssues:

There has been strong public and congressional sentiment express-d towards excavating the drums disposed of in the landfill even hough the feasibility study ruled out excavation because of tech-ical and safety concerns. Furthermore, the public has asked that PA consider research and development efforts to reduce the hazard ithin the site by the elimination of contaminants through state f the art technology.

A Generators Steering Committee has been organized to negotiate ith EPA. Currently, at least eight generators are participating. ne Committee has provided a considerable number of comments on ne draft study and has provided data representing their own ield investigation. The Committee has verbally offered to cap ne landfill and provide additional source control measures in he future should the cap alone prove to be ineffective. However, t this time, no formal offer, plan or supporting documentation as been provided to EPA.

In light of questions raised about the extent of off-site ground-ater contamination, it will be necessary to perform an additional ff-site hydrogeological investigation. Upon completion of the roposed investigation, if off-site plume control is determined to e necessary, a supplemental ROD will be prepared for approval f the additional remedial action.

ain Points:

The 45-acre Lone Pine Landfill operated for about 20 years end-ng in the late 1970's. During that time, along with municipal refuse and septage wastes, over 17,000 drums containing chemical wastes and several million gallons of bulk liquid chemical wastes were disposed of in the landfill. Hazardous substances continue to be present at the landfill and its environs.

° Severely contaminated groundwater plumes in both the shallow Vincentown and the deeper Red Bank aquifers appear to migrate from the landfill in a northerly direction towards and into the Manasquan River.

° There is considerable leachate seepage, especially after rainfall, at the landfill. Contaminated surface water runoff from the landfill flows into the adjoining wetlands to the north and then into the Manasquan River.

° Low levels of volatile organic compounds and heavy metals have already been detected in the river water column and sediments, just downstream of the site.

° Previous response actions at this site include a response to a chemical fire at the landfill in 1978. A magnetometric study followed by the excavation and sampling of 69 drums was undertaken in 1981. In 1982, twenty monitoring wells were installed and sampled. In 1983, Manasquan River sediments were sampled and five additional monitoring wells were installed and sampled to further define the extent of the contamination. In 1984, a groundwater monitoring well located at the northeastern toe of the landfill was installed as part of the leachate treatability study, and air quality monitoring was performed.

° VERSAR, the responsible parties' (PRP's) contractor, has sampled the Manasquan River on four occasions from June 1983 to February 1984. Their data, which has been presented to the Region, shows low levels of volatile organics in the river.

° Notice and §3007 letters were sent throughout 1982. Additional Information Request Letters were issued in 1983 and early 1984. Notice Letters addressing the results of feasibility study and impending design were issued in late summer 1984.

° The objective of the proposed remedial action is to control the migration of contamination from the site to protect public health and welfare, with particular emphasis on maintaining safe drinking water supplies and the natural surrounding environment. Although there are no potable public or private wells currently believed to be threatened, an off-line potable water reservoir is planned at a location 16 miles downstream from Lone Pine. The contamination from the landfill may impact the recreational uses of the river and its environs, as well.

° In June 1983, Camp Dresser and McKee completed a draft Feasibility Study. Through a survey of available remedial action technology and an analysis of site conditions, six alternatives addressing source control were identified and evaluated:

1) No action with monitoring.

2) Surface cap (no containment).

3) Surface cap; containment by pumping (400 gpm) of contaminated groundwater; and treatment.

4) Containment by means of a surface cap and a slurry wall penetrating approximately 30 feet through Vincentown aquifer to the Hornerstown formation, an aquitard; internal pumping (30 gpm) to maintain a negative internal gradient; and treatment.

5) Containment by means of surface cap and a slurry wall penetrating approximately 140 feet through the Vincentown and Red Bank aquifers to the impermeable Navesink Marl; internal pumping (30 gpm); and treatment.

6) Drum excavation and removal; surface cap; interception (400 gpm) of contaminated groundwater; and treatment.

° Based upon the analyses conducted for the June 1983 draft Feasibility Study and the public comments received on this document, in May 1984, three additional remedial alternatives which address source control were identified and evaluated:

7) Containment by means of a surface cap and a 30-foot slurry wall; internal pumping (30 gpm) and flushing; and treatment.

8) Containment by means of a surface cap and a 30-foot slurry wall; limited excavation (3 acre area of known drum disposal) of source materials; internal pumping (30 gpm) and flushing; and treatment of internal pumpage not used for flushing.

9) Containment by means of a surface cap and a 30-foot slurry wall; limited excavation of source materials; internal pumping (30 gpm); and treatment.

Based upon an initial evaluation and screening of these alternatives, the following alternatives were developed for a more detailed analysis:

Remedial Alternative Present Worth Cost ($ million)

Alternative	Capital	O&M	Total Present Worth
3	13.2	12.9 (0.79)*	26.1
4	10.7	6.47 (0.32)	17.1
9	30.9	6.47 (0.32)	37.4

*(annual O&M)

The treatment costs in the above table assume on-site treatment of the extracted groundwater. Below is a comparison of on-site treatment of the extracted groundwater versus treatment at the Ocean County Utilities Authority (OCUA) wastewater treatment plant.

Comparison of Capital and Annual Costs for On-Site and Off-Site Groundwater Treatment ($ million)

	Alternative 3	Alternative 4	Alternative 9
On-site Treatment System Capital Costs	2.19	0.92	0.92
On-site Treatment System Annual O&M Cost	0.67	0.23	0.23
OCUA Annual Charge	0.52	0.19	0.19
Option 1: 1 mile force main	0.26	0.21	0.21
Option 2: 4.5 mile force main	1.16	0.90	0.90

The recommended alternative (Alternative 4) includes on-site containment with a shallow groundwater cut-off wall and surface seal; internal pumping (30 gpm); and treatment. The total estimated present worth capital cost is $10.7 million. Annual operation and maintenance costs are estimated at $0.32 million (or $3.54 million present worth over 20 years). The present worth monitoring costs total $0.55 million for a total present worth cost of $17.1 million. A surficial drum cleanup at the adjacent borrow pit area and fence installation around the landfill will be performed during remedial implementation.

- The specific treatment scheme for the extracted groundwater will be designated upon completion of the ongoing treatability studies.
- An additional off-site groundwater investigation to determine the extent of the plume will also be performed.
- The State has agreed with this approach.
- The selected remedy is the cost-effective remedy for the site.
- Monies are available the Fund to finance the remedy.

Lone Pine Landfill Site, New Jersey
Remedial Alternatives

Alternatives	Capital ($ mil)	Present Worth ($ mil)	Public Health Considerations	Environmental Considerations	Technical Considerations	Public Comment
1. No Action with monitoring.	0.04	0.62	Unacceptable. Potential for direct contact with leachate and on-site contamination. Potential threat to reservoir should more persistent compounds be released.	Continued production of leachate and contamination of ground and surface water. Continued threat to flora and fauna.		Strong public resistance
2. Surface Cap.	7.2	9.70	Removes direct exposure threat to leachate breakouts. Still potential threat to reservoir should more persistent compounds be released since site not contained.	Continued contamination of ground and surface water. Continued degrad - ation of flora and fauna.	Common engineering practice.	Unacceptable to public. PRP's suggested remedial solution.
3. Cap, containment by groundwater pumping, and treatment.	13.2	26.1	Since source not contained by a physical barrier, failure of pumping system would present threat to reservoir.	Slower cleanup of ground and surface water than containment with physical barrier. Pumping failure would present threat to environment. Marginally less protection to flora and fauna than containment with cut-off wall.	No slurry wall constructed. Increased capacity extraction and treatment system Less reliable than containment with cut-off wall. Requires considerable pumping and O&M.	Community resistance to keeping contamination on-site.

Alternatives	Capital ($ mil)	Present Worth ($ mil)	Public Health Considerations	Environmental Considerations	Technical Considerations	Public Comment
4. Cap, shallow containment wall, and internal groundwater pumping and treatment.	10.7	17.1	Contamination within the landfill would be contained protecting reservoir and the recreational uses of the river. Physical containment provides greatest assurance of groundwater protection. Removes direct exposure risk.	Gradual restoration of flora and fauna in vicinity site. Gradual natural restoration of river and aquifer external to site. Prevents continued/increased contamination.	Reduced extraction well and treatment capacity. Easier to construct than deeper slurry wall, similar reliability.	Community resistance to keeping contamination on site.
5. Cap, deep containment wall, and internal groundwater pumping and treatment.	20.9	26.2	Contamination within the landfill would be contained, protecting reservoir. Marginally more protection than shallow wall.	Gradual restoration of flora and fauna in vicinity of site. Marginally more protection than shallow wall.	140 foot deep slurry wall just about extent of construction capability making it considerably more difficult to construct than the shallow wall.	Community resistance to keeping contamination on-site.
6. Drum excavation and removal, groundwater interception and treatment.	79.3	84.6	Reduces direct exposure risk. Reduced threat to reservoir. Increase risk to workers from fire/explosions and contact with hazardous substances.	Gradual restoration of flora and fauna in vicinity of site. Considerably more protection than cap and interception alternative. Potential for adverse air quality and odor impacts.	Significant safety and engineering problems. Waste quantity and nature of contamination unknown.	Community perceives excavation as most acceptable.

Alternatives	Capital ($ mil)	Present Worth ($ mil)	Public Health Considerations	Environmental Considerations	Technical Considerations	Public Comment
7. Cap, shallow containment wall, internal pumping, treatment, and flushing.			Potential for flushing of contaminants from system. Marginally more protection than containment.	Gradual restoration of flora and fauna in vicinity. Marginally more protection than containment.	Flushing not technically feasible for this site because of short-circulating and hydraulic infeas-ibilities. Containment still required.	Suggested by TRC.
8. Cap, shallow excavation internal pumping, flushing.			Increased risk to workers. Potential for removing part of source. Marginally more protection than containment.	Gradual restoration of flora and fauna in vicinity. Potential for adverse air quality and odor impacts. Marginally more protection than containment.	Flushing not technic-ally feasible for this site because of short-circuiting and hydraulic infeasibil-ities. Containment still required.	Suggested by TRC.
9. Cap, shallow limited drum excavation, ground water treatment.	30.8	37.4	Reduces direct ex-posure risk. Reduced threat to reservoir by removing part of source. Increased risk to workers from fire/explosions and contact with hazardous substances.	Gradual restor-ation of flora and fauna in vicinity of site and aquifer ex-ternal to site. Restoration capa-bilities equiv-ilent to other shallow slurry wall contaminant options. Po-tential for ad-verse air quality and odor impacts.	Significant safety and engineering problems. Source strength unknown. Quantity of waste to be removed unknown.	Perceived as desirable by community.

Next Steps

Action	Date
- AA-OSWER approves ROD	September 21, 1984
- Amend State Superfund Contract for Design	September 28, 1984
- Award IAG for Design	September 28, 1984
- Start Design	November 1, 1984
- Complete Design	May 1, 1985
- Amend State Superfund Contract for Construction	June 1, 1985
- Award IAG for Construction	June 1, 1985
- Start Construction	July 1, 1986
- Complete Construction	July 1, 1987

Key to Figures, Tables, and Attachments

Figures

Tables

Attachments

Summary of Remedial Alternative Selection
Lone Pine Landfill

Site Location and Description

Situated in a rural, marshy area, the 40-50 ft. high Lone Pine Landfill is located on Burke Road, off Elton-Adelphia Road, in Freehold Township, Monmouth County, New Jersey (see Figures 1 and 2). The 45-acre landfill, which is located about 500 feet south of the headwaters of the Manasquan River, about 1000 feet west of the 200-acre Turkey Swamp Fish and Wildlife Management Area, is situated on a 144-acre mostly wooded parcel owned by the Lone Pine Corporation. Along with municipal refuse and septage wastes, at least 17,000 drums and several million gallons of bulk liquid chemical wastes were disposed of in the landfill. The nature of these disposed materials is largely unknown.

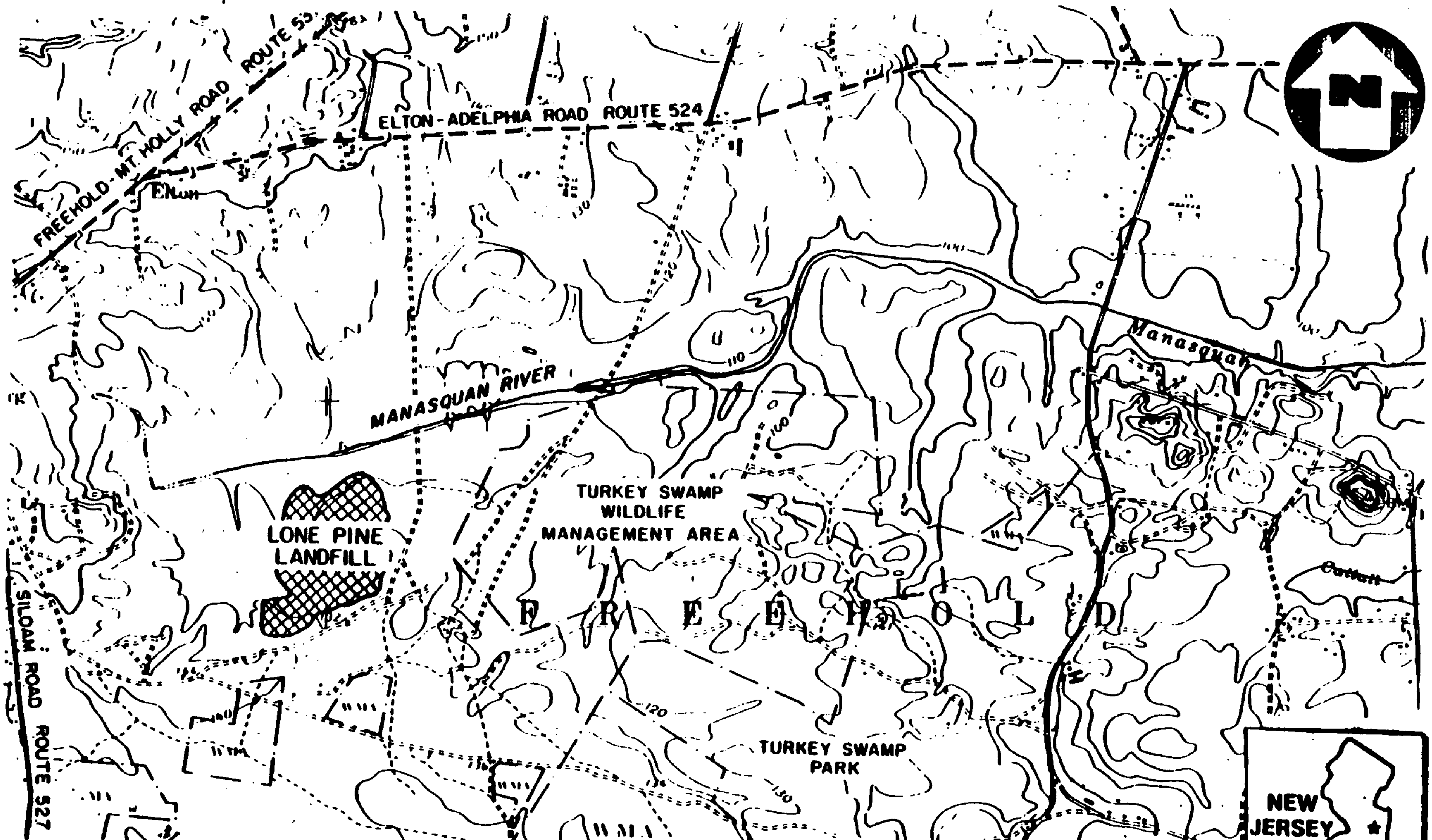
The landfill is bounded by Burke Road to the east and south, and a swamp to the west, which drains to the Manasquan River at the Landfill's northern boundary. The area in the vicinity of the Landfill is sparsely populated with only about half a dozen residences in the immediate vicinity, the closest being about 600 feet south of the landfill.

A local sportsman club, the Fin, Fur, and Feather Club, is located about 1000 feet to the east of the landfill. A 700-acre municipal potable water supply reservoir is planned for construction at a location 16 miles downstream of the landfill off the Manasquan River.

The landfill is located on relatively flat land which gradually slopes towards the Manasquan River to the north. The surrounding terrain is predominantly gently rolling Coastal Plains with small hills. The site lies within the 2.4 square mile subbasin of the regional Manasquan River watershed. Surface waters within the subbasin drain into tributaries of the easterly flowing Manasquan River. Groundwater in the immediate vicinity of the landfill provides a major source of water for the Manasquan River, which has a variable flow rate of approximately 2 to 70 cfs.

Figure 3 presents a generalized geological cross section in the vicinity of the site. Test pits around the landfill indicate that the water-bearing Vincentown sands is situated from several inches to several feet beneath the surface at the extreme east of the site, thickening in a wedge to a depth of about 30 feet towards the southeast. In the southwest portion of the site, a recent deposition of black organic topsoil is found on the surface.

Three major soil series have been identified in the immediate vicinity of the landfill: Atson, Lakehurst, and Lakewood series. The soils generally consist of gravelly sands, silty-gravelly



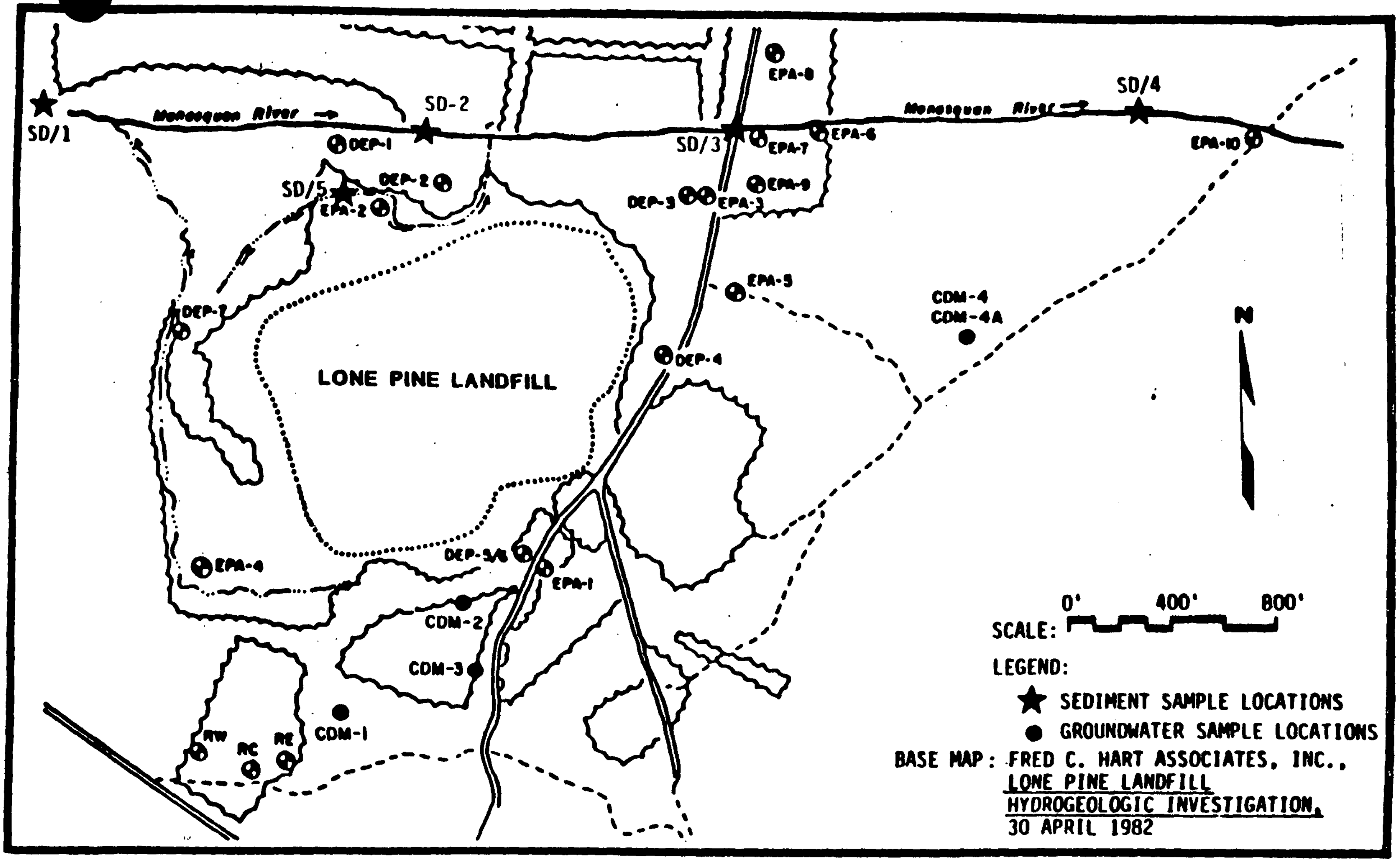
BASE MAP IS A PORTION OF THE U.S.G.S. ADELPHIA, NJ QUADRANGLE (7.5 MINUTE SERIES, 1957, PHOTOREVISED 1981).
CONTOUR INTERVAL 10'.

Figure 1

LOCATION MAP
LONE PINE LANDFILL SITE, FREEHOLD, NJ

SCALE: 1" = 200

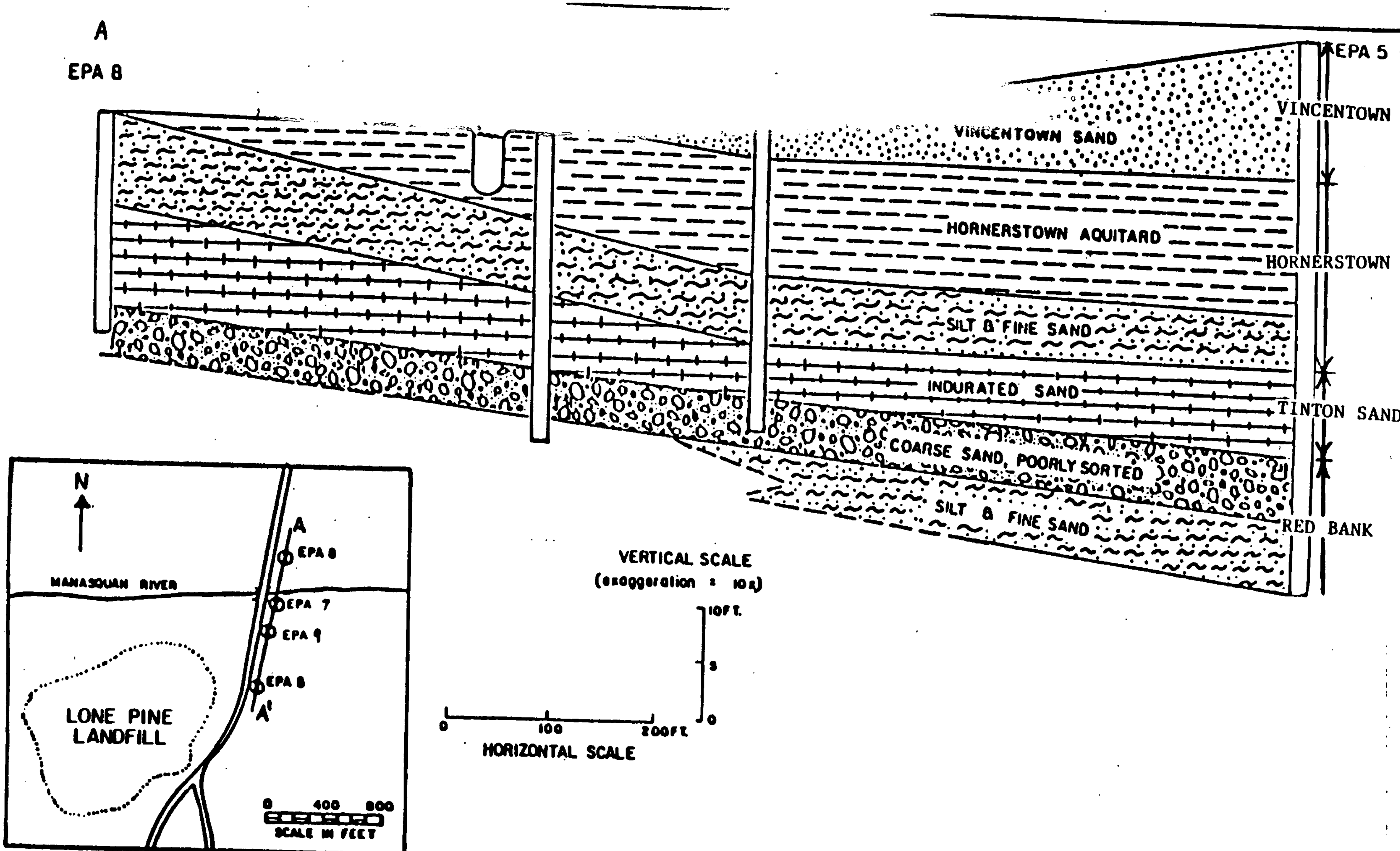
NUS CORPORATION
A Hallibu Company



LONE PINE LANDFILL

Figure 2

SITE MAP



SOURCE: FRED C. HART ASSOCIATES, INC., 1982

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LONE PINE LANDFILL

CROSS SECTION OF THE STRATIGRAPHY
IN VICINITY OF LONE PINE LANDFILL

Figure 3

sands and clayey-gravelly sands, with high permeability rates, generally increasing with depth. Figure 4 shows the location of the various surficial soils found at the site and Table 1 indicates the properties of these soils. Lone Pine Landfill is situated in the Coastal Plain physiographic province. The site is underlain by unconsolidated gravel, sand and clay.

The Vincentown, which lies directly beneath the topsoil, is underlain by the Hornerstown formation. The Vincentown Sand consists of fine-to-medium-grained quartz sand to a sandy, clayey, limestone character in the upper level and greenish-gray micaceous, clayey glauconitic fine-to-medium-grained sand in the lower level. The underlying Hornerstown formation, consisting of 10-12 feet of a deep green, silty, glauconitic, fine sand with varying amounts of clay, functions as an aquitard (a semi-confining bed)in restricting the vertical movement of groundwater between the Vincentown and Red Bank formations. This is underlain by the Tinton Sand which ranges from 5 to 8 feet thick and is heavily indurated with siderite, a finely crystalline ferric carbonate. The Tinton Sand exhibites moderate permeability depending on the degree of cementation. This is underlain by the water-bearing Cretaceous Red Bank Sand. Test borings indicate the presence of several distinct stratigraphic units within the Red Bank Sand. The upper portion of the formation is partially indurated, glauconitic, silty, fine sand. This is underlain by a layer of coarse and poorly sorted sands followed by a layer of silt and fine sand.

