

Hazardous Waste Ground-Water Task Force

Evaluation of E. I. DuPont DeNemour and Company Deepwater, New Jersey



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY



NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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Update of the Hazardous Waste Ground-Water Task Force evaluation of E.I. DuPont DeNemour and Company Inc., Deepwater, New Jersey.

The United States Environmental Protection Agency's Hazardous Waste Ground-Water Task Force and the New Jersey Department of Environmental Protection conducted an evaluation of the compliance of E.I. DuPont Nemours and Company Inc. with the interim status and ground-water monitoring requirements of the Resource Conservation and Recovery Act (RCRA) as adopted by New Jersey. The Task Force effort came about in light of concerns over the extent to which operators of hazardous waste land disposal facilities are complying with applicable ground-water monitoring regulations. The on-site inspection was conducted over a two-week period from March 31, 1986 to April 11, 1986. DuPont is one of 58 facilities that are to be evaluated by the Task Force.

The purpose of the Task Force evaluation is to determine the adequacy of ground-water monitoring programs at land disposal facilities in regard to applicable State and Federal ground-water monitoring requirements. The evaluation focused on (1) determining if the facility was in compliance with applicable regulatory requirements and policy (2) determining if hazardous constituents were present in the ground water (3) providing information to assist EPA in determining if the facility meets the EPA requirements for facilities receiving waste from response actions conducted under the Federal CERCLA Program.

The site evaluation conducted in March - April 1986 has revealed violations of RCRA and New Jersey Hazardous Waste regulations. In summary, these include, inadequate programs to meet compliance with RCRA and New Jersey groundwater monitoring regulations. Inadequacies in Duponts interim status ground-water sampling and monitoring procedures, deficiencies in both on-site and off-site analytical laboratories, and violations of current waste management practices and records maintained at Dupont.

Based on the Task Force Report and findings the following actions will be required by Dupont:

1. All zones of the uppermost aquifer (Glacial aquifer zones and Potomac-Raritan-Magothy aquifer zones) will be monitored by background and downgradient wells placed accurately for all hydrologic conditions;
2. Better define the rate and extent of migration of hazardous waste and hazardous waste constituents in the Glacial aquifer and Potomac-Raritan-Mogathy aquifer system;
3. Obtain porosity, permeability, hydraulic conductivity, transmissivity, storage coefficient, specific capacity, and transient ground-water flow gradients in the Glacial aquifer and the Potomac-Raritan-Magothy aquifer system, both vertically and horizontally;

4. Develop ground-water flow nets and hydrogeologic cross-sections to illustrate the relationships between the aquifers and the effects of the unlined RCRA units and surface water at the site;
5. Better define the centers of pumping and the areas of influence of the cones of depression;
6. Develop an assessment monitoring program for Chemical Waste "C" Landfill and revise the existing assessment program for the Waste Water Basins/Ditch system. An assessment monitoring program plan has been submitted to the State for area I of the Chemical Waste "C" Landfill. This plan is currently under review;
7. Revise current ground-water sampling and monitoring plan to address the deficient procedures, methods and quality Analysis/quality control programs as outline in the Task Force Report; and
8. Address deficiencies found in current waste management practices and records maintained at the facility.

A current Draft Administrative Order prepared by the State of New Jersey incorporates the deficiencies found in the Ground-Water Sampling and Analysis plan, (item 7), and violations pertaining to Waste Management Practices and Recordkeeping (item 8). After the Task Force inspection, DuPont began drilling new monitoring wells along the western periphery of the site. Seven 4-inch monitor wells were drilled along with twenty-eight 2-inch observation wells. Aquifer tests were performed to better define the hydrogeologic regime in that region of the site. This work was performed in order to address the deficiencies outlined by NJDEP in a technical notice of deficiency (NOD) for the ground-water portion of the Part B application. This NOD was issued on December 31, 1985. NJDEP is expecting a report on these aquifer tests. In addition, Dupont has submitted data in December of 1986 which may address deficiencies outlined above (1-6). This data was submitted in response to a USEPA Region II request for additional information for an exemption from the Minimum Technological Requirements (retrofitting surface impoundments), under Section 3005(j)(13). This data is presently under an administrative and technical review. This draft Administrative Order will be issued final by the State requiring E.I. DuPont to address items 7 and 8 and outstanding deficiencies not addressed in these recent submittals (items 1 through 6).

DuPont submitted closure/post-closure plans for the "A" and "C" Basins on August 15, 1986. The closure/post-closure plans for the Process Water Ditch System were submitted on November 3, 1986. The proposed closure plan for the "A" Basin is to stabilize the sediment, consolidate the stabilized sediments into a smaller area, and use the remaining area as a settling basin for the Waste Water Treatment Plant's effluent. The "C" Basin closure plan involves the removal and recovery of the lead-laden basin sediments. Residual contamination will be removed to a lead level agreed upon by NJDEP. The closure of the Process Water Ditch System

involves the installation of an overhead transfer system, collection and disposal of the approximately 2000 cubic yards of dinitrobenzene and 25 cubic yards of nitronaphthalene contaminated sediments from the ditch system, and sampling and analysis to determine further removal, decontamination, and/or disposal of materials in the ditches, and the design and implementation of a ground-water monitoring program. On February 20, 1987, NJDEP responded to DuPont's closure/post-closure plans. The plans for "A" Basin need administrative and technical revisions while the "C" Basin plans were approved with additional sampling recommended by NJDEP. The Process Water Ditch System plan was approved for its phase 1 program. The phase 1 results will determine the next steps of the plan.

ACKNOWLEDGEMENTS

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
HAZARDOUS WASTE GROUND-WATER TASK FORCE

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GROUND-WATER MONITORING EVALUATION

E.I. Dupont De Nemours & Co.
Deepwater, New Jersey

March 1987

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I. Executive Summary

A. Introduction

The Resource Conservation and Recovery Act (RCRA), an amendment to the Solid Waste Disposal Act, was passed in 1976 to address the safe disposal of the huge volumes of municipal and industrial solid waste generated nationwide. It has been amended twice since 1976, once in 1980 and most recently on November 8, 1984. This act is currently divided into nine subtitles. Subtitles C, D, and I lay out the framework for the three programs that make up RCRA: the hazardous waste management program, the solid waste program and the underground storage tank program, respectively.

Subtitle C of the Act establishes a program to manage hazardous waste from cradle to grave. Subtitle C regulations set requirements for the generation (40 CFR Parts 260 through 262), transportation (40 CFR Part 263) and treatment, storage or disposal, of hazardous wastes (40 CFR Parts 264 and 265). EPA divided the regulations for treatment, storage, and disposal facilities (TSDF) into two sets, one for interim status TSDF's and the other for permitted TSDF's. The interim status standards are found in 40 CFR Part 265, while the permit standards are found in 40 CFR Part 264.

Section 3006 of Subtitle C of RCRA allows the EPA to authorize State hazardous waste programs to operate in the State in lieu of the Federal Hazardous Waste Program.

The State of New Jersey received final authorization on February 21, 1985. This covers 40 CFP Parts 260 through 265 for the base RCRA program, but does not include new program elements under the Hazardous and Solid Waste Amendments of 1984 (HSWA).

Recent U.S. Environmental Protection Agency (EPA) studies reveal that some hazardous waste facilities may not be complying adequately with certain Federal and State requirements of this subtitle, specifically, subpart F, ground-water monitoring requirements to monitor their sites for evidence of ground-water contamination. Those standards consist of:

- ° Developement and installation of a monitoring system;
- ° Background monitoring;
- ° Routine monitoring and evaluation;
- ° Conducting assessments; and
- ° Reporting.

As a result of these findings, the Administrator of the Environmental Protection Agency (EPA) established a Hazardous Waste Ground-Water Task Force (Task Force). This Task Force is comprised of personnel from the EPA office of Solid Waste and Emergency Response (OSWER), Regional offices and state regulatory agencies. The task force will be conducting in depth on-site investigations at land disposal facilities with the following objectives:

1. Determine compliance with interim status ground-water monitoring requirements of 40 CFR Part 265 as promulgated under RCRA or the State equivalent (where the State has received RCRA authorization)
2. Evaluate the ground water monitoring program described in the facility's RCRA Part B permit application for compliance with 40 CFR Part 270.14(c)
3. Determine if the ground water at the facility contains hazardous waste constituents
4. Provide information to assist the Agency in determining if the TSDF meets the EPA ground-water monitoring requirements for waste management facilities receiving waste from response actions conducted under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Public Law 91-510)**
5. Identify significant ground-water management, technical and compliance problems, and take enforcement or other administrative actions to correct the problems

To address these objectives, each Task Force investigation will determine if:

- ° The facility has developed and is following an adequate ground-water sampling and analysis plan;
- ° Designated RCRA and/or State-required monitoring wells are properly located and constructed;
- ° Required analyses have been conducted on samples from the designated RCRA monitoring wells; and
- ° The ground-water quality assessment program outline or plan as appropriate is adequate.

This report presents findings and conclusions of a Task Force evaluation of the E.I. DuPont De Nemours & Co. Inc operation in Deepwater New Jersey conducted from March 31, thru April 10, 1986.

Task Force Participants

The USEPA-II Project Team included Sharon Jaffess, Hydrogeologist/New Jersey Hazardous Waste Facilities Section, Roger Ennis and Thomas Solecki, Environmental Engineers/New Jersey Hazardous Waste Compliance Section and from the Environmental Services Division, Nick Magriples, Environmental Engineer, Joseph Consentino, Environmental Scientist, and Fred Haber, Quality Assurance Specialist. Representing the State of New Jersey for the Task Force investigation were Sandra Hurd, Hydrogeologist/Bureau of Ground-Water Quality Management, David Zervas, Environmental Engineer, Bureau of Case Management, and Erwin Rutkowski, Environmental Engineer, Southern Region Enforcement. Task Force assistance and coordination were provided by Brian Lewis, Engineering Geologist, State of California, on assignment to USEPA. Julianne Howe, Richard Roat, David Billo, and Jim Thomas were the contract sampling team from GCA.

** EPA policy, stated in a May 6, 1985 memorandum from Jack McGraw on "Procedures for Planning and Implementing Off-Site Response", requires that TSDF's receiving CERCLA waste be in compliance with applicable RCRA groundwater monitoring requirements.

B. SUMMARY OF FINDINGS AND CONCLUSIONS

The findings and conclusions presented in this summary and report reflect conditions existing at the E.I. DuPont de Nemours & Company's Chambers Works facility in April 1986. Subsequent actions taken by the facility, the State, and Region II since this investigation are summarized in the accompanying update memorandum attached to this report.

In summary, the Task Force has determined that:

1. The interim status ground-water monitoring program is not in compliance with some of the ground-water monitoring requirements of the New Jersey Administrative Code (equivalent to 40 CFR, Part 265).
2. Various technical components of the ground-water monitoring program described in the facility's RCRA, Part B application have been found deficient with the requirements of 40 CFR, Part 270.14(c), and require modification.
3. The Task Force sampling confirmed that ground water at the facility contains elevated levels of hazardous waste constituents above background levels. Such levels were found in the Potomac-Raritan-Magothy aquifer system, which is a source of drinking water. Further investigation is needed to adequately determine the scope and extent of contamination.
4. Prior to the time of the inspection, the facility was considered to have no significant Class I violations, and as a result, was eligible to receive waste from clean-up actions under CERCLA. However, under the Superfund Reauthorization Amendments and the Task Force findings, the facility is not eligible to receive waste from clean-up actions under CERCLA owing to known releases of hazardous waste constituents into the environment and non-compliance with applicable ground-water monitoring regulations. DuPont certified LOIS compliance with the interim status ground-water monitoring requirements for two regulated units, the Chemical Waste "C" Landfill (detection monitoring program) and the Waste Water Basins/Ditch System (assessment monitoring program) in October, 1985.
5. At the time of the inspection, the facility was not considered in significant non-compliance. However, after the Task Force inspection, a number of violations of the interim status standards were initially identified, including deficiencies in current waste management practices and deficiencies in the Ground-Water Sampling and Analysis Plan.

Ground-Water Monitoring During Interim Status

The Task Force has determined that various technical components of the programs require modification and therefore, the programs do not meet compliance with RCRA interim status regulations. The basis for this determination is outlined below.

Borings at the Chambers Works facility indicate a complex sequence of alluvial and tidal marsh deposits, fluvioglacial deposits, and marine cyclic deposits. The lithologic information contained in the borehole logs was very general and the mineralogy, petrography, and geochemistry of the geologic units are therefore not defined. Consequently, the effects of contaminated ground water on the confining properties of the clay and silt units are uncertain. In addition, permeability and porosity can only be estimated resulting in general assumptions about the hydrologic properties of the geologic units. Despite this, a general depiction of the subsurface has been ascertained with aid from the published literature.

Well construction details on well logs do not fully correspond with the construction details submitted in the original Part B application. Unknown and possibly inadequate standards for well design and construction may be resulting in: insufficient ground-water flow to the well for sampling, the passage of formation materials (turbidity) into the well, and the degradation of long-term structural integrity required for RCRA monitoring wells. Drilling and well installation must utilize both a licensed driller and geologist and complete, detailed "as-built" well diagrams and borehole logs. Current borehole drilling and well installations are meeting State of New Jersey well drilling and construction requirements (N.J.A.C. 7:14A-6.13).

The geologic environment gives rise to a complex multi-aquifer system. The natural ground-water flow regime has been altered as a result of the regional pumping of the Potomac-Raritan-Magothy system aquifer and the site-wide pumping of the Glacial aquifer. Changes in pumping centers alter flow paths and gradients. This complex hydrologic system warrants a more comprehensive ground-water monitoring program than exists at the facility. The system of RCRA and NJPDES wells at the Chambers Works does not provide adequate data on every aquifer zone and the interrelationships between these zones. Consequently, accurate placement of background (upgradient) and downgradient wells for all hydrologic conditions was not achieved. To achieve such accuracy, the following characteristics must be defined for the geologic units comprising the shallow, middle, and deep Glacial aquifers, and the Potomac-Raritan-Magothy aquifer system: porosity, permeability, hydraulic conductivity, transmissivity, storage coefficient, specific capacity, and transient ground-water flow gradients. A lack of potentiometric data in aquifer zones both vertically and horizontally at the site underscores the need for additional piezometers and/or wells. Using the additional hydrologic data, ground-water flow nets and hydrogeologic cross-sections should be constructed to illustrate the relationships between the aquifers and the effects of the unlined RCRA units and surface water at the site. In addition, centers of pumping must be defined and the areas of influence of the cones of depression must be further identified. Only at this point can accurate detection and assessment monitoring points be verified and/or established. All zones of the uppermost aquifer under all hydraulic conditions must be monitored. Additional background wells must be installed in these zones (middle and deep Glacial aquifers and shallow Potomac-Raritan-Magothy aquifer zone) along with corresponding downgradient wells in positions adequate for detection and/or assessment programs (see further discussion

below). The Task Force recommends the incorporation of NJPDES wells with adequate construction and records to be incorporated into the RCRA system if found to be in proper locations. For those localities where no NJPDES wells can be used, new wells must be installed. Only at this stage can the rate, extent, and concentration of contaminant plumes be identified in the assessment program and the immediate detection of a release be monitored in the detection program.

The Chemical Waste "C" Landfill was in detection mode at the time of the Task Force inspection. Four wells screened in the shallow Glacial aquifer comprised the RCRA system. The Task Force found that the number of wells designated as the RCRA system was inadequate. All zones of the uppermost aquifer must be monitored by background and downgradient wells placed accurately for all hydrologic conditions. In addition, the Task Force sampling showed significant amounts of landfill-type waste found in RCRA downgradient well M-204. Therefore, the landfill should have been in assessment monitoring.

The Waste Water Basins/Ditch System unit was in assessment mode at the time of the Task Force inspection. The designated RCRA wells include fourteen wells, the majority in close proximity to the Waste Water Basins. Nine of the fourteen wells are screened in the shallow Glacial aquifer, including the two background wells. This program is inadequate for RCRA. As in the case of the landfill, ground-water monitoring for the Waste Water Basins and their regulated extensions, the ditches, must include background and downgradient wells screened in all portions of the uppermost aquifer and placed in locations valid for all hydrologic conditions. In addition, the fourteen designated RCRA wells are not adequate for monitoring the ditch system which is over 319,000 square feet. The current assessment program has not defined the rate and extent of migration of the hazardous waste or hazardous waste constituents or their concentrations in the ground water as required under §265.93(d)(4).

Ground-Water Sampling and Monitoring Procedures

Inadequacies were found in E.I. Dupont's sampling and analysis plan, dated June 1, 1982. These deficiencies include a lack of detail procedures for obtaining physical measurements prior to sampling, ensuring proper well evacuation, detecting immiscible contaminants, measuring field parameters, decontaminating equipment, and following a chain-of-custody. Also inadequate information is provided regarding analytical procedures, the facility's and facility contractor's quality assurance/quality control program(s) and procedures used to determine statistical increases over background measurements. Incorrect sample containers preservation methods, and holding times are provided for several parameters.

An oversight of Dupont's ground-water monitoring contractor, W.C. Services, was conducted on April 7, 1986. Numerous deficiencies were noted with regard to sampling procedures and equipment used. Also, in most instances, the procedures used in the field were not described, or in some cases, even mentioned in the sampling and analysis plan. As the sampling and analysis plan and procedures instituted were deficient, data generated from past monitoring should be considered questionable.

Well Sampling Data Analysis

Data generated from the monitoring wells sampled by the Task Force around the landfill seem to indicate that ground-water contamination is occurring in the vicinity of area 1 of the landfill, in particular, the west side. The highest levels of aluminum (3008 ug/l), barium (2200 ug/l), beryllium (50 ug/l), chromium (225 ug./l), cobalt (515 ug/l), copper (260 ug/l), cadmium (2.1 ug./l), nickel (416 ug/l), silver (42 ug/l), vanadium (527 ug/l), and cyanide (43 ug./l) were found in this area. Hazardous organic constituents (11), ranging from 2.6 ug./l of 2-nitrophenol to 140 ug./l of n-nitrosodimethylamine were also found in the downgradient well sampled near area 1. Migration of these contaminants appears to be towards the Delaware River, as Dupont's shallow Glacial zone potentiometric map (figures 21 & 22) reveal ground-water movement in that direction at the west side of the landfill.

Other monitoring wells sampled near the Delaware River indicate elevated levels of aluminum (19600 ug/l), chromium (82 ug/l), cobalt (66 ug/l), lead (37 ug/l), mercury (1.75 ug/l), and zinc (364 ug/l). Several hazardous organic constituents were detected, ranging from 2.5 ug/l for toluene to 2000 ug/l for 1, 2-dichloroethane. Physical observations and field measurements in two wells in this area seem to indicate the presence of a floating hydrocarbon layer.

Ground-water samples obtained from monitoring wells screened in the shallow Potomac-Raritan-Magothy aquifer zone indicate the presence of several hazardous organic constituents ranging from benzene (1.6 ug/l) to acetone (140 ug/l). Elevated levels of lead (61.8 ug/l), and barium (193 ug/l), were also discovered in these samples. The majority of these constituents present in the shallow Potomac-Raritan-Magothy aquifer zone parallel those present in the Glacial aquifer (see above). In addition, vertical flow gradients indicate the possibility of flow from the Glacial aquifer to the Potomac-Raritan-Magothy aquifer zone.

The highest concentrations of contaminants were found in ground-water samples from the shallow Glacial aquifer of the interior portion of the plant. The middle and deep Glacial aquifers showed similar levels of contamination, relative to each other. Monitoring wells along the property boundary indicate the presence of hazardous constituents similar to those found in other wells sampled by the Task Force. However, due to the various interceptor pumps being used at any one time, it is difficult to say whether the contaminants are being drawn outward from the center of the plant or inward from contamination which had migrated off-site. Further investigation of possible off-site migration of contamination at the southeast property boundary is necessary.

This widespread ground-water contamination on-site is occurring from the Waste Water Basins/Ditch System, landfill, and past practices. Factors that predominate are the similarities and widespread distribution of the organic contaminants in the monitoring wells, including those screened in the shallow Potomac-Raritan-Magothy aquifer zone. The majority of these contaminants parallel those present in the leachate from the landfill which is a "fingerprint" of the previous and present types of chemicals used at the facility and the types of wastes generated on-site and entering the ditch system.

NJDEP, EPA, and DuPont agreed upon an Appendix VIII sampling program in May, 1985 to more effectively characterize the ground-water contamination on-site. The Appendix VIII sampling results were transmitted to EPA in January, 1986. These showed 43 constituents in excess of 10 parts per billion (ppb). For example, well M-32 had Freon-TF at 52 ppb and the composite sample from wells M-1, M-2, and M-3 showed 40,500 ppb of chlorobenzene. The Task Force has determined that this Appendix VIII sampling program must be modified. The current program only monitors the Glacial aquifer. Federal and State regulations require the full extent and rate of migration of hazardous waste and hazardous waste constituents be defined. This can only be accomplished through an assessment program which includes monitoring wells in the Potomac-Raritan-Magothy aquifer system.