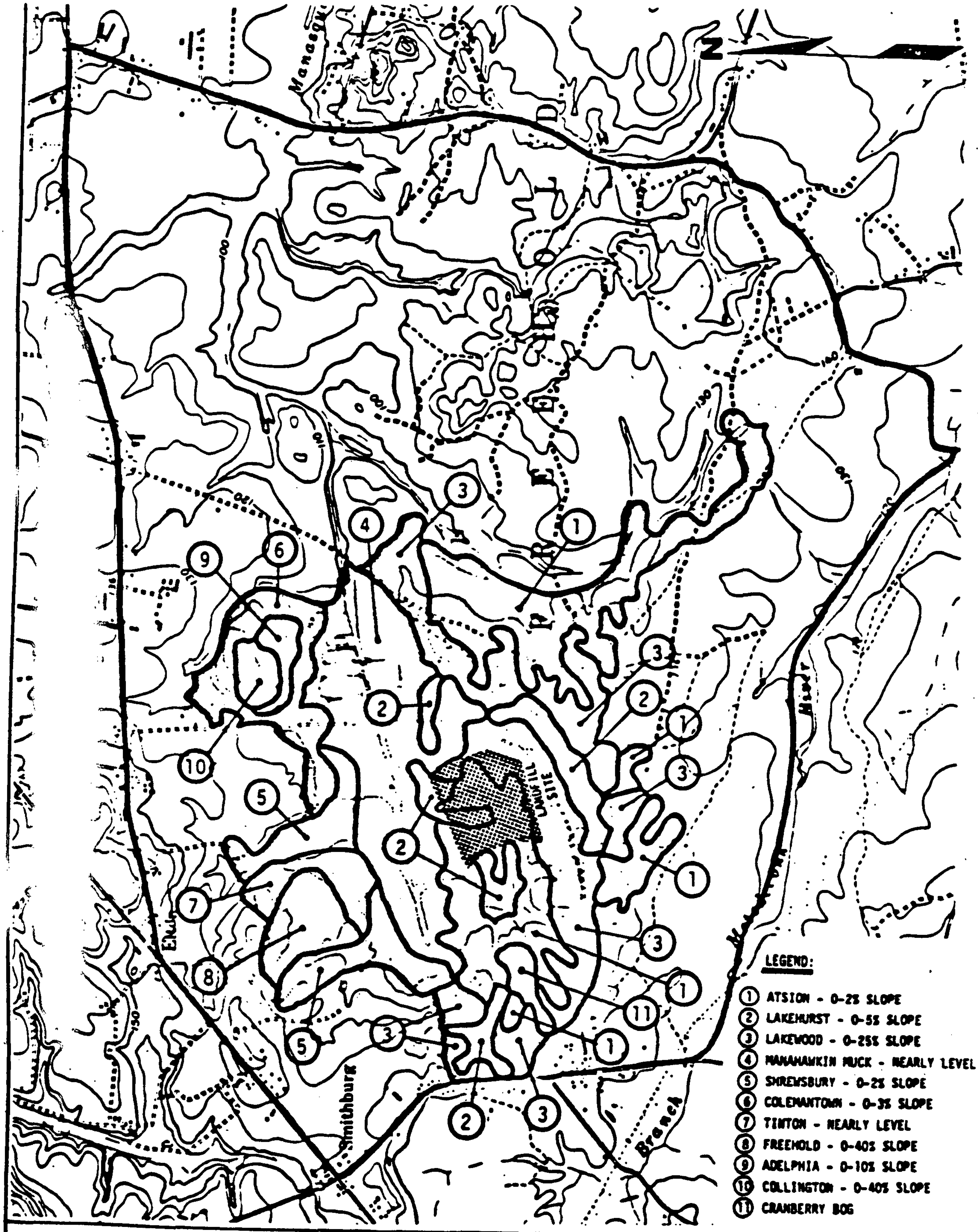
Below the Red Bank formation lies the Navesink Marl formation at an estimated 140 feet below the surface. Deep water-bearing formation below the Navesink Marl include the Englishtown and Raritan-Magothy aquifers. Table 2 shows the water bearing properties of the geologic formations found in the vicinity of the site.

No floodplains have been designated within the limits of this portion of the Manasquan River.

Surface features include several on-site leachate ponds and a dozen or so visible drums and debris at the borrow pit adjacent to the landfill across Burke Road. A chainlink fence and gate restrict access along Burke Road.

Site History

The Lone Pine Landfill operated from 1959 until 1979 when it was ordered closed by a New Jersey Department of Environmental Protection (NJDEP) Administrative Order. Until it was closed, Lone Pine accepted over 17,000 drums containing chemical wastes along with municipal refuse, large volumes of septage, and millions of gallons of bulk liquid chemical wastes.



CDM

SCALE: 1"=2000'

Figure 4

LONE PINE LANDFILL

SOIL TYPES AND SLOPES

Table 1

SOIL CHARACTERISTICS IN THE VICINITY OF LONE PINE LANDFILL

SOIL SERIES & SYMBOL	DEPTH TO SEASONAL HIGH WATER TABLE (ft.)	TYPICAL VERTICAL PROFILE (inches)	TEXTURE OF SUBSOIL	PERMEABILITY (in/hr)	NATURAL DRAINAGE CLASS	REACTION (pH)	ERODIBILITY	SUITABILITY FOR LANDFILL AND KIND OF LIMITATION
Atsion (At)	1-1.0 (apparent Nov.-June)	0-40	Sand or Loamy sand subsoil	6.0-20	Poorly drained	3.6-5.0	Low-moderate	Severe seasonal high water table at depth of 0-12 inches.
Lakehurst (Le)	1.5-3.5 (apparent Jan.-April)	0-60	Sand or Loamy sand subsoil	6.0-20	Moderately well drained	3.6-5.0	Low	Severe: seasonal high water table at depths of 1.5-3.5 hazard of ground-water pollution because of rapid permeability.
Lakewood (Lo)	6.0	0-60	Sand or Loamy sand subsoil	6.0-20	Excessively drained	3.6-5.0	Very low-low	Severe: Low amount of filter material; hazard of ground water pollution because of rapid permeability.
Shrewsbury (Sn)	0-1.0 (apparent Oct.-June)	0-60	Sandy clay loam subsoil, sandy surface layer lacking or > 20 inches	0.6-20	Poorly drained	3.6-5.0	Mod-low	Severe
Colemantown (Cn)	0-1.0 (perched Oct.-June)	0-60	Clayey subsoil, high glauconite	0.2-0.6	Poorly drained	3.6-5.5	-	Severe
Tinton (To)	5.0+	0-60	Sandy clay loam, low glauconite	2.0-6.0	Well drained	3.6-5.0	Subject to wind erosion if left bare	Low amounts of filter material rapid permeability in substratum permits groundwater pollution.
Freehold (Fr)	76.0	0-60	Sandy clay loam, subsoil, low glauconite	0.2-6.0	Well drained	3.6-5.0	Mod-High	Severe: slope
Adelphia (Ae)	15-4.0 (apparent Jan.-April,	0-60	Sandy clay loam subsoil, moderate glauconite	0.2-6.0	Moderately well drained	3.6-5.0	Mod-High	Severe: wetness
Collington (Cn)	6.0	0-60	Sandy clay loam subsoil, moderate glauconite	0.6-6.0	Well drained	3.6-5.5	Mod-Low	Severe: slope
Manahawk in Muck (Ma) at surface		0-60	Organic material-much sand, gravelly sand	>6.0	Very poorly	3.6-5.0	-	Severe: High water table, low bearing capacity; hazard of flooding.

Source: USDA Soil Conservation Service, 1982.

Table 2

[illegible] the Landfill

Geologic formation	Water-bearing properties	Water Quality
Vincentown Formation	Numerous domestic wells tap this sand; yields 10-50 gpm to domestic wells	Excellent Incidence of low pH and high iron content...
Hornerstown Sand	A poor aquifer; yields up to 5 gpm to domestic wells.	
Red Bank	Yields range from 3-30 gpm to domestic wells.	Acidic may require treatment for removal of iron.
Navesink Formation	Important to domestic consumers. Wells yield 10 gpm or less.	Excellent
Mount Laurel Sand Wenonah Formation	A single aquifer. Average yield 10 gpm. Maximum yield reported was 335 gpm.	Generally good, except for iron Moderately high hardness in some areas.
Marshalltown Formation	Not considered water-bearing in the county.	
Englishtown Formation	Average yield 25 gpm. Maximum yield reported 640 gpm. Average yield to large-capacity wells 410 gpm.	Excellent except for high iron content.
Woodbury Clay Merchantville Formation	Both formations act as a single aquiclude. Not water-bearing.	
Magothy Formation	Sands are discontinuous, and thickness variable. Maximum yield reported 250 gpm.	Generally good, except for iron and magnesium. Isolated problems have occurred with nitrates and some heavy metals, e.g., cadmium and chromium.
Raritan Formation	Contains most important aquifers. Yields range 100-1,400 gpm to large-diameter wells.	
Wissahickon Formation	No wells in this formation.	

Source: New Jersey Department of Conservation & Economic Development 1968

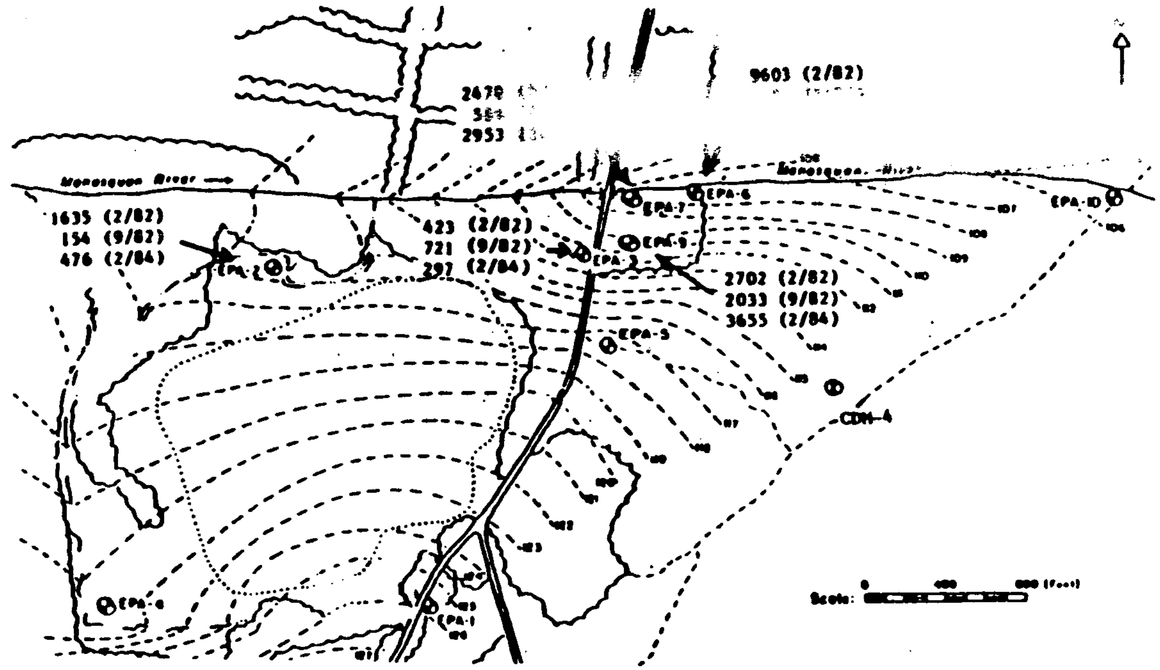
In the early 1970's, NJDEP unsuccessfully attempted to force the Lone Pine Corporation, the owner and operator, to update its operation to minimize the leachate and surface runoff problems at the landfill. Following a NJDEP sampling investigation in 1977 and a chemical fire and explosion in 1978, EPA sampled the leachate and the Manasquan River, detecting various organic compounds. By the end of 1979, NJDEP had closed the landfill to all wastes. An EPA inspection to determine the feasibility of a CWA §311-funded cleanup led to the recommendation that additional investigations be conducted on a high priority basis and that no §311 funds be activated. (Funding was not recommended because, at the time of the inspection, §311 actions were limited to incidents involving oil, and the State Attorney General had filed a suit against Lone Pine Corporation to insure proper closure.) Subsequent sampling studies indicated signficant levels of toxic organics and heavy metals in the groundwater and leachate, and low levels in the Manasquan River downstream of the site.

Following a magnetometric study in the summer of 1981, which indicated the possible presence of tens of thousands of steel drums, 69 drums were excavated. Thirty-five of these drums had retained partial contents with 25 containing sludge, and 10 containing liquid. A variety of organic priority pollutant substances, heavy metals, and pesticides were contained in these rusted, leaking drums.

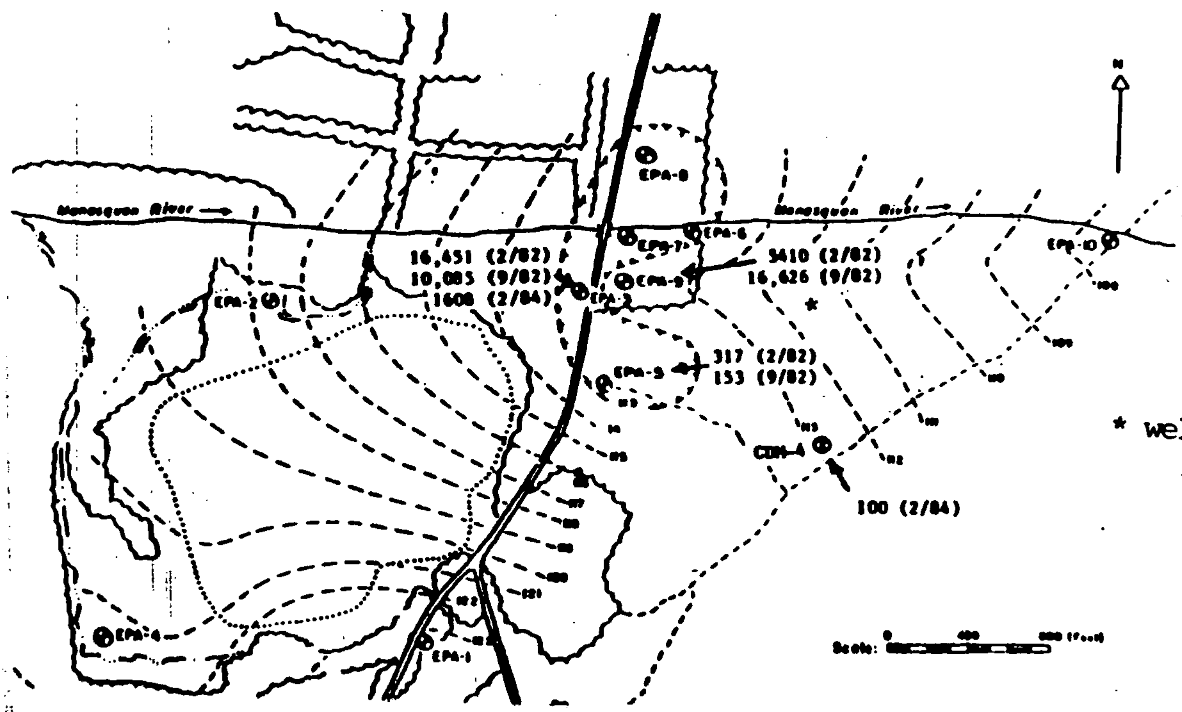
Based upon testimony stemming from the criminal trial of the principals of Scientific Chemical Processing (SCP), a waste processing firm, over 17,000 drums containing chemical wastes were illegally disposed of in the landfill. According to the testimony, large quantities of drummed solid and liquid wastes were sent to the landfill. The drum disposal operation at SCP involved the dumping of the materials in drums into large dumpsters. Where the drum could be totally emptied, it was sold to a drum reconditioner. When the drum could not be emptied, it was segregated and loaded into a dumpster for disposal at Lone Pine. If the drum was determined to contain solids at the bottom, it was considered not suitable for drum recovery and was disposed of, even though it might have contained considerable liquid content. Bulk disposal occurred also.

The results of a fall 1981 - winter 1982 hydrogeological investigation indicated severe groundwater contamination in both the shallow Vincentown and the deeper Red Bank aquifers, with the contamination appearing to migrate north and northeast, respectively, towards and into the Manasquan River (see Figure 5).

In July 1982, EPA and the State of New Jersey signed a State Superfund Contract to undertake a remedial investigation and feasibility study at the Lone Pine Landfill. As part of this study, in the Spring of 1983, additional field work including the



Vincentown Sands Aquifer
Water Table Surface



Red Bank Aquifer
Potentiometric Surface
Measured on March 31, '82
Lone Pine Landfill

* well not accessible for 2/84 sampling

CONTAMINATED GROUNDWATER MONITORING WELLS
Total Volatile Organics (ppb)
Figure 5

collection of Manasquan River sediment samples and an additional hydrogeological investigation was completed by Camp Dresser and McKee (CDM), the EPA Zone Contractor.

In July 1983, CDM completed a draft Feasibility Study. Following public review and comments, additional alternatives were evaluated and reported in a supplement to the Feasibility Study. This supplement was completed in May 1984 and submitted for public comment.

In May 1984, a groundwater monitoring well was installed at the northeastern toe of the landfill as part of the leachate treattability study.

In June 1984, CDM performed air quality monitoring at the site over a two day period.

In June, August, and November 1983, and February 1984, VERSAR, the contractor for the Generators Steering Committee, sampled the Manasquan River. The data from these investigations have been considered in the alternative analysis.

This fall, three monitoring wells will be installed through the landfill mound to better define the nature of the contamination emanating from the site and to assist in further describing the strata underlying the landfill.

The State of New Jersey has issued various orders requiring the Lone Pine Corporation to take any steps necessary to prevent leachate and runoff contamination. In addition, the State Attorney General has filed suit against the Corporation to insure proper closure of the landfill. On the federal level, the landfill's former general manager pleaded guilty to charges related to illegal dumping of hazardous waste at the site. A jury convicted three principals of Scientific Chemical Processing, a waste processing firm that used Lone Pine illegally to dispose of drummed and bulk wastes.

<u>Current Site Status</u>

There are four potential routes of exposure associated with the Lone Pine Landfill: direct contact, surface water, groundwater, and air.

The landfill is located adjacent to the Turkey Swamp Fish and Wildlife Management Area which is used extensively for hunting and fishing. The site is accessible to game, which through the process of nesting or feeding on the site, may introduce contaminants into the human food chain.

There are three intermittent feeder streams that lead into the 6-8 foot wide Manasquan River at its headwaters: two streams which originate in the woodlands to the north and northeast, and a stream to the south which winds through the northeast section of the site. Leachate has been observed flowing from the toe of the landfill through the woods into the marsh adjoining the Manasquan River and directly into the river itself via the stream that winds through the northeast section of the site. This leachate problem appears to be most pronounced following storm events. Samples of this leachate have indicated high levels of volatile organic compounds.

A sediment sampling investigation was performed in the Manasquan River and the southern tributary adjacent to the landfill. The investigation indicated the presence of low levels of contamination in the tributary's sediments. This contamination is attributed to the leachate and surface runoff.

The results of a hydrogeological investigation indicated severe groundwater contamination in both the shallow Vincentown and the deeper Red Bank aquifers beneath the landfill.

Water surface elevations in the wells installed during the ydrogeological investigation indicate that groundwater in the urficial Vincentown aquifer generally moves north, turning astward to parallel the direction of the flow in the Manasquan iver.

Since high concentrations of contaminants were found in the eeper Red Bank aquifer beneath the landfill, it is apparent hat there is a downward vertical movement of pollutants from e Vincentown to the Red Bank formation. This further indicates at the Hornerstown formation does not function as a confining ayer. Once the contaminants enter the semi-confined Red Bank quifer, they appear to migrate northeasterly towards the Manasquan iver. Since upward vertical gradients between the landfill and he river were found, it is believed that contaminants in the Red ank aquifer migrate back upwards into the Vincentown aquifer, eventually discharging into the Manasquan River.

When the landfill was constructed and operated, portions of the Vincentown Sands aquifer were excavated down to depths of as much as 10 feet below grade. Therefore, even though the drums were disposed of in the latter years of the landfill's operation, because they were disposed of by dumping off the edge of a truck onto the working face of the landfill drums may be located deep enough in the landfill to come into contact with the water table. It is also likely that residual pools of non-aqueous fluids from ruptured drums and from bulk liquid dumping may have settled in the lower depths of the landfill, providing a continuing source of contamination to the Vincentown aquifer as the wastes resolublize.

The general area in the vicinity of the landfill is sparsely populated: The nearest private wells (see Figure 6) include three upgradient residential wells screened in the Vincentown aquifer, the closest of which is approximately 600 feet south of the landfill; a nonresidential well screened in the Englishtown aquifer located approximately 1000 feet east of the landfill; and several residential wells screened in the Vincentown aquifer, located about 1/2 mile north of the site across the Manasquan River. (As indicated previously, groundwater data indicate that contamination apparently does not migrate north of the river.)

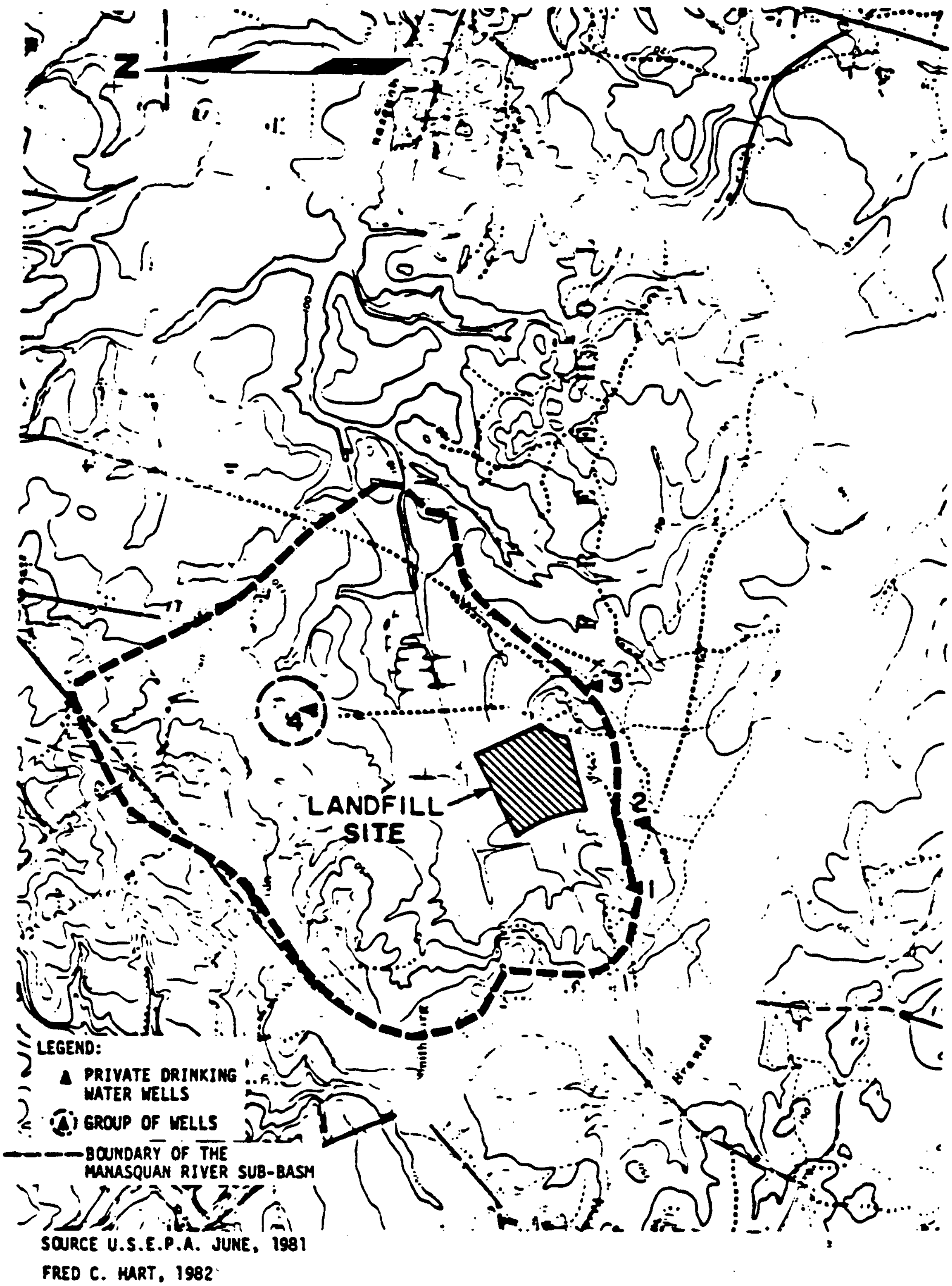
Approximately 85% of the Township residents are served by a municipal well system consisting of six wells, the closest of which is located approximately 4 miles northeast of the site (see Figure 7). Based upon the available data, it is believed that no existing groundwater drinking water supplies are presently threatened with contamination since the river apparently serves as a hydrogeological barrier and sink for the contaminated groundwater. (The monitoring well north of the river has consistently been found to be clean.) However, as a result of the surface runoff and leachate, and the input of the contaminated Vincentown and Red Bank aquifers into the river, low levels of organic compounds and heavy metals have been detected in the Manasquan River adjacent to and just downstream of the site. Surface water in the vicinity of the site is a major environmental concern since it provides water to wildlife and supports a variety of aquatic biota further downstream. In addition, the river is used for recreation and limited irrigation and a reservoir is planned for a site 16 miles downstream of the landfill.

The major class of contaminants currently being released from the landfill are volatile organic compounds, most notably benzene, chlorobenzene, methyl chloride, toluene, and vinyl chloride. A second class of compounds, base neutral extractables, in particular, isophorone and phthalates, are being released as well.

Tables 3, 4, 5 and 6 indicate the quantities of the contaminants found in the surface and groundwater, sediments, and on-site sludge, respectively. Many of these compounds are toxic and potential carcinogens.