Corrective Action Program

E.I. DuPont submits annual progress reports on their site-wide corrective action program every March. The latest available report, March, 1986, details the results of 1985. This most recent report concludes that the pumping program works overall but requires adjustment in the shallow Glacial zone along the western boundary of the site (the Delaware River). The Task Force, however, has determined that the corrective action program requires modifications beyond those cited in the March, 1986 report. First, the data supporting DuPont's claims of the overall effectiveness of the pumping program must be expanded. That is, ground-water flow has been most accurately defined in the shallow Glacial zone along the southern and eastern regions of the site. West of the Chemical Waste "C" Landfill and Waste Water Basins along the perimeter of the Delaware River, few data points exist for measuring ground-water levels or ground-water quality. There is also a lack of data in the region north and east of the Chemical Waste "C" Landfill as well as northeast of the Waste Water Basins. The middle and deep zones of the Glacial aquifer are more poorly defined in all of these sectors. The Potomac-Raritan-Magothy aquifer system has even fewer water level or ground-water quality monitoring points. In a hydrogeologic system as complex as this one, ground-water flow directions and the interrelationships between aquifer zones must be quantified better and include data for the changing patterns due to the changing centers of pumping.

The Task Force has determined that DuPont must monitor both the Glacial aquifer and the Potomac-Raritan-Magothy aquifer system and define the hydrogeologic parameters for all zones. Ground-water flow nets and hydrogeologic cross-sections must be constructed and the transient ground-water flow gradients must be determined. Once this information is known, then accurate determinations of the effects of the corrective action program can be made. At this point any modifications needed can be established.

Audit of Laboratories Used by DuPont

The evaluation of the analytical work of the laboratories being used by DuPont at the time of the investigation is included in the technical report. Inadequacies were found in the area of parameter selection which result in the generation of improper information in terms of regulatory compliance. Inadequacies were also found in the application of analytical methods which result in the generation of questionable data for certain parameters.

Several creditable laboratory practices were worth noting, including calibration procedures and the use of standard operating procedures, control charts, and sample preservation checks. Additionally, the DuPont laboratories are certified by the State of New Jersey for various analytical activities.

Comprehensive Evaluation Inspection

Observations of current waste management practices and a review of records maintained at DuPont have identified several Class I and Class II violations. These included the failure to date drums (accumulation start dates) at generator satellite storage areas, the presence of open drums, the failure to conduct daily inspections, the failure to maintain adequate aisle spacings, an inadequate closure plan, an inadequate waste analysis plan, and violations of DuPont's Temporary Operating Authorization (TOA).

II. Technical Report

A. Regulatory Requirements

RCRA

In 1965, the Solid Waste Disposal Act was passed with the primary purpose of improving solid waste disposal methods. It was amended in 1970 by the Resource Recovery Act, again in 1976 by the Resource Conservation and Recovery Act (RCRA).

RCRA was enacted by PL 94-580, October 21, 1976; 90 Stat. 95, 42 U.S.C. 6901 et seq.; Amended by PL 95-609, November 8, 1978; PL 96-463, October 15, 1980; PL 96-482, October 21, 1980; PL 96-510, December 11, 1980; PL 97-272, September 30, 1982; PL 97-375, December 21, 1982; PL 98-45, July 12, 1983; PL 98-371, July 18, 1984; PL 98-616, and November 8, 1984.

The Resource Conservation and Recovery Act is currently divided into nine Subtitles, A through I. Subtitles C, D and I lay out the framework for the three programs that make up RCRA.

Subtitle C of the Act establishes a program to manage hazardous waste from cradle to grave. The objective of this program is to assure that hazardous waste is handled in a manner that protects human health and the environment. The regulations are found in the Code of Federal Regulations (CFR). Title 40, Chapter I, Subchapter I, Parts 264, 265 and 270.

Section 3006 of Subtitle C of RCRA allows EPA to authorize a State hazardous waste program to operate in a State in lieu of the Federal Hazardous Waste Program. Under this section States could either apply for interim or final authorization. Interim authorization is received in two phases. Phase I and Phase II. Upon the State implementing a program "Substantially equivalent" to the RCRA program can the State apply for final authorization, a program equivalent to, and no less stringent than the Federal Program.

The State of New Jersey received Phase I interim authorization on February 2, 1983. Phase I allowed them to operate the regulations covering 40 CFR Parts 260 through 263, and 265. Phase IIA and phase IIB interim authorizations were granted to New Jersey on April 6, 1984. However, since New Jersey's application for phase IIA and phase IIB interim authorization was submitted after the deadline for inclusion of surface impoundments (January 26, 1983), their interim authorization only included the responsibility for permitting storage and treatment in tanks, containers, and incinerators. Phase II usually covers 40 CFR Parts 124, 264, and 270.

New Jersey applied for permitting authority of land disposal facilities on August 3, 1984. Their revised and complete application for final authorization was submitted on August 20, 1984. EPA published its intent to grant final authorization effective on February 21, 1985.

New Jersey's RCRA program is run primarily by Division of Waste Management. However, since ground-water protection is delegated to Division of Water Resources, they take primary responsibility for RCRA ground-water issues. New Jersey's program is more stringent than the Federal program in the following respects:

1. Waste oil is listed as a hazardous waste, consequently, more facilities are regulated;
2. No exemptions are provided from the ground-water monitoring program;
3. No waivers are granted during interim status.

New Jersey Department of Environmental Protection Responsibilities

NJDEP is responsible for permitting treatment, storage, and disposal (TSD) facilities within the State of New Jersey's borders as well as carrying out the other aspects of the RCRA program. NJDEP is also responsible for enforcement. Further, NJDEP must assist EPA in the implementation of the Hazardous and Solid Waste Amendments of 1984 (HSWA).

U.S. Environmental Protection Agency's Responsibilities

EPA provides the State of New Jersey with Federal funding. EPA regularly evaluates New Jersey's administration and enforcement of its hazardous waste program to ensure that the authorized program is being implemented consistent with RCRA. EPA also retains the right to conduct inspections and request information under Section 3007 of RCRA, to take enforcement action under Sections 3008, 3013, and 7003 of RCRA, and to enforce certain provisions of New Jersey State law. Currently, under Section 3006(g) of RCRA, 42 U.S.C. 6226(g), the new requirements and prohibitions imposed by HSWA take effect in authorized States. EPA must carry out these requirements until the States are authorized for HSWA. Therefore, EPA will administer HSWA in New Jersey until New Jersey applies for and receives authorization for HSWA. Therefore, EPA's direct responsibilities include:

1. Waiver requests; and
2. Solid Waste Management Units (SWMU).

B. Investigation Methods and Procedures

The Hazardous Waste Ground-Water Task Force Investigation of the E.I. Dupont De Nemours & Company Facility Consisted of:

1. Reviewing and evaluating records and documents from EPA Region II, New Jersey Department of Environmental Protection and E.I. Dupont;
2. Conducting a Compliance Evaluation Inspection (i.e., visual Inspection of Waste Management units, operation);
3. Evaluating on-site and off-site analytical laboratories;
4. Sampling and analyzing data from selected ground-water monitoring wells and leachate pumps, "Field Sampling";
5. Conducting a Comprehensive Ground-Water Monitoring Evaluation (CME).

Records/Documents Review

Records and documents from EPA Region II and the New Jersey Department of Environmental Protection offices compiled by an EPA contractor, were reviewed prior to and during the on-site inspection. On-site facility records were reviewed to verify and supplement information currently in government files. Selected documents requiring further evaluation were copied by the Task Force during the inspection.

These records and documents were reviewed to address the administrative, non-technical and technical requirements of 40 CFR Parts 265, Subpart B through R and the New Jersey Administrative Code N.J.A.C. 7:26-6,7,8,9 and 11 et seq.

40 CFR Subparts B through E address the administrative and non-technical requirements to ensure that owners and operators of TSDs establish the necessary procedures and plans to run a facility properly to handle emergencies or accidents. These subparts included:

<u>40 CFR Subpart</u>	<u>N.J.A.C. Subchapter</u>	<u>Subject</u>
B	9	General facility standards <ul style="list-style-type: none">◦ Waste analysis◦ Security◦ Inspections◦ Training◦ Ignitable, reactive or incompatible wastes
C	9	Preparedness and Prevention
D	9	Contingency plans and emergency procedures

40 CFR 265, Subparts F-R, are the interim status technical requirements to minimize the potential for threats resulting from hazardous waste treatments storage, and disposal.

Those subparts evaluated included:

<u>40 CFR Subpart</u>	<u>N.J.A.C. Subchapter</u>	<u>Subject</u>
F	6	Ground-Water Monitoring Requirements
G	9	Closure, post-closure requirements
H	9	Financial requirements
I-R	9&11	Record and document requirements factored to specific waste management methods (i.e. contains, tanks, surface, impoundments, incinerators...)

The Inspection procedures to verify compliance with these subparts included a series of checkpoints, procedures and documentation the New Jersey RCRA inspection checklist.

Comprehensive Evaluation Inspection

The compliance Evaluation Inspection conducted in April 1986 included identifying waste management units and reviewing waste management operations.

These items were reviewed to address the technical requirements of 40 CFR 265 Subparts I-R and N.J.A.C. 7:26-9,11 et seq. These subparts evaluated included:

<u>40 CFR Subpart</u>	<u>Subject</u>
I	Containers
J	Tanks
K	Surface Impoundments
N	Landfills
O	Incinerators
P	Thermal Treatment

The inspection procedures to verify compliance with these subparts included a series of checkpoints procedures and documentation, and the New Jersey RCRA inspection checklist.

Comprehensive Ground-Water Monitoring Evaluation

This portion of the investigation was composed of an office evaluation. The objective was to determine compliance with the Federal and State of New Jersey interim status ground-water monitoring requirements (40 CFR Part 265 subpart F and N.J.A.C. 7:14A-6.1 et seq.) and potential compliance with the requirements of 40 CFR 264 Subpart F and State of New Jersey requirements.

Records and documents from NJDEP and EPA-II were compiled by an EPA-HQ contractor. Those specifically relating to hydrogeology and ground-water monitoring were reviewed prior to the on-site inspection. Several meetings were executed between EPA-II and NJDEP hydrogeologists to discuss the site and choose optimal sampling locations for the inspection. The hydrogeologists selected 15 of the possible 157 wells, two surface water localities, and 2 leachate sump pump localities. The original 15 wells chosen are: M-12, M-13, M-14, M-22, M-25, M-59, M-63, M-64, M-67, M-91, M-92, 204, 241, 252, and 291. These choices were made based on vertical and horizontal spatial distributions and construction integrity (Table 1). Several pre-task force site visits occurred in order to familiarize all involved personnel with the Chambers Works facility.

The "Characterization of Site Hydrogeology Worksheet" from the draft version of the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document was used as a guideline for the office evaluation. The worksheet questions were answered using the Part B and any supporting documents supplied by DuPont. Further, three interviews were conducted pertaining to hydrogeology and the ground-water monitoring system. The first was conducted on Thursday, April 3, 1986 where DuPont was represented by their hydrogeological consultant, G. Sidney Fox, vice-president of Leggette, Brashears, & Graham, Inc. The second was on Friday, April 4, 1986 with DuPont employee, John Curry. The last interview was on Thursday, April 10, 1986 with G. Sidney Fox. The interviews are recorded in the hydrogeologist's log book.

Task Force Field Sampling

Sampling was conducted at E.I. DuPont, Chambers Works by the Task Force in order to determine; if the hazardous waste disposal, storage and treatment activities conducted at this site and regulated by the Resource Conservation and Recovery Act have impacted the quality of ground water underlying this facility, and in general, if the ground water at the facility contains hazardous waste constituents or other indicators of contamination from past/present facility activities. The Task Force's contractor, Alliance Technologies (formerly GCA), collected samples from 17 ground-water monitoring wells, two of the landfill's leachate collection sumps, and two bodies of surface water. Table 2 shows the monitoring well

Table 1. Rationale for Task Force Sampling Locations

Shallow glacial aquifer wells:	M14, M47, M64, M67, M70, 204, 241, 252
Medium glacial aquifer wells:	M3, M13, M63, 291
Deep glacial aquifer wells:	M1, M12, M18, M21
Shallow Raritan-Magothy aquifer wells:	M45C, M94, M92
RCRA wells (landfill):	252 upgradient, 204 & 241 downgradient
Wells previously sampled for Appendix VIII:	M1, M3, M47, M67
Wells close to wastewater basins:	M12, M13, M14, M47, M63, M64
Wells close to landfill:	252, 204, 241, 291
Wells acting as background:	252, M92(?)
Shallow well near an unlined ditch:	M70
Perimeter wells near residential area:	M18, M21, M94
Perimeter wells near Delaware River:	M63, M64

*In addition, 2 leachate samples will be taken from the "C" landfill, the Area I leachate system and the Area II/III leachate system.

**An allowance may be made for surface water samples as well.

specifications for the nineteen wells which were originally chosen to be sampled. Table 3 shows the physical characteristics of the wells measured during the sampling activities conducted by the Task Force. Table 4 presents an outline of ground-water monitoring activities conducted by the Task Force at E.I. DuPont during the period March 31, 1986 through April 10, 1986. This includes the order of well purging and sampling, as well as the equipment used, and the type of quality control samples taken to ensure reliable data.

Due to the lack of information available for well CP6-1, it was eliminated from the sampling list and replaced by well M-92. Well numbers M-67 and M-70 were both eliminated due to time and sampling limitations.

Prior to evacuation of the standing water in the well casing, air monitoring activities were conducted to determine if there was a need for respiratory protection. The instruments used included; an organic vapor analyzer (OVA), a photoionization detector (HNU), and a Geiger counter. Table 5 presents the results of the air monitoring data obtained at each well. An interface probe was used to determine the presence of an immiscible phase. A very thin floating layer was detected at well M-64 only.

All water level measurements were taken with a level indicator/sounder. After removal from the monitoring well, the probe and line were rinsed with isopropanol and deionized water. Due to problems with the available equipment and the large volumes of water that needed to be purged, ESD provided two submersible pumps and several four inch bailers. This deviation from the project plan protocol was necessary to allow the completion of the Task Force's sampling assignment in the time allotted. Even with this equipment, it was occasionally necessary to use more than one pump in a well at once, in order to purge three casing volumes in a reasonable amount of time (see Table 5).

The submersible pumps were constructed of all stainless steel, with a viton "impeller", and Teflon™ wrapped wires. Decontamination between wells consisted of a non-phosphate soap and water flushing through the internal system, and a similar type cleaning, including an isopropanol rinse, on the outside of the pump and line. The four inch teflon bailers were cleaned/rinsed at EPA's Edison laboratory prior to their use in the field. The cleaning/rinsing procedure consisted of a thorough washing with hot water and a non-phosphate detergent, followed by successive rinses with acetone and methylene chloride. After being air dried, the bailers were wrapped in aluminum foil.

Three volumes were purged from all of the monitoring wells except for M-64 and M-92. M-64 was purged to dryness after approximately two volumes, and was sampled after recovery. M-92 was purged till two volumes had been removed and the pH, temperature, and specific conductivity field measurements had all stabilized.

Table 2. Well Construction Specifications for Monitoring Wells Sampled by the Task Force

Well No.	Total Depth (Ft.)	Ground Elev. (Ft.) C.W. Datum	Top of Casing (Ft.)	Casing Diam. (In.)	Screened Interval C.W. Datum/ FT. BGL	Screen/ Casing Mat'l	Screen Length/ Slot Size (Ft.)	Static Water Level (Ft.)/Date/ Datum	Date Instal.
M1	119	8.79	10.19	6	100-105/ 109-114	304SS/ Steel	5/-	2.25/4-82/ C.W.	6/66
M3	68	8.86	9.76	6	55-60/-	304SS/ Steel	5/-	.7/6-66/ C.W.	6/66
M12	90	7.74	8.04	6	- /85-90	304SS/ Steel	5.4/.030	2.3/4-82/ C.W.	2/67
M13	57	7.79	8.59	6	- /52-57	304SS/ Steel	5.4/.030	2.6/6-66/7	2/67
M14	21	7.93	11.03	6	8-13/15.5- 21	304SS/ Steel	5.4/.030	5.6/6-66/ C.W.	2/67
M18	109	7.05	9.05	6	97-102/-	304SS/ Steel	5/-	-	-
M21	112	10.85	12.35	6	96-101/-	304SS/ Steel	5/-	-	-
M45c	186	15.17	16.17	6	166-171/-	304SS/ Steel	5/-	32.67/4-82/ C.W.	6/79
M47	22	8.54	9.14	6	7-12/-	304SS/ Steel	5/.020	-	9/72
M63	36	-	10.04	6	22.4-27.4/ 31-36	304SS/ Steel	5/.020	-	8/84
M64	15	-	10.72	6	1.4-6.4/ 10-15	304SS/ Steel	5/.020	-	8/84
M67	18	-	-	6	4-9/13-18	304SS/ Steel	5/.020	4.8/7-84/ C.W.	7/84
M70	20	-	11.85	6	5-10/15- 20	304SS/ Steel	5/.020	-	10/84
M94	198	7.18	8.89	6	186-191/ 193-198	304SS/ Steel	5/-	37.4/4-82/ C.W.	-
CP6-1	180	8.20	11.38	4	-	-	-	-	-
204	21	8.80	10.89	4	2-12/-	PVC/ PVC	10/.020	2.9/1-85/ C.W.	1/85
241	20	6.70	8.10	4	4-14/10- 20	PVC/ PVC	10/.020	3.4/1-85/ C.W.	9/78
252	20	5.91	8.70	4	4-14/-	PVC/ PVC	10/.020	4.7/10-81/ C.W.	10/81
291	70	-	11.78	6	50-60/60- 70	PVC/ PVC	10/.020	-	9/78

Table 3. Physical Characteristics of Wells Measured and Sampled by Task Force at E.I. DuPont (3/31/86 - 4/10/86)

Well No.	Total Depth (ft.)†	Static Water Level (ft.) †	Casing Diam. (in.)	Volume in Column (gal.)	Volume Purged (gal.)
M1	114.48	15.88	6	145.0	435.0
M3	68.80	14.56	6	79.6	240.0
M12	76.30	15.42	6	84.0	268.0
M13	54.44	15.41	6	57.3	180.0
M14	24.57	11.60	6	19.0	57.0
M18	109.14	14.33	6	139.0	417.0
M21	113.48	17.88	6	138.0	420.0
M45c	187.70	55.69	6	194.0	582.0
M47	20.56	11.41	6	13.3	40.0
M63	39.08	12.10	6	39.6	120.0
M64*	17.23	8.29	6	25.0	40.0
M92	197.52	57.50	6	203.0	410.0
M94	198.82	53.27	6	214.0	642.0
204	22.76	7.72	4	9.6	30.0
241	21.62	5.36	4	10.3	31.8
252	22.89	4.50	4	12.0	36.0
291	70.82	10.91	6	87.0	261.0

† All measurements taken from top of casing

* Very thin immiscible layer detected

Table 4. Outline of Ground-Water Monitoring Activities Conducted by Task Force at E.I. DuPont (3/31/86 - 4/10/86)

<u>Date</u>	<u>Activity</u>
3/31	equipment preparation
4/1	Well 204- purged/sampled (2" bailer)† Well 241- purged/sampled/field blank/facility split (2" bailer)† Well 291- start purge; stopped due to miscalculation of purge volume
4/2	Well 291- purged (ESD submersible pump)/sampled (2" bailer) Well 13- purged (ESD submersible pump)/sampled (2" bailer) Well 14- purged/sampled/field blank (2" bailer)†
4/3	Well 252- purged/sampled/facility split (2" bailer)† Well 3- purged (ESD submersible pump)/equipment blank/sampled/field blank (2" bailer) Well 47- purged/sampled/duplicate (2" bailer)† Well 1- start purge; stopped due to submersible pump failure
4/4	Well 63- purged (ESD submersible pump)/sampled/field blank (2" bailer) Well 64- purged/sampled (2" bailer)†
4/7	Well 21- purged (ESD submersible pump)/sampled/field blank (2" bailer) Well 18- purged (ESD submersible pump)/sampled (2" bailer)
4/8	Well 92- purged (combination of ESD submersible pump and GCA bladder pump)††/sampled/field blank (2" bailer) Well 94- purged (combination of ESD submersible pump and extended 4" bailer)/sampled (2" bailer)
4/9	Well 1- purged (ESD extended 4" bailer)/sampled (2" bailer)† Well 45c- purged (combination of two ESD submersible pumps)/sampled/duplicate/field blank (2" bailer)

cont.

Table 4. (cont.)

<u>Date</u>	<u>Activity</u>
4/10	Well 12- purged (ESD submersible pump)/ sampled (2" bailer) Surface water sample #1 * Surface water sample #2 ** Leachate sump #1 (facility split)*** Leachate sump #2****

- † separate bailer used for purging and sampling
- †† only two casing volumes purged at this well (see report)
- * located at northwest corner of landfill
- ** located at northwest corner of dredge material
- *** located at southwest corner of landfill
- **** located at southeast corner of landfill

Table 5. Results of Air Monitoring at Ground-Water Monitoring Wells
Conducted by Task Force at E.I. DuPont (3/31/86 - 4/10/86)

Well No.	OVA readings (ppm)		HNU readings (ppm)		Geiger readings (mrems/hr)	
	background	well	background	well	background	well
M1	3	3	0.2	9-20	0.02	0.02
M3	3	3	0.2	5	0.02	0.02
M12	3	3	0.2	0.2	0.02	0.02
M13	3	3	0.2	9	0.02	0.02
M14	3	3	0.2	10	0.02	0.02
M18	3	3	0.2	0.2	0.02	0.02
M21	3	3	0.2	0.2	0.02	0.02
M45c	2	2	-	-	0.01	0.01
M47	2	2	0.2	0.5	0.01	0.01
M63	3	6	0.2	4	0.02	0.02
M64	3	3	0.2	2	0.02	0.02
M92	3	3	0.2	0.2	0.01	0.01
M94	2	2	-	-	0.02	0.02
204	2	2	0.2	0.2	0.02	0.02
241	2	2	0.2	0.2	0.02	0.02
252	2	2	0.2	3	0.02	0.02
291	2	2	0.2	0.2	0.02	0.02

Leachate was collected from Sump #200 (Area I of landfill, southwest corner) and Sump #274 (Area II and III of landfill, south side). All leachate samples were collected on the final day to prevent possible cross-contamination of any ground-water samples. Samples from M-12 and the surface waters, were taken on the morning of the same day, however they were packaged and sealed prior to handling any leachate samples in the afternoon.

GCA wore self-contained breathing apparatus (SCBA) and protective clothing during the sampling. All other persons present wore full-face respirators. Samples were collected directly from a wide-mouthed tap after having initially allowed flow through to clear the line of any stagnant liquid.

Surface water samples were collected from two locations on the site; the northwest corner of the landfill, south of Well 252, and the northwest corner of the dredge landfill. Samples were grabbed directly in the proper containers from the upper portion (6 inches) of the body of water. Field blanks were taken each day during the survey. One equipment blank was taken to determine if there was any contamination of the sample due to the equipment.

The sampling procedures followed were those described in the Work/Quality Assurance Sampling Plan for the Ground-Water Task Force Inspection Plan at E.I. DuPont. All sampling was conducted using teflon bailers equipped with bottom emptying valves. Samples were collected for the analytical parameters summarized in Table 6 and analyzed by EPA contractor laboratories.

Following the collection of the samples, GCA placed the samples in coolers containing ice. Samples were preserved, and if necessary filtered, upon return to the staging area. Packaging was conducted in accordance with applicable Department of Transportation regulations for shipment to the EPA contract laboratories. As required under RCRA, receipt for samples were offered to and signed by facility personnel. Samples were split with the facility at well numbers 252 and 241, and leachate sump #1.

Table 6. Summary of Analytical Parameters Sampled for by Task Force
at E.I. DuPont (3/31/86 - 4/10/86)

Volatile Organics Analysis (VOA) Purge and Trap
Volatile Organics Analysis (VOA) Direct Injection
Purgeable Organic Carbon (POC)
Purgeable Organic Halides (POX)
Extractable Organics
Pesticides/Herbicides
Dioxin
Total Metals
Dissolved Metals
Total Organic Carbon
Phenols
Cyanide
Nitrate & Ammonia
Sulfate & Chloride

Evaluation of Onsite and Offsite Laboratories

The onsite and offsite laboratory facilities handling ground-water samples were evaluated regarding their respective responsibilities under the Dupont ground-water sampling and analysis plan. Analytical equipment and methods, quality assurance procedures and records were examined for adequacy. Laboratory records were inspected for completeness, accuracy and compliance with State and Federal requirements. The ability of each laboratory to produce quality data for the required analysis was also evaluated.

Facility Description and Operation

General Information

E.I. DuPont de Nemours & Company, Incorporated (DuPont, Chamber Works) operates a 737 acre treatment, storage and disposal facility located at the base of the Delaware Memorial Bridge in southern New Jersey. It is in both Pennsville and Carney's Point Townships.

Facility Address: E.I. DuPont De Nemours & Company Inc.
Chambers Works
Deepwater, New Jersey 08023

Telephone Number: 609 - 299 - 5000

RCRA Contact: Alfred Pagano, Ph.D
Consulting Associate

Facility I.D. Number: NJD 002385730

Facility Background

The facility traces its history back to the turn of the century and slightly before. Its products have been associated with the two major World Wars in the defense area, as well as U.S. products areas as a consequence of the wars (i.e. dyes, synthetics, textiles, etc.)

During the 1970's a major waste water treatment plant (WWTP) was constructed primarily to handle on-site generated wastes; a major portion of which was dedicated to dye-stuff manufacturing which ceased about the time of the WWTP construction. Excess capacity presently exists.

At the present time DuPont Chambers Works is a major manufacturer of organic chemicals and organic intermediates utilizing nearly 2000 separate chemical processes. Approximately 750 finished products are manufactured including: fluorinated hydrocarbons (freons), petroleum chemicals (tetra-alkyl lead), elastomers (vitron and hytrel), aromatics (phenylene diamines) and other speciality chemicals. The facility has an overall storage capacity of approximately 600,000 barrels and a transfer capacity of 200,000 barrels per day.

Numerous treatment, storage and disposal activities are carried on to handle on-site generated waste from the manufacturing operation with the major unit being the WWTP. Additionally, this facility accepts hazardous (manifested) and non-hazardous waste for treatment, storage and disposal at Chambers from other DuPont intra-company sites. As a result of on-site waste disposal capabilities, DuPont, as a generator, does not usually manifest waste off-site. Areas where off-site manifesting occurs are usually when the waste is being recycled by a non-DuPont facility to secure recovery of a constituent in the waste.

The commercial operational DuPont (acceptance of manifested off-site hazardous waste from non-DuPont sources) involves the operation. This seven day per week 24 hour per day operation also receives classified as non-hazardous per straight bills of lading. The organized hazardous waste treated in this unit consists of bulk aqueous, flammable organic and inorganic solutions with a single phase character.

Waste is received at DuPont via ships, railroad cars, tank trucks. On-site waste is carried primarily by unlined or partially lined systems which are detailed as follows:

"A" System - This system receives contaminated process, sanitary, septic well water, and storm water to be fed to the WWTP. This has an unlined surface impoundment intended to handle high volume water, WWTP bypass and potential spills.

"B" System - This system receives cooling water, non-contaminated water, and WWTP effluent. This system has an unlined surface for solids settling prior to river discharge under an NPDES permit.

"C" System - This system receives lead contaminated water which is fed into an unlined surface impoundment. The effluent from the "C" system is fed into the "A" system.

"D" System - This system receives cooling water and non-contaminated storm water for direct discharge.

"E" System - This system delivers treated water effluent from the WWTP to the "B" basin.

"F" System - This system carries storm water which is discharged directly to the river.

Various manufacturing areas which feed these systems include the following:

<u>Area</u>	<u>System</u>
Aromatics - East	A-B
Aromatics - West	A-B
Speciality Chemicals - East	A-B
Speciality Chemicals - West	A-B
Polymer Products	A-B
Freon	A-B-D
Petroleum Chemicals	A-B-C-D
Logistics	B
Utilities	A-D
Laboratories	A-B

DuPont Chambers Works is presently operating under federal interim status and New Jersey temporary authorization issued 6/27/80 and extended indefinitely 12/29/82. This facility is currently in the permitting process. The Part B was received August 11, 1983.

The facility notified EPA and filed a Part A application on November 5, 1980 for the following RCRA regulated activities.

- ° Generation of Hazardous Waste
- ° Transportation of Hazardous Waste
- ° S01 (Storage in containers) 600,000 gallons
- ° S02 (Storage in tanks) 200,000 gallons
- ° S03 (Waste Pile) 2,500 cubic yards
- ° S04 (Storage in surface impoundment) 91 000,000 gallons
- ° D80 (Disposal in Landfil) 420 Acre feet
- ° T01 (Treatment in tank) 50 millions gallons per day
- ° T02 (Treatment in surface impoundment 5.6 millon gallons per day
- ° T03 (Treatment by incineration) 5 tons per hour
- ° T04 (Thermal Treatment) 6 tons per hour

Figure 1. DuPont Chambers Works Waste Management Units

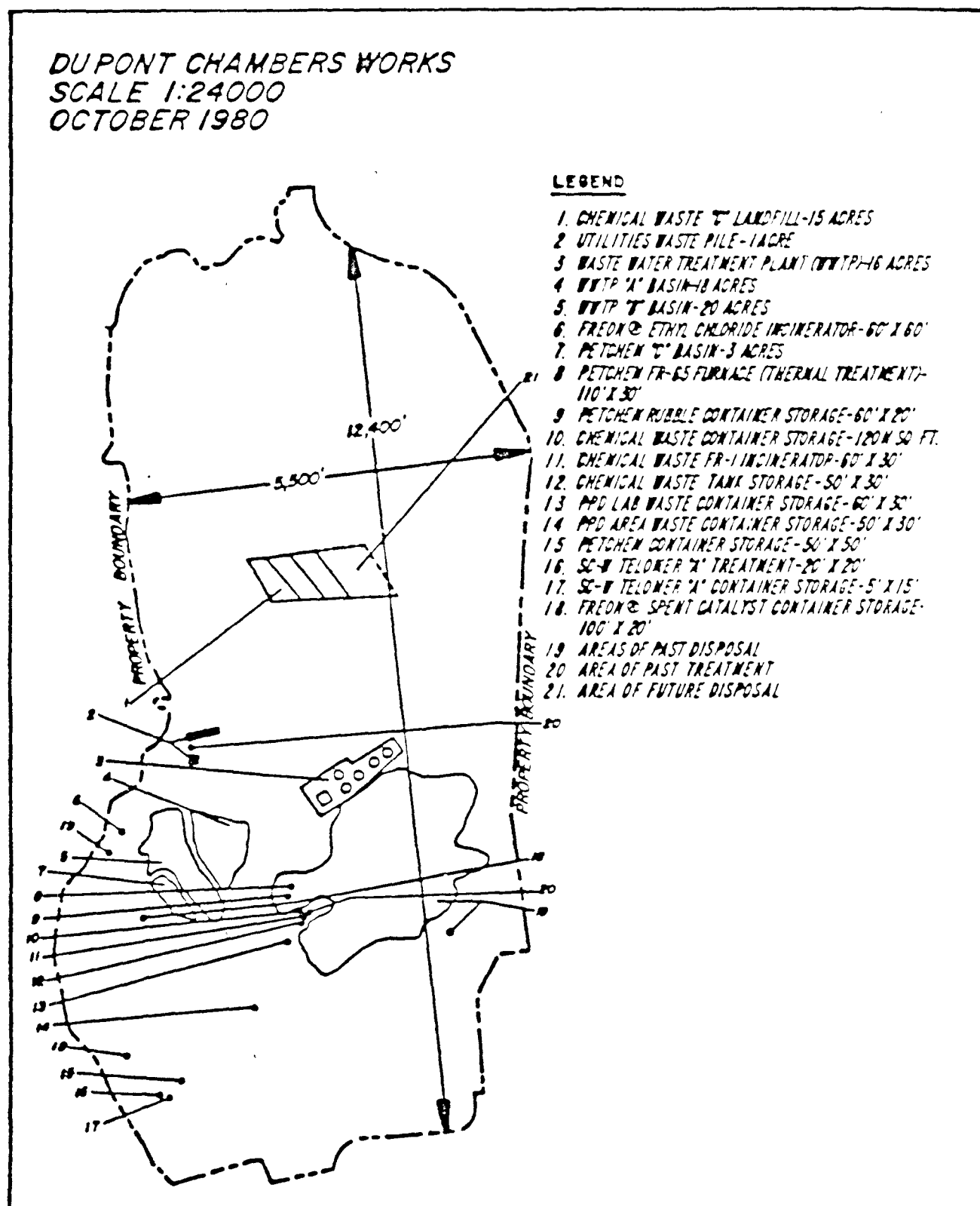
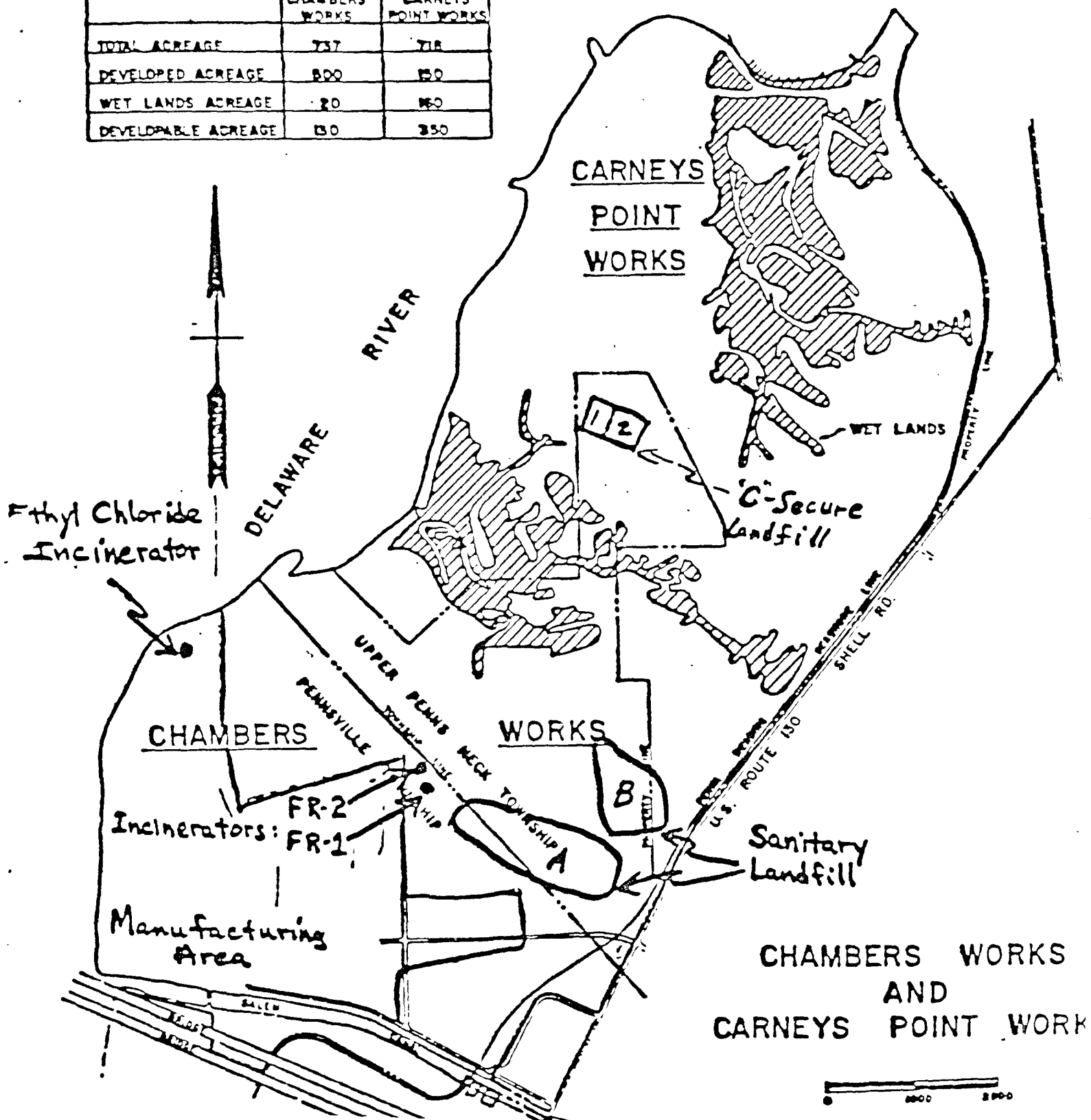


Figure 2. Chambers Works and Carneys Point Works

	CHAMBERS WORKS	CARNEYS POINT WORKS
TOTAL ACREAGE	737	718
DEVELOPED ACREAGE	800	150
WET LANDS ACREAGE	20	160
DEVELOPABLE ACREAGE	130	350



H Y D R O G E O L G Y

Figure 4. Physiographic Provinces of New Jersey

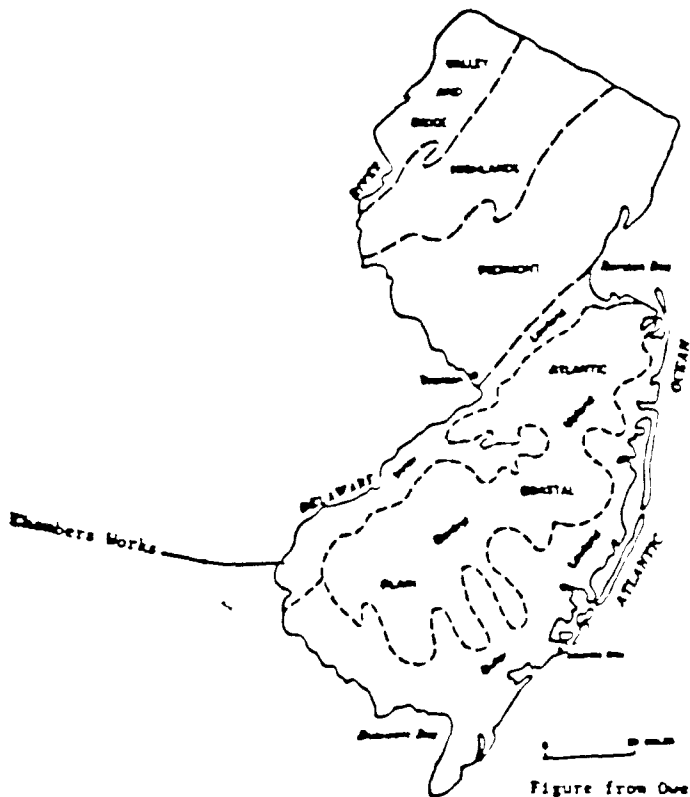
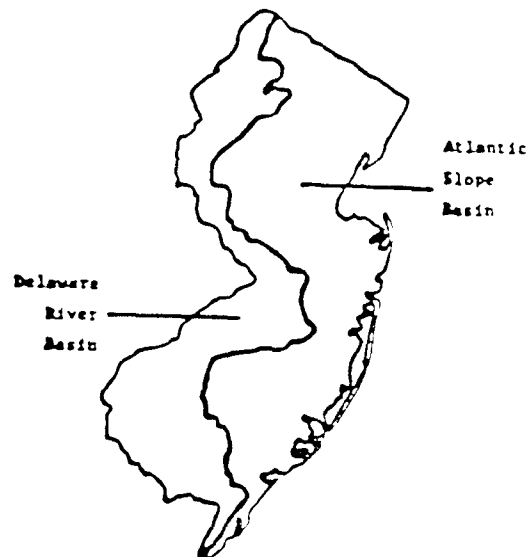


Figure from Owens, J.P. and A.F. Sohl, Shelf and Deltaic Paleoenvironments in the Cretaceous-Tertiary Formations of the New Jersey Coastal Plain, in the Geology of Selected Areas in New Jersey and Eastern Pennsylvania and Guidebook of Excursions, 1969, S. Subitsky, Editor

Figure 5. Location of the Delaware River Basin



Adapted from the United States Geological Survey Water-Data Report NJ-84-2
Water Resources Data, New Jersey, Water Year 1984

Figure 6. The Fall Line

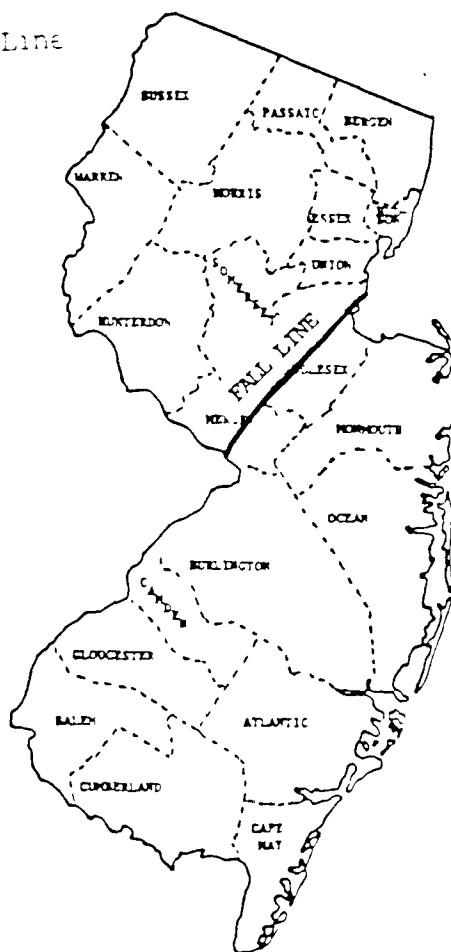
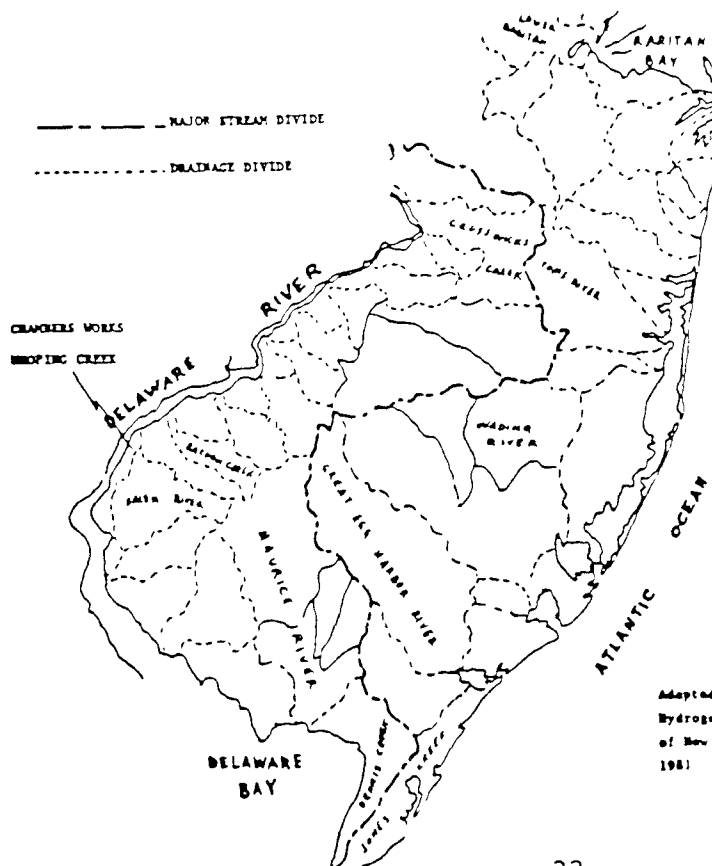