Table 3
Summary of Manasquan River
Surface Water Analytical Data

Compound	Maximum Concentration (ppb)	
Volatile Organics	EPA	VERSAR*
Benzene	25	19
Chlorobenzene	140	
1,2-Dichloroethane	120	

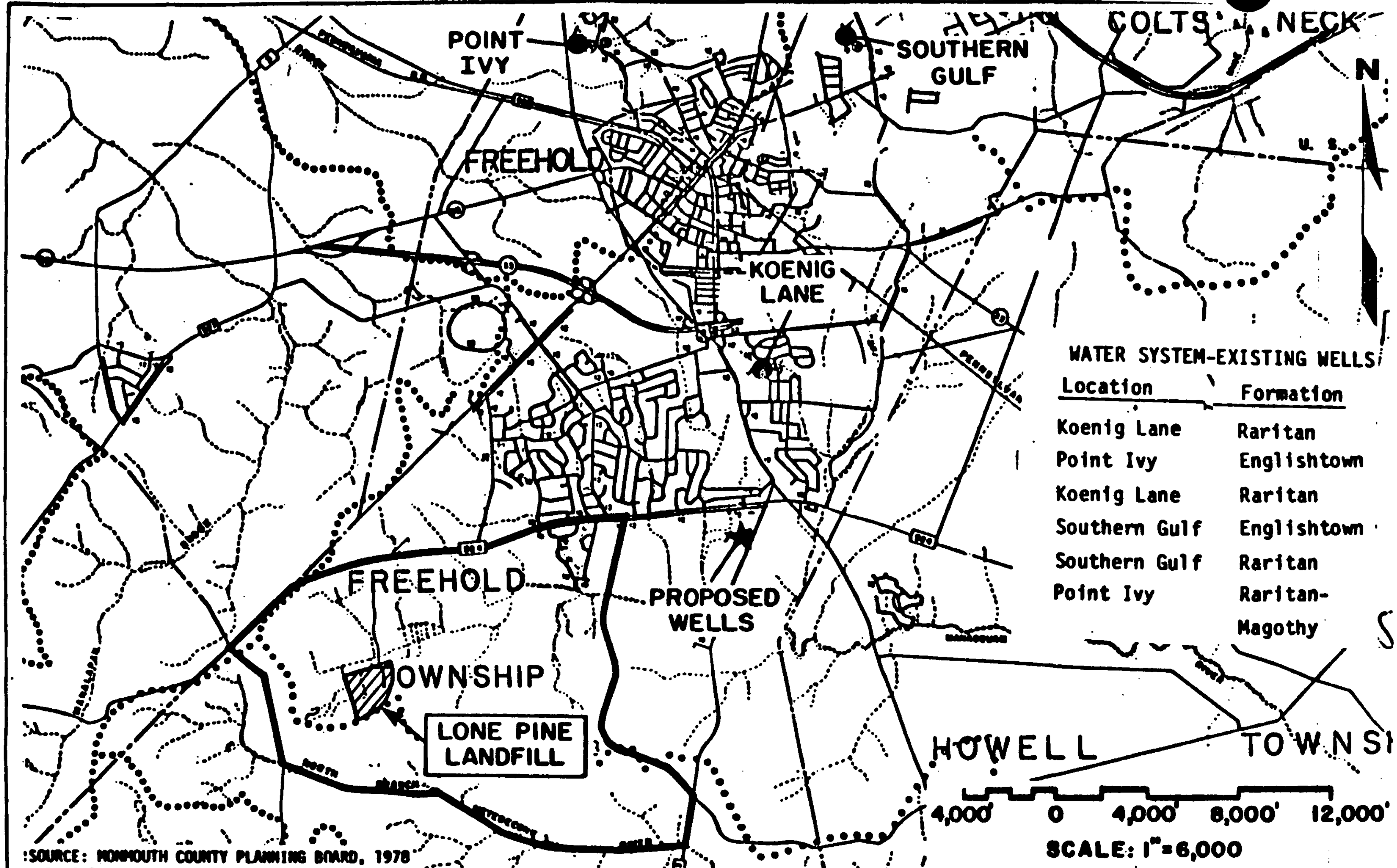


CDM

Figure 6

LONE PINE LANDFILL

LOCATION OF PRIVATE DRINKING WATER WELLS



CDM

environmental engineers, scientists, planners & management consultants

Figure 7

LONE PINE LANDFILL

LOCATION OF EXISTING & PROPOSED DRINKING WATER WELLS

Volatile Organics (Cont.)	EPA	VERSAR*
1,1-Dichloroethane	220	
1,1-Dichloroethene	23	
1,2-trans-Dichloroethene	29	
Ethylbenzene	280	9
Methylene chloride	35	
Tetrachloroethene	32	
Toluene	26	12
Trichloroethene	28	
Trichlorofluoromethane	15	
Vinyl chloride	440	

*Contractor for Generators Steering Committee

Table 3
Summary of Manasquan River
Surface Water Analytical Data (Cont')

Compound	Maximum Concentration (ppb)	
	EPA	VERSAR*
Acid Compounds		
Benzoic acid	280	
2-methylphenol	44	
4-methylphenol	400	
Phenol	trace	1.6
Base/Neutral Extractables		
4-methyl-2-pentanone	4200	
Bis (2-ethylhexyl)phthalate	trace	
Chloromethane	13	
Di-n-butyl phthalate	trace	
Diethylphthalate	24	
Naphthalene	170	
O-xylene	340	
Phenanthrene	trace	
Inorganics (ppm)		
Aluminun	1.3	0.35
Arsenic	0.013	trace
Barium	1.0	0.05
Cadmium	0.012	trace
Iron	380.	20.3
Lead	0.049	trace
Manganese	1.2	0.1

Inorganics (ppm)

Tin	0.052	trace
Zinc	0.13	0.02

*Contractor for Generators Steering Committee

Table 4

Summary of Groundwater Analytical Data--EPA Wells

Compound	Maximum Detected Concentration (ppb)
Base/Neutral Extractables	
Bis(2-ethylhexyl) phthalate	523
Di-n-Octyl phthalate	57
Acid Compounds	
Pentachlorophenol	70
Phenol	625
Volatile Organics	
Benzene	1939
Chlorobenzene	97
Chloroform	8
1,2-Dichloroethane	1655
1,1-Dichloroethane	208
1,1-Dichloroethene	98
1,2-trans-Dichloroethylene	2128
Ethylbenzene	3325
Methylene Chloride	527
Tetrachloroethylene	76
Toluene	4708
Trichloroethene	370
Trichloroethylene	1423
Vinyl Chloride	334
Inorganics (ppm)	
Aluminum	80
Arsenic	0.042
Barium	0.82
Cadmium	0.77
Chromium	1.9
Copper	1.3
Iron	14,000
Lead	4.8
Manganese	0.91
Zinc	39.

Table 5

Summary of Manasquan River Sediment Analytical Data

Compound	Maximum Detected Concentration (ug/kg)
Base/Neutral Compounds	
Bis (2-ethylhexyl) phthalate	<400
Volatiles	
Benzene	31
Chlorobenzene	<2.5
Ethylbenzene	140
Methylene Chloride	478
Fluorotrichloromethane	7
Styrene	<2.5
O-xylene	7.4

Table 6
Summary of On-Site Soil Samples

Compound	Detected Concentration (ppb)
Volatiles	
Benzene	2900
Chlorobenzene	4100
1,2-Chloroethane	260
Chloroform	95
1,1-Dichloroethylene	6
Ethylbenzene	25,000
Methylene Chloride	170
1,1,2,2-Tetrachloroethane	1040
Tetrachloroethylene	12,000
1,1,1-Trichloroethane	1600
1,1,2-Trichloroethane	34
Trichloroethylene	24,000
Toluene	80,000

Based upon the results of a magnetometric investigation in 1981, 69 drums were excavated from 4 of 8 locations coinciding with magnetometric profiles showing large anomalies. The drums, containing solids, liquids, and viscous sludges, ranged from empty to 3/4 full. The solid samples obtained, varied from a thick, black polymer-like substance to a black and brown sludge. The liquid samples were a variety of colors. The results from the sampling of 35 of the drums that contained waste materials are delineated in Table 7. An evaluation of this data indicates the presence of various organics, pesticides, and heavy metals solids and sludges.

Table 7

Summary of Excavated Drum Liquid, Viscous Material, Sludge and Solid Samples

Compound	Maximum Detected Concentration (ppm)			
Base/Neutral Extractables	Liquid	Viscous material	Sludge	Solids
Nitrobenzene	-	-	-	1800
Bis(2-ethylhexyl)phthalate	16.	-	2200	19,000
Butyl benzyl phthalate	3.5	-	-	4500
Di-n-butyl phthalate	54.	1200	1000	13,000
Naphthalene	1.1	2200	400	-
Di-n-octyl phthalate	1.9	-	340	-
1,4-Dichlorobenzene	0.11	-	-	-
Diethyl phthalate	32.	3700	3600	4500
Benzo (a)pyrene	3.7	-	-	-
Isophorone	-	-	3200	-
Pesticides				
Aldrin	-	-	0.4	57
4,4'-DDT	-	-	-	1.43
Alpha-endosolfan	-	0.2	1.68	22.
Heptachlor	-	-	0.82	33.
Heptachlor epoxide	-	-	120.	-
Alpha-BHC	-	-	-	-
Beta-BHC	-	-	0.82	105.
Delta-BHC	-	-	0.17	-
PCB-1260	-	0.71	-	-
Acid Compounds				
2-nitrophenol	3.6	-	-	-
phenol	50.	-	-	-
Volatile organics				
Benzene	27.	110.	150.	8.5
Chlorobenzene	-	-	0.81	4.8
1,2-Dichloroethane	11.	-	38.	10.
1,1,1-Trichloroethane	-	-	0.79	0.7
1,1,2-Trichloroethane	-	-	-	14.
Chloroform	0.21	-	0.63	3.2

Volatile organics	Liquid	Viscous material	Sludge	Solids
1,1-Dichloroethylene	0.16	-	0.16	0.18
1,2-trans-Dichlorethylene	1.4	-	7.1	8.3
Ethylbenzene	43.	2000.	300.	3400.
Methylene Chloride	340.	160.	240.	38.
Tetrachloroethylene	410.	28.	52.	58.
Toluene	2400.	220.	5600.	5900.
Trichloroethylene	4.5	-	8.6	19.
Inorganics				
Arsenic	80	200	230	80
Antimony	230	68	780	320
Chromium	1400	24	1000	1600
Beryllium	3	2	9	3
Cadmium	14	trace	trace	140
Copper	2400	210	29,000	610
Lead	410	20	8900	500
Nickel	2000	39	200	300
Selenium	40	100	trace	1900
ilver	18	52	12	50
Thallium	40	100	trace	trace
inc	5800	97	1200	880

Table 7

Summary of Excavated Drum Liquid, Viscous Material, Sludge and Solid Samples

DESCRIPTION OF SAMPLES

Sample description	Remarks
Solid clear glassy material (possibly a polymer)	Sampled from a 3/4 full drum. Sample had to be chipped by chisel. OVA and PID readings showed no response.
Transluscent thick polymer-like material	Sampled from a 3/4 full drum. Sample had to be chipped by chisel. OVA and PID readings showed no response.
Solid polymer-like material	Sampled from a 3/4 full drum. Sample had to be chipped by chisel. OVA and PID readings showed no response. Adequate sample could not be collected and was not submitted for analysis.
Dark brown, viscous material	Sampled from a 3/4 full drum. OVA and PID readings showed no response.
Solid, polymer-like material	Sampled from a 3/4 full drum. OVA and PID readings showed no response. Adequate sample could not be obtained and was not submitted for analysis.
Oily solid material	Sampled from a semi-crushed drum. PID picked up aromatic compounds.
Standing water	Groundwater sample.
Standing water	Groundwater sample.
White crystaline solid	Sampled from an open drum.
Gluey grey sludge-like material	Sampled spilled material from a crushed drum. OVA reading was 200 ppm.
Grey sludge-like material	Sampled from an open crushed drum.

Table 7 continued

DESCRIPTION OF SAMPLES

Sample description	Remarks
Blue liquid	Sampled from a leaking semi-crushed drum.
Black sludge	Sampled from a semi-crushed drum.
Black solid/sludge	Sampled from a semi-crushed drum.
White sludge	Sample from a semi-crushed drum.
Black water	Two (2) groundwater samples.
Red solid	Sampled from a semi-crushed drum.
Black liquid	Sampled from a leaking drum.
White liquid	Sample from a leaking drum.
Black solid	Sampled from a semi-crushed drum.
Grey tan solid	Sampled from a semi-crushed drum.
Pink liquid	Sampled from a 3/4 full drum. OVA reading was greater than 1000 ppm. Drum had bluish color similar to Ashland Chemical drum.
Yellow liquid	Sampled from a leaking drum.
Black liquid	Groundwater sample.
Black solid/sludge	Sampled from spilled materials of a crushed drum.
Brown solid	Sampled from a semi-crushed open drum.

Table 7 continued

DESCRIPTION OF SAMPLES

Sample description	Remarks
Brown viscous sludge	Sampled from 3/4 full drum. OVA reading was 350 ppm.
Black liquid	Sampled from a drum. OVA reading was greater than 1000 ppm.
Viscous sludge	Sampled from a 3/4 full drum. OVA reading was greater than 1000 ppm. Drum had Ashland Chemical markings. Other distinct marking was 1044-7-10.
Black liquid	Sampled from a 3/4 full drum. OVA reading was greater than 1000 ppm.
Grey powdery solid	Sampled from a 1/2 full drum. OVA reading was greater than 1000 ppm.
Purple crystalline solid	Sampled from a 1/2 full drum.
Red powdery solid	Sampled from a 3/4 full drum.
Viscous liquid	Sampled from a 3/4 full drum. OVA reading was greater than 1000 ppm. Drum had Ashland Chemical markings.
Black liquid	Sampled from a semi-crushed drum.
Black sludge	Sampled from material spilled from semi-crushed drums, faint red color coating, marking could not be read.
Black sludge	Sample apparently shaped by being in a drum.
Red solid material	Sampled from an open crushed drum. OVA reading was greater than 1000 ppm.
Black standing water	Groundwater sample.

Although there is evidence of severe groundwater contamination in the vicinity of the site and distressed vegetation on and adjacent to the landfill, only low levels of contamination have to date been detected in the adjacent Manasquan River. This may be due to volatilization taking place in the river. Additional groundwater investigation will better define the extent of off-site contamination. Several hundred yards downstream of the site, these compounds have not been detected. However, since this landfill is "young" in terms of how recently many of the hazardous substances were disposed of (late 1970's), it is believed that the currently detected compounds may not be totally representative of the wastes that were disposed of and, consequently, of the wastes that may eventually be discharged to the environment. One reason for this is that the various contaminant adsorptive, bsorptive, and density properties may affect the introduction f these contaminants into the groundwater. Other possible easons include the presence of intact drums containing unreleased astes, the perching of contaminants in impermeable zones within he landfill, or the presence of solid residues that will solublize hen exposed to water. As a result, a major concern is the otential threat to the thousands of residents of Monmouth and orthern Ocean Counties who will receive their drinking water rom the planned downstream reservoir, should a release of more ersistent pollutants from this uncontrolled landfill occur ometime in the future. Public recreational areas downstream of he site, as well as local and downstream flora and fauna, may lso be impacted from such a release.

The concern over the latent threat of release of highly oxic compounds from the landfill is based upon the data derived rom the drum excavation and sampling program, as well as the esults of a careful review of testimony presented at the Scientfic SCP trial and responses stemming from information requests f companies. From these sources, a partial listing of wastes hat were transported to SCP has been compiled. Because of the llegal nature of the operation, records as to which of these wastes were ultimately disposed of at Lone Pine are not available. However, based upon a review of the trial transcripts, it is clear that Lone Pine was used by SCP for the disposal of large quantities of drummed waste and also large volumes of bulk waste. The drums contained liquids, solids, and sludges. The sludges were likely to have been highly contaminated due to contact with drummed material emptied into dumpsters during the separation activities at SCP. The sludges also had a high moisture content, at times being as much liquid as solid. Significant amounts of hazardous substances were also transported to the site by transporters including Freehold Cartage.

The compiled partial listing of SCP wastes presents a best guess approximation of what might have been disposed of in the landfill. Many of the hazardous substances included on this list are contaminants currently detected in high concentrations in the groundwater, including benzene, chlorobenzene, methylene chloride, and toluene. Significant quantities of organics and heavy metals that have not been detected in the groundwater, have also been identified as having been accepted by SCP, and may have been disposed of in the landfill. Table 8 shows a partial listing of drummed wastes that may have been illegally disposed of at Lone Pine by SCP.

It has been suggested that the level of contamination present in the groundwater has been decreasing over time. However, by evaluating the data, it can be seen that this does not appear to be true. Referring to Figure 5, while the total volatile organic concentrations in the Vincentown appear to be relatively constant, except for one monitoring well that has decreased by an order of magnitude, there is an order of magnitude increase in one Red Bank monitoring well and contamination has been detected in a previously clean well. In addition, samples from the monitoring well installed at the toe of the mound for the leachate treatability study, has shown total volatile organic concentrations significantly higher than the concentrations detected in the monitoring wells downgradient of the site (see Table 4): 160,000 ppb Methylene Chloride at the toe of the mound, as compared to 527 ppb in the plume; 15,000 ppb Trichlorethylene versus 1423 ppb; 3700 ppb Benzene versus 1939 ppb; 4200 ppb Ethyl Benzene versus 3325 ppb; and 24,000 ppb Toluene versus 4708 ppb. The data apparently indicates that considerable quantities of contamination are currently being released from the landfill.

Despite gross contamination of the aquifers beneath and downgradient of the landfill, the present impact on human health is believed to be low since, currently, there are no known downgradient receptors. Presently, hunters, dirt bikers, and other trespassers who might come into direct contact with the leachate seeping from the landfill are the only known human receptors believed to be threatened.

Wildlife that feed and nest on the landfill and its vicinity may also be exposed to and accumulate contaminant concentrations from the landfill. These fauna, if hunted, may also introduce contamination into the human food chain.

In March 1984, a sample taken from downgradient monitoring well CDM-4A (see Figure 2) in the Red Bank formation, identified contamination in a location that tested clean for organics previously. Also a sample from previously contaminated downgradient well EPA-5, recently tested clean for organics. Since a link has been established between the wastes in the landfill and the contamination found in surface and groundwater in the vicinity of the site, on-site remedial measures were evaluated. The recent groundwater sampling, however, has raised questions regarding the extent of the contaminated plume and the actual contaminant transport route. As a result, the monitoring wells will be resampled and several additional wells will be installed as part of the proposed additional off-site hydrogeological investigation. Based upon this evaluation, the extent of the contaminant plume and the need for off-site plume control will be determined.

In June 1984, air quality samples were taken at the site during a two day period. Table 9 shows the results of this investigation.

Table 8

Partial Listing of Wastes That May Have Been Disposed of At Lone Pine

Acetophenane
Acids
Acrylates
Acrylonitrile
Aldehydes
Amides
Anthracite
Antimony
Aromotics
Arsenic Trioxide
Benzene
Butanediol
Butanol
Butyl Phenol
Carbon Tetrachloride
Caustics
Chlorobenzene
Chloroethane
Chloroform
Chromic Acid
Copper Waste
Cresyl Acid

Cyclohexane
Dichlorobenzene
Dimethyl Ketone
Diphenyl
Diphenyl Methane
Diphenyl Oxide
Dyes
Epoxy Wash
Ethanol
Ethers
Ethyl Acetate
Ethylene Dichloride
Flamable Wastes
Fluroide
Formaldehyde
Halogenated Mix, Spent
Heptaldehyde
Heptane
Heptene
Hydazine

Inks
Kerosene
Lacquer, spent
Latex Residue
Maleic Anhydride
Melamine
Mercury Salts
Methanol
Methyl Bezamid
Methyl Cellulose acetate
Methyl Chloroform
Methyl Isobutyl Ketone
Methyl Vinyl Ketone
Mithramycin
Monomers
Nail Polish Wastes
Naphthalenes, chlorinated
Nickel, Waste Plating Solution
Nitrates
Nitroaniline
2-Nitropropane
Otoledine
Paint Thinners and Sludges
Paladium Catalyst
Pharmaceutical wastes
Phenols
Phosphoric Acid
Pigment, Waste
Plasticizers
Polymers
Pyridine
Radioactive Residues
Resins
Sodium Cyanide
Solvent, Spent
Toluene
Trichloroethane
1,2,3 Trichloropropane
Varnishes
Varsol, waste
Vinyl Pyridine
Xylene
Zinc

Table 9

Summary of Air Quality Analytical Data

Compound	Maximum Detected Concentration (mg/m^3)
1,1,1-Trichloroethane	0.17
Trichloroethylene	0.08
Benzene	0.08
1,1,2,2-Tetrachloroethylene	0.04
Toluene	0.69
Ethylbenzene	0.14

Based upon this data, while volatile organics are detected, it does not appear that there is a significant air contamination problem at this time.

Enforcement

Potentially responsible parties (PRPs) have been identified.

The Lone Pine Steering Committee is a generator committee which was organized to negotiate with EPA. Currently, at least eight PRP's are participating and four meetings have been held. The Committee has provided a considerable number of comments on the draft study and has provided data representing their own field investigations. The Committee has offered to cap the landfill and provide additional source control measures in the future should the cap prove to be an effective source control measure, however, no supporting documentation has been provided by them to support their recommended alternative and, as of this date, no settlement has been reached.

It is EPA's intention to negotiate with the PRP's for the implementation of the remedy. If these negotiations are fruitless, or if it appears that the PRPs are not negotiating in good faith, then EPA may consider the issuance of a CERCLA §106 Administrative Order for the construction of the remedial action.

Alternatives Evaluation

The primary objective of the feasibility study was to evaluate remedial alternatives using a cost-effective approach consistent with the goals and objectives of CERCLA. A cost-effective remedial alternative as defined in the NCP (40 CFR 300.68J) is "the lowest cost alternative that is technologically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of the public health, welfare, or the environment." The NCP outlines procedures and criteria to be used in selecting the most cost-effective alternative.

The first step is to evaluate public health and environmental effects and welfare concerns associated with the problem. Criteria to be considered are outlined in Section 300.68(e) of the NCP and include such factors as actual or potential direct contact with hazardous material, degree of contamination of drinking water, and extent of isolation and/or migration of the contaminant.

The next step is to develop a limited list of possible remedial alternatives which could be implemented. The no-action alternative may be included on the list.

The third step in the process is to provide an initial screening of the remaining alternatives. The costs, relative effectiveness in minimizing threats, and engineering feasibility are reviewed here. The no-action alternative may be included for further evaluation when response actions may cause greater environmental or health damage than no-action responses. A no-action alternative may also be included if it is appropriate relative to the extent of the existing threat or if response actions provide no greater protection.

With respect to the no-action alternative, the results of the field investigation and the feasibility study indicate that there are significantly high levels of contamination at Lone Pine. Specifically, the groundwater beneath the site is severely contaminated and is migrating towards and into the Manasquan River. The NJDEP has established a maximum concentration of total volatile organic compounds for possible closure of drinking water wells as 100 ppb. Although there are no drinking water wells immediately affected by the site, as was shown in Table 4, groundwater samples have been far in excess of this value. Also, the concentrations of some of the detected contaminants are far in excess of exposure levels based upon unit cancer risk (UCR) values which have been identified by EPA for drinking water. These levels are based upon an incremental increase in cancer risk of 10^{-6} assuming exposure to a 70 Kg adult consuming 2 liters of water per day. The groundwater concentrations of Benzene, 1,2-Dichloroethane, and 1,1-Dichloroethene are 2881, 1749, and 2908 times their UCR levels, respectively. In addition, considerable quantities of leachate are oozing from the landfill into the river. Low levels of volatile organics have been detected in the river just downstream of the site. Although significant contaminant levels are believed to be entering the river (samples from the monitoring wells located on the southern bank of the river are severely contaminated), the lower concentrations detected in the river may be attributable to volatilization. Additional hydrogeologic investigations are planned to better define the extent of off-site groundwater contamination and to answer questions raised concerning whether the plume of contamination fully discharges into the Manasquan River.

In addition, the landfill's unprotected side slopes are subject to erosion, increasing the potential for the transport of contaminants into the Manasquan River. Also, the erosion may expose wastes in the future, thereby creating additional health risks due to direct contact.

In addition, any future spread of contamination if no action is implemented could adversely impact future growth and development in areas north of the landfill that are currently zoned for residential development. Parklands adjacent to the site could also be adversely affected if the portion of the Manasquan River located within the park is unable to support waterfowl and other forms of wildlife.

Two major concerns have been identified in relation to this ite. The first is primarily a public health concern related to he 35 million gallon per day reservoir which is planned at a ocation 16 miles downstream from the site. (The dilution factor ssociated with the 16 mile distance from the site to the proposed eservoir intake is estimated to be 55:1 based upon the ratio of rainage areas. It can be expected that any volatile organics ould have volatilized by the time they reached the reservoir, owever, relatively little dilution is provided for persistent ompounds.) Because of the uncertainty of the nature of the astes disposed of in the landfill, there is concern about future eleases of more persistent compounds from this uncontrolled ite. A change in the nature of the contamination currently manating from the landfill may impact the future water supply, hreatening the health of thousands of people in Monmouth and cean Counties. (It should be noted that the State of New Jersey ntends to discontinue over 20 sources of contamination along he Manasquan River as part of its program to begin the construcion of the proposed reservoir.)

The second concern, the impact of the site on the local nvironment, is both a public health and environmental issue. Terrestrial and aquatic flora and fauna appear to have been adversely affected at and adjacent to the site. In addition, downstream portions of the Manasquan River are stocked with trout which may be consumed by humans.

Based upon the results of the field investigation and the feasibility study, the potential impact of Lone Pine Landfill on the adjacent environment, and the potential contamination of the proposed reservoir, it was determined that the no-action alternative does not adequately protect public health and the environment and that a remedial measure should be implemented.

From the evaluation of existing data and information on the nature and the extent of the contamination associated with the Lone Pine Landfill, the following objectives were established:

1) To maintain an adequate safe drinking water supply for the population that could be affected by groundwater contamination migration;

2) To protect the Manasquan River surface water uses (fishing, swimming and water supply) from contaminant release; and

3) To prevent local exposure to contaminated materials at the site and in adjacent areas (soil, sediment, and leachate).

Although groundwater cleanup is also an objective, this issue will be addressed later with a separate Record of Decision.

With these objectives in mind, a list of feasible remedial measures was developed. Alternatives identified as having the potential to meet the remedial response objectives were subjected to a two-step evaluation process. The first step consisted of an initial screening of the candidate alternatives (see Table 10) based upon relative present worth cost, environmental impacts, and engineering considerations. The second step consisted of a more thorough evaluation.

Since the landfill's source strength and composition is largely unknown, the contaminant transport model used to simulate the relative contaminant transport for the remedial alternatives was calibrated to achieve the best fit to observed contaminant plume data. Various remedial schemes were simulated and evaluated by projecting the contaminant loading rates to the Manasquan River. (Field sampling results indicate significantly lower concentrations in the surface water than is predicted by the model since volatilization was not considered in the groundwater contaminant transport model). Because of the limited available data on the quantity and nature of the waste in the landfill and since the potential for contamination to continue to be released from the landfill exists, to ensure a conservative design a constant source strength was assumed for modeling purposes. It was also assumed that the wastes are evenly distributed over the landfill and capable of sustained, steady state releases. It should be noted that the purpose of the contaminant transport modeling was only to help evaluate the relative effectiveness of each alternative, the remedial alternative analysis and selection was based upon the groundwater flow model, which evaluated the effects of various containment and pumping schemes on the flow of groundwater in the underlying aquifers.

As a result of the initial screening, Alternative 2, the surface cap alternative, was deleted from further consideration. This alternative allows the contamination to be released from the landfill, but at a reduced rate.

Based upon the available data and field observations, it appears that no significant groundwater mound (attributable to infiltration) exists within the landfill nor does it appear that the water level in the landfill substantially impacts the area groundwater flow, but rather the water encountered in the landfill is infiltrated water perched on top of local impermeable layers (such as impervious sludge zones). While infiltration may occur at the landfill surface, a major portion is believed to be diverted to surface seeps, never entering the Vincentown aquifer. Thus, the net nfiltration to the saturated zone of the Vincentown within the andfill is estimated to be no greater than that to the undisturbed ortion of the Vincentown Sands. These assumptions are supported y field observations indicating that seeps are intermittent and ccur at various elevations and contain apparently different ontaminants based upon staining color. Furthermore, no water as encountered in one of the trenches excavated for drum sampling. relatively low mound beneath the landfill in the Vincentown uifer does occur, but it is believed to be due to upgradient ows and surrounding surface controls rather than infiltration.

The hydraulic impact of the installation of a surface cap 0^{-7} cm/sec) alone was simulated under the conservative assumption at all of the infiltrated water recharged the Vincentown Sands uifer and was reduced from about 0.1 cfs to 0.01 cfs or by 90% the Cap. However, as it was stated above, only a small portion the infiltrated water is believed to activelly enter the ncentown aquifer, with the majority being diverted to surface eps. (Once the landfill is capped, all of the rainwater that filtrates the cap that does not become perched, will eventually ach the underlying aquifer, since the surface seeps will have en eliminated.) The simulation of the installation of a cap sulted in a lowering of the water table by approximately 1 ot, corresponding to a reduction in the lateral groundwater ow beneath the landfill from 0.03 - 0.04 cfs to about 0.01 s. Over the area of the landfill, this represents an average ecrease in the saturated thickness of the Vincentown Sand layer f approximately 10% with less than a 2% change in the thickness f the unsaturated zone. However, there is evidence that the ite was excavated down to depths of 10 feet into the Vincentown ands aquifer during the period in which the landfill was being constructed and operated. Measurements from monitoring wells around the site indicate that the groundwater surface is above this level, allowing the lateral flow component of groundwater at the lower depths of the landfill, to flood the bottom of the fill area, potentially allowing the solubilization and dispersion of substances derived from ruptured drums and from bulk liquid dumping.