Figure 7. The Coastal Plain's Drainage Divide



Adapted from Vorishak, E.F. and W.K. Foster
Hydrogeologic Conditions in the Coastal Plain
of New Jersey, Open-File Report 81-405, USGS,
1981

Figure 8. Typical Section through the Coastal Plain (NW-SE)

Adapted from: USGS Miscellaneous Geologic Investigations Map I-514-B, Engineering Geology of the Northeast Corridor Washington, D.C., to Boston, Massachusetts: Coastal Plain and Surficial Deposits, 1967

Tch	Cohansey Sand
Tkw	Kirkwood Formation
Tmq	Manasquan Formation
Tvt	Vincentown Formation
Tht	Hornerstown Sand
Krb	Red Bank Sand
Kns	Navensink Formation
Kml	Mount Laurel Sand
Kw	Wenonah Formation
Kmt	Marshalltown Formation
Ket	Englishtown Formation
Kwb	Woodbury Clay
Kmv	Merchantville Formation
Kmg	Magothy Formation
Kr	Raritan Formation
Kp	Potomac Group

CONTOUR INTERVAL 100 FEET
WITH SUPPLEMENTAL CONTOURS AT 50-FOOT INTERVALS
DATUM IS MEAN SEA LEVEL

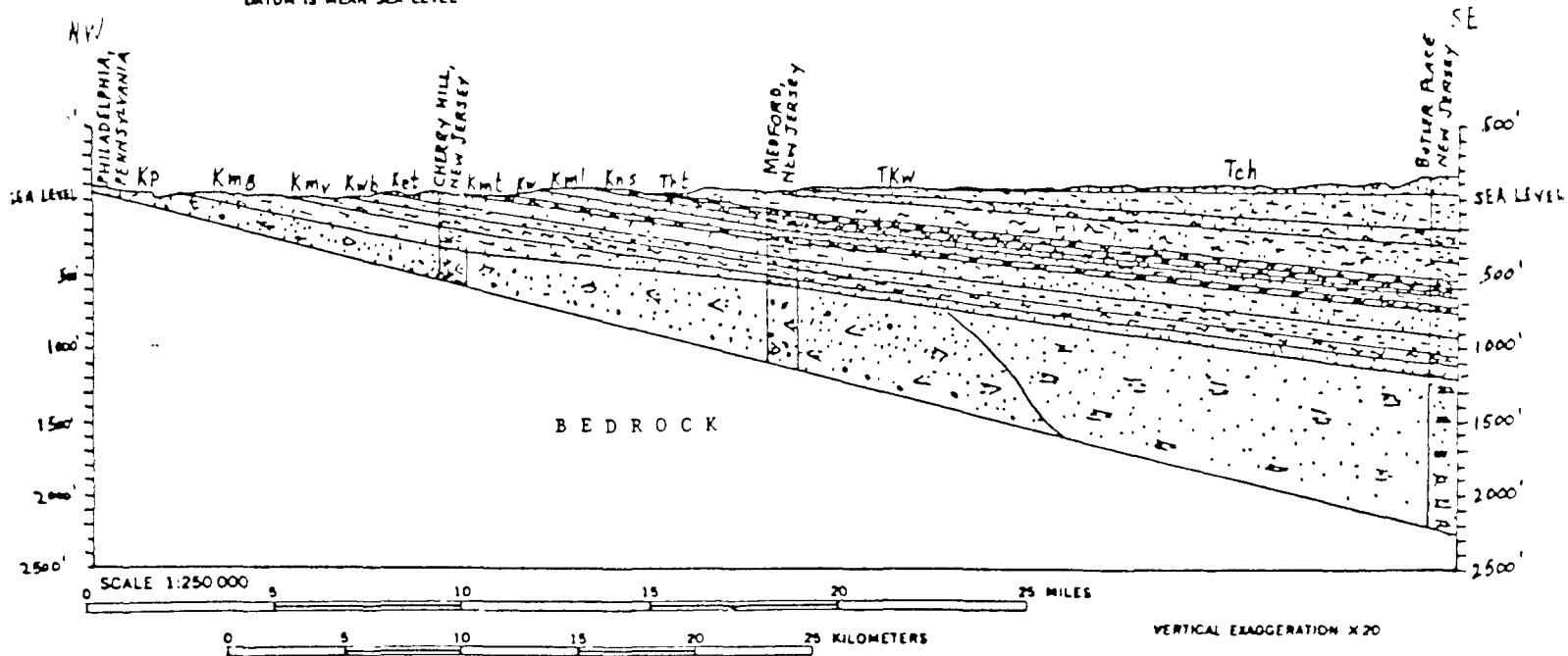
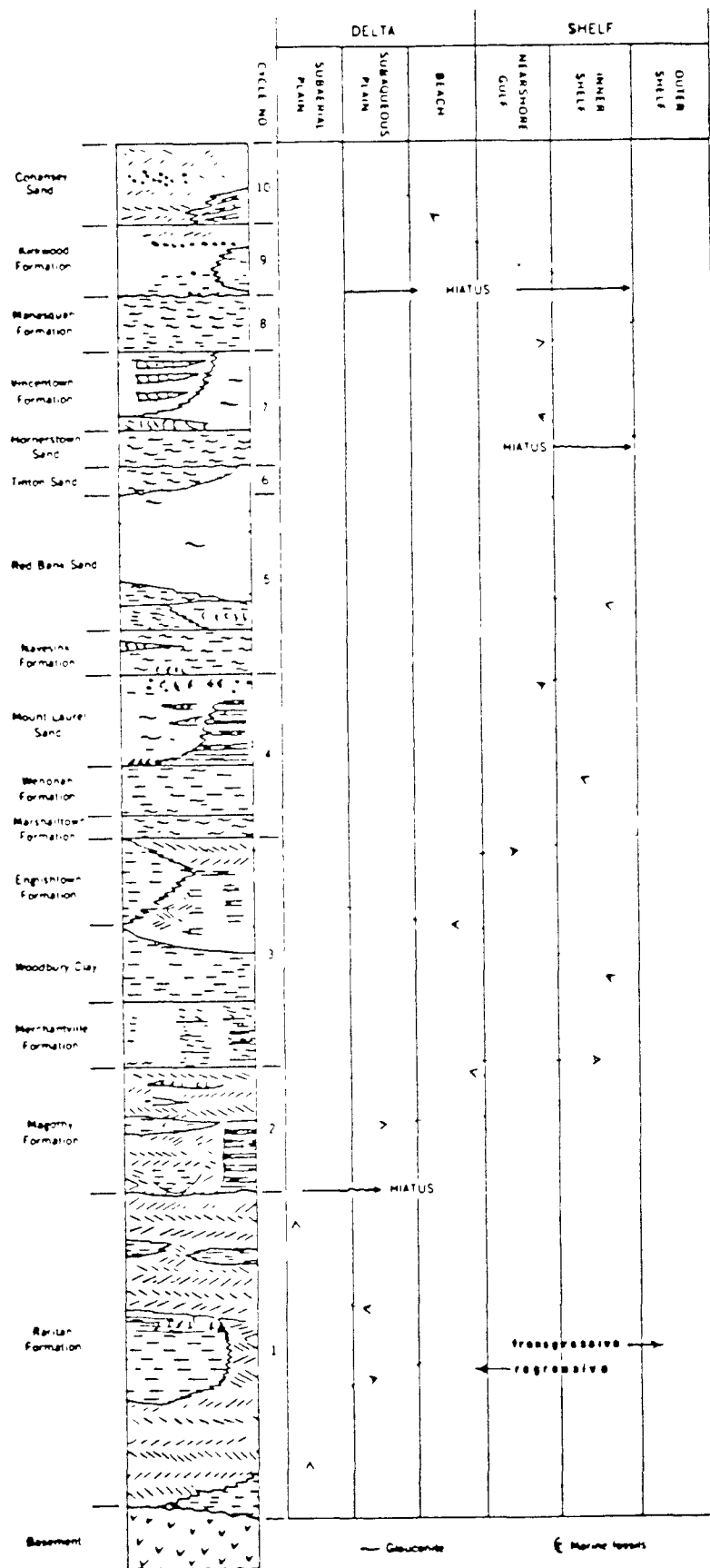


Figure 9. Stratigraphic Section showing Transgressive/Regressive Cycles



From: Owen, J. and Sohl, N., Shelf and Deltaic Paleoenvironments in the Cretaceous-Tertiary Formations of the Coastal Plain, in Geology of Selected Areas in New Jersey and Eastern Pennsylvania and Guidebook of Excursions, S. Subitzky, Editor, USGS, 1969.

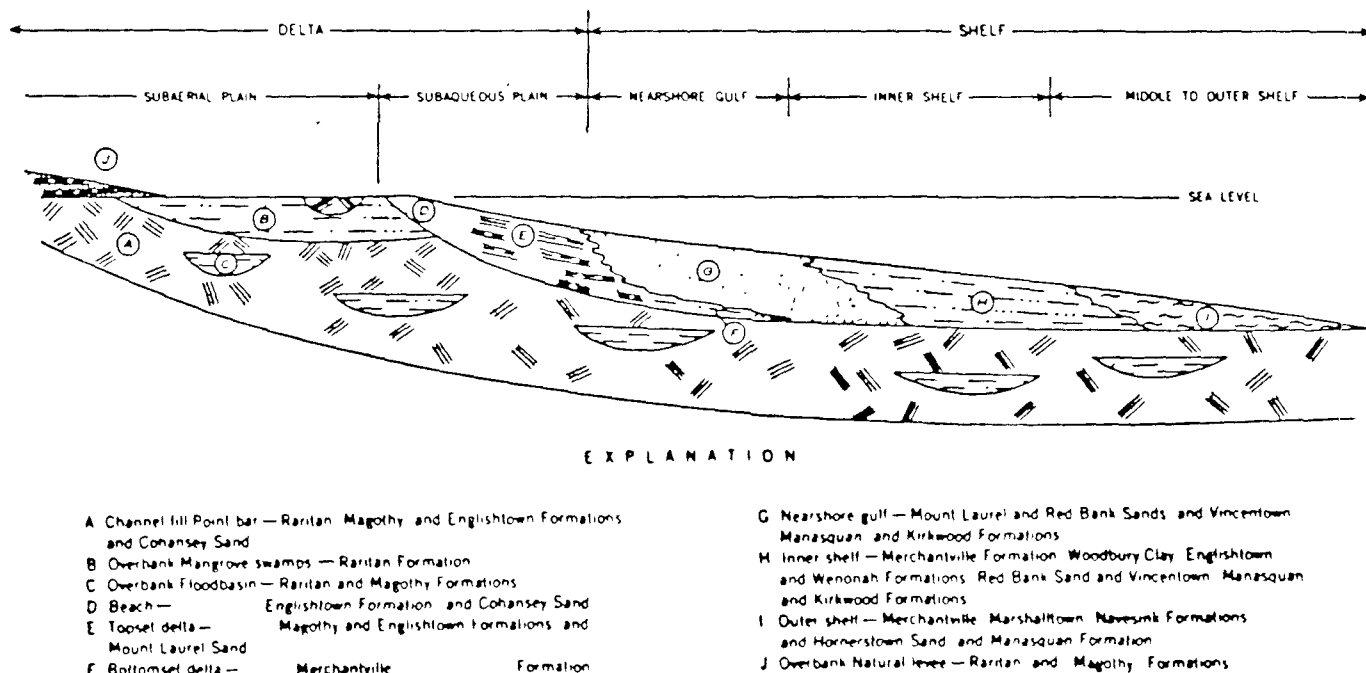
Rock Units

Table 7 depicts all units in the Coastal Plain, from oldest to youngest providing age, lithology, and thickness. This regional information is an essential part in the comprehension of the Chambers Works site subsurface and its relationship to the surrounding communities.

Hydrogeologic Setting

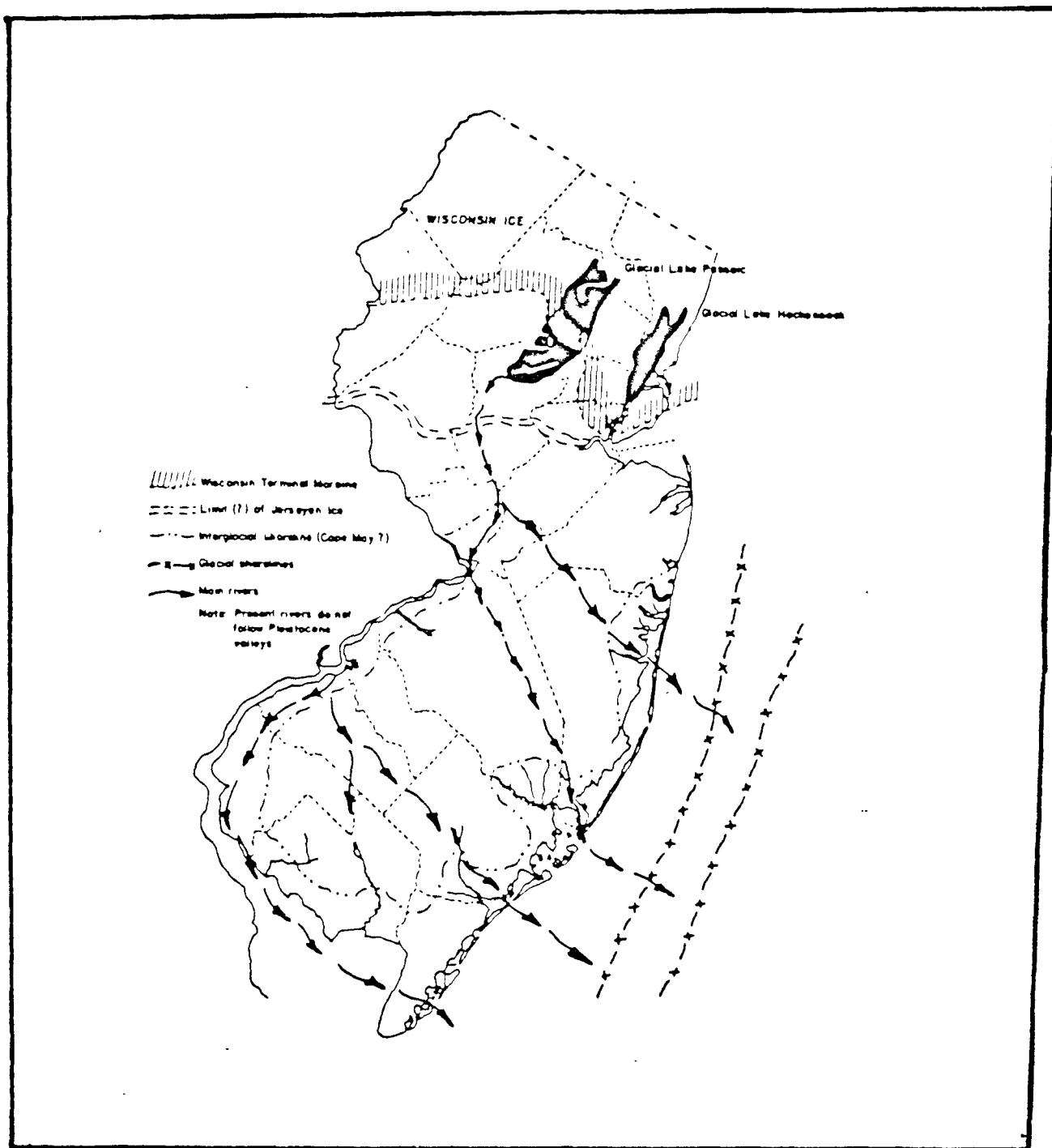
Table 8 depicts the hydrogeologic units of the Coastal Plain from oldest to youngest. Hydrogeologic properties under confined and unconfined conditions are provided. These properties are an integral part in the comprehension of the original ground-water flow regime at the site and its adaptation to the pumping of water supply wells in the surrounding area and the interceptor well system set-up by Leggette, Brashears, Graham & Company, Inc.

Figure 10. Composite Diagram of the Depositional Environments



From: Owen, J. and Sohl, N., Shelf and Deltaic Paleoenvironments in the Cretaceous-Tertiary Formations of the Coastal Plain, in *Geology of Selected Areas in New Jersey and Eastern Pennsylvania and Guidebook of Excursions*, S. Subitzky, Editor, USGS, 1969.

Figure 11. The Wisconsin Glacial Cycle in New Jersey



From: Widmer, Kemble, 1964, The Geology and Geography of New Jersey, Volume 19, The New Jersey Historical Series.

Table 7. Geologic Units of the Coastal Plain Physiographic Province

UNIT	AGE	LITHOLOGY	THICKNESS
Beaufort Group	Early Cretaceous	Interbedded sand, gravelly sand and clay with abundant coarse lenticular material. Sand commonly moderately to well sorted, extensively cross-stratified, mostly quartz. Gravel fraction all quartz and quartzite, stones generally less than 5" in diameter. Clay chiefly kaolinitic and illitic; beds massive, locally crudely stratified, lenticular; commonly red, white or yellow. Massive ironstone beds common under Hill crests.	As much as 150 ft in outcrop area; thickness in subsurface to between 700 and 800 ft.
Paricut Formation	Cretaceous	Chiefly massive, cross-bedded sand, interbedded with thick beds of clayey silt and laminated clay and silt. Clay minerals kaolinitic and illitic. Extensive differential cementation; thick ironstone beds common under topographic crests.	About 200 ft in outcrop area; 800 ft in subsurface.
Parotchy Formation	Cretaceous	Thin to thick beds of dark-colored clayey silt and lightly-colored quartz sand. Mica and pyrite in small amounts. Clay minerals chiefly kaolinitic and illitic; contains large limonitized lens.	Thins and thickens along outcrop belt. Ranges from 150 ft near Paritan Bay to as little as 10 ft. As much as 200 ft in subsurface.
Perchville Formation	Cretaceous	Chiefly clayey silt and clayconglomerate to quartzose sand; highly variable. In southwestern N.J., siliceous quartz sand, thick-bedded, poorly sorted; siderite concretions, sorted siderite concretions.	50 ft.
Woodbury Clay	Cretaceous	Very clayey and somewhat siliceous dark-gray silt, sorting very poor, bedding massive, crudely laminated at top. Contains abundant compressed carbonaceous matter and finely crystalline pyrite. Clay dominantly illitic. Pinched out somewhere to the northeast of Woodstown.	As much as 50 ft in west-central area; in subsurface, increases to about 100 ft.
Brilliantown Formation	Cretaceous	Glaucous clayey sand, in southwestern N.J., thick, massive, dark clayey silt. Silt beds contain considerable sand-sized carbonaceous matter and mica. All major clay minerals present.	20-150 ft in outcrop area.
Marshalltown Formation	Cretaceous	Quartzose clayconglomerate sand, fine-grained, very silty and clayey, massively bedded, dark-colored. Very fossiliferous in southern N.J. mica, feldspar, finely crystalline pyrite common. All major clay minerals present. Overlies the Brilliantown Formation in part of the Coastal Plain but overlies the Woodbury Clay in much of Salem County.	15-50 ft.
Wernick Formation	Cretaceous	Glaucous clayey sand, generally dark, siliceous, and feldspathic. Ranges from fine-grained at base to medium-grained at top. Poorly to moderately sorted; massive to thin-bedded. Rich pyrite content.	As much as 70 ft in outcrop. Unit pinched out near Delaware River.
Mount Laurel Sand	Cretaceous	Southern part of Trenton, N.J., massive, moderately to well sorted feldspathic clayconglomerate quartz sand, medium grained (in N.J.), coarsening southward.	Ranges from 30 to 170 ft.
Revsine Formation	Cretaceous	Clayey, silty clayconglomerate sand, greenish, very silty and clayey, thick-bedded, dark gray. All major clay minerals present, finely compressed carbonaceous matter, and finely crystalline pyrite.	Maximum 45 ft.
Red Bank Sand	Cretaceous	Chiefly quartz sand, massive to very thick-bedded. Upper beds tough, mostly indurated, coarse-grained dark quartz-clayconglomerate sand. Beneath, in sequence, are beds of medium-grained quartz sand and fossiliferous sandy silt. To the southwest, beds become dark, poorly sorted, siliceous clayconglomerate sand, quartz and feldspar major minerals; all major clay minerals present. Mica abundant in silt.	As much as 100 ft. Unit does not persist for any appreciable distance in the subsurface.
Vinton Sand	Late Cretaceous	Massive dark-grayish to red, well-sorted clayconglomerate quartz to quartz-clayconglomerate sand, medium-bedded cementation by finely crystalline siderite.	Maximum thickness 25 ft.
Northampton Sand	Paleocene	Glaucous sand, fine to medium-grained, locally very silty and clayey, poorly sorted and massive bedded. Sand particles almost all clayconglomerate, but include some well-rounded quartz grains. Silt-clay fraction mostly bright green finely divided clayconglomerate, and some finely crystalline pyrite. Occurs out from northern N.J. to the eastern shore of Chesapeake Bay.	Thickness about 50 ft in outcrop and in subsurface.
Vincennes Formation	Paleocene	A cemented quartzose (fine sand with gravel), dark clayconglomerate quartz sand, in west-central and southern N.J.	50 ft in southwest N.J.; thickness in subsurface to about 100 ft.
Neversink Formation	Early-middle Eocene	Silty, clayey clayconglomerate sand with interbedded silt-clay. Generally thick-bedded to massive. Upper part, sand, interbedded with highly nonconformable clayey silt beds; lower part contains dark-brown apatite pellets, and siderite fragments, sand dominantly quartzose in lower beds.	50 ft (only lower part exposed); thickness increased to about 200 ft southwest.
Elmwood Formation	Middle Eocene	Chiefly fine-grained siliceous quartz sand, locally clayey or silty, interfingering with thick clay-silt to southwest. In south, beds darker due to finely divided organic matter. Minerals in clay-silt bed include, quartz, illite, and kaolinite. Partial secondary siliceous cementation common in southern N.J.	Generally to about 100 ft.
Conversy Sand	Pliocene(?) - Pliocene(?)	Chiefly quartz sand with some clay and gravel. Sand medium-grained, well-sorted, cross-stratified, loose. Gravel beds more extensive in northwest, commonly cross-stratified, occur as well-defined channels in sand, dark, thick, siliceous silt-clay beds in south. Sand is arkosic in southwest. Pebbles in gravel well-rounded, less than 2" in diameter, mostly quartz and quartzite, with metamorphic rock fragments common in south. Kaolinitic and illitic major clay minerals in clay-silt beds.	Thickness to 200 ft in southwest.
Chesapeake Formation	Pleistocene	Lowland terraces composed of clay, silt, sand, gravel, scattered boulders as much as 4 ft in diameter, in differing proportions, gravel and boulders most abundant near the mouths of major rivers. Sorting fair to good. Bedding excellent to good, commonly thick, horizontal; sand and silt generally cross-stratified, clay beds massive and discontinuous. Gravel and boulders vary widely in composition but quartz, quartzite, and chert predominate; sand and silt primarily of detrital composition, with large concentrations of rock fragments. Clay minerals highly varied. Sand loose, silt and clay generally soft. Color light gray to buff; clay at depth blue-gray. Overlain by heavy accumulations of mud and peat where clayey beds are at or near surface. Lenticular and micaceous boulders interspersed within several feet of surface.	Thickness variable, as much as 200 ft beneath Delaware Bay. May be more than 100 ft thick in northern Delaware.
Peat, Swamp, and Estuary Deposits	Pleistocene	Interbedded silt, fine-grained sand, clay, and organic in differing proportions. Sorting is good to fair. Soft, noncompact, in part semifluid. Color is light brown to black. Commonly overlain by artificial fill. Part semifluid. Color is light brown to black. Commonly overlain by artificial fill.	Generally less than 15 ft.

Table 8. Hydrogeologic Units of the Coastal Plain Physiographic Province

UNIT	GENERAL HYDROLOGIC CONDITIONS			WATER TABLE CONDITIONS		COMMENTS
	WELL YIELD G/M	COEFF. PERM. G/D/FT ²	SP. CAP. G/M/FT	SP. YIELD %	FRESHWATER CONTENT G/YD ³	
Potomac Group	3-1900 R 500 M	290-2170 R 1600 M	2.4-86 R 21 M	15-20 R	20-40 R	Individual aquifers range from a few feet to 100 ft in thickness; clay layers locally thick and function as confining beds.
Raritan Formation	10-1900 R 500 M	200-2000 R 1000 M	10-44 R 20 M	15-20 R	30-40 R	Individual aquifers range from a few feet to 80 ft in thickness; water occurs mostly under artesian conditions. Clay units locally thick and function as confining beds.
Magothy Formation	10-100 R	56-740 R	ND	5-15 R	10-30 R	Moderate to highly permeable; yields large quantities of water from several zones.
Hatawan Formation	7-180 R 37 M	100-200 R	.2-9.5 R 1.5 M	10-12 R	20-24 R	Functions as a minor aquifer where sand predominates.
Merchantville Formation	0-10 R	.02-15 R	ND	5	10	Functions mainly as a confining bed capable of transmitting significant quantities of water where sizable differences in head exist between the overlying and underlying aquifers.
Woodbury Clay	ND	.002-.2 R	ND	2	4	Functions as a confining bed. Pinches out northeast of Woodstown.
Englishtown Formation	5-520 R 100 M	50-300 R	ND	10-15 R	20-30 R	Minor aquifer; absent in southernmost and westernmost New Jersey.
Marshalltown Formation	ND	.002-3 R	ND	5	10	Functions as a confining bed. Overlies the Woodbury Clay in Salem County.
Wenonah Formation	1-5 R 2 M	0.6-7 R	ND	8-10 R	16-20 R	Extensive minor aquifer with Mount Laurel Sand.
Mount Laurel Sand	5-300 R 100 M	40-160 R	ND	10-15 R	20-30 R	Minor aquifer.
Nauesink Formation	ND	.03-15 R	ND	5-10 R	10-20 R	Leaky confining bed; permeability increases to a maximum in Salem County.
Red Bank Sand	2-25 R	1-100 R	ND	5-R R	10-16 R	Absent southwest of Arnetown.
Tinton Sand	ND	ND	ND	ND	ND	
Homerstown Sand	0-5 R	.02-15 R	ND	5-10 R	10-20 R	Functions primarily as a confining bed over artesian aquifers.
Vincentown Formation	ND	10	ND	5	10	Minor aquifer in southwestern New Jersey.
Manasquan Formation	3-60 R	0.3-120 R 6 M	0.2-1.2 R 0.6 M	5-10 R	10-20 R	Primarily a confining bed. Locally supplies small yields to domestic wells.
Kirkwood Formation	5-860 R 200 M	110-1100 R	1.2-17.5 R 8.2 M	8-10 R	16-20 R	Includes at least two significant aquifers which yield moderate to large supplies.
Cohansey Sand	10-2000 R 500 M	250-3000 R 1000 M	5-40 R 20 M	19-23 R	38-46 R	Unconsolidated thick permeable aquifer, chiefly confined with direct recharge; locally artesian.
Cane May Formation	5-1000 R	300-1000 R	0.3-20 R	17-23 R	34-46 R	Water occurs mainly under water-table conditions. Direct recharge from precipitation. Clay layers in subsurface act as confining beds, causing artesian conditions locally; a promising aquifer in the southern Delaware Basin.
Marsh, Swamp, and Estuary Deposits	ND	0.1-2 R	ND	20-30 R	40-80 R	

R RANGE
M MEDIAN

Adapted from: USGS Miscellaneous Geologic Investigations Map I-514-B, Engineering Geology of the Northeast Corridor Washington, D.C., to Boston, Massachusetts: Coastal Plain and Surficial Deposits, 1967

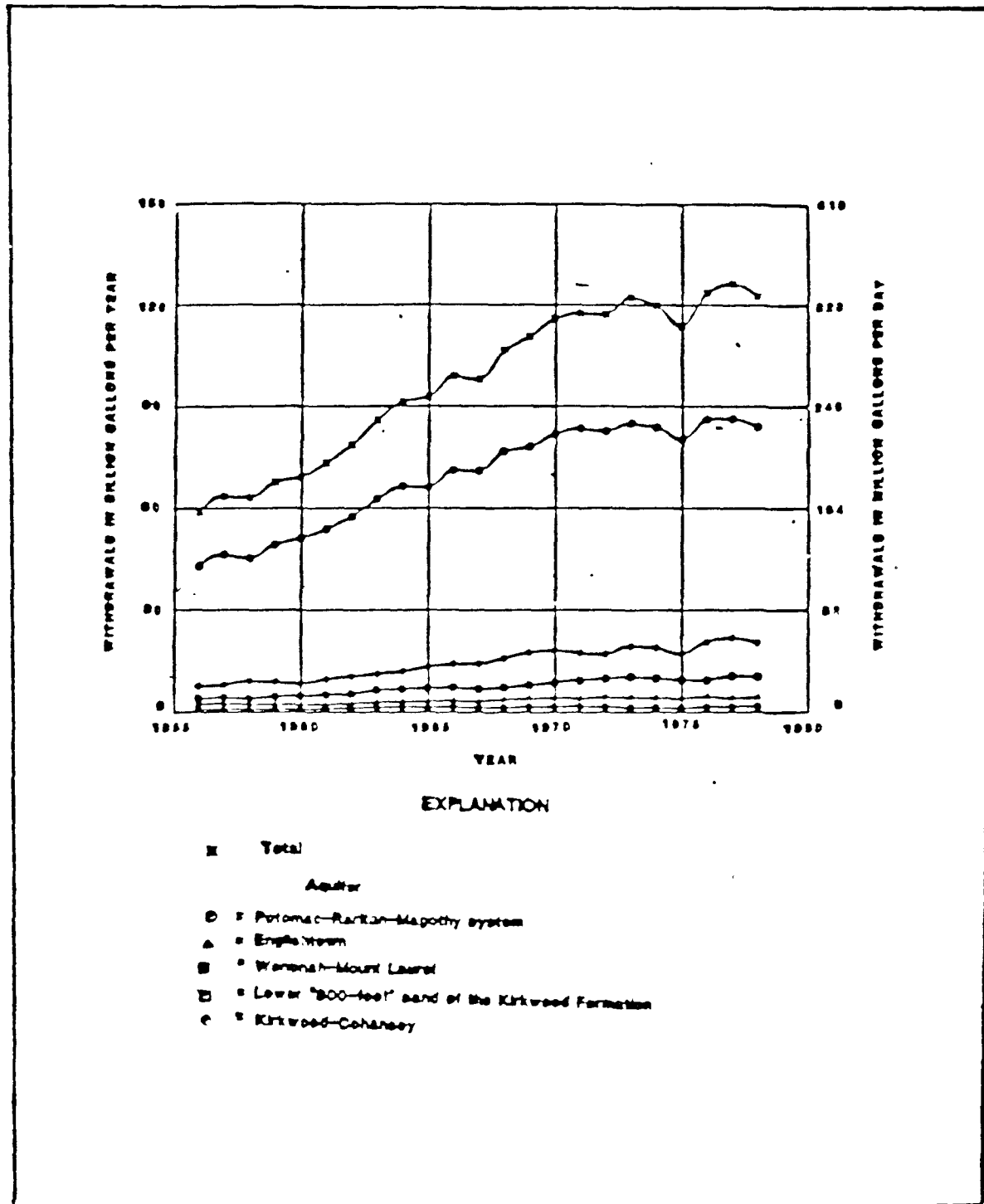
The Delaware River Basin

The Delaware River Basin covers 12,865 square miles (Parker, et.al., 1964). The original source of ground water within its formations is precipitation (Olmstead, et.al., 1960). Recharge occurs by infiltration at the land surface. The average annual precipitation, evapotranspiration, and runoff for the years 1921-50 are 44 inches/year, 23 inches/year, and 21 inches/year respectively. During the 1950's, about 6.1 billion gallons per day (BGD) of surface water and ground water was withdrawn from the basin collectively; 95% of this being surface water from streams, lakes, and reservoirs (Parker, et.al., 1964). Ground-water withdrawal amounted to 343 MGD in 1955 (Parker, et.al., 1964). Natural ground-water discharge occurs at the relatively low parts of outcrops of aquifers (along rivers, streams, marshes, and swamps) throughout the basin and total discharge including evapotranspiration approximates 10 BGD (Parker, et.al., 1964). Only where excessive pumping reverses the natural ground-water flow scheme do streams act as recharging locations rather than discharge points (Olmstead, et.al., 1960).

The Coastal Plain

The Coastal Plain accounts for 2,750 miles of the Delaware River Basin. For the period between 1941-78, average annual precipitation, evapotranspiration, and runoff is 44 inches/year and 20 inches/year respectively (Vowinkel, et.al., 1981). Since ground water accounts for 80% of the Coastal Plain's water supply (Vowinkel in Walker, 1983), it is evident why there is an upward trend in ground-water withdrawal. By 1978, pumpage in the Coastal Plain exceeded 270 MGD (Walker, 1983). This increasing trend is reflected in the water levels of the confined aquifers. According to the U.S. Geological Survey Water-Data Report NJ-84-2, there was a net decline in water levels except in the northern section of the Coastal Plain where 1984 levels in the Potomac-Raritan-Magothy aquifer system and the Englishtown aquifer leveled off (Bayersfield, et.al., 1985). The available Coastal Plain ground-water supply was derived in the 1960 Delaware River Basin Report, about 1,600 MGD (Olmstead, et.al., 1960). The majority of this ground water is found in the following hydrogeologic units: the Potomac-Raritan-Magothy aquifer system, the Englishtown aquifer, the Wenonah-Mount Laurel aquifer, the Kirkwood aquifer, and the Cohansey aquifer. Figure 12 shows the major ground-water withdrawals from the Coastal Plain between 1956 and 1978. The Potomac-Raritan-Magothy aquifer system is the major source of ground water.

Figure 12. Major Ground-Water Withdrawals from the Coastal Plain of New Jersey by Aquifer, 1956 - 1978



From: Vowinkel, E.F. & W.K. Foster, 1981, Hydrogeologic Conditions in the Coastal Plain of New Jersey, USGS Open-File Report 81-405

The Delaware River and Salt Water Intrusion

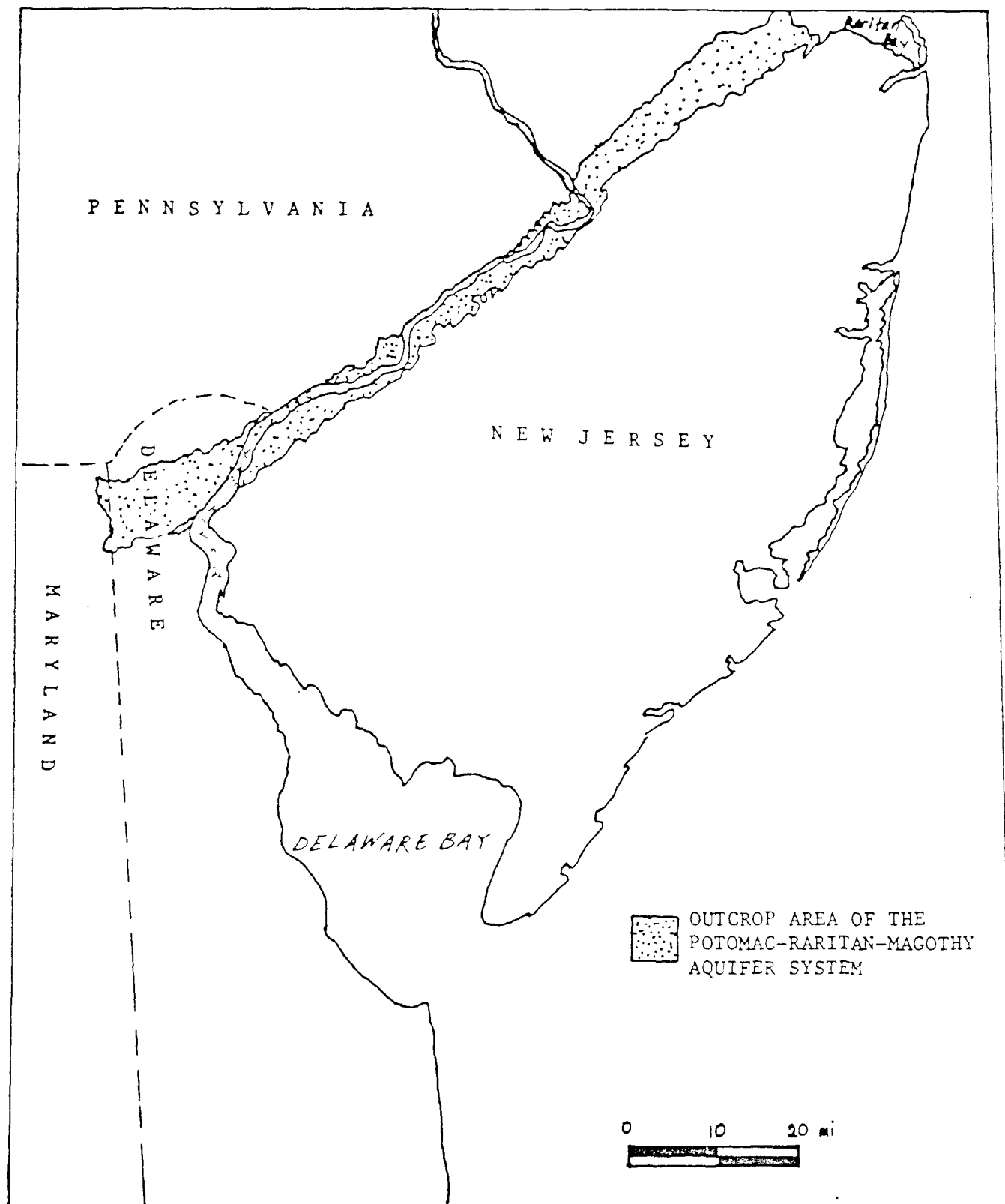
The Delaware River enters the Coastal Plain when it crosses the Fall Line at Trenton, New Jersey. Where it crosses the Fall Line, the river becomes tidal, and fresh water and salt water mix in its lower reaches (Parker, *et. al.*, 1964). Maximum rates of tidal flow at the Delaware Memorial Bridge exceed the fresh water discharge of the river entering the tidal sector (Miller, *et. al.*, 1962). Observations at the Delaware Memorial Bridge show great variations in specific conductance values which show a strong correlation to the tide; as the tide comes in, specific conductance increases, as the tide goes out, specific conductance decreases (Miller, *et. al.*, 1962). Where the river flows over the outcrops of the Early Cretaceous Coastal Plain formations (fig. 13) these aquifers are recharged with river water (Parker, *et. al.*, 1964). Figures 7, 12, & 13 show that the latter occurs in a region of high volume ground-water withdrawal as well as in the vicinity of the Chambers Works site. The significance is demonstrated in the observation that ground-water withdrawal induces recharge from surface water bodies (rivers, streams, lakes, etc.) (Parker, *et. al.*, 1964). Therefore, saline water replaces the pumped fresh water in the aquifers. Salt water encroachment into the aquifers differs due to natural conditions as well. In general, salt water extends farthest inland in the lowest aquifers (Olmstead, *et. al.*, 1960). Figure 14 shows the hypothetical salt water/fresh water interface. It must be noted that salt water content and total dissolved solids (TDS) content show a relationship. Matthess (1982) determined that TDS in mg/l in fresh water could be estimated by multiplying the specific conductance of the water in $\mu\text{S}/\text{cm}^*$ by the factor 0.65. The specific conductance of an aqueous solution of one or more salts is made up of the conductances of the individual cations and anions. A background value for total dissolved solids may be derived from the work performed by Parker & others (1964); the range in dissolved solids in uncontaminated ground water from the Early Cretaceous aquifers was 30 - 200 ppm (1964). Chloride concentrations in the lower Potomac-Raritan-Magothy aquifer range from 250 mg/l to 27,000 mg/l (Luzier in Walker, 1983).

The Hydrologic System

As seen in table 8, the hydrologic table, the Coastal Plain is actually one interrelated hydrogeologic system. Due to its structural and depositional settings, it is a series of alternating aquifers and aquitards. The Quaternary deposits usually display water-table conditions although silt and clay lenses may cause local confining conditions. Due to the wedge-shape of the Coastal Plain, the artesian aquifers of Tertiary and Cretaceous age receive direct recharge at their outcrops and from infiltration of water percolating through Quaternary deposits unconformably overlying them. This system was originally saturated with salt water, a fact of its mostly marine depositional environment (Olmstead, *et. al.*, 1960). With time, the system was flushed out with fresh water. As previously discussed, salt water intrusion is both a natural and man-induced phenomenon.