In addition, the strata underlying the landfill is complex and not fully understood. The planned installation of monitoring wells into the landfill mound will help provide further information relative to the level of water in the mound and help to better describe the subsurface strata. The potential problems are compounded by the uncontrolled manner in which disposal took place, resulting in the possibility that solvents could mobilize chlorinated organics which might otherwise tightly adsorb onto soil particles. Several non-volatile organic substances detected in the excavated drums (see Table 7), pose a cancer risk in drinking water at very low concentrations. Some of these constituents and their respective exposure levels based upon UCR values include Benzo (a) Pyrene (0.00304 ppb), Aldrin (0.00306 ppb), DDT (0.00416 ppb), Heptachlor (0.0104 ppb), and PCBs (0.00806 ppb). Although some of these substances were only found in trace amounts, the limited excavation and sampling program presents the possibility that significant quantities of these substances could be in the landfill. Therefore, the evidence shows that the reduction in infiltration resulting from the installation of a surface cap alone willnot eliminate the contaminant flux from the landfill to the groundwater.

The PRPs have expressed an interest in implementing Alternative with a contingency plan should the monitoring program show that capping alone is ineffective in controlling releases from the landfill. However, as was indicated, the evidence does not support the PRP's conclusion that a cap alone would effectively prevent future releases to the environment. In addition, if this landfill had been a permitted hazardous waste disposal facility, closure in compliance with RCRA would be required which would entail a cap and a liner. Also, the State of New Jersey has specifically stated that a cap alone is inadequate and unacceptable.

Alternative 5, the deep slurry wall, was deleted form further consideration because it would cost about $9 M more than a shallow wall, while yielding only a slight groundwater cleanup advantage. In addition, this alternative presents technological difficulties in that the required depth of excavation is just about at the limits of available technology. Unlike the shallow containment wall system, the deep wall will entrap existing contaminated groundwater which is currently present in the Red Bank aquifer immediately below the site, removing it from the active flow field. An analysis of alternatives for groundwater cleanup will be conducted in the future and will address off-site groundwater contamination. If groundwater cleanup is recommended, then pumping and treating the off-site contaminated groundwater will have a cost considerably lower than $9 M.

Alternative 6 consists of the complete drum excavation and removal along with disposal of contaminated soil. This alternative was deleted from further consideration because it was not considered cost-effective and because the potential safety and engineering problems associated with drum excavation far outweighed the long-term benefits. The cost estimate for complete drum removal is at least $80 M. The major safety concern results from a fire and explosion potential from the use of construction equipment, or spontaneous combustion, due to the presence of methane from the disposal of organics, including septage wastes. In addition, opening the landfill is likely to result in the release of odors associated with landfills undergoing anaerobic decomposition as well as the emission of volatile organic vapors from hazardous materials which in themselves are potentially harmful to public health. Excavation would subject on-site workers to the potential for direct contact with hazardous materials. Furthermore, the reliability of this alternative is questionable. It is likely that the majority of the buried drums have ruptured due to the high compressive forces and suspected corrosive environment in the fill area. (This is not to say, however, that the contents of the drums have necessarily left the landfill. Dispersion within the landfill is a function of many factors including the substance's density and the adsorptive and absorptive capacities of the soil and other solid materials disposed of in the landfill.) The materials that have leaked from the ruptured drums when added to the several million gallons of bulk liquid chemical wastes that were disposed of at the site yields a considerable quantity of waste that may not be removed with the excavated drums and the adjacent soil and waste material. So in short, it would be extremely difficult to identify all of the contaminated material and even a complete excavation of the drums and the adjacent soil and waste material may not necessarily remove the bulk of the contamination.

Table 10
Remedial Alternatives for the Lone Pine Landfill Site

1) No action with monitoring.

2) Surface cap (no containment).

3) Surface cap; containment by pumping contaminated groundwater (400 gpm); and treatment.

4) Containment by means of a surface cap and a slurry wall penetrating approximately 30 feet through the Vincentown aquifer to the Hornerstown formation, an aquitard; internal pumping (30 gpm) to maintain a negative internal gradient; and treatment.

5) Containment by means of a surface cap and a slurry wall penetrating approximately 140 feet through the Vincentown and Red Bank aquifers to the impermeable Navesink Marl; internal pumping (30 gpm); and treatment.

6) Drum excavation and removal; surface cap; interception (400 gpm) of contaminated groundwater; and treatment.

7) Containment by means of a surface cap and a 30-foot slurry wall; internal pumping (30 gpm) and flushing; and treatment of internal pumpage not used for flushing.

8) Containment by means of a surface cap and a 30-foot slurry wall; limited excavation (3 acre area of known drum disposal) of source materials; internal pumping (30 gpm) and flushing; and treatment of internal pumpage not used for flushing.

9) Containment by means of a surface cap and a 30-foot slurry wall; limited excavation of source materials; internal pumping (30 gpm); and treatment.

The flushing alternatives (7 & 8) consist of pumping contaminated ground water from below the landfill, treating it, and discharging it back on the landfill surface by spray irrigation or by subsurface injection with a piping or trench system. This concept is based on the use of relatively clean water to "flush" the contaminants from within the landfill mound with subsequent collection and treatment. This approach is intended to eventually lead to a removal of contaminants from the landfill. This alternative was determined to be technically infeasible because of the impermeable zones within the landfill, the likelihood for short-circuiting of the recharged water, and the hydraulic infeasibility of flushing in the northern and the northwestern portions of the landfill (where the bulk of the drums were allegedly disposed). In addition, the maintenance of the recovery wells will be difficult due to the high likelihood for clogging as a result of high iron concentrations. The wells will have to be cleaned and/or repaired frequently and a skilled operator will be required to carefully monitor the performance of the system. Thus, because of the significant operation and maintenance requirements, and since it is likely that flushing will have limited effectiveness in areas of known waste disposal, these options were deleted from further consideration.

After the completion of the initial screening of technologies, a further evaluation was conducted in order to recommend a cost-effective alternative. The following alternatives were developed for a more detailed analysis of effectiveness and cost measures.

Table 11
Alternatives Undergoing Final Evaluation

3) Surface cap; containment by pumping (400 gpm) of contaminated groundwater; and treatment.

4) Containment by means of a surface cap and a slurry wall penetrating approximately 30 feet through the Vincentown aquifer to the Hornerstown formation; internal pumping (30 gpm); and treatment.

9) Containment by means of a surface cap and a 30-foot slurry wall; limited excavation of source materials; internal pumping (30 gpm); and treatment.

This narrowed list of remedial alternatives was further evaluated according to the following criteria: cost, reliability, implementability, operation and maintenance requirements, environmental impacts, and safety requirements.

According to the NCP, a total cost estimate must also be considered for remedial actions and must include both construction and annual operation and maintenance costs. These costs were estimated for the alternatives under consideration. A present worth value analysis was used to convert the annual operation and maintenance costs to an equivalent single value. These costs were considered over a 20 year period at a 10 percent discount rate.

Alternative 3: Surface cap; containment by pumping (400 gpm) contaminated groundwater; and treatment.

This alternative differs from the slurry wall alternatives in that no physical on-site containment is provided, but rather a groundwater flow pumping system is used to collect contaminated groundwater before it enters the river. This interception system is composed of a series of off-site wells with a relatively high pumping rate. The wells are located in a zone between the landfill and the river since existing data indicate that flow is toward the river.

Simulation results indicate that this scheme will allow for partial treatment of the existing plume. The extraction wells provide a mechanism for capturing contaminants prior to their reaching the Manasquan River and continuous pumping will be required until the source is dissipated. Complete aquifer restoration could not be achieved until the source contaminants have ceased to migrate from the landfill, which is estimated to take more than 20 years. This alternative is capable of meeting the response objectives, is technically feasible and has a net positive impact on the environment, however, the lack of a containment wall implies greater adverse consequences to water quality if the pumps and treatment system should fail to perform properly in the future. In addition, the high pumping rate significantly affects operation and maintenance requirements and cost.

Alternative 4: Containment by means of a surface cap and a slurry wall penetrating approximately 30 feet through the Vincentown aquifer to the Hornerstown formation; internal pumping (30 gpm); and treatment.

Simulation results indicate that internal pumping within the Vincentown aquifer at 30 gpm will create a negative pressure gradient within the confines of the shallow slurry wall (similar to a sump pump), restricting the movement of contaminated groundwater away from the site. This will cause the groundwater to flow inward through the slurry wall and upward through the Hornerstown formation, effectively containing the source of contamination.

This alternative allows the migration of contaminants already in the Red Bank formation beneath the landfill to continue, pending resolution of the appropriate action for groundwater cleanup.

This alternative is technologically feasible, is capable of meeting the response objectives and is effective from an environmental standpoint. And because of the low pumping rate, associated operation and maintenance requirements will be considerably less than Alternative 3. In terms of non-cost and cost ranking, this alternative appears to be the cost-effective and environmentally sound choice for source control at this site.

Alternative 9: Containment by means of a surface cap and a slurry wall penetrating approximately 30 feet through the Vincentown aquifer to the Hornerstown formation; internal pumping (30 gpm); limited excavation of source material; and treatment.

This alternative is the same as alternative 4 but with the addition of a limited excavation of source material prior to containing the site.

Total excavation was previously discussed and eliminated from further consideration due to health, safety, and technical considerations. This alternative consists of a limited excavation program in an area of suspected high concentration drum disposal.

The proposed limited excavation is based on previous subsurface investigations at the landfill. These investigations included both a geophysical survey which identified magnetic anomalies within the landfill and a limited subsurface exploration program which investigated the presence of buried drums. The results of these programs were applied to evaluate the magnitude and extent of the proposed excavation.

The limited excavation program was assumed to include three acres where buried drums were previously found. The results of the earlier field excavation program were utilized to develop assumptions regarding the number of drums which would be encountered and the quantities of hazardous waste which require either on-site treatment or off-site disposal. Based upon assumptions regarding the locations and contents of the drums derived from the previous excavation activities, it was estimated that 7,700 drums could be recovered and approximately 45,000 cubic yards of contaminated soil and refuse would be handled as bulk hazardous waste.

Opening the landfill will likely result in adverse impacts on air quality from the release of odors and the emission of hazardous organic vapors which are potentially harmful to public health. On-site workers will be subjected to risks from direct contact with the excavated materials. In addition, workers will be subjected to dangers from fire and explosion.

Although the excavated drums and surrounding contaminated soil will be removed, a large area of the remaining landfill will still contain soil contaminated by the disposal of bulk liquid wastes or by the contents of ruptured drums.

Since the distribution of the contamination is largely unknown, there is no assurance that this limited excavation will remove a significant portion of the total quantity of waste within the landfill. Therefore, the site will still need to be contained as in Alternative 4, offering about the same level of protection to public health and the environment as containment alone, but adding over $20 million to the cost.

Table 12 shows the various costs associated with the alternatives considered in the final screening.

Table 12
Present Worth
Remedial Alternative Costs Comparison ($ million)
for a Twenty Year Period

Alternative	Capital	O&M		Total Present Worth
3	13.2	12.9	(0.79)*	26.1
4	10.7	6.47	(0.32)	17.1
9	30.9	6.47	(0.32)	32.4

*(annual O&M)

As part of the Lone Pine Landfill remedial program, it will be necessary to treat the extracted contaminated groundwater. A treatability study has been initiated to identify treatment methods and preliminary operating parameters for an on-site treatment scheme, as well as an evaluation of discharging the contaminated water to a main trunk line sewer of the Ocean County Utilities Authority wastewater treatment plant. The potential discharge points for an on-site plant include the Manasquan River to the north of the site, and the Metedeconk River to the south. The results of this treatability study will be incorporated into the project design.

The treatment costs in Table 12 assume on-site treatment of the extracted groundwater. Table 13 shows the capital and operating costs for the on-site and off-site treatment schemes under consideration. Option 1 employs the construction of a force main through the woods along the river for a distance of approximately one mile to intersect with the main trunk line sewer. Option 2 employs the construction of a 4.5 mile force main along a roadway right-of-way to the main trunk line.

Table 13

Comparison of Capital and Annual Costs for On-site and Off-site Groundwater Treatment ($ million)

	Alternative 3	Alternative 4	Alternative 9
On-site Treatment System Capital Cost	2.19	0.92	0.92
On-site Treatment System Annual Operation Maintenance Cost	0.67	0.23	0.23
OCUA Annual Charge	0.52	0.19	0.19
Option 1: 1 Mile Force Main	0.26	0.21	0.21
Option 2: 4.5 Mile Force Main	1.16	0.90	0.90

Community Relations

Throughout the feasibility study and the associated field work, all sampling data and reports have been submitted to the Freehold Township Health Officer who maintains a public repository and is the Chairman of the Freehold Township Technical Review Committee (TRC), a group of local residents and health officials appointed by the Mayor to review all technical documents associated with this project.

After publically releasing the draft Feasiblity Study, a three week public comment period ended on June 24, 1983, the date of the public meeting to discuss the findings of this document. The meeting was announced via a press release (see Attachment 1) which identified three public repositories as well as the location of the public meeting -- Freehold Township Administration Building, Freehold, New Jersey. This meeting was attended by 80 people consisting of EPA, NJDEP, TRC, several citizen groups, the local Congressional Representative, and local residents. Attachment 2 is a list of attendees.

As a result of comments offered by the TRC at several meetings, two additional alternatives were evaluated, which led to the development of the Supplemental Feasibility Study. This document was released to the public for comment on June 27, 1984, and a public meeting was held on August 1, 1984.

The date of the public meeting to discuss the findings of the Supplemental Feasibility Study with the public, was announced via a press release (see Attachment 3). The press release indicated the location of the meeting which was attended by 100 people. Attachment 4 is a list of attendees.

At the public meetings, as well as the TRC meetings, concerns were raised regarding containing the waste on-site. It is the community's preference to have all of the 45-acre landfill excavated and taken away. It is their belief that as long as the source of contamination remains, the Township could be adversely affected. It has been requested by the community that EPA perform a research and development investigation at the site to evaluate innovative decontamination techniques.

Attachment 5 is a responsiveness summary which summarizes the comments on the feasibility study, the public meetings, the meetings with the TRC, and comments from the Generators Steering Committee.

Consistent with Other Environmental Laws

The selected remedial alternative complies with all substantive requirements of RCRA, the Clean Water Act, and the Clean Air Act.

Recommended Alternative

According to 40 CFR part 300.68 (j), cost-effectiveness is described as the lowest cost alternative that is technically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of public health, welfare, and the environment. Nine alternatives were evaluated. The no action alternative was found to provide inadequate protection of public health and the environment. Surface capping with no containment was also found to provide an inadequate level of protection because of the continuing potential for groundwater contamination. This potential results from the existence of a shallow surficial groundwater aquifer and evidence that wastes were buried beneath the water table. Moreover, rupturing drums are likely to release liquids in the future which would migrate into the groundwater. This risk is enhanced by sampling results which show the presence of solvents in addition to chlorinated organics, some of which are suspected carcinogens at very low concentrations in drinking water, which might otherwise have a tight affinity for soils. A cap with high rate groundwater interception by pumping would be feasible as would containment by a slurry wall. A shallow slurry wall (30 feet) was found to have the same level of reliability as a deep slurry wall (140 feet). Site excavation and flushing alternatives were also considered. Complete excavation of the 45 acre site with disposal of contaminated waste and soil was found to be impractical and dangerous. Flushing was found to be not feasible because of potential operational and reliability problems.

Table 12 shows the present worth costs for the most feasible alternatives which include containment by high rate pumping (3); containment by a shallow slurry wall (4); and shallow slurry wall containment and limited excavation (9).

The limited excavation alternative has the highest present worth cost at $37.4 million. Because of the uncontrolled and random nature of dumping at the site, it is not possible to assume that the limited excavation will remove even as much as half of the waste from the site. Therefore, the same capping and containment measures are necessary as would be required without the excavation. The extra cost for this alternative and the additional health and safety risks do not result in additional reliability in terms of reduced release to the environment.

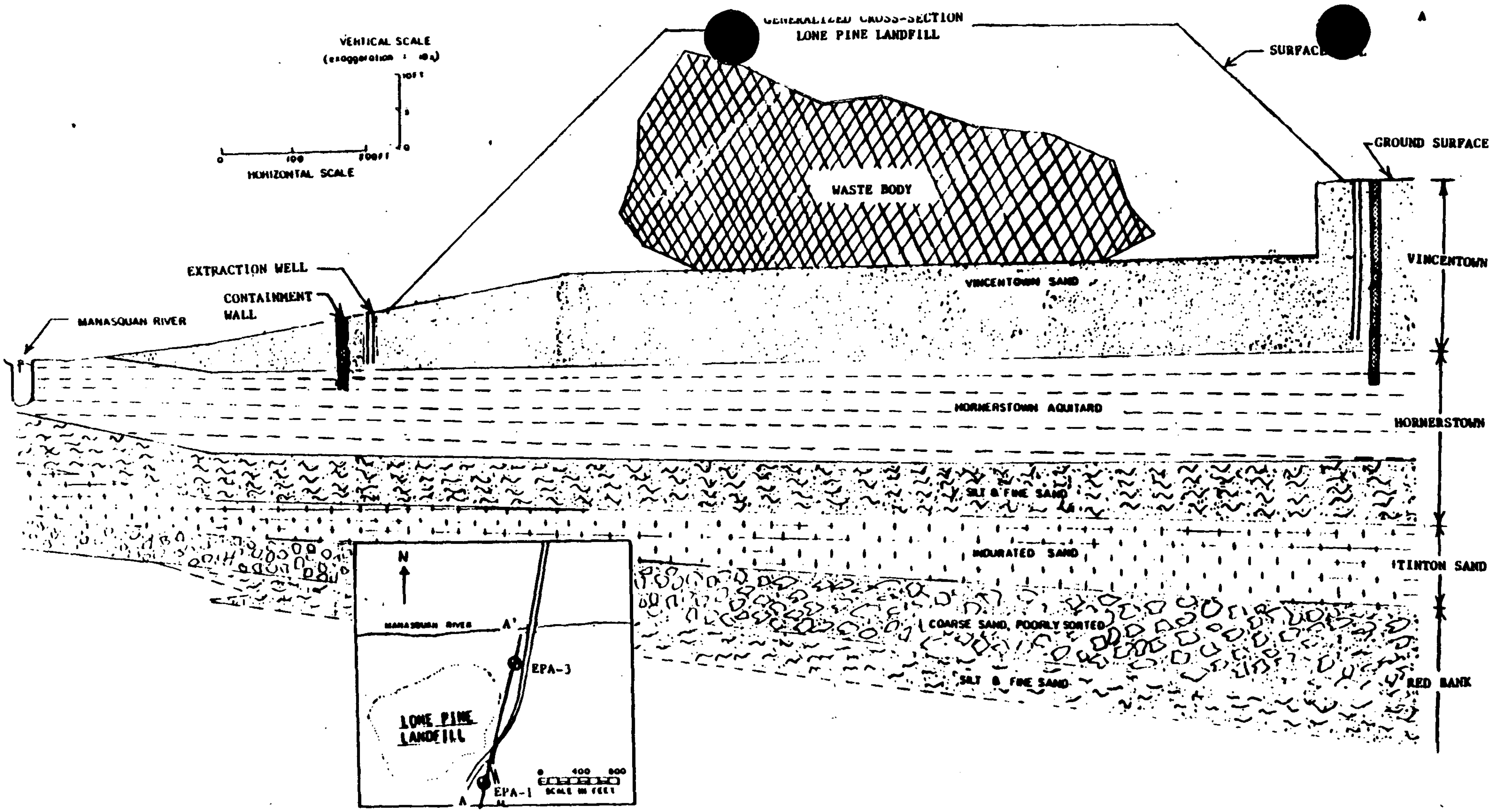
Containment by high rate pumping has a present worth of $26.1 million and the slurry wall alternative has a present worth of $17.1 million. The reason for the large difference is associated with the capital cost and the cost for long-term water treatment at a pumping rate of 400 gpm versus 30 gpm. However, an important advantage of the larger pumping rate is that it will also result in cleanup of some existing groundwater contamination. Preliminary simulation results from the feasibility study suggest that the off-site contaminated plume could be recovered at a lower pumping rate of 200 gpm (if a slurry wall is in place) for a present worth cost of about $8 million. Thus, even if an off-site groundwater cleanup program were initiated in the future along with the shallow slurry wall alternative, the combined present worth cost ($25.3 million) would be less than the cost for plume interception at the high pumping rate of 400 gpm. In addition, the slurry wall will provide more reliable containment and the off-site plume cleanup could be accomplished in about 20 years. Because of the uncontained source, high rate pumping is likely to continue well beyond 20 years. Therefore, capping with a shallow slurry wall is the cost-effective alternative for this site.

The recommended alternative (see Figure 8), consists of the following on-site and off-site activities:

<u>On-site</u>:

o <u>groundwater cut-off wall</u>

On-site containment will be provided through the use of a shallow groundwater cut-off wall penetrating approximately 30 feet through the Vincentown aquifer and keying into the Hornerstown formation, an aquitard. The wall will ring the landfill's perimeter for a distance of about 6000 feet, enclosing approximately 45 acres. The groundwater cut-off wall will be installed to achieve a maximum permeability of 1.0 x 10^{-7} cm/sec.



PROPOSED REMEDIAL SOLUTION: SURFACE CAP, CONTAINMENT WALL, AND PUMPING AND TREATMENT

Figure 8

o surface seal

To reduce rainwater infiltration and gas release, the landfill mound will be covered by a multi-layer surface sealing system as follows: A 1-foot layer of fill will be used to grade the existing local fill cover. This layer will be covered with a 1-foot thick layer of clay (permeability not to exceed 1.0×10^{-7} cm/sec), a 1-foot thick layer of fine fill and a 6-inch layer of topsoil. The topsoil will be seeded to stabilize the surface. The cap will comply with requirements under RCRA.

o internal wellfield

Because the downward flow of contaminants from the Vincentown aquifer into the Red Bank aquifer must be checked, an internal pumping system (30 gpm) consisting of a series of six wells, is included to produce a negative, inward gradient similar to a sump pump, to relieve the hydraulic escape of contaminants through the Hornerstown formation, an aquitard. This internal pumping system will also remove any water that has infiltrated the surface seal or the groundwater cut-off walls.

o treatment system

The contaminated groundwater extracted from the wellfield inside the groundwater cut-off wall will be treated or pretreated, as necessary, and tested prior to discharge to the Manasquan or Metedeconk River or the Ocean County wastewater treatment plant interceptor. An on-site physical/chemical treatment scheme would address the contaminated groundwater as it is received rather than being designed for anticipated contamination levels since the source strength is unknown and the nature of the contamination may change over time. The specific treatment system will be designated upon completion of the ongoing pilot plant and bench scale treatability studies.

If on-site treatment is selected, the treatment plant effluent would be discharged to a 1-day storage tank to allow sampling and testing prior to discharge to the Manasquan or Metedeconk River in accordance with NJPDES. If the Ocean County wastewater treatment plant is utilized as the treatment mechanism, it is likely that a force main will be utilized to convey the waste to the interceptor located in the vicinity of the site. The ongoing treatability studies will assure the compatability of the contaminated groundwater to the proposed treatment system.

o monitoring program

Six nested observation wells, screened above and below the Hornerstown formation would be used to monitor the effectiveness of the remedy and to facilitate determination of seasonal optimum pumping rates at each location.

o surficial cleanup

A surficial drum and debris cleanup at the adjacent borrow pit area will be performed during remedial implementation. This material will be disposed of on the landfill before capping, since it is believed that these drums are empty.

o site securing

The existing fencing restricts vehicular and pedestrian traffic from Burke Road. The entire site will be enclosed to exclude to the extent possible wildlife, hunters, and dirt bikers.

Off-site:

o limited groundwater sampling and monitoring program

The need to implement an on-site containment measure to prevent any future releases of persistent hazardous compounds from the landfill has been established by evaluating the available data. Because of the questions raised about the contaminant flow path By recent sampling results at this site, additional off-site groundwater sampling will be performed to better define the extent of the contaminant plume emanating from the landfill and to define the need for off-site plume control.

Cost summary for recommended remedial alternative 4

The following table represents a cost estimate for the proposed remedial actions. Cost sharing for the off-site field investigation and design portion is 100% EPA-financed. Cost sharing for construction is 90% EPA and 10% State. The actual requested amount for the off-site field investigation, design, and construction phase of this project is $11.2 million. As a result of consideration of credit given to the State by EPA, the State's share of the capital cost is reduced by $33,000.

Table 14
Selected Remedial Alternative Capital Costs

Activty	Costs
Cap and Surface Cleanup	$ 5,690,000
Shallow Containment Wall	882,000
Internal Wellfield	210,000
Treatment System*	921,000
Storage	150,000
Monitoring Program	30,000
Engineering and Contingencies (35%)	2,759,050
Total Capital Cost (EPA share $9,610,845. state share: $1,031,205)	$10,642,050
Preparation of Detailed Design	$1,060,000
U.S. Army Corps of Engineers Service During Design and Construction	532,103
Additional Off-Site Field Investigation	100,000
Total Funds Required (EPA share: $11,302,948, state share: $1,031,205)	$12,334,153

* The actual costs associated with the groundwater treatment facility will be determined upon completion of the ongoing treatability studies. The more conservative on-site treatment system was used for costing purposes.

Operation and Maintenance

o monitoring

As part of the remedial action, a water and air sampling program, which is consistant with State permit requirements, is included to monitor changes in the nature and extent of contamination at the site to determine the effectiveness of the operation. The water sampling plan will be modified as necessary upon completion of the planned hydrogeological investigation.

Groundwater sampling in both the Vincentown and Red Bank formations will consist of sampling from two pairs of nested monitoring wells. Surface water samples will be collected at two Manasquan River locations. Ground and surface water samples will be analyzed for priority and non-priority pollutants semi-annually for the first 2 years and annually, thereafter, if the rate of contamination decreases. In addition, if an on-site treatment plant is constructed, as long as the plant is in operation, the plant's effluent would be sampled daily for total organic carbon and total organic halides and weekly for volatile organics.

Following the installation of the surface seal, total hydrocarbons monitoring (and meteorological data collection) would be repeated for 2 months to test the effectiveness of the surface seal. Four gas monitoring wells will be installed and sampled for methane quarterly for the first 5 years, and semi-annually thereafter, if no methane problems are determined to exist. Sampling for priority pollutants would be conducted quarterly for the first 3 years and semi-annually, thereafter, if contaminant levels are acceptably low.

o <u>operation and maintenance</u>

The remedial measures proposed for the Lone Pine Landfill have operation and maintenance requirements to protect the integrity of the remedy.

To maintain a negative internal gradient at the site, a series of six extraction wells will be required. These will be located within the boundary of the slurry wall, but outside of the fill area, and extending an average depth of 30 feet below grade. These wells will extract approximately 30 gpm. The high natural iron content in the groundwater may result in fouling of the groundwater extraction wells and screens by iron-oxidizing bacteria. A cleanup frequency of once per 6 months and a replacement frequency of once every 2 years is anticipated to maintain the effectiveness of the groundwater extraction system.

The 30 gpm of highly contaminated groundwater extracted to maintain the negative gradient within the landfill will have to be treated. A treatability study is currently being conducted to identify feasible on-site treatment methods as well as an evaluation of discharging the contaminated groundwater to the Ocean County Utilities Authority (OCUA) wastewater treatment plant. In either instance, routine operation and maintenance will be required to maintain the integrity of the remedy. An on-site system would most likely include a combination of unit processes, the operation and maintenance of which will be required. Sludge generated in this treatment process will have to be dealt with regardless of whether it is hazardous or not. If the OCUA is utilized to treat the extracted contaminated groundwater, the force main, as well as the pump station and the associated appurtenances, will have to be maintained.

The landfill mound will be covered by a multiple-layer, grass-covered surface system which would also include provisions for drainage swales to transport rainwater away from the landfill. Repairs of subsidence, erosion, and burrowing by animals, as well as grass mowing, will be required to maintain the integrity of the surface sealing system.

The 6000 linear-foot slurry wall encircling the site will require periodic testing to ensure its structural integrity. A gas control system consisting of a series of gas monitoring wells will be provided and will have to be maintained.

The annual operation and maintenance requirements for the recommended remedial measure are as follows:

Table 15
Annual Operation and Maintenance Costs for Selected Remedial Alternative

Item	Annual Cost (20 years)
Internal Wells	$3,234
Surface Seal	5,000
Groundwater treatment	228,000*
Storage	750
Subsurface monitoring program	87,850
Total	$324,734

* or $196,750 if the OCUA wastewater treatment plant is utilized.

It is the Region's recommendation that EPA finance the operation and maintenance for a period not to exceed one year.

Schedule

Table 16
Remedial Alternative Implementation Schedule

Activity	Date
-Complete Enforcement Negotiations	September 21, 1984
-Final Record of Decision	September 21, 1984
-Amend State Superfund Contract for Design	September 28, 1984
-Award IAG for Design	September 28, 1984
-Begin Design	November 1, 1984
-Complete Design	May 1, 1985
-Amend State Superfund Contract for Construction	June 1, 1985
-Award IAG for Construction	June 1, 1985
-Begin Construction	July 1, 1985
-Complete Construction	July 1, 1987

Future Actions

o field investigation

Because of the uncertainties regarding the extent of the off-site contamination developed as a result of the recent round of monitoring well sampling, additional off-site hydrogeological investigative work will be necessary. This will include the placement of four monitoring wells to the north of the Manasquan River, two monitoring wells south of the river, and the resampling of selected existing monitoring wells. This work is tentatively schedueled to begin in late October 1984.

ATTACHMENT 5-2
RESPONSIVENESS SUMMARY
SUMMARY OF RESPONSES TO COMMENTS

Attachment 5-2
Responsiveness Summary
Summary of Responses to Comments

Summary of Public Meeting Comments and Responses
Freehold Township -- June 24, 1983

- Concern was expressed about the validity of groundwater model parameters since the landfill contents are not known. In response, it was pointed out that complete knowledge of landfill contents is not necessary to generate valid results from the model.

- An attorney for the generator group stated that his client is attempting to cooperate with EPA. He questioned EPA about other major companies that allegedly have not been contacted. He was informed that EPA is investigating all possible leads and that if he has some information, EPA would be more than happy to follow up on it.

- A resident north of the Manasquan River reported that there are taste and odor problems in his well water. He was promised that EPA would sample his well.

- It was asked whether or not food chain studies were performed as part of the feasibility study. Response was no.

- Concern for the Englishtown aquifer was expressed. In response it was pointed out that there is no hydrologic reason to expect contamination in Englishtown aquifer from Lone Pine Landfill.

- A question was raised concerning possible contaminated areas in vicinity of landfill proper. Response was that the EPA was continuing to test these areas.

- The sentiment expressed was that as long as the source of contamination remains, the Township could be adversely affected. Reconsideration of the excavation alterntive was recommended. In response, it was pointed out that there are not enough facilities in the U.S. to accept all the excavated hazardous material from Lone Pine and the other hazardous sites. Excavation has major technical, environmental, and cost problems associated with it, as well.

- The question was asked if, costs aside, excavation is technically feasible. CDM reponded that assurances of technical feasibility are uncertain.

- It was suggested that a combination solution be considered as a possibility: remove, test and dispose of all the drums that can feasibly be removed, and apply a containment solution to the remainder of the drums. In response, it was indicated that much of the buried material is probably under water, requiring extensive dewatering and treatment of highly contaminated water removed by the dewatering process.

- The opinion expressed by the concerned citizens was that as long as unquantifiable risk exists with leaving the material in the landfill, the excavation alternative should not be dismissed. In response, it was stated that further examination and discussion of this alternative with the Township Technical Review Committee would occur.

- A resident near the Manasquan River expressed concern for the safety of his private well. The Region committed to testing his water.

- It was asked if the levels of volatile organic compounds that are being found are toxic to native aquatic life in the area. In response, it was noted that no specific biotic toxicity studies have been done.

- The point was made that any substance from Lone Pine that contaminates the proposed Manasquan River reservoir could affect over 100,000 people. In response, it was indicated that protecting the public is the intent of EPA's actions at this site.

- In response to a question asked about the pumping rate used in the report, it was stated that the 200 gpm rate was based on optimizing the groundwater cones of depression.

Summary of Public Meeting Comments and Responses
Freehold Township, August 1, 1984

- In response to EPA's acknowledgement of the need to acquire additional data relative to the extent of the off-site plume, a member of the Technical Review Committee said that his organization and the citizen's advisory committee "are heartened [that] you intend to obtain additional data. The committee does not object to the proposed action, but we prefer if you do it in a fashion that does not foreclose other alternatives in the future. We would support the removal of at least some toxins from the site. We don't feel your data base supports a final decision yet."

- It was recommended that research and development work be performed at the site. In response, it was indicated that we would give some thought to this proposal.

- A question was raised about the status of the ongoing leachate treatability study. In response, it was indicated that a laboratory trailer has been placed on-site to begin compatability tests. A preliminary evaluation utilizing a well recently installed at the toe of the mound has been completed, indicating leachate compatability with the Ocean County Utilities Authority (OCUA) wastewater treatment plant. Based upon this preliminary analysis, it appears that it may be more economical to send the leachate to the OCUA rather than treating on-site.

- The question was asked whether a liquid discharge outside the Manasquan basin would impact the reservoir yield. In response, it was indicated that extracting 30 gpm would have a negligible impact on the Manasquan basin.

- "Why does EPA not want to address the contaminated sediments in the Manasquan River?" was asked. In response, it was indicated that the contamination levels detected in the river adjacent to the landfill are not high enough to warrant dredging. In addition, it is unlikely that sediment transport will occur to pose a threat to the proposed off-line reservoir intake.

- A question was raised regarding the pile of drums and debris across the road from the landfill. In response, it was pointed out that removal of the drums and debris in the borrow pit area across the road is part of the proposed remedial action.

- It was asked whether EPA assessed the contamination of the Englishtown Sands aquifer below the landfill. In response, it was indicated that EPA has sampled two existing wells in the Englishtown and that as part of the additional offsite investigation, EPA will be installing deep monitoring wells screened in multiple layers down to the bottom of the Red Bank aquifer to further assess the extent of the contamination. If nothing is found in the lower Red Bank it is likely that the Englishtown is also clean.

- Because of variability in the sampling data from the site, questions were raised regarding the laboratory measurement errors in assessing the degree of contamination. In response, it was pointed out that small changes in the numbers are insignificant. Only the order-of-magnitude variations in the data, such as those found at EPA well No. 3A, have significance in evaluating the contaminant flux at this site. Nevertheless, the data have been verified and validated by EPA using strict quality assurance/quality control procedures and EPA is confident that these data are beyond reproach.

- It was asked why the excavation costs were estimated to the nearest $5 if there are so many uncertainties associated with this remedial alternative. In response, it was indicated that the costs were calculated based upon assumptions using the limited available data. There are clearly errors in the calculations.

- An attorney for the generators indicated that based upon their analysis of the available records and the estimated lifespan of drums, the drummed waste does not pose a significant threat to the environment. It was further indicated that the generators feel that a cap and a comprehensive monitoring program with trigger mechanisms to activate new phases before the site threatens the public should be implemented as a remedial measure at this site. NJDEP responsded that a cap alone is not acceptable. NJDEP added that the plume must also be addressed. The attorney added that the community is also liable for paying a share of the remedial costs since they also utilized the landfill.

- It was asked whether there are any chemical residues in the flora in the area. The response was that there have not been any studies in this regard.

- It was asked why plume control is under discussion between EPA and NJDEP. In response it was indicated that there is a problem in defining the extent of the plume. Additional investigation is necessary in light of the most recent round of well sampling.

- The question was asked of the generators why they were offering to do work at the site at their own expense. They responded that everyone who sent waste to the landfill is liable and that their companies chose not to "hide in the bushes" but to make a good faith effort to address the problems here.

<u>Freehold Township Technical Review</u>
<u>Committee Comments and Responses</u>
<u>May 4, 1983</u>

- A question was asked regarding the extent of the available air data. Concern was expressed about what was happening to the volatile organics. Response was that at that time EPA had little air data and additional investigation was planned.

- It was suggested that holes be bored or acid be injected into the mound to accelerate the degradation of the drums, to encourage the purging of the contamination during the_pumping and treatment activitis. In response it was indicated that if the site was contained the condition of the drums was not important.

- Sentiments were expressed towards excavating the drums from the landfill. In response, it was indicated that drum excavation was being evaluated in the draft Feasibility Study.

Response to July 13, 1983 Technical Review Committee Meeting Comments

1. Analysis of the groundwater hydrology in the vicinity of Lone Pine indicates that contamination migrates and discharges to the Manasquan River rather than migrating vertically downwards into the Englishtown aquifer.

2. Unit processes, each addressing specific contaminant classes, will be utilized to treat the extracted groundwater. Bench scale and pilot scale treatability studies, which will commence shortly, will establish specific design criteria for the selected treatment system. Monitoring of the effluent will indicate the effectiveness of the treatment scheme.

3. As part of the Lone Pine Landfill Feasibility Study, EPA investigated two adjacent potential sites, the Solico site and the borrow pit, which were alluded to.

   The Solico site, which was used as a waste lagooning area, was excavated in the late 1970's in response to a New Jersey Department of Environmental Protection (NJDEP) Administrative Order. Both the local health officer and the NJDEP requested that EPA investigate this area. Subsequently, a monitoring well network was installed to determine the presence of contaminants in the area. Test results of the wells found the Solico area to be relatively clean, with no significant levels of contaminants detected.

   In regard to the borrow pit, it has been suggested that this area, where several dozen rusted drums were scattered over the surface, was used for drum disposal. However, based upon the testimony of the landfill's general manager and a bulldozer operator, extensive drum disposal occurred only at the landfill. This is further supported by the fact that the high water table beneath the borrow pit would make subsurface drum disposal extremely difficult. It is also unlikely that disposal took place here since an active landfill was available across the road. We did, however, install a monitoring well downgradient of this area which confirmed the absence of contamination here. A surficial drum cleanup will be performed at the borrow pit when a long-term remedial solution is implemented at the landfill.

4. Containment walls have history going back as far as the 1940's, primarily in conjunction with large dam projects. Slurry wall compatability/constuctability tests will be performed during the remedial design phase to determine the optimum material composition. In cases where the permeability of the containment wall is found to increase in the presence of hazardous waste, an admixture of certain polymers have been successful in the past in preventing the breakdown of the retaining properties of the wall.

5. The Region has identified several parties to which various quantities of the contents of the landfill can be attributed. Little is known of the composition of the bulk and drummed chemical wastes disposed of here. The Region's drum excavation at this site in 1981 uncovered 69 drums. The contents of these drums were useful in helping to develop a treatment scheme for the Lone Pine Landfill.

6. The planned limited air quality monitoring program is intended to provide an intensive short-term survey of air contaminants emanating from the site. Air samples will be collected to provide 8-hour, time-weighed average values for priority pollutants. Local meteorological conditions will assist in the evaluation of the site's overall air quality conditions.

7. As was indicated in the draft Feasibility Study, although removing the drums would potentially remove a major source of contamination from the landfill, drum excavation will not address the millions of gallons of materials that has leaked from the deteriorating drums. The EPA's drum excavation activities at Lone Pine in 1981 uncovered numerous drums that were no longer intact. Since all of these excavated drums were near the surface and above water in the landfill, it is reasonable to assume that the remaining 17,000-50,000 drums, which may be underwater and subjected to considerable compressive pressures, are in far worse condition.

   Excavation of the drums could potentially allow the release of high levels of hazardous substances to the atmosphere, cause chemical fires, and/or explosions.

   The state-of-the-art technology is such that after excavation, we would not be completely certain that all the drums had been located and removed.

   Excavation of drums below any encountered water will require extensive dewatering and treatment of highly contaminated water removed by the dewatering process.

1. A press release, indicating the availability of the draft Lone Pine Landfill Feasibility Study at three local repositories, immediately preceded the release of this document. In keeping with the Agency's current policy, three weeks were allowed for the public to review and comment on the study.

2. Unit processes, each addressing specific contaminant classes will be utilized to treat the extracted groundwater. A bench scale and pilot scale treatability study, will establish specific design criteria for the selected treatment system.

   Treated water would be analyzed daily for total organic carbon and total organic halides and weekly for total volatile organics to verify that the treatment system is working properly.

   The proposed treatment system will be designed to handle a wide range of varying conditions, however, if some type of "extremely toxic chemical" suddenly appears, and the treatment system is unable to properly remove it, then the effluent would be temporarily retained while the system is modified, as necessary, to address the new contaminant. Regardless, any discharge would have to meet the State's discharge permit requirements.

3. The pumping and treatment schemes were modeled assuming a continuous strength, worst-case contaminant source during the life of the program. If anything, the system is over designed.

   Placing a cap over the landfill will reduce infiltration which may inhibit the deterioration of the drums and reduce the quantity of contaminants, being released from surface seeps and to the aquifers, however, as long as the landfill is contained, the degree of drum deterioration is irrelevant.

4. The EPA's drum excavation activities at Lone Pine in 1981 uncovered numerous drums that were no longer intact. Since all of these excavated drums were near the surface and above the water in the landfill, it is reasonable to assume the remaining drums which may be under water and subject to considerable compressive pressures, are in far worse condition.

   In regard to the markings on some of the drums, we have used this information to seek out potentially responsible parties. Since it is possible that the drums could have been used more than once before ultimately being disposed of in the landfill and because of the illegal nature of the drum disposal activities here, it would prove very difficult to determine what was actually disposed of and by whom by tracing the markings on the drums.

5. The feasibility study evaluated the feasibility of various alternatives that may be applicable to the particular contamination problem at this site. We know enough about the problem at this site to lay out and develop reasonable remedial solutions. More data, however, will have to be collected to adequately design and implement the selected remedial alternative. Specifically, a leachate treatability study will be undertaken and a slurry wall constructability/compatability test will be performed.

6. During short-duration, high intensity rainfall events, there is considerable runnoff and leachate breakouts at the site, potentially, allowing a signficant discharge of contamination to the Manasquan River. It would be expected that once the storm event has ended the condition of the landfill would more or less return to its pre-storm "steady-state" conditions. Capping the landfill, as proposed in the alternatives evaluated in the draft Feasibility Study, would reduce the infiltration and its associated leachate breakout problems.

7. Although removing the drums would potentially remove a major source of contamination from the landfill, drum excavation will not address the millions of gallons of bulk liquid wastes disposed of there, as well as the materials that has leaked from the deterioriating drums. The EPA's drum excavation activities at Lone Pine in 1981 uncovered numerous drums that were no longer intact. Since all of these excavated drums were near the surface and above the water in the landfill, it is reasonable to assume that the remaining 17,000-50,000 drums which maybe under water and subject to considerable compressive pressures, are in far worse condition.

   Excavation of the drums could potentially allow the release of high levels of hazardous substances to the atmosphere, cause chemical fires, and/or explosions.

   The state-of-the-art technology is such that after excavation, we would not be completely certain that all the drums had been located and removed.

   Excavation of drums below any encountered water will require extensive dewatering and treatment of highly contaminated water removed by the dewatering process.

8. The study assumes that the public would react adversely to drum excavation because excavation could change the situation from one that does not currently theaten the public to one that could cause releases of high levels of hazardous substances, cause chemical fires, and/or explosions. The potential long-term benefits are dwarfed by the potential short-term threats and impacts.

9. Assuming that the drums could be excavated, the volume of material that would have to be removed from the landfill would translate into perhaps 20 daily truck trips over a period of a year or more. This much traffic, despite stringent safety procedures, would greatly increase the odds of traffic accidents and the resultant exposure of the public to hazardous substances.

10. As part of the Lone Pine Landfill Feasibility Study, EPA investigated the two sites, the Soilco site and the borrow pit. The Soilco site, which was used as a waste lagooning area, was excavated in the late 1970's in response to a New Jersey Department of Environmental Protection (NJDEP) Administrative Order. In order to determine the potential of contamination from this source, we installed a monitoring well network in the area which showed no significant quantities of contamination.

In regard to the borrow pit, it has been suggested that this area, where several dozen rusted drums were scattered over the surface, was used for drum disposal. However, based upon the testimony of the landfill's general manager and a bulldozer operator, extensive drum disposal occurred only at the landfill. This is further supported by the fact that the high water table beneath the borrow pit would make subsurface drum disposal extremely difficult. It is also unlikely that disposal took place here since an active landfill was available across the road. We installed a monitoring well downgradient of this area which confirmed the absence of contamination here.

A surficial drum cleanup will be performed at the borrow pit when we implement a long-term remedial solution at the landfill.

11. If the drums disposed of at the landfill were largely intact and easily accessible, and if there were no bulk liquid waste disposal at this site, then incineration could very well be a viable approach.

Technical Review Committee Meeting
Comments and Responses
Freehold Township October 31, 1983

It was requested that EPA consider a limited excavation/incineration proposal developed by Energy Incorporated. Response was that EPA would evaluate the proposal.

Technical Review Committee Meeting
Comments and Responses
Freehold Township on July 10, 1984

- o A request for a time range of concentrations per well to show how contamination has varied through time was made. CDM will provide a computer listing of the requested data.

- o The presence of heavy metals in upgradient wells was questioned. In response, it was pointed out that many of the metals in question are naturally occurring in high concentrations in this area. The other metals can be attributed to leaching from the stainless steel screens and galvanized risers.

- Because monitoring well CDM-4A has shown contamination in the most recent sampling round, the adequacy of the groundwater model was questioned. In response, it was indicated that additional field monitoring was planned to better define the off-site contamination problem.

- The long-term integrity of the containment system was questioned. It was indicated that operation and maintenance of the system is required as it is necessary to maintain our bridges and highways. In addition, it was pointed out that replacement costs for the slurry wall are included in the cost estimate.

- A question was raised regarding the relationship between the level of contamination found in the plume and the proposed containment scheme. It was indicated in response, that source control is independent of and not influenced by the level of off-site contamination.

- It was asked whether or not a slurry wall would work. It was indicated, in response, that the U.S. Army Corps of Engineers has had considerable experience with slurry walls.

- The integrity of the Englishtown aquifer was questioned. In response, it was indicated that EPA tested two existing wells screened in the Englishtown aquifer and found them to be clean. The planned additional monitoring north of the Manasquan River will further ascertain the integrity of the Englishtown aquifer.

- The question was raised as to why incineration was not evaluated. In response, it was indicated that since limited excavation must precede ultimate disposal, and since excavation was ruled out for this site, considering incineration was a moot point.

- It was asked whether a phased approach towards containment could be employed -- delay the cap until groundwater had been extracted for a while. Response was that this proposal would be considered.

Response Technical Review Committee Comments
August 17, 1984

EPA is discussing with EPA's Municipal Environmental Research Laboratory the prospect of performing R & D at the site to evaluate innovative decontamination techniques.

Response to Monmouth County Board of Health Comments June 20, 1983

I. Scope of Study

As part of the Lone Pine Landfill Feasibility Study, EPA investigated the two adjacent potential sites, the Soilco site and the borrow pit, which were alluded to.

The Soilco site, which was used as a waste lagooning area, was excavated in the late 1970's in response to a New Jersey Department of Enivronmental Protection (NJDEP) Administrative Order. Both the local health officer and the NJDEP requested that the EPA investigate this area. Subsequently, a monitoring well network was installed to determine the presence of contamination in the area. Test results of these wells found the Soilco area to be relatively clean with no significant levels of contaminants detected.

In regard to the borrow pit, is has been suggested that this area, where several dozen rusted drums were scattered over the surface, was used for drum disposal. However, based upon the testimony of the landfill's general manager and a bulldozer operator, extensive drum disposal occurred only at the landfill. This is further supported by the fact that the high water table beneath the borrow pit would make subsurface drum disposal extremely difficult. It is also unlikely that disposal took place here since an active landfill was available across the road. We did, however, install a monitoring well downgradient of this area which confirmed the absence of contamination here.

A surficial drum cleanup will be performed at the borrow pit when we implement a long-term remedial solution at the landfill.

II. Groundwater Contaminaton Assessment

Analysis of the groundwater hydrology in the vicinity of Lone Pine indicates that contamination migrates and discharges to the Manasquan River rather than migrating vertically down into the Englishtown aquifer.

EPA sampled two existing wells in the Englishtown Sands aquifer confirming that no contamination has migrated from the Red Bank aquifer to the Englishtown Sands. Additional monitoring is planned.

III. Air Quality Monitoring at the Landfill

Air quality monitoring to date, albeit limited in scope, does not indicate severe releases of volatile organics at this time.

A time-weighted continuous air monitoring program was conducted to identify the constituents and concentrations of emissions from the site. Meteorologic data was also collected in order to allow prediction of the fate of these emissions in the environment.

IV. Identification of Contaminants

Although removing the drums would potentially remove a major source of contamination from the landfill, drum excavation will not address the million of gallons of bulk liquid wastes disposed of, as well as the material that has leaked from the deteriorating drums. The EPA's drum excavation activities at Lone Pine in 1981 uncovered numerous drums that were no longer intact. Since all of these excavated drums were near the surface and above water in the landfill, it is reasonable to assume that remaining 17,000-50,000 drums which maybe under water and subject to considerable compressive pressures, are in far worse condition.

Excavation of the drums could potentially allow the release of high levels of hazardous substances to the atmosphere cause chemical fires, and/or explosions.

The state-of the-art technology is such that after excavation, we would not be completely certain that all the drums been located and removed.

Excavation of drums below any encountered water will require extensive dewatering and treatment of highly contaminated water removed by the dewatering process.

Analysis for dioxin (TCDD) was included in the 1981 sampling of excavated drums, the 1982 and 1983 sampling of monitoring wells, and the 1983 sampling of stream bottom sediments. In all cases the chemical was not detected.

Analytical results from the April 1983 sampling of river sediments found no organic priority pollutants at Burke Road. Inorganic compounds were not present in high concentrations except for iron and aluminum which are known to be ubiquitous in the environment. A tributary from the landfill and a point in the river approximately 700 feet downstream from the westernmost tributary from the landfill are contaminated with several organic priority and non-priority pollutants.

V. Contaminant Transport in Ambient Environment and Computer Modeling

Volatile organics were modeled because they are the dominant class of priority pollutants presently released from the landfill and thus represent the best body of data to use for the model.

Other classes, such as heavy metals, are not at this time present in severe concentrations. However, the report recognizes that this could change in the future.

VI. On-Site Waste Treatment System Proposed

Treated water would not be routinely analyzed for priority pollutants as this would be prohibitively expensive. Instead, it is proposed that treated water would be analyzed daily for total organic carbon and total organic halides and weekly for total volatile organics to verify that the treatment system is working properly. Other discharge criteria such as heavy metals would also be specified in the discharge permit issued by NJDEP.

Air contaminants released during treatment, such as from an air stripping process, would be controlled as necessary to meet NJDEP air pollutant emission standards.

VII. Slurry Wall Construction/Life

Slurry wall deterioration has been accounted for by providing for replacement of the wall. In actual practice, the groundwater monitoring system would allow monitoring slurry wall effectiveness. As a result, the actual slurry wall replacement schedule could be determined by the monitoring data.

VIII. Operations Not Studied

1. Discharge to a wastewater treatment plant is an option that is specifically being studied during the ongoing treatability studies.

2. If the drums disposed of at Lone Pine Landfill were largely intact and easily accessible, and if there were no bulk liquid waste disposal at this site, then incineration could very well be a viable approach. However, based upon data and information available, the potential long-term benefits of drum excavation are dwarfed by the potential short-term threats and impacts, and the associated technical and safety problems.

Response to Energy Incorporated's Proposal
October, 1983

There are allegations that 17,000 to 50,000 drums of hazardous waste have been disposed of at the Lone Pine site. EPA's investigation has documented that at least 17,000 drums and 2.5 million gallons of bulk liquid waste have, in fact, been dumped at the landfill. If, hypothetically, 17,000 drums were all filled with liquid, they would have contained a total of 0.935 million gallons at the time of disposal. If, on the other hand, there were 50,000 drums buried, and all were filled with liquid they would have contained 2.75 million gallons. Thus, hypothetically, the landfill would have received a total of 3.435 to 5.25 million gallons of liquid waste.

It is important to note that the extreme conditions in the landfill make it highly unlikely that all of the drums are now intact. It is more probable that substantial amounts of any liquid materials disposed of have escaped their drummed containers and dispered within the landfill. Thus, excavation of the drums and the adjacent soil and waste material will not necessarily remove the bulk of liquid which they may have contained at the time of disposal.

In its proposal, Energy Incorporated assumed that 50,000 drums were deposited in the landfill. The firm believes that it would be able to remove and destroy about 1.37 million gallons of the drummed waste. Considering the bulk liquid waste which may not be affected by the excavation program, it is possible that a considerable portion of the hazardous waste dumped in the landfill would not be removed. (Assuming that most of the bulk and drummed waste is still in the landfill, removing 1.37 million gallons of waste would be equivalent to only 26% of the 5.25 million gallons.) If the landfill received more than the 2.5 million gallons of bulk liquid (which we believe did occur) or less than the 50,000 drums, the Eneregy Incorporated proposal could result in the removal of substantially less hazardous waste.

In developing its proposal, Energy Incorporated made certain debatable assumptions regarding the location and recoverability of the drums buried at the landfill. The assumption that 50 to 83 percent of the drums fall within the high density anomalies identified in the metal detection study that we performed in 1981, and that only 10 to 20 percent of the unruptured drums will rupture during recovery operations, would not be verifiable until after the excavation had been completed. The validity of these assumptions would, thus, significally influence the accuracy of the estimated hazardous waste recovery, as well.

In addition, the costs associated with any required dewatering of the landfill to allow the performance of the excavation activities and the associated incremental costs of treating this highly contaminated water were not considered is this proposal.

As was indicated in the draft Feasibility Study, excavation of the drums at the site could potentially allow the release of high levels of hazardous substances to the atmosphere, and cause chemical fires, and/or explosions. Other risks include contaminated surface runoff during the excavation activities as well as the potential release of volatilized heavy metal and particulate matter to the atmosphere during incineration.

One additional point worth nothing is that the Energy Incorporated proposal includes incineration of excavated materials on the site as opposed to some off-site facility. The acquisition of the necessary state and federal permits to incinerate hazardous waste in this community would be no easy task.

Based upon the data and information currently available, EPA believes that the potential long-term benefits of drums removal are dwarfed by the potential short-term threats and impacts, and the associated technical and safety problems. In general, the Energy Incorporated proposal does not offer significant advantages over the containment options evaluated in the draft Feasibility Study. The most significant drawback of this proposal is that it leaves the majority of the contamination in the landfill. Furthermore, the Energy Incorporated proposal increases the overall remedial implementation costs without significantly reducing the long-term source control maintenance pumping requirements.