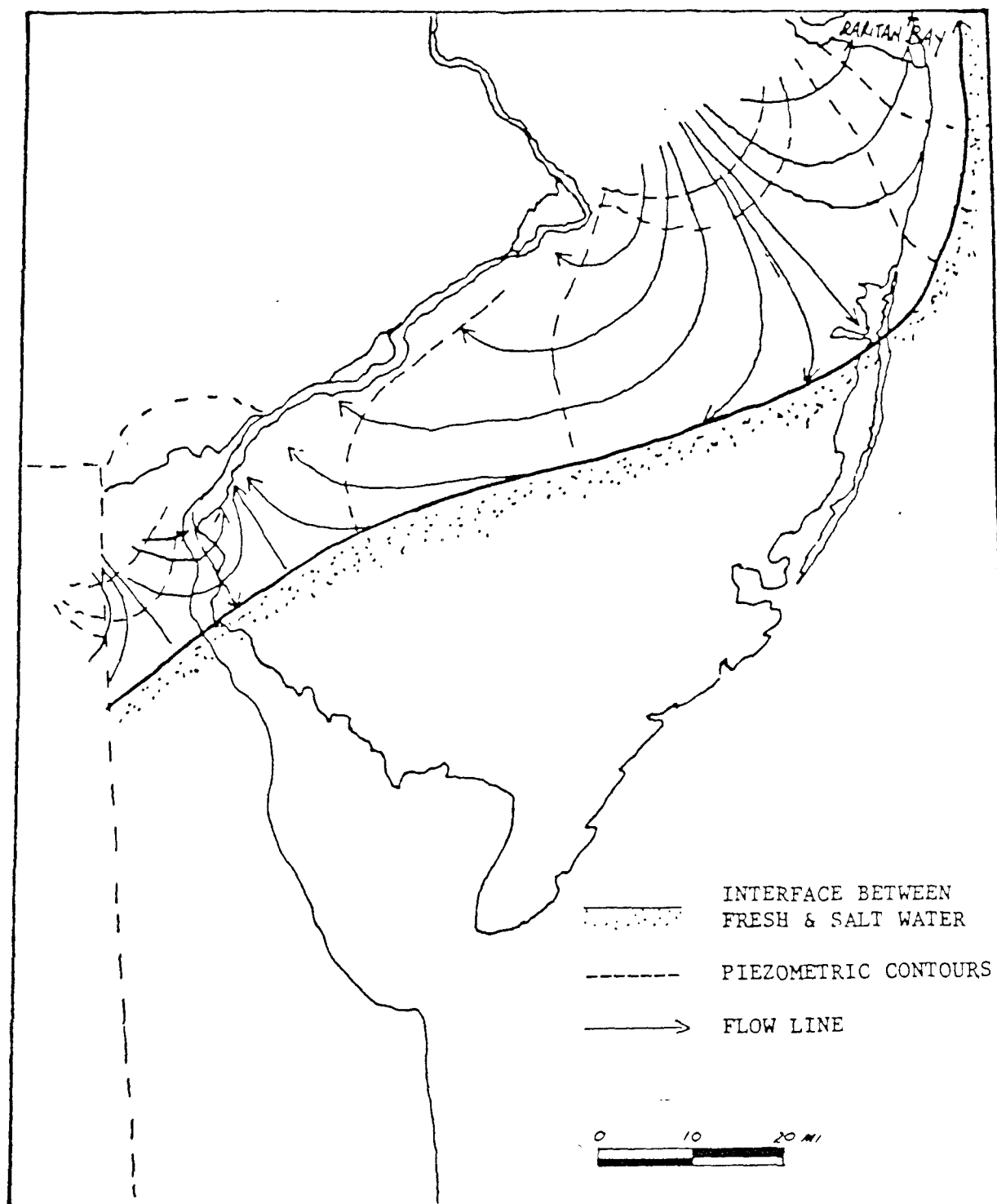
* $\mu\text{S}/\text{cm}$ = micro Siemens (formerly mho) per centimeter

Figure 13. Outcrop Area of the Potomac-Raritan-Magothy Aquifer System (Recharge/Discharge Zone) along the Delaware River



Adapted from: Parker, G.G., A.G. Hely, W.B. Keighton, F.H. Olmsted, & others, 1964, Water Resources of the Delaware River Basin, USGS Professional Paper 38

Figure 14. The Hypothetical Salt Water - Fresh Water Interface & Theoretical Flow Pattern in the Potomac-Raritan-Magothy Aquifer System



Adapted from: Parker, G.G, A.G. Hely, W.B. Keighton, F.H. Olmsted, & others, 1964, Water Resources of the Delaware River Basin, USGS Professional Paper 38

CHAMBERS WORKS SETTING

The hydrogeology specifically pertaining to the Chambers Works site has been derived from information submitted to EPA and NJDEP by DuPont and a literature search. DuPont gathered hydrogeological information by a number of workers: a DuPont geologist in the 1960's, a well drilling company (W.C. Services [formerly A. C. Schultes]) from the 1960's through the 1980's, and the consulting firm Leggette, Brashears, & Graham, Inc. (LBG) from the 1970's through the 1980's.

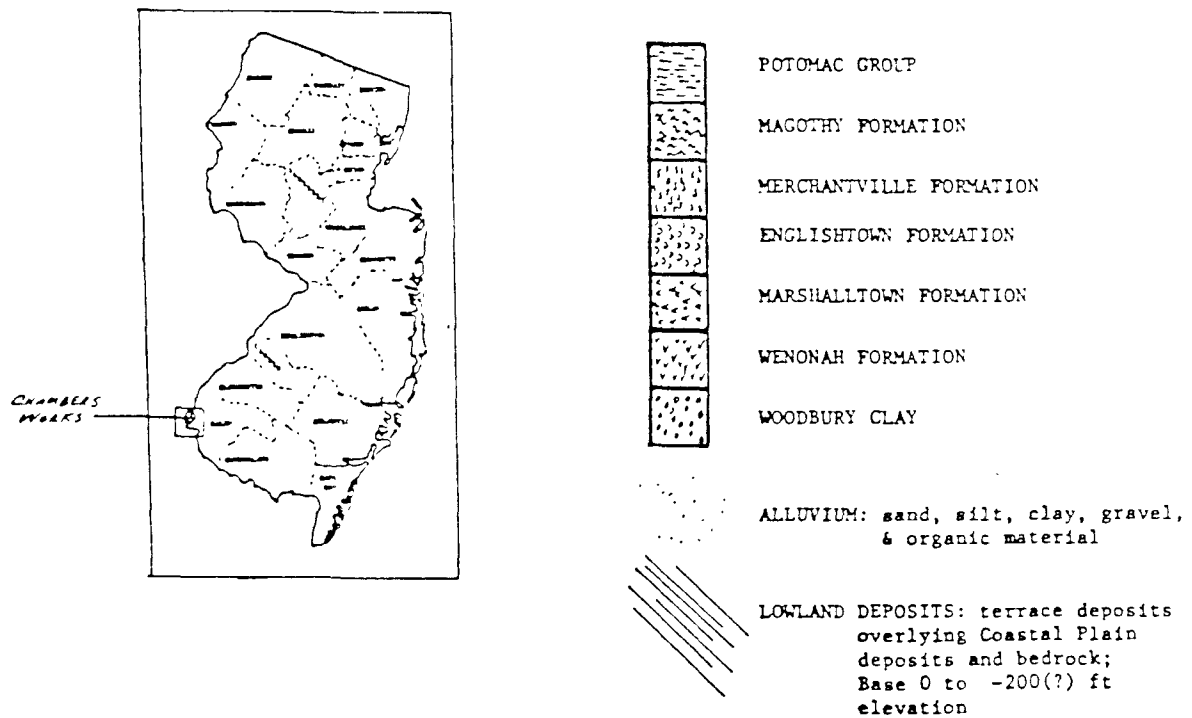
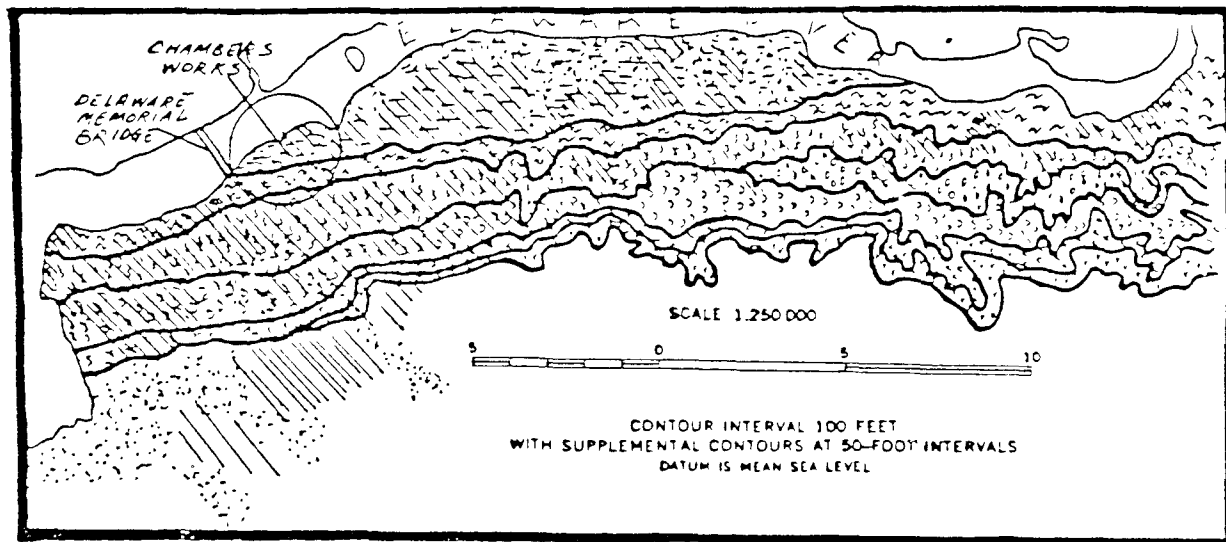
Quaternary Deposits

As depicted on figure 15, the surficial geology of Salem County, the Chambers Works was built on marsh and swamp deposits and glacial outwash (Cape May Formation). Approximately 15 ft of fill was placed over the natural sediment (Curry, pers.comm.). USGS reports the marsh and swamp deposits to achieve a maximum thickness of 15 ft. The Cape May Formation is reported to be 100 ft thick in northern Delaware. These reports correlate with the information submitted by DuPont. LBG reported the deposits underlying the Chambers Works to attain a thickness of 120 - 130 ft and exist as highly permeable stringers and lenses of sand and gravel interfingering with silt and clay zones (LBG, 1981). Figure 16 is the LBG general stratigraphic interpretation of the site. It correlates with Minard's interpretation of Penns Grove; an ancient valley in the Delaware cut into the Cretaceous Raritan Formation presently filled with Quaternary glacial/interglacial sediments (1969).

The uppermost sands are directly recharged by local infiltration at the land surface with eventual permeation into the deeper zones. LBG reports true water-table conditions to a depth of 40 ft and semi-artesian conditions encountered from 40 - 120 ft (LBG, 1981). This meshes well with the USGS description of the Cape May Formation; direct recharge, water-table conditions in general but local artesian conditions due to clay lenses.

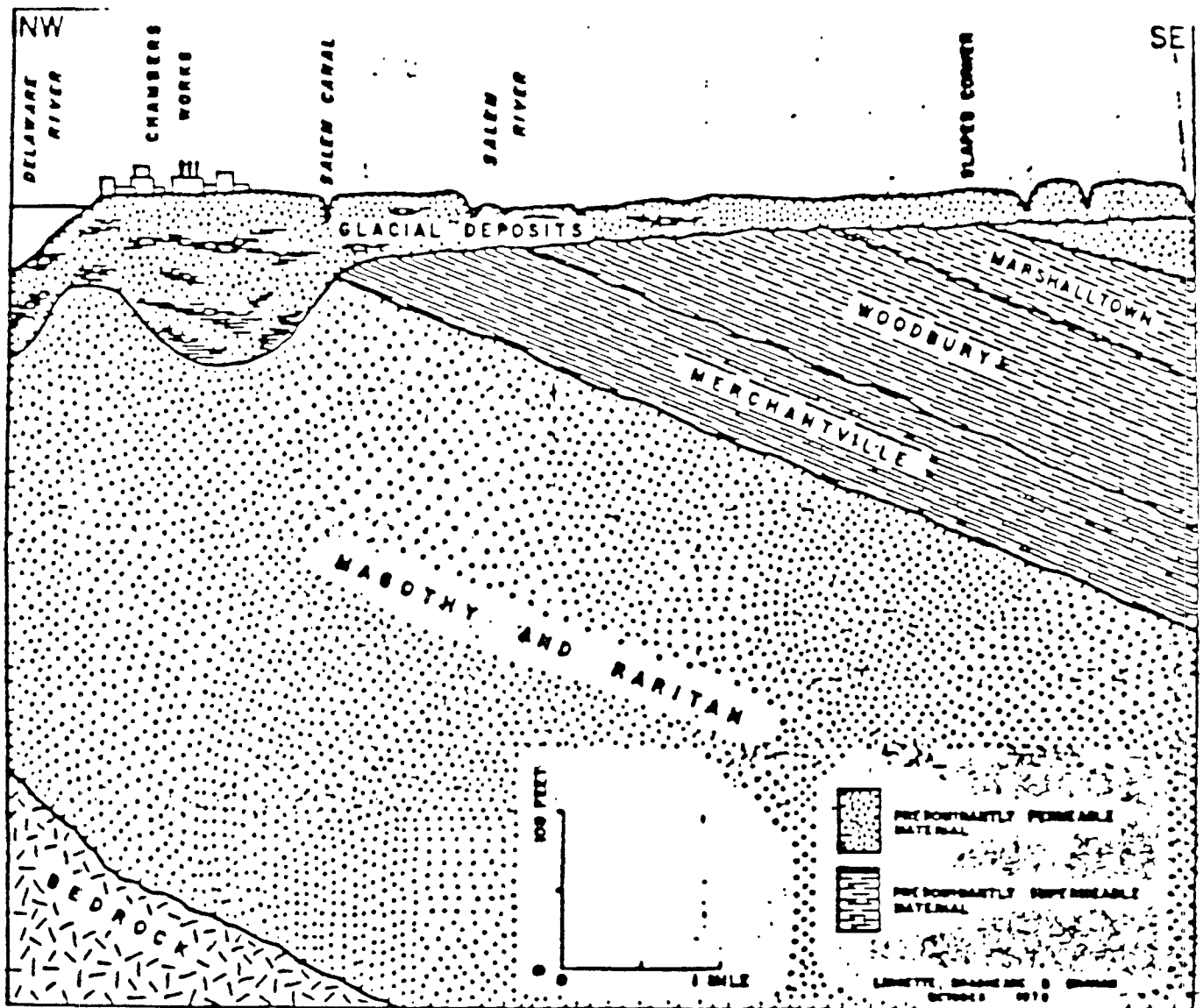
An important hydrologic factor in this area is that the marsh and swamp deposits may serve as portals for salt water encroachment into underlying aquifers where the hydraulic head has been lowered below sea level by pumping (Parker, et. al., 1964). Salt water intrusion in the Glacial aquifer zones has not been considered a factor by DuPont. The effects are important on a chemical basis, as salt water influences the TDS content of the ground water.

Figure 15. Coastal Plain and Surficial Geology in Salem County



Adapted from: USGS Miscellaneous Geologic Investigations Map I-514-B, 1967, Engineering Geology of the Northeast Corridor Washington, D.C., to Boston, MA.: Coastal Plain and Surficial Deposits

Figure 16. Leggette, Brashears, & Graham, Inc.
General Stratigraphic Interpretation of the Chambers
Works facility



E. I. du Pont de Nemours & Co., Inc.
CHAMBERS WORKS, DEEPWATER, N. J.

SCHEMATIC GEOLOGIC PROFILE OF
DIPPING COASTAL PLAIN SEDIMENTS ON
BEDROCK FLOOR, SOUTHEASTWARD, FROM
DELAWARE RIVER AT DEEPWATER POINT, N. J.

Cretaceous Deposits

Figure 15 depicts the surficial geology and outcrop areas of the Coastal Plain formations in Salem County. As shown, directly beneath the Quaternary deposits (alluvium and lowland terrace deposits) are the Early Cretaceous formations which comprise a major aquifer system in the Coastal Plain. This is the Potomac-Raritan-Magothy aquifer system.

Gill and Farlekas defined three major zones in this aquifer system underlying the approximately 400 square miles southwest of Trenton adjacent to the Delaware River (Walker, 1983). These are delineated as shallow, middle, and deep. The deep and middle zones lack a confining unit in places adjacent to the Delaware River (Gill and Farlekas in Walker, 1983). LBG's interpretation of this system corresponds; they define only a shallow and deep aquifer for the Potomac-Raritan-Magothy aquifer system at the Chambers Works.

Table 7 and table 8 provide the general lithologic and hydrologic data for the Potomac-Raritan-Magothy aquifer system. Specifically, the deep aquifer is composed of undifferentiated sand, gravel, silt, and clay of the Potomac Group and Raritan Formation. It lies unconformably on pre-Cretaceous bedrock which acts as a confining unit (Walker, 1983). The upper confining unit is the Woodbridge Clay Member of the Raritan Formation, a thick sequence of silt and clay (Farlekas in Walker, 1983). The shallow aquifer is mainly the Magothy Formation; sand and clayey silt. Its lower confining unit is the Woodbridge Clay Member of the Raritan Formation while its upper confining unit is the Merchantville Formation and Woodbury Clay.

The Potomac-Raritan-Magothy aquifer system yielded 50 billion gallons of water in 1967 in Salem, Gloucester, Camden, and Burlington counties (Gill, et.al., 1976). Aquifer tests in Burlington, Camden, and Gloucester indicate transmissivity ranging from 2,300 to 31,000 ft³ per day and a storage coefficient ranging from .000033 to .004 (Meisler in Gill, et.al., 1976). According to Gill (1976) this aquifer system is the most heavily pumped in New Jersey.

DuPont contends that industrial contamination only threatens the aquifers of the uppermost 120 - 130 ft (the Glacial aquifers). The company has concluded from their data that no hydraulic connection exists between the uppermost units and the Potomac-Raritan-Magothy aquifer system. However, the known confining unit for the shallow aquifer of this system, the Merchantville Formation, does not exist at the Chambers Works site (figures 15 and 16). It is possible that confining zones exist within the Glacial aquifer and the Magothy Formation. However, these zones have not been proven to be impermeable or ubiquitous throughout the site. Walker (1983) has also determined that in some localities, the deep Potomac-

Raritan-Magothy aquifer may receive recharge vertically through the leaky confining unit between the middle and deep Potomac-Raritan-Magothy aquifers; potentiometric heads in the middle and deep zones are similar and are generally lower than the heads in the shallow aquifer.

Glacial Aquifers

The natural ground-water flow in these deposits has not been specifically defined in the literature. It can be postulated that ground water originally flowed from topographic highs to topographic lows with recharge from infiltration of precipitation. Where these systems are hydraulically connected to other aquifers or surface water systems, flow would be affected by the properties of these other systems.

THE ALTERED GROUND-WATER FLOW REGIME

In general, ground water flows from outcrop areas and from downdip regions of the aquifers toward the major cones of depression. In some localities, the flow directions are toward natural discharge points (Walker, 1983).

The 1956 Gill and Farlekas (1976) map shows the effects of artificial ground-water discharge by pumping (purge) wells. The pumping of the ground water created cones of depression causing flow radially inward toward these wells. Areas of heavy ground-water use are at the centers of the cones of depression. Continuous and higher capacity pumping has created a larger cone of depression influencing a larger region as shown in the 1968 map.

At the Chambers Works, LBG has produced potentiometric surface maps for the upper and lower Potomac-Raritan-Magothy aquifers in the annual progress reports for their "corrective action program." The 1985 report, as illustrated in figure 20, indicates that ground water in the deep aquifer travels northwesterly, towards the Delaware River. The shallow aquifer's flow is towards the south with both a southwesterly and southeasterly component.

LBG has also produced potentiometric surface maps for each of the three zones of the Glacial aquifer. Maps were constructed using the highest and lowest water levels for each zone. Figures 21 through 26 compare the 1977 flow regime with the 1985 flow regime. Generally, the maps portray the influence of the cones of depression on each Glacial aquifer zone due to the various wells used for purging and their pumping capacities through time. In all cases the cones of depression are of greater extent in 1985 than in 1977 due to the capacity purged from the wells along with the length of time the "corrective action program" has been running.