Response to Report to Howell Township
on Remediation at the Lone Pine Landfill
February, 1984

p.1. Volatile organics were selected for modeling at this site because they are currently detected in the monitoring wells and the river; pesticides have not been detected. Modeling volatile organics is a best-quess approximation of the hydrogeological and contaminant transport at this site.

p.2. The substantial benefits associated with removing the source of contamination by excavation are overshadowed by the technical and safety problems associated with this option. Containment of the site will prevent the release of contaminants to the environment.

p.5 The details regarding the monitoring of the site after the implemenation of a remedial solution will be finalized during the project's design phase.

p.31 Heptachlor was detected in five of the excavated drums, three of which also contained aldrin. It should be noted that four of these drums were found in one of the eight excavated pits and the other drum was found in an adjacent pit. Extrapolating these findings to 50,000 drums (the presence of only 17,000 drums have been confirmed) is not a statistically accurate representation.

p.32 Aldrin and heptachlar are not water soluble and, therefore, would not be as mobile through the aquifers into the river as the report claims. Reducing the water flow through the landfill by capping, and the pumping and slurry wall would prevent any pesticide release to the environment.

p.41 Based upon the EPA's drum excavation activities at Lone Pine, the vast majority of the drums disposed of at this site are probably no longer intact. If the site is contained, however, the quantity of waste remaining in the landfill is irrelevant. In addition, containing the landfill and drawing down the internal hydraulic head may decrease the exposure of water to the contents of the drums, reducing the waste's mobility.

p.47 Removing the drums and associated contaminated fill material is not only expensive, but poses many safety and technical problems which make it infeasible. While important, cost is not the only factor responsible for the rejection of this alternative. The \$22-\$50 million figure is broken down to \$16-38 million for excavation of drums and associated contaminated fill material and \$6 -12 million for transportation to a secure landfill in Niagara Falls. The cost of the actual drum removal is \$350-500/drum.

The Department of Environmental Protection has completed its review of the Report to Howell Township on Remediation at the Lone Pine Landfill as prepared by Frank Sciemammano of F-E-S Associates.

Page 10 The "magnetic survey indicated up to 50,000 55-gallon drums may be buried in the landfill". This was not substantiated by the excavation program conducted by EPA's Field Investigation Team. Drums were found in less than half of the testpits conducted at areas of significant shallow anomlies.

Page 18 A. There is a misunderstanding of NJDEP guidelines established for recommendation of closure of a drinking water well. The use of the "50 ppb individual" guideline is only to be used in evaluation of potable water well and not for on-site monitoring wells. The wells referred to are not potable wells.

Page 19 Any effluent discharge to Manasquan River will be required to comply with all NJDEP water quality guidelines including pesticides. NJDEP must license any treatment facility and this facility must meet all applicable criteria.

Page 22 Selection of the remedial alternative is based on both cost effectiveness and soundness of environmental applicability. The resultant treatment system is designed or will be designed to treat and handle the suspected range of influent concentrations.

Page 26 High nutrient concentrations cannot be considered indicative of landfill contamination. Nutrient input from the marsh area adjacent to the stream may be responsible for a significant percentage of the apparent nutrient load. Durand and Zimmer, 1982 indicated that in the coastal plain of New Jersey, surface water is almost exclusively derived from groundwater input through swamps and marshes. Also, the nutrient input and exchange in swamps is evident due to the relatively high productivity in the marsh areas.

Page 27 It is true Versar showed a large reach of the Manasquan River downstream of Lone Pine Landfill is devoid of aquatic life. However, the postulation that the depauperate macroinvertebrate community in the Upper Manasquan may be due to loading effects of the stream by Lone Pine is unfounded based on the data.

A. Versar did not evaluate macroinvertebrate communities upstream of impacts of Lone Pine Landfill for subsequent comparison with downstream samples.

B. Error in sampling was very evident. A total of four square feet of sediments were sampled over a large area of the river. Sampling of benthic invertebrates is frought with wide variations due to selection of sampling location, size of sample, variation of population distribution (aggregates), spatial area coverage, etc.

C. Versar's evaluation of chemical and biological data indicate "a small river with good water quality characteristics except for pH being below 7.0 to 8.0 range and the slight presence for iron as a precipitate on the surface substances". This condition is a characteristic of coastal plain streams and rivers.

D. Versar did not evaluate: (1) submerged aquatic vegitation, (2) emergent aquatic vegetation, and (3) benthic macro and microphytes. The presence of these organisms in the environment are indicative of certain environmental conditions.

E. Versar concluded that "the presence of iron and the lack of suitable substrate for benthic macroinvertebrates probably results in limiting the aquatic community more than any other existing factor".

The presence or absence of macroinvertebrate communities in the Upper Manasquan River should not be used as a strong indicator of detrimental effects caused by Lone Pine Landfill. Streams in general tend to exhibit longitudinal biological zonation of both pelagic and benthic species. Changes and, therefore, instability of the stream community are more pronounced at the headwaters of the stream than at the lower parts due to changes in volume of flow and rapid water chemistry changes. Therefore, species, density and diversity would be low due to naturally occurring stressful conditions.

Current is the major limiting factor in determining spatial distribution of pelagic and benthic fauna in streams. Most benthic invertebrates show very specialized adaptation for maintaining spatial orientation in stream environments such as clinging, suckers, permanent attachment, threads, sticky body parts, burrowing, limited swimming ability. These adaptations appear to be designed for maintaining postion and not for upstream migration. Consequently, upstream migration of benthic macroinvertebrates would be minimal in streams with higher current velocity (which is typical of headwaters of streams and rivers). The major pathways for upstream colonization in streams where current is the limiting factor, appear to be migration through very low water conditions or through "sweepstakes dispersal".

As pointed out by Versar, substrate appears to be limiting in the Upper Manasquan. This, secondarily, when coupled with current velocity may be responsible for the absence of benthic macroinvertebrates. No upstream data is available in the Versar Report to substantiate this hypothesis; however, sand and silt appear to be the most dominante sediment type in the upper reaches of the Manasquan.

Sand and silt is the least favorable of conditions for macroinvertebrate colonization and usually exhibit the lowest number of individuals and lowest species diversity found in stream communities. Epipssamon and endipssamon have highly specialized adaptations for populating sand and silt environments. Current velocity, however, would severely limit distribution of these organisms. This would appear to be the case with the headwaters of the Manasquan River adjacent to Lone Pine Landfill.

Page 30 All contaminants have been evaluated by the C.D.M. Feasibility Study and the design of the treatment system indicates this. The F.E.S. report emphatically states that "substances other than volitile organics have been ignored." This is incorrect.

Page 31 The importance of the pesticides aldrin and heptachlor as possible contaminants of the Manasquan River are grossly over estimated in this report.

1. It is assumed that all of the pesticides believed to be in the landfill will eventually enter the river. However, one cannot assume that cyclodiene insecticides have a similar mobility to volatile organics. In fact they do not. Cyclodiene insecticides (aldrin, dieldrin, heptachlor, heptachlor epoxide) have been classified as having Class I mobility, indicating these compounds are considered immobile in soils. This includes the slightly more soluble epoxides of aldrin and heptachlor (dieldrin, heptachlor epoxide) (Helling et. al 1971)

Cyclodienes are relatively insoluable in water (heptachlor 50 ppb, aldrin 27 ppb, dieldrin 190 ppb) which would cause a great decrease in their surface water transport. Any aldrin or heptachlor that managed to enter the Manasquan would quickly partition out into bottom and suspended stream sediments. It is not likely that such pesticides would be transported very far downstream. These compounds are very resistant to degredation with soil halflives of 1-10 years (Menzie 1972). This halflife is greatly reduced in anaerobic systems; however, Lichtenstein (1977) showed a reduction of dieldrin concentration to 6.5% of the original concentration in 28 days under anaerobic conditions.

32 The ". . . contents of 50,000 drums contained in the entire landfill." This statement implies that it is confirmed that 50,000 drums are buried in the landfill. No definitive evidence exists as to the number of drums or their contents.

35 Slurry wall technology is a well-developed technology and has been proven to be successful at a number of hazardous waste sites. Various literature and documentation exist on this subject that are available for research.

36 The conclusions reached concerning pesticide removal are unfounded. Pesticides are easily treated and removed by conventional treatment technology and will be removed by the treatment system designed for site remediation.

38 Dr. Pinder, Consulting Hydrologist and Chairman of the Department of Civil Engineering, Princeton University, has been requested by NJDEP to review and evaluate the model designed by CDM for Lone Pine Landfill.

41 The preparation of this report preceded the current round and proposed round of sampling of both groundwater wells and surface waters. These results will be used to validate the groundwater model results.

46 Any discharge from a treatment plant on the site will be licensed and regulated by NJPDES regulations.

Page 57 Air emissions from any treatment process are regulated by NJDEP-Air Pollution and will be treated to adequate levels.

The New Jersey Department of Environmental Protection June 28, 1983

All of the NJDEP comments have been addressed in the reports or through discussions among the specialists involved.

Several comments pertain to treatment parameters and objectives. Resolution of these concerns will be addressed during the treatability studies and conceptual design.

Response to U.S. Army Corps of Engineers Comments May 23, 1983

All of the U.S. Army Corps of Engineers (COE) comments have been addressed through discussions among the specialists involved. The COE's primary concern was that there is insufficient data available to establish design criteria for the development of plans and specifications for remedial design. CDM acknowledges in the feasibility study that additional investigatory work is necessary for purposes of design, recommending several activities to supplement the existing data and information. Air quality sampling, a leachate treatability study, a groundwater cut-off wall constructability/compatability tests will have to be performed and exploratory soil borings will be required along the planned perimeter of the groungwater cut-off wall.

COMMENTS ON BEHALF OF A GROUP OF COMPANIES THAT SENT WASTES TO LONE PINE June 29, 1983

I. Existing Data Fail to Show a Substantial Threat to Public Health or the Environment from the Site

I.A. Existing Drinking Water Supplies

I.B. Future Drinking Water Reservoir

These two sections basically present statements and references from the report. Since they do not specifically contest technical material in the report, no response is deemed necessary.

I.C. Environmental Impacts

Over ten years of adverse effect on the environment in the vicinity of Lone Pine from the landfill has been documented (see e.g., EID (Vol. 3), pp. 28-38). That natural acidity and stream bottom conditions influence the natural aquatic habitat in the area does not invalidate the statement in the EID that reduction of priority and nonpriority pollutant releases from the landfill into adjoining surface and groundwater will allow "gradual restoration of the wetland areas and biological communities normally found in the headwaters of the Manasquan River" (emphasis added).
Furthermore, it must be appreciated that hazardous substances other than volatile organics are present in the landfill and that evidence exists of ongoing release of these substances into the ground and surface water (i.e., analytical data shows highly contaminated groundwater and sediments in the tributaries that carry surface runoff from the site.)

It is certainly consistent with the objective to protect the environment to develop and carry out a remedial plan to prevent these releases before they occur and do harm to the environment.

II. The Existence of Unknown Wastes at the Site Does Not Alone Provide a Sufficient Rationale for Immediate Implementation of a Major Remedial Action

This comment appears to recommend the No Action alternative with a monitoring program, Alternative 1. This alternative was given full and equal consideration in the report. It was clearly recognized in the report (Vol. 1, p. 189) that under certain conditions the alternative could be found acceptable.

It is not the unknown wastes alone that constitute the impetus for remedial action at the site. There are known wastes deposited at the site that are now being released to the environment. The combination of present contaminant releases and potential for continued releases provide the rationale for implementation of remedial measures.

III. The Remedial Feasibility Report Is Inconsistent with CERCLA and the NCP by Its Failure to Examine the Full Range of Alternatives

A number of comments in this section merit discussion. The statement that the "risk is indistinguishable from the risk presented by any inactive landfill in the United States" does not stand up in the face of evidence that hazardous substances were disposed of at the site and are now emanating from the site into the environment. This fact clearly distinguishes the Lone Pine Landfill site from most inactive landfills.

The early warning concept (a feature of Alternative 1) was not eliminated, as claimed in the comment. On the contrary, Alternative 1 was carried through to the final evaluation step. (A full range of alternatives was developed and subjected to an initial screening process, from which five alternatives were selected for further evaluation.) The final step rated this alternative against the other four remaining alternatives in terms of cost and five non-cost evaluation criteria (further subdivided into 16 sub-criteria). This relative rating system gave a ranking for the alternative which, per se, did not "eliminate" the alternative but presented its advantages and disadvantages.

The remedial response criteria used in the feasibility study were developed by USEPA and NJDEP (Vol. 1, p. 9) and were approved for use as an evaluation tool for comparison of remedial action alternatives.

IV. The Remedial Feasibility Report Is Inaccurate and Incomplete

IV.A. The Modeled VOC Levels

The significance of the 1000 ppb VOC level has been misunderstood. 1000 ppb VOC is a calculation based on a model-derived pollutant mass release and an estimated average stream base flow of 2 cfs. The number should not be compared with discrete sampling events. Results from sampling events can vary as a function of recent rainfall, surface runoff, winds, etc. The importance of the model-derived Burke Road concentrations (Vol. 1, Fig. 4-32) is in the relative differences shown among the alternatives.

IV.B. Cost Calculations

The bases for costs are given on pages 10-11 and 123-129, Vol. 1. Furthermore, O&M costs do include replacement of the slurry wall (p. 11, Vol. 1) and care of the cap over the 50-year project life cycle (Table 5-3, Vol. 1).

IV.C. Off-Site Remedies

Land application is discussed on pages 116-117, 121-122 and 187, Vol. 1. Land north of the river is unacceptable for application of effluent because such application would spread contaminants in an uncontaminated aquifer recharge zone.

V. The Remedial Feasibility Report Does Not Comply with the National Environmental Policy Act

V.A. Inadequate Opportunity for Public Comment

In keeping with EPA's current policy, three weeks were allowed for the public to review and comment on the draft feasibility study.

V.B. Inadequate Consideration of Mitigative Measures
V.C. Inadequate Discussion of Environmental Impacts

Responses to the assertions in sections V.B. and V.C. are found in Sections I, II and III.

RESPONSES TO GENERAL QUESTIONS RELATIVE TO THE MASS TRANSPORT

MODEL RAISED AT THE JANUARY 30, 1984 MEETING

1. The model can simulate decay using an exponential decay function after the advection/dispersion computations.

2. Adsorption can be simulated by retarding particle advection.

3. Decay and adsorption were not simulated at Lone Pine due to the lack of site-specific data.

4. River concentrations were computed from the mass of particles to the river and to active rising water nodes in the vicinity of the river divided by the volumetric discharge of water at all such nodes during that time step.

5. All contaminant modeling was for total volatile organics. The site data were not sufficient to model individual constituents, and the study objectives were to determine if contaminants were reaching the river, in what approximate quantities, and to compare the relative effectiveness of a set of proposed remedial action alternatives.

6. Time of travel simulations indicate that contaminants located within the active flow field beneath the mound reach the Manasquan River in approximately 8-12 years.

ADDITIONAL CONCERNS RAISED BY THE COMMITTEE'S TECHNICAL CONSULTANTS

Numerous concerns and issues were raised at the January 30, 1984, meeting and in the February 10, 1984 letter prepared by Peter W. Walcott. These are discussed below.

1. Number of Buried Drums

The feasibility study report refers to 50,000 as the possible number of drums disposed in the landfill. This was based on an existing report. Regardless, the 50,000 figure has no impact on the model results, as the source strength used in the simulations was determined through the calibration process to reflect the strength that resulted in the best fit to the observed contaminant plume data. The source strength used is in no way related to any assumption as to a number of buried drums or a drum decay rate.

Responses to Papadopoulus & Associates, Inc. Review

a. Water Levels Used for Calibration

CDM reviewed all available groundwater head data in preparation for calibration of the flow model. It was our conclusion that the March 31, 1982 data were representative of average conditions as suggested in the F.C. Hart report. Table 1 presents a comparison of the March 31, 1982 readings versus the arithmetic mean of all groundwater head readings at the appropriate locations. This table supports our conclusions. Furthermore, the data collected on March 31, 1982 provide a complete set of measured values for each well. Measured data on other dates were incomplete for all locations or did not closely approximate mean values.

We agree that observation wells located in the phreatic aquifer close to the Manasquan River will indeed be influenced by stages in the river. The wells in the lower units will not be as significantly influenced. Most of the observation wells close to the river in the phreatic aquifer are located in the Hornerstown formation, which is not a significant aquifer.

b. Calibration of Groundwater Flow Parameters

The responses to questions 2, 3, & 4 on the January 30, 1984 Agenda presented herein clarify the questions regarding recharge.

Regarding the calibration results in the vicinity of monitoring wells EPA 4/4A, it is believed that the computed values are higher than the observed values as a result of a misrepresentation of the actual surface elevations in the adjacent stream due to the limited topographic data available at the time the model was developed. The detailed survey completed by CDM in June 1983 indicates that the surface elevations used in the model were somewhat high in the vicinity of EPA 4/4A.

Note also that well EPA 4A responds very slowly and is believed either partially clogged or screened in a relatively impervious unit. The time lag for the well to respond may produce gradients which are not representative of average field conditions. The observed gradient of this well has reversed several times over the period of observation; thus, it appears that there is not any permanent upward or downward gradient at this location.

Model nodes in the immediate vicinity of EPA 4A indicate both upward and downward gradients. This location appears to be quite variable in its vertical gradient, and no consistent regional pattern exists.

The implications of the variance between the model and the observed value are not, under any circumstances, pervasive. The fact that the head is "fixed" (as an active rising water node) adjacent to EPA 4/4A has little effect on gradients in the landfill or along the Manasquan River or its other tributaries.

c. <u>Mounding Within the Landfill</u>

It is our opinion based on available data that no significant groundwater mound exists within the landfill. This is supported by FIT, NJDEP, and CDM field observations indicating that seeps are intermittent and occur at various elevations and contain apparently different contaminants based on color staining. Specifically, former FIT employees who spent long periods of time onsite have related to us that leachate seeps were prevalent at the higher elevations in the landfill side slopes only after rainfall events. During dry weather conditions leachate seepage was greatly reduced. As a result, we do not believe that a significant mound exists or that the water level within the landfill substantially impacts the area groundwater flow. In addition, no water was encountered in one of the trenches excavated for drum sampling.

A mound inside the landfill to a depth near the surface is not likely. It would require many years of rainfall pooling within the landfill without release to the underlying aquifer. Such releases, however, have been demonstrated to occur by the presence of contaminated groundwater to the north of the landfill and by seeps from the side slopes. Furthermore, a significant mound, which does not seep in dry periods, would require unrealistic hydraulic properties, i.e., extremely low horizontal hydraulic conductivity. Likewise, a significant transient mound which rises 20-40 feet during rainfall would require unrealistic values of specific yield. Neither of these characteristics are borne out by the behavior of landfills in general nor with the majority of reported cover materials (Vincentown sand) and landfilled materials, nor with the materials encountered by FCHA in the test pits.

We believe that the seeps and water encountered in some of the FCHA test pits at the top of the landfill results from local perching of infiltration due to heterogeneities within the landfill itself, e.g., impervious sludge zones, clayey "day" cover material, etc. Note that a relatively low mound beneath the landfill in the Vincentown does in fact occur in the simulation of average conditions and that seeps are simulated around the periphery of the landfill on all but the southerly side. This mound is carried by flow from upstream and surrounding surface controls rather than high rates of direct infiltration for which there is no supporting data. Note that while more than average infiltration may occur at the landfill surface, a major portion is diverted to surface seeps. Thus, the net infiltration to the saturated zone of the Vincentown within the landfill is estimated to be no greater than that to undisturbed portions of the Vincentown sands.

d. Transport Model Calibration

CDM did not relate the release of contaminants to any specific mechanism. We also believe the calibration was quantitative in nature and not merely qualitative.

CDM did review the limited quantity of time history data for contaminants at observation wells and did not see adequate trends to permit their use in transient calibration. Furthermore, the groundwater sampling techniques used for the collection of data prior to 1980 did not conform, for the majority of samples, with current guidelines developed by the EPA for sampling volatile organics. Data values prior to 1980 for volatile organics appear correlated to the volume of water pumped from monitoring wells prior to sample extraction and may not be indicative of actual aquifer conditions with respect to volatile organic concentrations at the time of sampling. Therefore, we do not agree that use of the limited transient data would have provided any additional estimates of the source strength parameters.

c. Simulated vs. Observed Concentrations in the Manasquan River

No attempt was made to simulate the Manasquan River due to a lack of data and the volatile nature of the indicator contaminants being used in aquifer simulations. The concentrations of contaminants quoted for the Manasquan River are areally averaged and merely represent the total mass of contaminants entering the Manasquan River system divided by the accompanying volume of water discharged. The actual observed values in the river are a function of many natural forces, which were not simulated. For example, the contaminant levels will be very sensitive to rainfall, depth of flow, surface area, antecedent conditions, temperature, wind, and other conditions. Contaminants will be discharged in the drainage courses around the landfill, as well as to the river proper, which provides for differing opportunities for volatilization and degradation before reaching the various downstream observation points. Table 2 is a listing of the available surface water data. They show that values fall on both sides of the areally averaged value of 1000 ppb total volatiles. While more values are lower, this is to be expected, as natural forces will tend to cause rapid volatilization of the highest concentrations which should occur furthest upstream from the Manasquan River observation points. The conclusion to be drawn from this analysis is not the accuracy of the Manasquan River simulation, but that we are illustrating the relative effectiveness of each alternative simulation and that there are contaminants being discharged with whatever potential impacts they may have.

We note that the recent round of sampling undertaken by Versar under contract to the Steering Committee indicates lower levels of contaminants at Burke Road than generally observed in any of the data available to CDM at the time of model calibration. If these results were to indicate a decay in the source strength at the landfill, then we would expect to observe a commensurate reduction in the contaminant levels in the observation wells around the landfill and along the streams. We, therefore, requested a complete round of sampling of all wells and surface waters by EPA to determine the current overall contaminant levels in the groundwater. This sampling has been completed.

Table 3 summarizes the results of the latest sampling round. The observed levels were consistent with previous observations in wells that have been clean or at low levels (EPA1, 1A, 2A, 4, 4A, 5, 6A, 7A, 8, 8A, 9A, 10, and 10A). The levels were also consistent for wells EPA 3 and 5, which have showed contamination in the past. Wells 3A, 5A, and 6, all near the presumed plume centerline, showed an approximately one order of magnitude decrease, which may have indicated a decreasing source strength. However, wells EPA 7 and 9, which are also along that presumed centerline, showed levels consistent with previous observations. Therefore, the data do not conclusively show that there has been a decay in the source strength.

RESPONSE TO PREVIOUSLY WRITTEN QUESTIONS DISCUSSED AT JANUARY 30, 1984 MEETING

1. What are the hydraulic properties of the simulated units as determined from field tests and how do these values compare with those used in the model?

Two sets of hydraulic property data are available, those collected by F.C. Hart, Associates (FCHA), and those collected by CDM subsequent to the modeling efforts. Initially, CDM based its model parameter values on the FCHA results, but these were adjusted (increased) during calibration to match the observed piezometric surface data. A comparison of the CDM data and the values used in the final development of the model for horizontal hydraulic conductivity in feet/day (K) are as follows:

Formation	CDM Measured (Geometric Mean)	Used in Calibrated Model
Vincentown	43.8	30
Upper Red Bank	13.1	4
Lower Red Bank	47	60

The FCHA observations were, in general, approximately an order of magnitude lower than the CDM observations, but the FCHA staff involved in data collection and analysis expressed reservations relative to the quality of some of the field data. A tabulation of the CDM measured values is attached as Table 4. These were analyzed using methods developed by Hvorslev (1951).

2. What was the basis of the recharge rates used in the model?

Two references were used in the development of recharge rates:

1. Rhodehamel, E.C., A Hydrologic Analysis of the New Jersey Pine Barrens Region, New Jersey Department of Conservation and Economic Development, Division of Water Policy and Supply, Water Resources Circular No. 22, 1970.

2. Jablonski, L.A., Groundwater Resources of Monmouth County, New Jersey, Special Report No. 23, State of New Jersey, Department of Economic Development, Division of Water Policy and Supply, 1968.

Based on these reports, the recharge rate for the Vincentown formation was estimated to be 18.8 inches/year. No data were available for the Hornerstown formation recharge, and that value was estimated to be 4.8 inches/year based on the characteristics of the formation. These values are applied by the model to all nodes representing the phreatic surface. Over some of the area, however, recharge is rejected as a result of rising water conditions or specified head at the node. The net recharge to the system is therefore reduced. Under the average conditions to which the model was calibrated, a total discharge to all surface nodes of 2.42 cfs was calculated. This represents an average net recharge of 10.2 inches/year over the gross modeled area (2065 acres). This net recharge compares favorably with the basin wide average of 0.55 mgd/square mile (11.55 inches/year) estimated by Jablonski.

3. What is the respective percentage of the modeled area covered by the Vincentown, Hornerstown, and Upper Red Bank sand outcrops?

The Vincentown, Hornerstown, and Upper Red Bank formations covered 97.3%, 2.7%, and 0%, respectively of the modeled area. (Note that these values have been revised from those presented at the January 30th meeting.) The average applied recharge based on the above percentages is 18.49 inches/year or 378,900 cubic feet/day (4.4 cfs). Of this recharge 208,700 cubic feet/day (10.2 inches/year) discharges to the surface through the groundwater system and the remainder (170,200 cubic feet/day) is rejected and becomes a part of direct runoff.

4. What is the flow mass balance under the simulated existing conditions? Specifically, what are the total fluxes: a) from recharge, b) to the Manasquan and Metedeconk Rivers and to each of their tributaries, and c) across the southern boundary (beneath the Metedeconk) of the modeled area?

The simulated groundwater discharge to various sources is as follows (all in cubic feet/day):

Manasquan River above Burke Road	34,800
Western (upstream) tributary	22,700
Drainage ditch north of Manasquan	3,200
Southerly flowing ditch north of the landfill	4,300
Sub total base flow upstream of Burke Road	(65,000)
Discharge to Manasquan (downstream of Burke Road)	50,800
Northeastern tributary (boundary)	1,200

Eastern boundary (southerly Manasquan tributary)	65,900
Total base flow to Manasquan River in model area	(182,900)
Metedeconk River	25,700
Total Discharge for Grid Area	208,600

In all simulations the mass balance was within 0.1 to 0.2%.

5. How does the model calculate flux to specified head and to active "rising-water" nodes?

The calculation of flux to specified head and active rising water nodes in DYNFLOW is implicit in the code's finite element solution technique. Stratigraphic layers within the system are represented in the model by a set of vertical prisms called working elements. Each element is formed by six nodes, three from above and three from below. During simulation, each element is further subdivided into three tetrahedra. Flow within and between tetrahedra is then computed based on Darcy's Law and the principal of Conservation of Mass Flux at specified head and active rising water nodes, therefore, is computed as a function of the piezometric heads in surrounding nodes and the hydraulic properties (permeability and storage coefficients) in all tetrahedra. Piezometric head at rising water nodes in the system are assumed fixed at ground surface if the computed head in the phreatic aquifer rises to ground surface.

6. How was the 2 cfs baseflow in the Manasquan River determined?

As listed in the answer to question #4, 0.75 cfs upstream of Burke Road, 0.58 cfs to the Manasquan downstream of Burke Road, and 0.78 cfs from the southerly tributary sums to 2.12 cfs for the modeled area. The downstream boundary of the model is just downstream of the Versar sampling location MSN-1a.

7. What was the calibration process used in arriving at the equivalent horizontal hydraulic conductivity of slurry walls? To which elements was this equivalent hydraulic conductivity applied?

The word "calibration" as stated in the CDM feasibility study report related to hydraulic conductivity of slurry walls should have been "calculated." The conductivity applied was element-specific, and was selected to provide the same resistance through the element as would a three foot thick slurry wall with a hydraulic conductivity of 10 cm/sec assuming that flow is essentially transverse to the well. It was applied to all elements along the boundary of the landfill. Figure 1 depicts the slurry wall elements.

8. What were the mass balance residuals in the simulation of each of the evaluated remedial alternatives?

The mass balance residuals from the flow model were less than 0.1-0.2% in all cases.

9. What are the contaminant mass balances at the end of each five-year simulation interval during the modeling of existing conditions? Specifically, what were the contaminant masses that had: a) left the landfill, b) entered the Manasquan River and <u>each</u> of its tributaries, and c) been stored within each simulated layer?

Table 5 is a listing of the mass balance values. The values are for the entire flow field. The simulations did not display mass balance values by layer.

10. How does the model calculate contaminant fluxes to specified head and active "rising-water" nodes?

Any simulated particle that breaks the plane of the model boundary within an element connected to such a node is assumed to discharge at the nearest node. Concentrations at each node are computed based on the total mass of particles leaving the node divided by computed water flux at that node.

11. How was the 1,000 ppb contaminant concentration in the Manasquan River computed?

The average mass flux to the river and its tributaries for the last 600 days of the calibration period was 4.44 kg/day. Dividing this by an average flow of 2.12 cfs yields a concentration of 857 ppb which rounded to 1000 ppb. Note that this is the value which would be expected in the river at the easterly model boundary if the contaminants were conservative and undisturbed in the surface waters.

Approximately 90% of the contaminants discharge upstream of Burke Road. The computed concentration at Burke Road would, therefore, be 2180 ppb on the basis of the same assumptions.

12. How was the model used to simulate the loading of contaminants from the landfill into the underlying aquifer?

Contaminant particles of a given, constant mass (the source) were injected into the system in the phreatic aquifer at 22 points within the landfill at a rate based on the calibration of the contaminant transport model. Figure 2 indicates the points at which particles were injected. A uniform injection rate at each point over the simulation time period was used. Contaminant transport is simulated as a transient using the equilibrium flow field, as discussed in Appendix B. A thirty day time step was used.

13. How was the loading of contaminants and their equivalent concentrations determined? What were the values used in the simulation of existing conditions?

The loading of contaminants was determined in the calibration process. Initially, a unit contaminant strength was used at individual locations. The relative concentrations were compared to measured values in the field and the strength and location of the source was adjusted on the basis of this comparison as necessary. What evolved from this process was that a uniform distribution of source over the landfill, constant over the 10 year operation of the landfill, best reproduced the pattern observed in the field. The strength was then proportioned to reproduce the observed field values as closely as possible.

The calibrated rate was 6.23 kg/day total mass flux uniformly distributed over each of the 22 injection points used.

14. What were the loading rates of contaminants and/or equivalent concentrations during the evaluation of remedial Alternatives 4 and 4A? What was the basis for using these rates and concentrations?

The same source strength was used for Alternatives 4 and 4A as was used for existing conditions. The flow field solution changed, since there is no recharge to the landfill elements, but given the uncertainties with respect to the source itself, a conservative assumption of no change in mass loading was made. The conservative approach was adopted in light of existing information which suggests that a large mass of contaminants was disposed of at the site. Based on this CDM had no reason to make any other assumption.

Simulations indicate that even with a cap in place, horizontal flow occurs through the lower depths of the landfill, since the piezometric surface is still within the Vincentown. Thus, the potential for contaminants to continue to be removed from the landfill exists, and CDM feels it is appropriate to maintain the source strengths to insure a conservative design.

Potential mechanisms for maintaining the discharge of contaminants could be either:

- rupture of buried containers, with subsequent release of aqueous solutions which would enter the water table through percolation,
- non-aqueous fluids which are located within the landfill or the flow field and gradually enter solution,
- rupture of buried containers within the flow field, or
- residual pools of non-aqueous fluids from bulk dumping presently existing at the water table which would continue to enter solution slowly in the groundwater flow field.

15. No Question #15 was presented.

16. Are the models used for the study documented and publicly available?

The computer codes used are proprietary to CDM and are not publicly available. Documentation beyond that provided in the feasibility study report is attached as Appendix A for the DYNFLOW code and as Appendix B for the DYNTRACK code.

17. Did the models used for this study receive outside peer review?

The models have been reviewed by Professor John Wilson of the University of New Mexico (formerly of MIT) and Professor Lynn Gelhar of MIT. Professor Gelhar also reviewed the Lone Pine application.

TABLE 1

COMPARISON OF MARCH 31, 1982 MEASURED PIEZOMETRIC SURFACE ELEVATIONS WITH 10 MONTH MEAN PIEZOMETRIC SURFACE ELEVATIONS

WELL NO.	FEET ABOVE MSL	MEAN OF OB-SERVED FEET ABOVE MSL	DIFFERENCE FEET
EPA-1	125.78	125.56	-0.22
EPA-1A	123.51	123.16	-0.35
EPA-2	115.76	115.74	-0.02
EPA-2A	117.40	117.37	-0.03
EPA-3	112.19	112.13	-0.06
EPA-3A	112.61	112.63	+0.02
EPA-4	121.76	121.84	+0.08
EPA-4A	121.41	121.23	-0.18
EPA-5	117.68	117.42	-0.26
EPA-5A	112.66	112.63	+0.03
EPA-6	107.57	107.58	+0.01
EPA-6A	112.76	112.54	-0.22
EPA-7	107.57	107.52	-0.05
EPA-7A	112.66	112.44	-0.22
EPA-8	110.46	110.52	+0.06
EPA-8A	112.67	112.42	-0.25
EPA-9	110.49	110.29	-0.20
EPA-9A	113.17	113.12	-0.05
EPA-10	105.37	105.17	-0.20
EPA-10A	107.43	107.27	-0.16
DEP-1	116.49	116.60	+0.11
DEP-2	115.61	115.55	-0.06
DEP-3	111.43	111.27	-0.16
DEP-4	120.16	120.24	-0.08
DEP-5	126.14	125.76	-0.38
DEP-6	123.44	123.10	-0.34
DEP-7	118.57	118.73	+0.16
RE	130.20	129.67	-0.53
RC	130.41	130.02	-0.39
RW	130.95	131.17	+0.22

TABLE 4

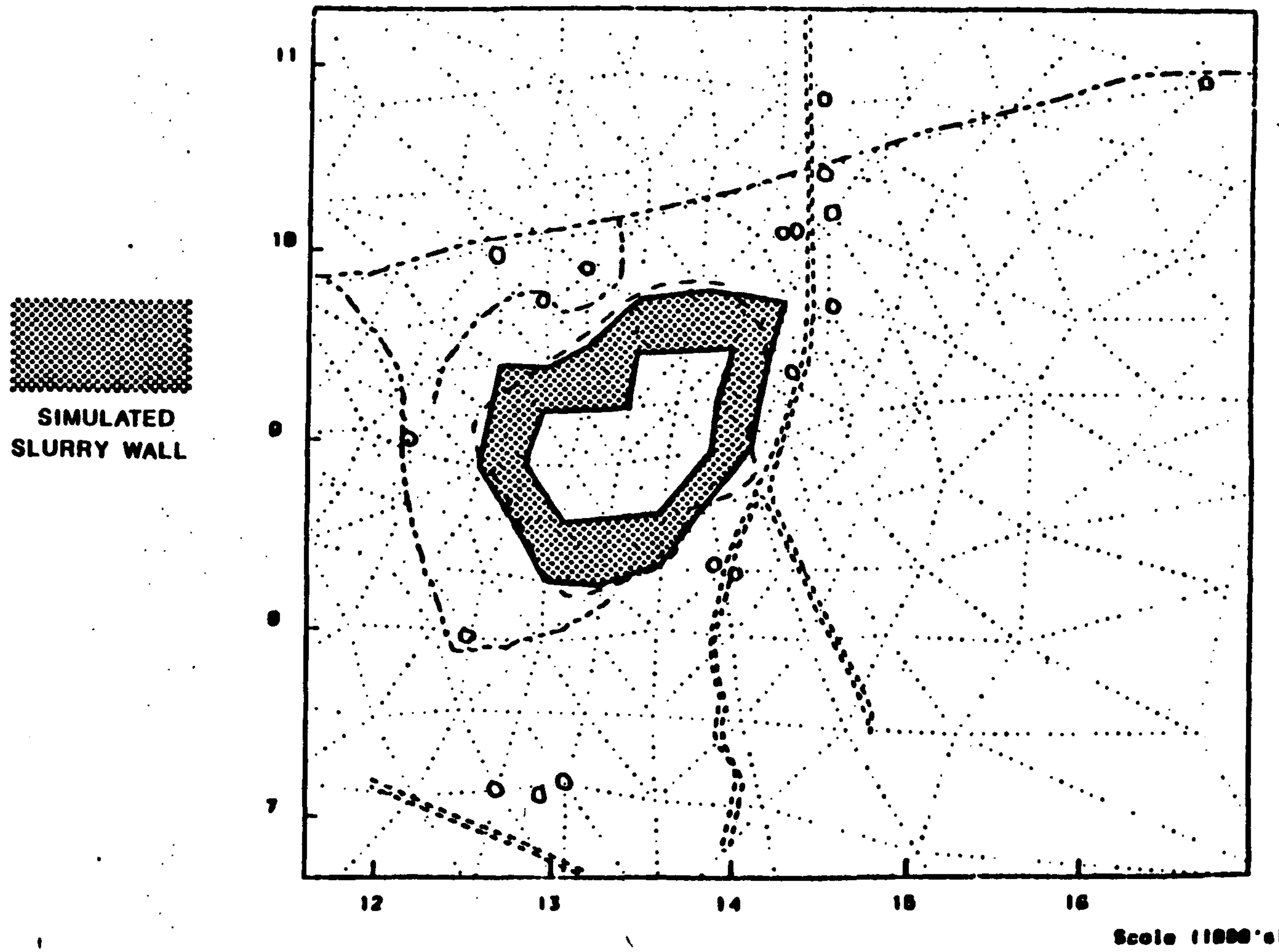
FIELD TEST HYDRAULIC CONDUCTIVITY

(FT/DAY)

WELL/LOCATION	K	K	K	SCREENED FORMATION
EPA-1	15.2	48	4.8	Lower Red Bank
2	21.1	67	6.7	Vincentown
2A	14.3	45	4.5	Lower Red Bank
4	18.7	60	6.0	Vincentown
4A	0.23	0.75	0.075	Lower Red Bank
5	24.2	78	7.8	Vincentown
5A	18.7	60	6.0	Lower Red Bank
6	3.4	11	1.1	Hornerstown/Upper Red Ban
7	13.6	43	4.3	Hornerstown/Upper Red Ban
8**	94.7	-	-	Hornerstown/Upper Red Ban
8A**	168.9	-	-	Lower Red Bank
9	1.5	4.8	0.48	Hornerstown/Upper Red
10	5.5	17	1.7	Vincentown
CDM-1	29.8	94	9.4	Vincentown
2	12.5	40	4.0	Vincentown
3	8.0	25	2.5	Vincentown
4	8.4	27	2.7	Vincentown
4A	12.6	40	4.0	Lower Red Bank

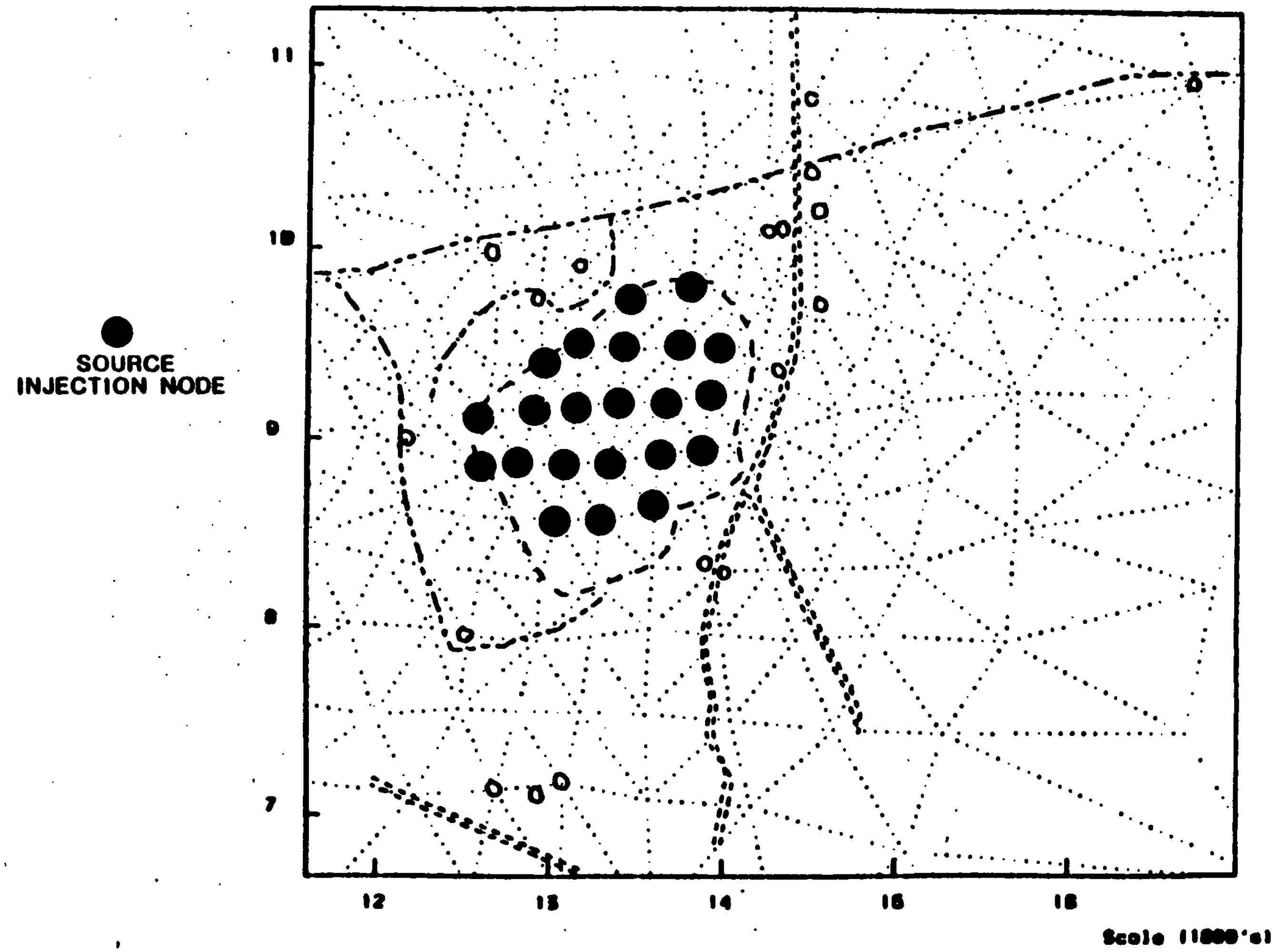
*Based on an anisotropy ratio of 1:10

**From constant head test data; all other tests were falling head



LONE PINE LANDFILL	ELEMENTS USED FOR SLURRY WALL SIMULATION

FIGURE 1



LONE PINE LANDFILL	SOURCE INJECTION LOCATIONS

FIGURE 2

TABLE 2

MANASQUAN RIVER IMMEDIATELY UPSTREAM OF BURKE ROAD

SAMPLER:	UNKNOWN BCM	JAN-26-79 BCM	MAR-04-80 CAL	FEB-05-1982 FCHA	SEP-14-1982 FCHA
ACROLEIN					
ACRYLONITRILE					
BENZENE	750.		<10.	14.	
CARBON TETRACHLORIDE					
CHLOROBENZENE					
1,2-DICHLOROETHANE					
1,1,1-TRICHLOROETHANE					
1,1-DICHLOROETHANE			<10.		
1,1,2-TRICHLOROETHANE					
1,1,2,2-TETRACHLOROETHANE					
CHLOROETHANE					
2-CHLOROETHYL VINYL ETHER					
CHLOROFORM	1.	.200	<10.		
1,1-DICHLOROETHYLENE					
TRANS-1,2-DICHLOROETHYLENE			<10.		
1,2-DICHLOROPROPANE					
TRANS-1,3-DICHLOROPROPYLENE					
CIS-1,3-DICHLOROPROPYLENE					
ETHYLBENZENE			<10.		
METHYLENE CHLORIDE	.100		<10.		
CHLOROMETHANE			<10.		
BROMOMETHANE					
BROMOFORM					
DICHLOROBROMOMETHANE					
TRICHLOROFLUOROMETHANE					
DICHLORODIFLUOROMETHANE					
CHLORODIBROMOMETHANE					
TETRACHLOROETHYLENE	2.	.400			
TOLUENE	400.		<10.	18.	
TRICHLOROETHYLENE			<10.		
VINYL CHLORIDE			19.		

BLE 2 (Cont.)

MANASQUAN RIVER IMMEDIATELY DOWNSTREAM OF THE CONFLUENCE WITH THE DRAINAGE DITCH DUE NORTH OF THE LANDFILL

SAMPLER:	UNKNOWN BCM	OCT-17-79 NJHD	FEB-05-1982 FCHA	SEP-14-1982 FCHA
ACROLEIN				
ACRYLONITRILE				
BENZENE	960.		25.	2200.
CARBON TETRACHLORIDE				
CHLOROBENZENE				100.
1,2-DICHLOROETHANE				120.
1,1,1-TRICHLOROETHANE				
1,1-DICHLOROETHANE				220.
1,1,2-TRICHLOROETHANE				
1,1,2,2-TETRACHLOROETHANE				
CHLOROETHANE				
2-CHLOROETHYL VINYL ETHER				
CHLOROFORM	.900			
1,1-DICHLOROETHYLENE				23.
TRANS-1,2-DICHLOROETHYLENE				1700.
1,2-DICHLOROPROPANE				
TRANS-1,3-DICHLOROPROPYLENE				
CIS-1,3-DICHLOROPROPYLENE				
ETHYLBENZENE			12.	5000.
METHYLENE CHLORIDE	.100		22.	
CHLOROMETHANE				
BROMOMETHANE				
BROMOFORM				
DICHLOROBROMOMETHANE				
TRICHLOROFLUOROMETHANE			15.	
DICHLORODIFLUOROMETHANE				
CHLORODIBROMOMETHANE				
TETRACHLOROETHYLENE	1.			32.
TOLUENE	580.		26.	4800.
TRICHLOROETHYLENE				28.
VINYL CHLORIDE				440.

TABLE 2 (Cont.)

DRAINAGE DITCH DUE NORTH OF THE LANDFILL

SAMPLER:	UNKNOWN BCM
ACROLEIN	
ACRYLONITRILE	
BENZENE	1450.
CARBON TETRACHLORIDE	
CHLOROBENZENE	
1,2-DICHLOROETHANE	
1,1,1-TRICHLOROETHANE	
1,1-DICHLOROETHANE	
1,1,2-TRICHLOROETHANE	
1,1,2,2-TETRACHLOROETHANE	
CHLOROETHANE	
2-CHLOROETHYL VINYL ETHER	
CHLOROFORM	1.
1,1-DICHLOROETHYLENE	
TRANS-1,2-DICHLOROETHYLENE	
1,2-DICHLOROPROPANE	
TRANS-1,3-DICHLOROPROPYLENE	
CIS-1,3-DICHLOROPROPYLENE	
ETHYLBENZENE	
METHYLENE CHLORIDE	.300
CHLOROMETHANE	
BROMOMETHANE	
BROMOFORM	
DICHLOROBROMOMETHANE	
TRICHLOROFLUOROMETHANE	
DICHLORODIFLUOROMETHANE	
CHLORODIBROMOMETHANE	
TETRACHLOROETHYLENE	.900
TOLUENE	540.
TRICHLOROETHYLENE	
VINYL CHLORIDE	

TABLE 2 (Cont.)

DRAINAGE DITCH ADJACENT TO NORTHWEST CORNER OF THE LANDFILL

SAMPLER:	UNKNOWN BCM
ACROLEIN	
ACRYLONITRILE	
BENZENE	1530.
CARBON TETRACHLORIDE	
CHLOROBENZENE	
1,2-DICHLOROETHANE	
1,1,1-TRICHLOROETHANE	
1,1-DICHLOROETHANE	
1,1,2-TRICHLOROETHANE	
1,1,2,2-TETRACHLOROETHANE	
CHLOROETHANE	
2-CHLOROETHYL VINYL ETHER	
CHLOROFORM	.800
1,1-DICHLOROETHYLENE	
TRANS-1,2-DICHLOROETHYLENE	
1,2-DICHLOROPROPANE	
TRANS-1,3-DICHLOROPROPYLENE	
CIS-1,3-DICHLOROPROPYLENE	
ETHYLBENZENE	
METHYLENE CHLORIDE	
CHLOROMETHANE	
BROMOMETHANE	
BROMOFORM	
DICHLOROBROMOMETHANE	
TRICHLOROFLUOROMETHANE	
DICHLORODIFLUOROMETHANE	
CHLORODIBROMOMETHANE	
TETRACHLOROETHYLENE	.800
TOLUENE	380.
TRICHLOROETHYLENE	
VINYL CHLORIDE	

TABLE 2 (Cont.)

MANASQUAN RIVER IMMEDIATELY UPSTREAM OF DRAINAGE DITCH CONFLUENCE DUE NORTH OF THE LANDFILL

SAMPLER:	OCT-17-1979 BCM
ACROLEIN	
ACRYLONITRILE	
BENZENE	170.
CARBON TETRACHLORIDE	
CHLOROBENZENE	21.
1,2-DICHLOROETHANE	
1,1,1-TRICHLOROETHANE	
1,1-DICHLOROETHANE	
1,1,2-TRICHLOROETHANE	
1,1,2,2-TETRACHLOROETHANE	
CHLOROETHANE	
2-CHLOROETHYL VINYL ETHER	
CHLOROFORM	
1,1-DICHLOROETHYLENE	
TRANS-1,2-DICHLOROETHYLENE	25.
1,2-DICHLOROPROPANE	
TRANS-1,3-DICHLOROPROPYLENE	
CIS-1,3-DICHLOROPROPYLENE	
ETHYLBENZENE	
METHYLENE CHLORIDE	
CHLOROMETHANE	
BROMOMETHANE	
BROMOFORM	
DICHLOROBROMOMETHANE	
TRICHLOROFLUOROMETHANE	
DICHLORODIFLUOROMETHANE	
CHLORODIBROMOMETHANE	
TETRACHLOROETHYLENE	
TOLUENE	370.
TRICHLOROETHYLENE	
VINYL CHLORIDE	

MANASQUAN RIVER AT IRON BRIDGE ROAD

SAMPLER:	JUN-14-1983 VERSAR	AUG-16-1983 VERSAR	NOV-17-1983 VERSAR	MAR-05-1984 NUS
ACROLEIN				
ACRYLONITRILE				
BENZENE	4.		11.	8.
CARBON TETRACHLORIDE				
CHLOROBENZENE				<2.
1,2-DICHLOROETHANE				
1,1,1-TRICHLOROETHANE				
1,1-DICHLOROETHANE				
1,1,2-TRICHLOROETHANE				
1,1,2,2-TETRACHLOROETHANE				
CHLOROETHANE				
2-CHLOROETHYL VINYL ETHER				
CHLOROFORM				
1,1-DICHLOROETHYLENE				
TRANS-1,2-DICHLOROETHYLENE				
1,2-DICHLOROPROPANE				
TRANS-1,3-DICHLOROPROPYLENE				
CIS-1,3-DICHLOROPROPYLENE				
ETHYLBENZENE	7.		7.	5.
METHYLENE CHLORIDE				
CHLOROMETHANE				
BROMOMETHANE				
BROMOFORM				
DICHLOROBROMOMETHANE				
TRICHLOROFLUOROMETHANE				
DICHLORODIFLUOROMETHANE				
CHLORODIBROMOMETHANE				
TETRACHLOROETHYLENE				
TOLUENE	4.		11.	4.
TRICHLOROETHYLENE				
VINYL CHLORIDE				

TABLE 2 (Cont.)

MANASQUAN RIVER AT JACKSON MILLS ROAD

SAMPLER:	FEB-19-1981 EPA11	JUN-14-1983 VERSAR	AUG-16-1983 VERSAR	NOV-17-1983 VERSAR	MAR-05-1984 NUS
ACROLEIN					
ACRYLONITRILE					
BENZENE					<2.
CARBON TETRACHLORIDE					
CHLOROBENZENE					
1,2-DICHLOROETHANE					
1,1,1-TRICHLOROETHANE					
1,1-DICHLOROETHANE					
1,1,2-TRICHLOROETHANE					
1,1,2,2-TETRACHLOROETHANE					
CHLOROETHANE					
2-CHLOROETHYL VINYL ETHER					
CHLOROFORM	<10.				
1,1-DICHLOROETHYLENE					
TRANS-1,2-DICHLOROETHYLENE					
1,2-DICHLOROPROPANE					
TRANS-1,3-DICHLOROPROPYLENE					
CIS-1,3-DICHLOROPROPYLENE					
ETHYLBENZENE					
METHYLENE CHLORIDE	<10.				
CHLOROMETHANE					
BROMOMETHANE					
BROMOFORM					
DICHLOROBROMOMETHANE					
TRICHLOROFLUOROMETHANE					
DICHLORODIFLUOROMETHANE					
CHLORODIBROMOMETHANE					
TETRACHLOROETHYLENE					
TOLUENE					<2.
TRICHLOROETHYLENE					
VINYL CHLORIDE					

MANASQUAN RIVER AT GEORGIA ROAD

SAMPLER:	FEB-19-1981 EPA	JUN-14-1983 VERSAR	AUG-16-1983 VERSAR	NOV-17-1983 VERSAR	MAR-05-1984 NUS
ACROLEIN					
ACRYLONITRILE					
BENZENE					
CARBON TETRACHLORIDE					
CHLOROBENZENE					
1,2-DICHLOROETHANE					
1,1,1-TRICHLOROETHANE					
1,1-DICHLOROETHANE					
1,1,2-TRICHLOROETHANE					
1,1,2,2-TETRACHLOROETHANE					
CHLOROETHANE					
2-CHLOROETHYL VINYL ETHER					
CHLOROFORM					
1,1-DICHLOROETHYLENE					
TRANS-1,2-DICHLOROETHYLENE					
1,2-DICHLOROPROPANE					
TRANS-1,3-DICHLOROPROPYLENE					
CIS-1,3-DICHLOROPROPYLENE					
ETHYLBENZENE					
METHYLENE CHLORIDE	14.				<2.
CHLOROMETHANE					
BROMOMETHANE					
BROMOFORM					
DICHLOROBROMOMETHANE					
TRICHLOROFLUOROMETHANE					
DICHLORODIFLUOROMETHANE					
CHLORODIBROMOMETHANE					
TETRACHLOROETHYLENE					
TOLUENE					
TRICHLOROETHYLENE					
VINYL CHLORIDE					

TABLE [illegible] (Cont.)

. MANASQUAN RIVER UPSTREAM OF CONFLUENCE WITH WESTERN DRAINAGE DITCH

SAMPLER:	JAN-26-79 BCM	OCT-17-79 BCM	MAR-04-1980 CAL	MAR-04-1981 EPA	MAY-31-1981 EPA	FEB-05-1982 FCHA	SEP-14-1982 FCHA	MAR-05-1984 NUS
ACROLEIN								
ACRYLONITRILE								
BENZENE			<10.	<10.	28.		4400.	
CARBON TETRACHLORIDE								
CHLOROBENZENE					2.		140.	
1,2-DICHLOROETHANE								
1,1,1-TRICHLOROETHANE								
1,1-DICHLOROETHANE								
1,1,2-TRICHLOROETHANE								
1,1,2,2-TETRACHLOROETHANE								
CHLOROETHANE								
2-CHLOROETHYL VINYL ETHER								
CHLOROFORM			<10.					
1,1-DICHLOROETHYLENE								
TRANS-1,2-DICHLOROETHYLENE							29.	
1,2-DICHLOROPROPANE								
TRANS-1,3-DICHLOROPROPYLENE								
CIS-1,3-DICHLOROPROPYLENE								
ETHYLBENZENE					9.		280.	
METHYLENE CHLORIDE			<10.				35.	
CHLOROMETHANE			13.				13.	
BROMOMETHANE					2.			
BROMOFORM								
DICHLOROBROMOMETHANE								
TRICHLOROFLUOROMETHANE								
DICHLORODIFLUOROMETHANE								
CHLORODIBROMOMETHANE								
TETRACHLOROETHYLENE	.100							
TOLUENE			<10.	<10.	47.		370.	6.
TRICHLOROETHYLENE								
VINYL CHLORIDE							36.	

TABLE 2 (Cont.)

SAMPLER:	OCT-17-1979 BCM	FEB-19-1981 EPA	MAY-31-1981 EPA	JUN-14-1983 VERSAR	AUG-16-1983 VERSAR	NOV-17-1983 VERSAR	MAR-05-1984 NUS
ACROLEIN							
ACRYLONITRILE							
BENZENE	9.			19.		22.	17
CARBON TETRACHLORIDE							
CHLOROBENZENE							<2.
1,2-DICHLOROETHANE							
1,1,1-TRICHLOROETHANE							
1,1-DICHLOROETHANE							
1,1,2-TRICHLOROETHANE							
1,1,2,2-TETRACHLOROETHANE							
CHLOROETHANE							
2-CHLOROETHYL VINYL ETHER							
CHLOROFORM							
1,1-DICHLOROETHYLENE							
TRANS-1,2-DICHLOROETHYLENE	2.	<10.					
1,2-DICHLOROPROPANE							
TRANS-1,3-DICHLOROPROPYLENE							
CIS-1,3-DICHLOROPROPYLENE							
ETHYLBENZENE				9.		7.	5.
METHYLENE CHLORIDE	1.	16.					
CHLOROMETHANE							
BROMOMETHANE							
BROMOFORM							
DICHLOROBROMOMETHANE							
TRICHLOROFLUOROMETHANE							
DICHLORODIFLUOROMETHANE							
CHLORODIBROMOMETHANE							
TETRACHLOROETHYLENE							
TOLUENE	3.			9.		12.	5.
TRICHLOROETHYLENE							
VINYL CHLORIDE							

TABLE 3
PRIORITY POLLUTANT ANALYTICAL RESULTS/VOLATILE FRACTION

SAMPLE NUMBER	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SAMPLE LOCATION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]													
Acrolein													
Acrylonitrile													
Benzene				[illegible]					[illegible]	< 2	[illegible]	[illegible]	
Carbon tetrachloride													
Chlorobenzene				[illegible]					[illegible]		[illegible]	[illegible]	[illegible]
1,2-Dichloroethane	[illegible]												
1,1,1-Trichloroethane							< 2						
1,1-Dichloroethane	[illegible]			[illegible]					[illegible]		17	[illegible]	
1,1,2-Trichloroethane													
1,1,2,2-Tetrachloroethane													
Chloroethane													
2-Chloroethyl vinyl ether (mixed)													
Chloroform							< 2						
1,1-Dichloroethylene													
1,2-trans-Dichloroethylene				[illegible]								[illegible]	
1,2-Dichloropropane													
1,3-Dichloropropylene (1,3-Dichloropropene)													
Ethylbenzene	[illegible]	< 2		[illegible]	< 2				[illegible]	< 2	[illegible]	[illegible]	
Methylene chloride (Dichloromethane)													
Methyl chloride (Chloromethane)													
Methyl bromide (Bromomethane)													
Bromoform (Tribromomethane)													
Bromodichloromethane													
Trichlorofluoromethane													
Dichlorodifluoromethane													
Chlorodibromomethane													
Tetrachloroethane (Tetrachloroethylene)												< 2	
Toluene	[illegible]			[illegible]	< 2				[illegible]	< 2	[illegible]	[illegible]	
Trichloroethane (Trichloroethylene)													
Vinyl chloride				71									

NOTES: Blank spaces indicate that the chemical was not detected
- a - Concentrations in ug/l
- b - Concentrations in ug/kg
- c - Concentrations in mg/l
- d - Concentrations in mg/kg
- * - Analysis did not pass QA/QC requirements
- (-) - Analysis was not performed

PRIORITY POLLUTANT ANALYTICAL RESULTS/VOLATILE FRACTION

SAMPLE NUMBER	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SAMPLE LOCATION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Blank	Blank	[illegible]	[illegible]	[illegible]
[illegible]													
[illegible]	[illegible]	[illegible]	[illegible]			[illegible]							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							
Benzene	[illegible]						[illegible]				3.7		
Carbon tetrachloride													
Chlorobenzene							< 2				< 2		
1,2-Dichloroethane													
1,1,1-Trichloroethane													
1,1-Dichloroethane													
1,1,2-Trichloroethane													
1,1,2,2-Tetrachloroethane													
...loroethane													
...loroethyl vinyl ether (mixed)													
...roform													
...-Dichloroethylene													
...trans-Dichloroethylene													
...Dichloropropane													
...Dichloropropylene (1,3-Dichloropropene)													
...benzene			< 2				38				4.6		
...ylene chloride (Dichloromethane)										4.1			
...yl chloride (Chloromethane)													
...yl bromide (Bromomethane)													
...oform (Tribromomethane)													
...dichloromethane													
...orofluoromethane													
...orodifluoromethane													
...odibromomethane													
...achloroethane (Tetrachloroethylene)													
...ene			< 2	< 2		< 2	59		< 2		4.3		
...hloroethane (Trichloroethylene)													
...l chloride													

NOTES: Blank spaces indicate that the chemical was not detected
- a - Concentrations in ug/l
- b - Concentrations in ug/kg
- c - Concentrations in mg/l
- d - Concentrations in mg/kg
- e - Analysis did not pass QA/QC requirements
- (-) - Analysis was not performed

PRIORITY POLLUTANT ANALYTICAL RESULTS [illegible]

[illegible]													
[illegible]													
[illegible]													
Benzene													
Carbon [illegible]													
Chlorobenzene							[illegible]						
1,2-Dichloroethane													
1,1,1-Trichloroethane													
1,1-Dichloroethane							[illegible]						
1,1,2-Trichloroethane													
1,1,2,2-Tetrachloroethane													
Chloroethane													
2-Chloroethyl vinyl ether (mixed)													
Chloroform													
1,1-Dichloroethylene													
1,2-trans-Dichloroethylene							170						
1,2-Dichloropropane													
1,3-Dichloropropylene (1,3-Dichloropropene)													
Ethylbenzene			1.0	< 2			2.1						
Methylene chloride (Dichloromethane)						2.3							
Methyl chloride (Chloromethane)													
Methyl bromide (Bromomethane)													
Bromoform (Tribromomethane)													
Bromodichloromethane													
Trichlorofluoromethane													
Dichlorodifluoromethane													
Chlorodibromomethane													
Tetrachloroethane (Tetrachloroethylene)													
Toluene	6.2		3.3		< 2	< 2	4.0						
Trichloroethane (Trichloroethylene)													
Vinyl chloride													

NOTES: Blank spaces indicate that the chemical was not detected
- a - Concentrations in ug/l
- b - Concentrations in ug/kg
- c - Concentrations in mg/l
- d - Concentrations in mg/kg
- * - Analysis did not pass QA/QC requirements
- (-) - Analysis was not performed

TABLE 5

MASS SUMMARY - FOR LONE PINE SIMULATIONS
(all in grams)

RUN	QP GPM	TOTAL MASS IN	MASS PUMPED <EXTERNAL>	MASS RIVER	TOTAL MASS REMOVED <EXTERNAL>	MASS REMAINING	MASS LOST	MASS TRAPPED (REMOVED FROM SIMULATION)	RUN DESCRIPTION
EPINE2 (10)	-	2.286E7	-	1.045E7	1.045E7	1.222E7	0	-	10 YEAR
R1A9 (5)	-	1.143E7	-	8.924E6	8.924E6	1.472E7	0	-	
R2A9	-	1.143E7	-	1.026E7	1.026E7	1.588E7	0	-	NO ACTION
R3A9	-	1.143E7	-	1.091E7	1.091E7	1.640E7	0	-	
R4A9	-	1.143E7	-	1.148E7	1.148E7	1.635E7	0	-	
R1A1 (5)	180	-	1.403E6	1.225E6	2.628E6	1.860E5	0	9.406E6	DEEP
R2A1	180	-	6.560E4	8.533E4	1.509E5	3.506E4	0	-	WALL
R3A1	180	-	9.662E3	1.756E4	2.722E4	7.840E3	0	-	50 GPM
R1A2 (5)	-	-	-	2.152E6	2.152E6	6.724E5	0	9.396E6	DEEP
R2A2	-	-	-	5.407E5	5.407E5	1.318E5	0	-	WALL
R3A2	-	-	-	1.069E5	1.069E5	2.468E4	0	-	NO PUMPS
R1A3 (5)	180	-	1.910E6	1.368E6	3.278E6	3.148E6	0	5.794E6	SHALLOW
R2A3	180	-	7.147E5	5.444E5	1.259E6	1.010E6	0	8.790E5	WALL
R3A3	180	-	2.507E5	1.580E5	4.087E5	3.619E5	0	2.394E5	50 GPM
R4A3	180	-	7.264E4	8.229E4	1.549E5	1.156E5	0	9.140E4	
R1A5 (5)	360	-	3.026E6	4.428E5	3.469E6	2.757E6	9.024E3	5.985E6	SHALLOW
R2A5	360	-	1.041E6	3.721E5	1.413E6	9.353E5	0	4.087E5	WALL
R3A5	360	-	4.241E5	5.774E4	4.818E5	2.907E5	0	1.628E5	100 GPM
R4A5	360	-	1.431E5	2.273E4	1.658E5	8.814E4	2.795E2	3.648E4	
R1A8 (5)	-	-	-	7.644E6	7.644E6	3.503E6	0	1.073E6	SHALLOW
R2A8	-	-	-	2.141E6	2.141E6	1.358E6	0	4.400E4	WALL
R3A8	-	-	-	7.227E5	7.227E5	6.336E5	0	1.700E3	NO PUMPS
R4A8	-	-	-	3.435E5	3.435E5	2.895E5	0	6.000E2	
R1F4 (5)	400	1.143E7	7.167E6	1.421E6	8.588E6	1.374E7	0	1.322E6	LANDFILL
R2F4	400	1.143E7	9.756E6	1.651E6	1.141E7	1.368E7	0	8.000E4	CAP
R3F4	400	1.143E7	9.753E6	1.570E6	1.132E7	1.370E7	0	9.000E4	100 GPM
R1B4 (5)	-	1.143E7	-	7.633E6	7.633E6	1.588E7	0	1.370E5	LANDFILL
R2B4	-	1.143E7	-	9.302E6	9.302E6	1.800E7	0	8.000E3	CAP
R3B4	-	1.143E7	-	1.018E7	1.018E7	1.924E7	0	1.000E4	NO PUMPS
B4B4	-	1.143E7	-	1.123E7	1.123E7	1.943E7	0	1.000E4	

Response to Steering Committee Comments
August 1, 1984

- o EPA does not dispute the fact that the levels of contaminants detected in the Manasquan River are relatively low at the represent time. However, the information available from EPA°s review of SCP records regarding the quantity and the nature of the hazardous substances potentially disposed of in the landfill makes a conservative approach to the protection of public health and the environment appropriate.

  As noted in the comments, many of the drums in the landfill indeed may have ruptured, however, EPA believes that the high levels of volatile organics currently being measured do not necessarily indicate the total array of hazardous substances which may be present in the landfill due to the following reasons:

  Adsorptive and absorptive capacities of the soils and municipal refuse disposed of in the landfill, the densities of the hazardous substances in relation to the other liquids in the landfill, and the perching of liquids in impermeable zones within the landfill may have significantly influenced the transport of the hazardous substances disposed of here. Because of the high contaminant levels detected in the groundwater, the potentially slow transport rate of contaminants in groundwater, and the potential impact on the reservoir and the local flora and fauna, the need for implementing a corrective remedial action is deemed necessary. In that there is a lateral component of contaminant transport that a cap alone will not prevent, this suggested remedial alternative is not deemed acceptable to adequately protect human health and the environment.

- o Upon completion of the ongoing treatability studies, the specific treatment scheme will be designated. The Steering Committee argues that it is impossible to determine the cost-effectiveness of treatment at this time. The most expensive treatment possibility is, however, cost-effective. Therefore, it is clear that if a less expensive option proves to be feasible, then that option will, obviously, be even more cost-effective.

Response to Lone Pine Steering Committee Comments
August 31, 1984

1. Since the landfill°s source strength and composition is largely unknown, the contaminant transport model used to simulate the relative contaminant transport for the remedial alternatives was calibrated to achieve the best fit to observed contaminant plume data. Various remedial schemes were simulated and evaluated by projecting the contaminant loading rates to the Manasquan River. Field sampling results indicate much lower concentrations in the surface water than is predicted by the model. This is largely because volatilization was not considered in this groundwater contaminant transport model.

Because of the limited available data on the quantity and nature of the waste in the landfill, and because the potential for contamination to continue to be released from the landfill exists, it was appropriate to maintain the source strength to ensure a conservative design. It was also assumed that the wastes are evenly distributed over the landfill and capable of sustained, steady-state releases for ease in modeling. It should be noted that the purpose of the contaminant transport modeling was only to help evaluate the relative effectiveness of each alternative, and the remedial alternative analysis and selection was based upon the ground water flow model, which evaluated the effects of various containment and pumping schemes on the flow of groundwater in the underlying aquifers.

Based upon the available data, it appears that no significant groundwater mound (attributable to infiltration) exists within the landfill or that the water level in the landfill substantially impacts the area groundwater flow, but rather the water encountered in the landfill is perched on top of local impermeable layers (such as impervious sludge zones). While infiltration may occur at the landfill surface, a major portion is believed to be diverted to surface seeps. Thus, the net infiltration to the saturated zone of the Vincentown with the landfill is believed to be no greater than that to the undisturbed portion of the Vincentown Sands. A relatively low mound beneath the landfill in the Vincentown does occur, however, it is believed to be due to upgradient flows and surrounding surface controls rather than infiltration.

As was indicated previously, the predicted contaminant concentrations in the Manasquan River are a result of groundwater inputs. Volatilization is not part of the groundwater contaminant transport model. It is not unreasonable to expect significant reductions in volatile organics concentrations once the contaminant°s groundwater transport media becomes surface water. It should be noted that the monitoring wells on the southern river bank are severely contaminated. This is significant because these river bank monitoring wells can be considered at the groundwater/surface water interface which implies that severely contaminated groundwater is recharging the river.

4. As a result of the initial screening, it was determined that the surface seal alone will not achieve the cleanup objectives because the migration of contamination from the landfill will not be eliminated by the reduction in water infiltration caused by installation of clay cap. Installation of a cap that reduces infiltration by 90% will result in the lowering of the water table by approximately 1 foot. However, there will still be vertical and horzontal flow of water into the landfill. Flow out of the landfill will be reduced but not eliminated.

Moreover, there is evidence that the site was excavated down to depths of 10 feet into the Vincentown Sands aquifer during the period in which the landfill was being constructed and operated. Measurements from sampling wells around the site indicate that the groundwater surface is likely to be above this level, allowing the lateral flow component of groundwater at the lower depths of the landfill to flood the bottom of the fill area, permitting the solubilizing and dispersion of residual pools of substances derived from ruptured drums and from bulk liquid dumping. The potential problems are compounded by the uncontrolled manner in which disposal took place, resulting in the possiblity that solvents could moblilize chlorinated organics which might otherwise tightly adsorb onto soil particles.

5. Opportunity for public input and compliance with NEPA are discussed elsewhere in the record.

   Since contaminated groundwater will be extracted in the proposed containment scenario, it will have to be treated. Upon completion of the ongoing treatability study, the most acceptable treatment system will be selected. Currently, two systems are under evaluation -- on-site treatment and treatment at the regional wastewater treatment plant.

<u>Comments on Versar°s Reports</u>

o Considering the fact that no information was given regarding Versar°s sampling quality assurance, and the adequacy of their sampling and preservation procedures, the accuracy of their results is unknown.

o It is questionable whether single grab samples can accurately characterize the extent of the contamination of the Manasquan River. Composite samples over several days or weeks would probably be more representative.

o Essentially, Versar relied on limited data to draw comprehensive conclusions regarding the degree of contamination at the site.

1. <u>Information Pertaining to the Nature of the Material Disposed of at the Lone Pine Landfill</u> (1984 Comments, pages 8 to 12)

A number of comments of the Lone Pine Steering Committee question the nature of the waste deposited in the Lone Pine Landfill. Specifically, the Steering Committee states that "concern over liquid filled drums at Lone Pine is unfounded and contrary to the evidence which is available." In addition the committee states that "EPA has available to it the records of companies whose wastes were deposited at Lone Pine; EPA has never suggested that there is any evidence that chemical wastes more deleterious that those already identified were buried at Lone Pine." Moreover, the Steering Committee has stated that the bulk of the material entering the landfill from Scientific Chemical Processing (SCP) was in the form of bulk solids not drums, infering that this material is not particularly hazardous.

EPA takes exception to the Steering Committee's comments in this area. EPA staff have pursued a number of avenues in attempting to characterize the material in the landfill. First, EPA has conducted a thorough review of the records of SCP available as a result of the criminal proceedings. Moreover, EPA has issued information request letters to approximately 140 companies. A review of this material indicates that a wide range of both organic and inorganic hazardous substances were sent to Lone Pine.

The few excerpts from the testimony cited by the Steering Committee relative to the nature of the material are totally refuted by the bulk of the transcripts. Specificallly, both the testimony of Carmine Trezza, the foreman at SCP-Newark, and Henry Heflich, the hauler who took material from SCP to Lone Pine indicate that large quantities of both liquid and solid waste in both drums and bulk form went to Lone Pine.

The drum disposal operation at SCP involved the dumping of the material in drums into a large dumpster. Where the drum could be emptied totally, it would be sold to a drum reconditioner (TREZZA, pg. 2886). When the drum could not be emptied, it would be segregated and loaded into a dumpster for disposal at the Landfill. The method by which SCP segregated the drums was to hit the drum with a pipe to determine if it was filled with liquids or solids. If the drum was found to have solids AT THE BOTTOM, the drum was considered to be solid (i.e., not suitable for drum recovery) and disposed of even though there might be considerable liquid content in it (TREZZA, pg. 2951). This is stated specifically by Trezza:

> "...chemicals that had come in to us that had enough solid in them that we could not get it out. so we called them solid drums and put them on Henry's truck."
> (TREZZA, pg. 3049)

Moreover, Trezza was asked specifically:

> Q. "Were the materials that were put on the trucks totally solid?"
>
> A. "There were times when they were not totally solid"
> (TREZZA, pg. 2952)

Although Trezza testified that he was warned to be careful what to load, and that it was more economical to dump the liquid drums into the dumpsters, there is ample evidence that often the drums were liquid. Specificaly, Heflich testified that:

> "...it started out with hard material and then it got to be all kinds of drums."
>
> "Well, drums that was in their yard, if there was liquid in them or they didn't pump them out, they would just load it on a truck and take them into a landfill."
>
> Q. "Drums containing liquid material or solid material, or what?"
>
> A. "Both"
> (HEFLICH, pg. 1017)

Heflich also estimated the disposal of drums as 50-100 drums/load, 4-5 loads per week for the entire time of disposal. (HEFLICH, pg. 1019)

George Borden, the general manager of Lone Pine, also testified as to the nature of the drummed waste, noting that the drums were different than first planned:

"The drums were heavier, harder to pusn, and would rupture if you hit them wrong with the blade on the bulldozer. It was liquid that came out." (BORDEN, pg. 1505)

"It had a strong odor, like paint thinner." (BORDEN, pg. 1505)

Additionally, EPA's excavation and drum sampling program carried out in the summer of 1981 verified that a number of drums contained liquid contents.

The Steering Committee implies in their comments that the bulk material taken by Heflich from SCP to Lone Pine was innocuous. This is not borne out by the evidence. The bulk material was generated by dumping the liquid drums of material into a dumpster, allowing any solids to settle, and then siphoning off any aqueous. The material in the dumpster, while likely to be hazardous in and of itself, was also likely to be contaminated by contact with the liquids poured into the dumpster. Furthermore, there is ample testimony that the 'sludge' was not dry nor innocuous, but rather had a high moisture content and was highly contaminated. Specifically, both Heflich and Trezza testified as to the nature of the sludge. The material was transported in sludge boxes that had "a sealed back door on them so that they could hold and haul liquid material." (HEFLICH, pg. 960) Heflich described the material that was put in the dumpsters as:

"sludge that was in the bottom of the drums that was not burnable and was a noxious material...rest of it would be dry or sludge that they could not do nothing more with" (HEFLICH, pg. 973)

Heflich stated: "It was more of a liquid material than a sludge material." (HEFLICH, pg. 1011) He later added:

"It was different at different times. It was liquid and sludge. There was some sludge in it, but it got to be a little bit more liquid." (HEFLICH, pg. 1013)

When asked if the waste changed he responded:

"Not much. Sometimes it would be some sludge in there. There was a lot of liquid in there."

Other testimony indicates that there was not a concerted effort to dewater the sludge, instead quite the contrary:

"we might have thrown some (liquids) in, if we felt the solids could absorb it"
(TRESSA, pg. 3130)

Borden also testified as to the nature of the material.

"It was a thick, gluey substance, like paint"
"...It smelled like paint"
(BORDEN, pg. 1507)

Finally, there is evidence that at some point bulk disposal of liquids occured. Specifically, Heflich testified that liquid waste and tank trailers went to the landfill. (HEFLICH, pg. 1020) "We brought liquid material into the landfill." (HEFLICH, pg. 1021) and

"it was an industrial waste and it was a non-flammable material" (HEFLICH, pg. 1022)

As to volume, Heflich again indicated that roll-offs would be taken from SCP to Lone Pine 4 to 5 times a week over the entire period of disposal.

In summary, it is clear that Lone Pine was used for the disposal of large quantities of drummed waste and also large volumes of bulk waste. These drums contained both liquids and solids. The sludges were likely to be highly contaminated due to contact with the drummed liquids and also had a high moisture content, at times being as much a liquid as a solid. Therefore, there is ample evidence that the Lone Pine Landfill contains a large volume of highly contaminated material and represents a continued source of contamination.

2. <u>EPA's Alleged Failure to Examine Records Gathered Under the Grand Jury Subpoena in Newark, New Jersey</u> (1983 Comments, pages 2 and 9)

EPA representatives have carefully examined these records under the provisions of a disclosure order granted by a U.S. District Court judge.

3. <u>Alleged Failure of EPA to Contact Additional Companies or to Send Out Additional Notice Letters</u> (1983 Comments, page 1)

Between December 1983 and July 1984 EPA has sent letters to to an additional one hundred and thirty-five companies requesting information about the disposal of hazardous substances which may have ended up at Lone Pine. Notice Letters were sent out before the commencement of the Remedial Investigation and Feasibility Study, and additional letters affording private parties an opportunity to perform design and remedial work at the site were mailed to potentially responsible parties on September 12, 1984.

4. <u>Cost Calculations</u> (1983 Comments, page 13)

In a letter, dated December 15, 1983, a copy of the basic design criteria and cost estimates for the surface seal and drainage swales was sent to Randy Mott, counsel to the Lone Pine Steering Committee hereinafter, ("Steering Committee"). In a letter, dated May 1, 1984, EPA solicited the views of the Steering Committee on these cost estimates. No response was provided. In December 1983 CDM backup materials were made available in Boston, Massachusetts and were reviewed by representatives of the Steering Committee.

5. <u>Compliance With the National Environmental Policy Act and Opportunity for Input from Public</u> (1983 Comments, pages 13-15 and 1984 Comments, pages 1 &13)

EPA policy is set forth in the September 1, 1982 Memorandum entitled, "Applicability of Section 102(2)(C) of the National Environmental Policy Act ("NEPA") of 1969 to Response Actions under Section 104 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980." (A copy of that policy is attached.) The agency's procedures in this case are a functional equivalent of the NEPA process and the record establishes that EPA has fully considered environmental impacts of the alternatives and mitigative measures. Adequate opportunity for public comment has been afforded. Comments were formally solicited in June 1983 and from June 27 to August 1, 1984, and two formal public meetings were held during these periods. The Steering Committee erroneously refers to "three weeks of notice" in the 1984 Comments.) EPA has also held five meetings with representatives of the Freehold Township Lone Pine Landfill Technical Review Committee, and EPA officials have met with representatives of the Steering Committee on May 11, 1983, January 19, 1984, January 30, 1984, and June 27, 1984. The charge that the Steering Committee has not had access to EPA information is misleading. Representatives of the Steering Committee have examined EPA files and obtained copies of documents. Sampling results have been delivered to the Steering Committee on an on-going basis, and CDM files in Boston have been made available to and reviewed by the generators. "Simulations" and other information requested by the companies have been provided. EPA flew CDM representatives to New York to answer questions posed by the Steering Committee in a meeting on January 30, 1984. Subsequently, EPA provided The Steering Committee with written answers (including supplementary materials) to the questions. EPA and CDM representatives have also been at the two public meetings. EPA has solicited the views of the Steering Committee at different dates without response.

6. <u>Compliance with the National Contigency Plan</u> (1984 Comments pages 5 and 8)

The Steering Committee suggests that EPA is not complying with the National Contingency Plan ("NCP"). No citations are provided, and in one case reference is made to sending changes which have not been finalized or even proposed in the Federal Register yet. EPA has complied with the NCP, including provisions on source control remedial actions at 40 CFR 300.68. The agency's actions are consistent with the Congressional goal of protecting public health and the environment.

STATE OF NEW JERSEY
DEPARTMENT OF COMMUNITY AFFAIRS
DIVISION OF LOCAL GOVERNMENT SERVICES

JOHN P. RENNA
COMMISSIONER

363 WEST STATE STREET
CN 803
TRENTON, N.J. 08625

August 20, 1984

Joel Singerman, Project Manager
Hazardous Waste Site Branch
Environmental Protection Agency
26 Federal Plaza, Room 402
New York, NY 10278

RE: State Review Process SAI: NJ 8 4-9022

Applicant: Joel Singerman, Project Manager, Hazardous Wste Site Branch, E.P.A., 26 Federal Plaza, Room 402, New York, NY 19278 212-264-9589

Program: Detailed Design of Recommended Remedial Solution for Lone Pine Landfill (Freehold Township)

Project: Direct Development Activity

Pursuant to the system developed in New Jersey for the intergovernmental review of applications for Federal financial assistance and direct development acitivities, the above referenced project has been submitted to the State Review Process and:

____ No comments have been received from reviewing agencies.

_X_ Comments from the agencies identified on Page 2 have been received and are transmitted herewith.

Should you have any questions, please do not hesitate to contact us at 609/292-9025.

Sincerely,

Joseph A. Valente

Nelson S. Silver, P.P.
Administrator
Urban Assistance Unit

for the Single Point of Contact
State Review Process