KEY FOR FIGURES 17 THROUGH 26



OUTCROP OF POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM



POTENTIOMETRIC CONTOUR



DOWNDIP LIMIT OF FRESH WATER (LESS THAN 250 mg/l CHLORIDE CONCENTRATION) OF THE LOWER AQUIFER IN THE SYSTEM

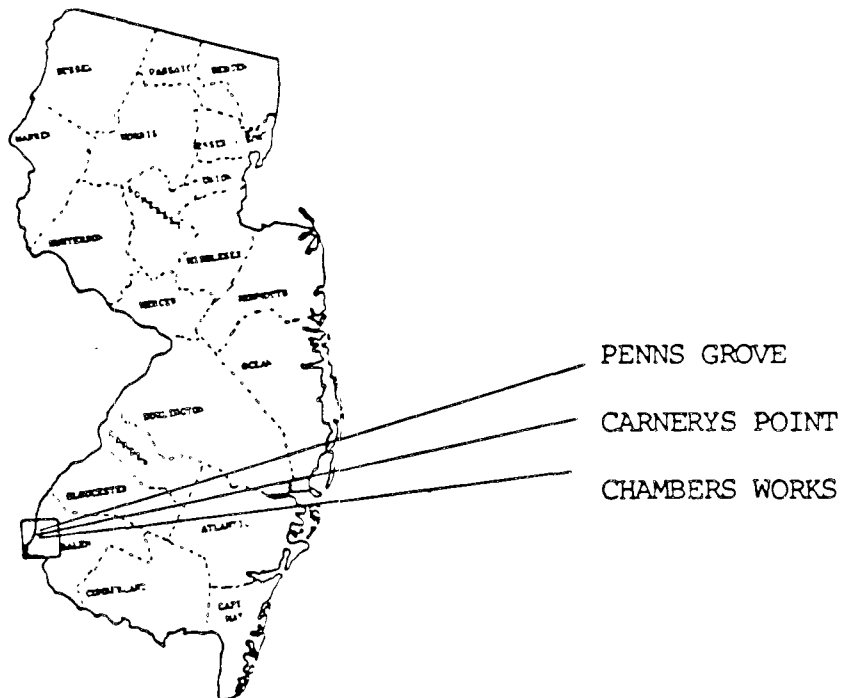
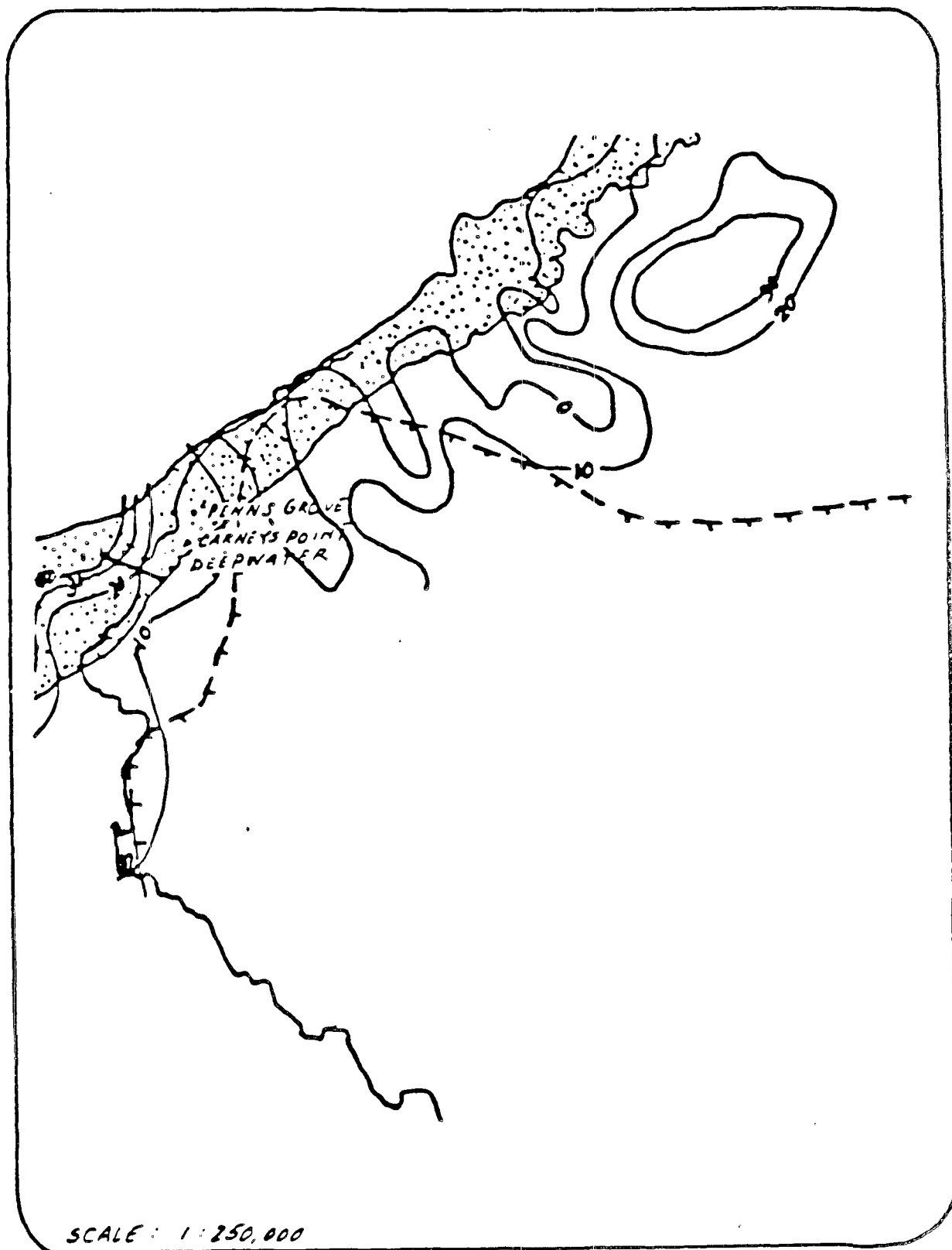
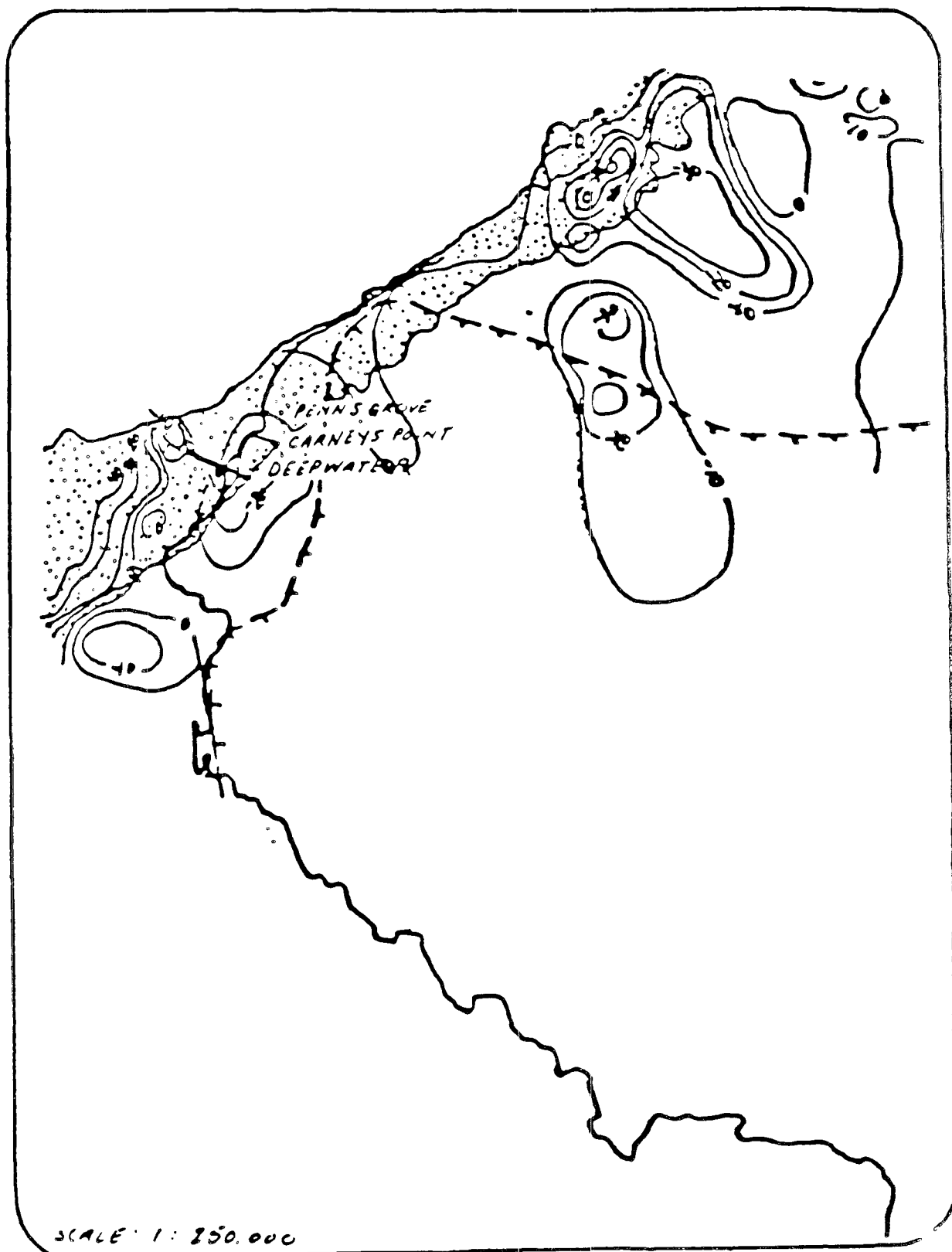


Figure 17. Generalized Prepumping (1900) Potentiometric Surface of the Potomac-Raritan-Magothy Aquifer System



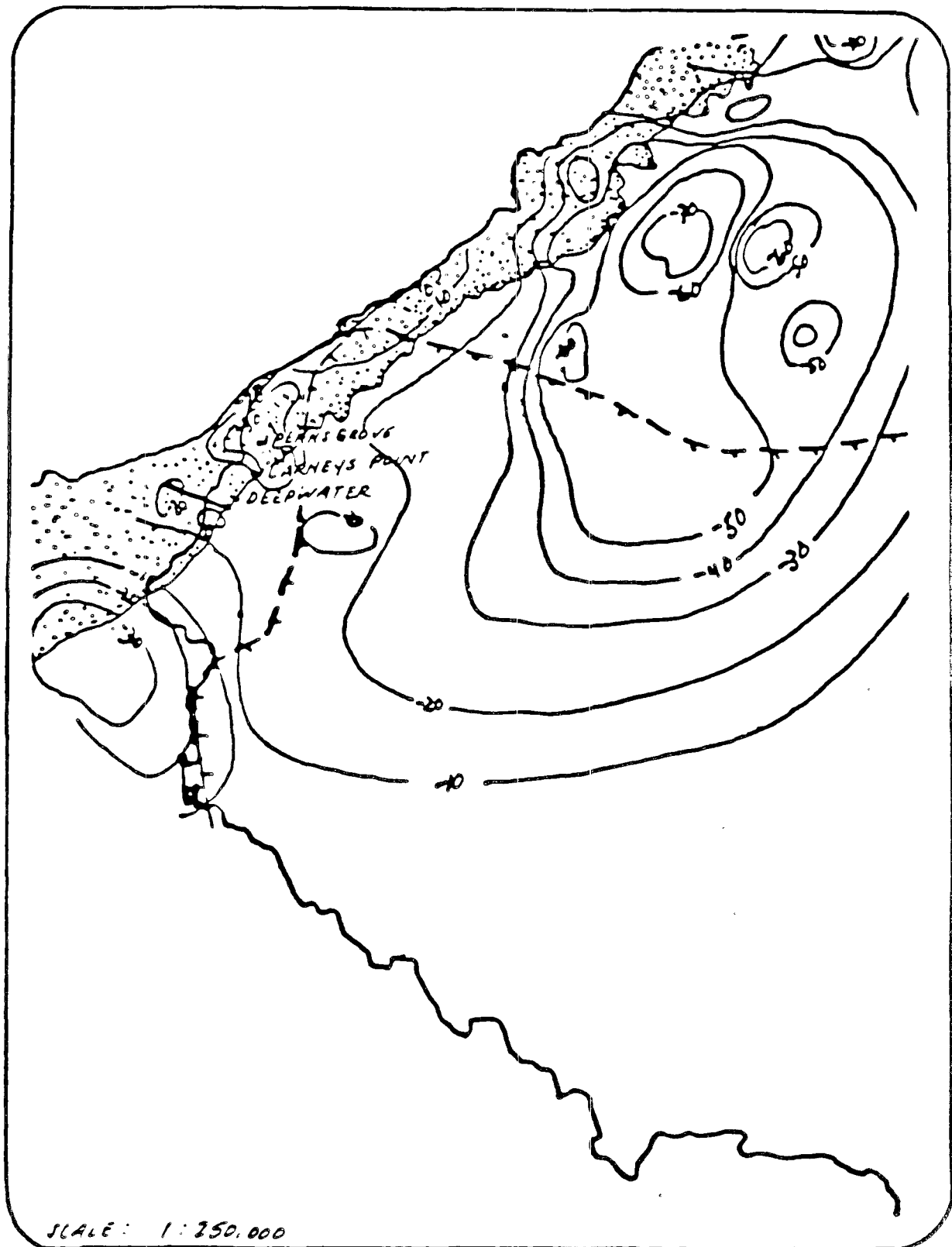
Adapted from: Gill, H.E. & G.M. Farlekas, 1976, Geohydrologic Maps of the Potomac-Raritan-Magothy Aquifer System in the N.J. Coastal Plain, USGS Atlas HA-557

Figure 18. Generalized Potentiometric Surface of the Potomac-Raritan-Magothy Aquifer System for 1956



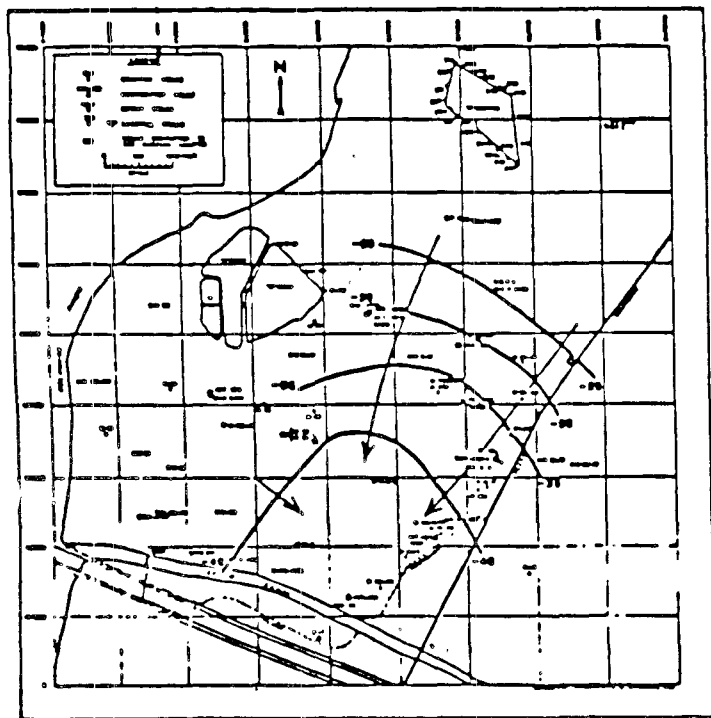
Adapted from: Gill, H.E. & G.M. Farlekas, 1976, Geohydrologic Maps of the Potomac-Raritan-Magothy Aquifer System in the N.J. Coastal Plain, USGS Atlas HA-557

Figure 19. Generalized Potentiometric Surface of the Potomac-Raritan-Magothy Aquifer System for 1968

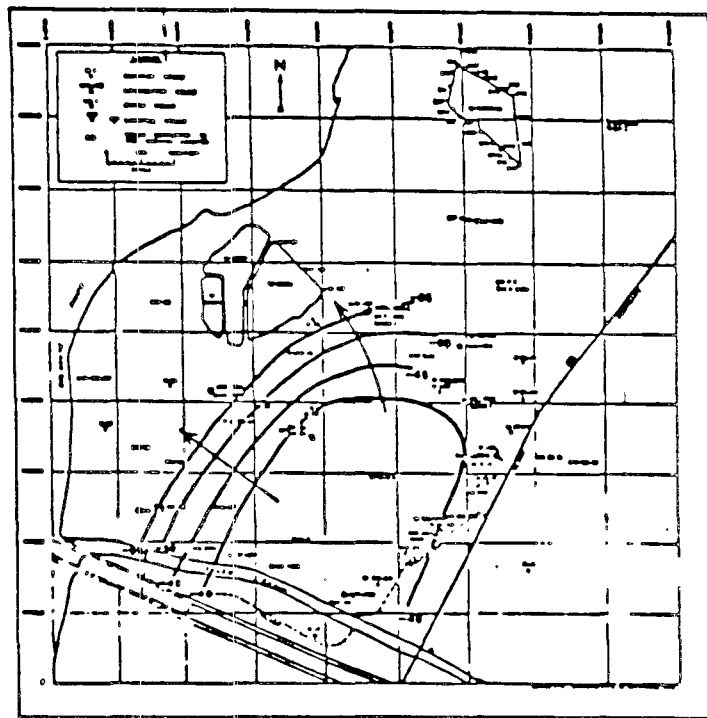
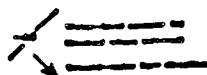


Adapted from: Gill, H.E. & G.M. Farlekas, 1976, Geohydrologic Maps of the Potomac-Raritan-Magothy Aquifer System in the N.J. Coastal Plain, USGS Atlas HA-557

Figure 20. Potentiometric Surface Maps for the Shallow and Deep Potomac-Raritan-Magothy Aquifer Zones at the Chambers Works (LBG)

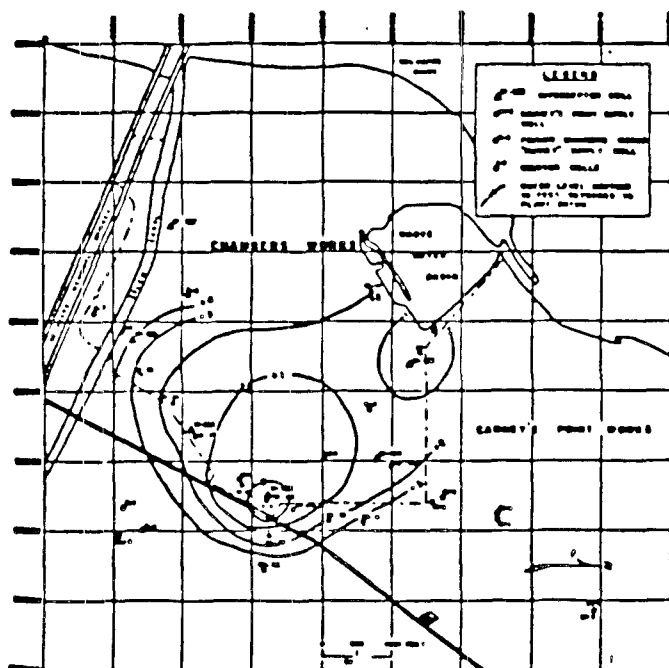


POTENTIOMETRIC SURFACE OF
THE SHALLOW RARITAN AQUIFER
OCTOBER 25, 1966



POTENTIOMETRIC SURFACE OF
THE DEEP RARITAN AQUIFER
MARCH 25, 1966

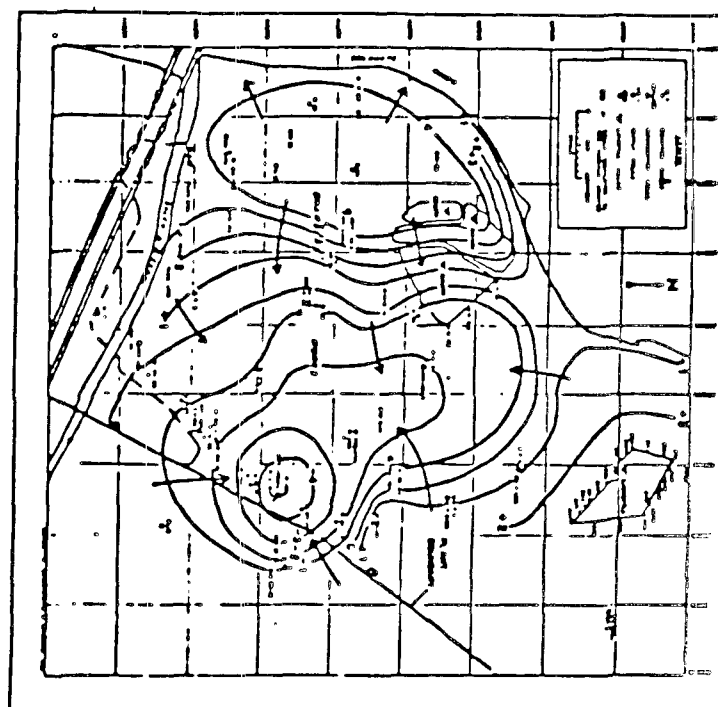
Figure 21. Potentiometric Surface Maps for the Highest Water Levels in the Shallow Glacial Zone (1977 & 1985) (LBG)



HIGHEST WATER LEVEL IN SHALLOW GLACIAL ZONE IN 1977, BASED ON APRIL 18 DATA, WITH THE FOLLOWING WELLS PUMPING:

W-1 2-210 GPM
W-2 2-200 GPM
DUNN 1 2-220 GPM
TOT 4-670 GPM

Observation points are shown where indicated
Water level is shown

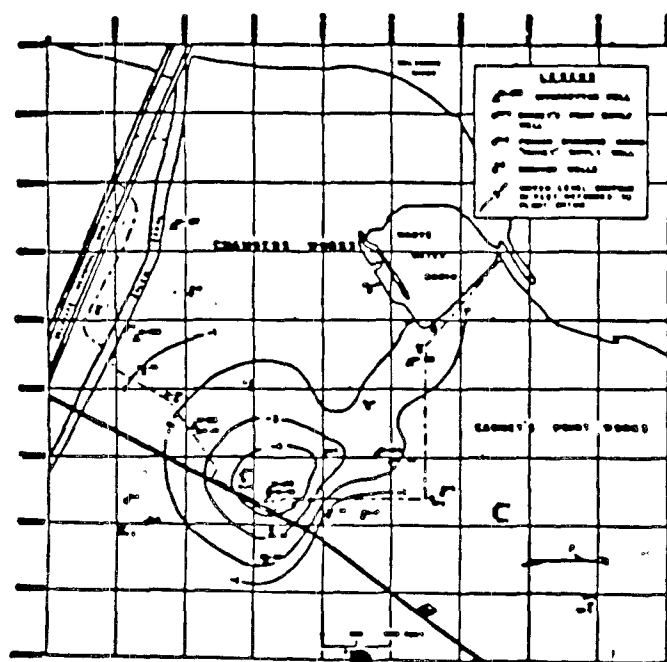


HIGHEST WATER LEVELS IN THE SHALLOW GLACIAL ZONE JANUARY 2, 1985

PUMPING WELLS:

W-1-100A	400	GPM
W-1-100A	400	GPM
W-1	370	GPM
TOTAL	1170	GPM

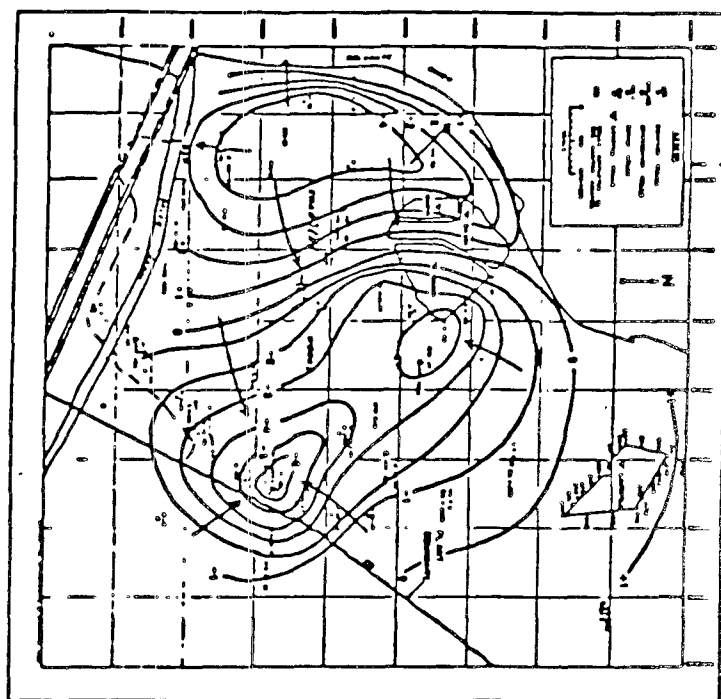
Figure 22. Potentiometric Surface Maps for the Lowest Water Levels in the Shallow Glacial Zone (1977 & 1985) (LBG)



LOWEST WATER LEVEL IN SHALLOW GLACIAL ZONE
OCTOBER 1977, BASED ON OCTOBER 1977
DATA, WITH THE FOLLOWING WELLS PUMPING:

W-102 = 100 GPM
W-103 = 100 GPM
RANNEY S = 300 GPM
TOTAL = 500 GPM

--- Contour interval 100 feet
--- Contour interval 50 feet

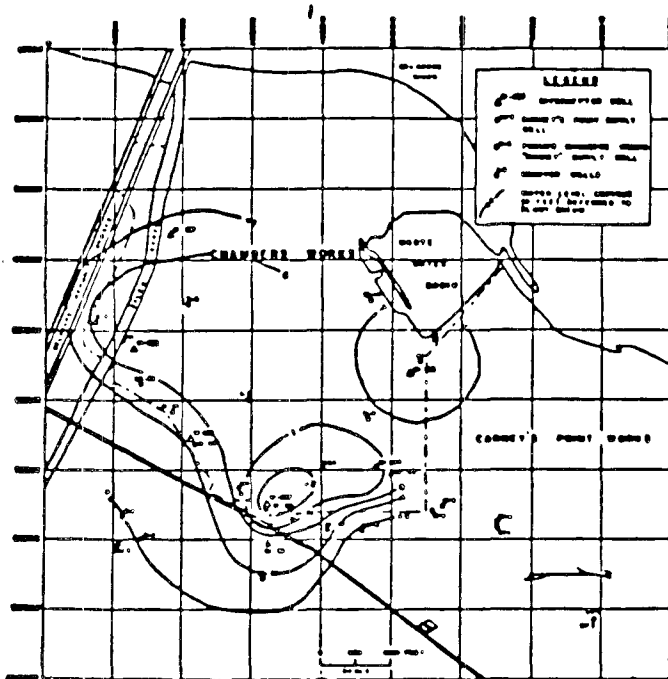


LOWEST WATER LEVELS
IN THE SHALLOW
GLACIAL ZONE
JUNE 1985

PUMPING WELLS:

W-102A	200	GPM
W-103	200	GPM
R-S	500	GPM
W-100	100	GPM
TOTAL	1000	GPM

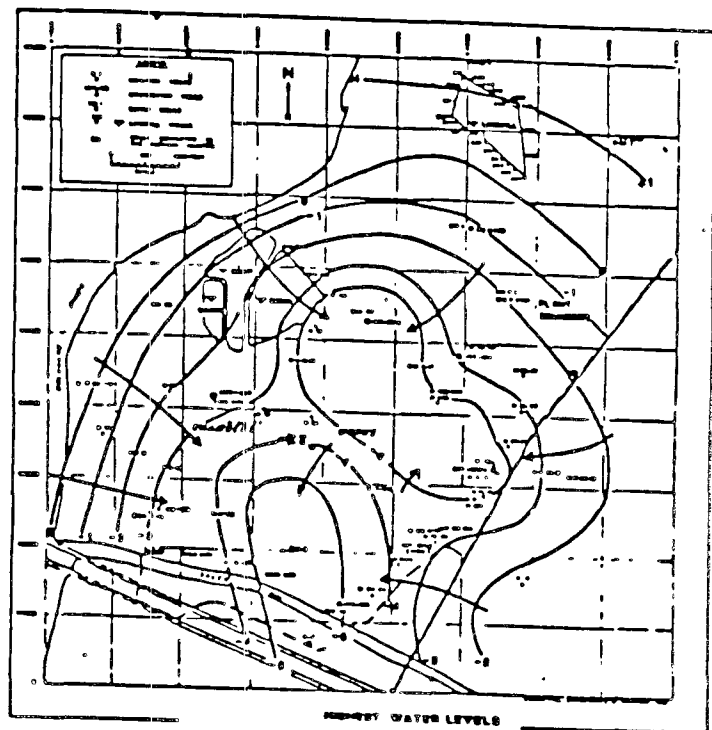
Figure 23. Potentiometric Surface Maps for the Highest Water Levels in the Middle Glacial Zone (1977 & 1985) (LBG)



HIGHEST WATER LEVEL IN MIDDLE GLACIAL
AQUICLUD ZONE, IN 1977, BASED ON APRIL 12
DATA, WITH THE FOLLOWING WELLS PUMPING:

W 102 = 110 GPM
W 103 = 240 GPM
B-2 = 220 GPM
TOTAL = 670 GPM

--- Contour lines are
drawn from the data

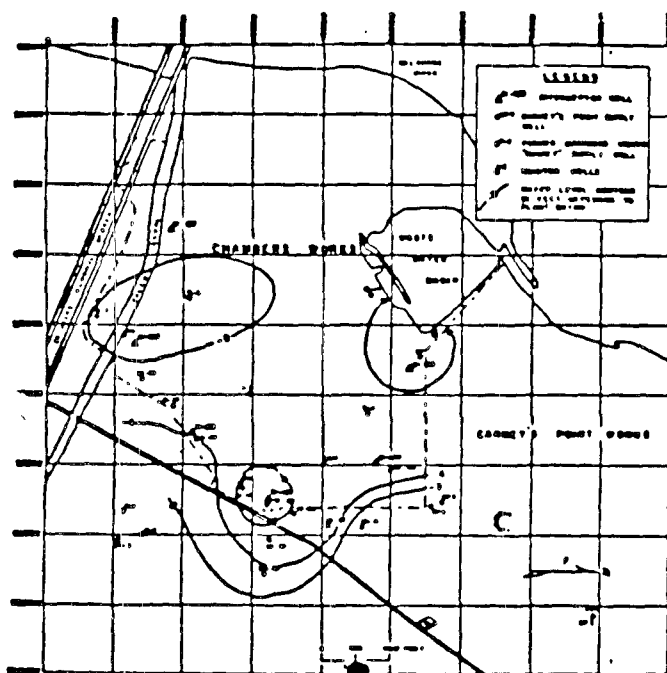


HIGHEST WATER LEVELS
IN THE MIDDLE
GLACIAL AQUIFER
JANUARY 2, 1985

PUMPING WELLS:

WY-102A	600 GPM
WY-103A	400 GPM
B-2	220 GPM
TOTAL	1220 GPM

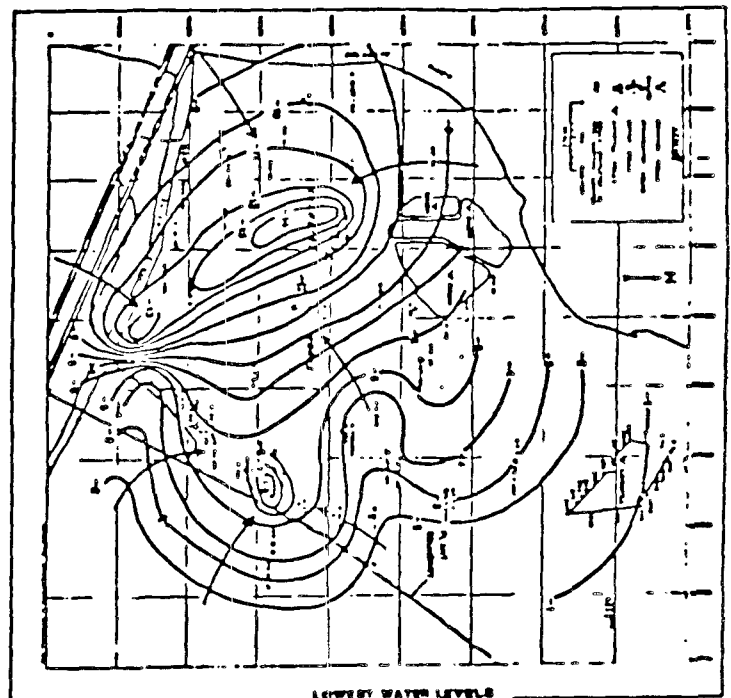
Figure 24. Potentiometric Surface Maps for the Lowest Water Levels in the Middle Glacial Zone (1977 & 1985) (LBG)



LOWEST WATER LEVEL IN MIDDLE GLACIAL
ADVERSE ZONE IN 1977, BASED ON OCTOBER 19
DATA, WITH THE FOLLOWING WELLS PUMPING:

W-K 1 = 200 GPM
W-K 3 = 340 GPM
BARNETT 3 = 300 GPM
TOTAL = 840 GPM

--- Contour interval 100
--- Contour interval 500

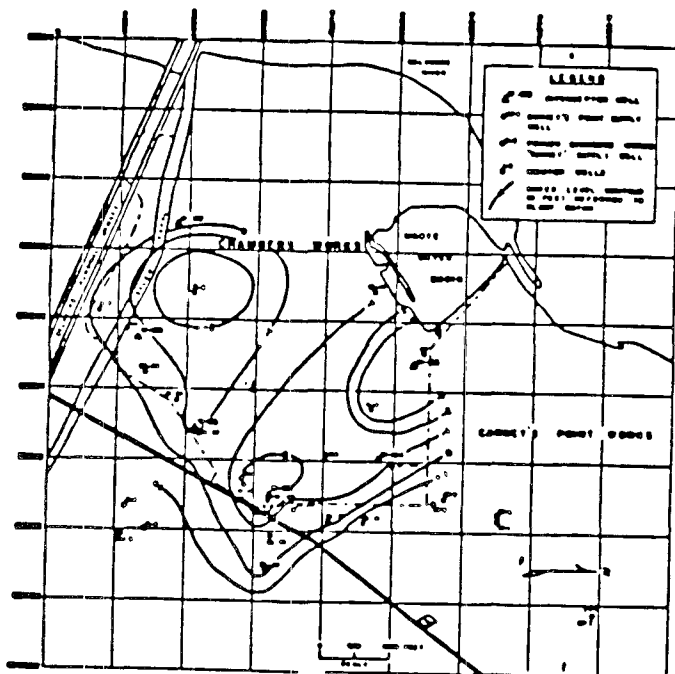


LOWEST WATER LEVELS
IN THE MIDDLE
GLACIAL ADVERSE
ZONE IN 1985

PUMPING WELLS:

W-K 1	200	GPM
W-K 3	340	GPM
BARNETT 3	300	GPM
TOTAL	840	GPM

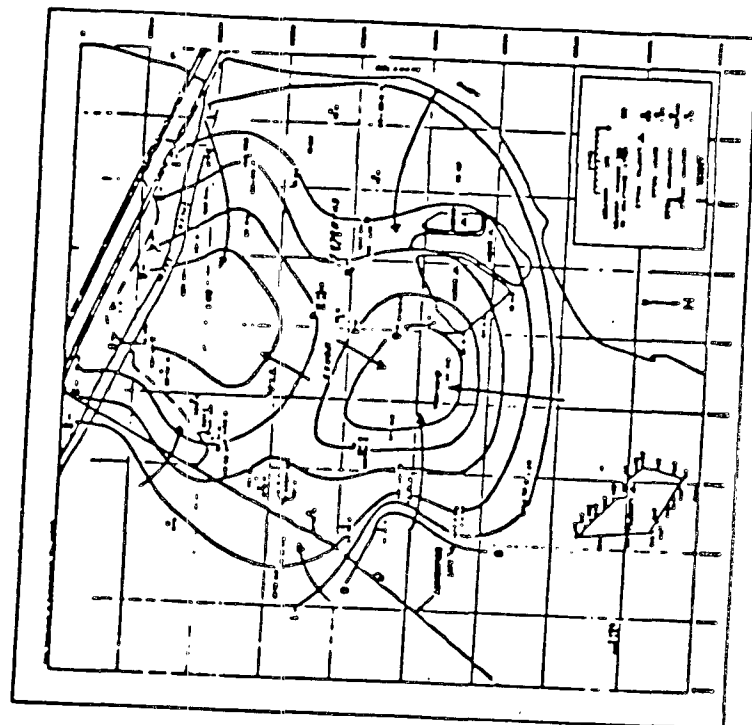
Figure 25. Potentiometric Surface Maps for the Highest Water Levels in the Deep Glacial Zone (1977 & 1985) (LBG)



HIGHEST WATER LEVEL IN DEEP GLACIAL
AQUIFER ZONE IN 1977, BASED ON APRIL 12
DATA, WITH THE FOLLOWING WELLS PUMPING:

W-100 = 240 GPM
W-103 = 240 GPM
BARNETT 8 = 270 GPM
TOTAL = 670 GPM

— Contour lines are
— Contour lines are
— Contour lines are

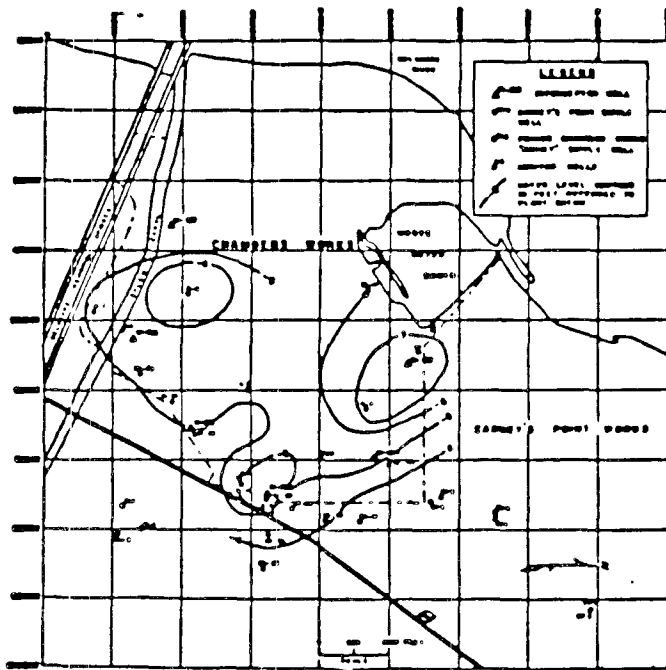


HIGHEST WATER LEVELS
IN THE DEEP
GLACIAL AQUIFER
JANUARY 2, 1985

PUMPING WELLS:

WY-100A	200 GPM
WY-102A	270 GPM
B-8	270 GPM
TOTAL	740 GPM

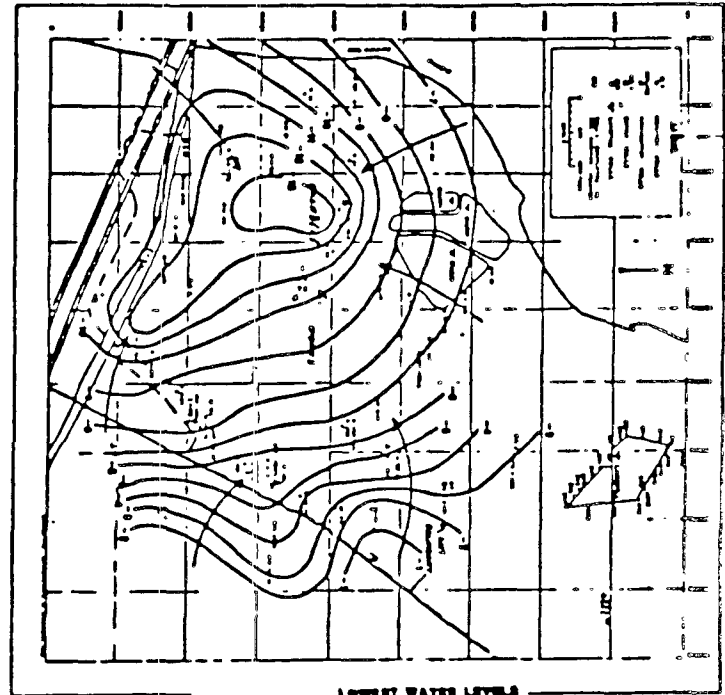
Figure 26. Potentiometric Surface Maps for the Lowest Water Levels in the Deep Glacial Zone (1977 & 1985) (LBG)



LOWEST WATER LEVEL IN DEEP GLACIAL
ADQUIFER ZONE IN 1977, BASED ON OCTOBER 10
DATA, WITH THE FOLLOWING WELLS PUMPED:

W-100 = 200 GPM
W-50 = 350 GPM
SARNOY'S = 200 GPM
TOTAL = 850 GPM

Observation wells and
contour lines shown
Observation well location



LOWEST WATER LEVELS
IN THE DEEP
GLACIAL AQUIFER
JUNE 25, 1985

PUMPING WELLS:

WY-100A	200	GPM
WY-100	410	GPM
S-5	210	GPM
WY-100	200	GPM
TOTAL	1020	GPM

GROUND-WATER MONITORING REQUIREMENTS

NEW JERSEY GROUND-WATER REGULATORY HISTORY

On May 6, 1970, the Solid Waste Management Act became effective. It was authorized by the New Jersey Statutes Annotated (N.J.S.A.) 13:1E. It was amended in 1975. Under this Act, the New Jersey Department of Environmental Protection (NJDEP) established its Division of Waste Management (DWM) and promulgated the regulations under the New Jersey Administrative Code (N.J.A.C.) Title 7, Volume C, Subtitle F, the Hazardous Waste Regulations (N.J.A.C. 7:26-1, 4, 7-13A). Ground water is specifically regulated under N.J.A.C. 7:26-9.5.

In 1976, New Jersey passed the Spill Compensation and Control Act. This Act was the model for the Federal Government's Act, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980.

Passage of the Water Pollution Control Act occurred on April 25, 1977. This Act was authorized by N.J.S.A. 58:10A-1. Under the Water Pollution Control Act, the NJDEP promulgated the regulations under N.J.A.C. 7:14 which were filed and became effective on July 27, 1977. Prior to passage of this Act, rules governing the protection of ground water were established. These are found under N.J.A.C. 7:9 and 7:10. N.J.A.C. 7:9 was adopted pursuant to the authority of N.J.S.A. 26:2E-1 et seq., 13:1D-1 et seq., 58:10A-1 et seq., and 58:11A-1 et seq. and was filed and became effective prior to September 1, 1969. N.J.A.C. 7:10 was adopted pursuant to the authority of N.J.S.A. 58:11-1 et seq. and was filed and became effective prior to September 1, 1969. Amendments to N.J.A.C. 7:10 were adopted pursuant to the authority of N.J.S.A. 13:1D-1 et seq., 58:12A-1 et seq., and 58:12A-1 et seq. and were filed and became effective on July 13, 1979, as R.1979d.271. Under N.J.A.C. 7:9 and 7:10, regulations exist for ground-water quality standards, sealing abandoned wells, and primary and secondary drinking water standards. Also, N.J.A.C. Title 7, Subtitle D established the NJDEP's Division of Water Resources (DWR). Since the Water Pollution Control Act was passed to enable the NJDEP to control water pollution, create a pollutant discharge elimination system, provide penalties, and grant rule-making authority, the regulations under N.J.A.C. 7:14A were created, in addition to N.J.A.C. 7:9, 7:10, and 7:14. N.J.A.C. 7:14A is the New Jersey Pollutant Discharge Elimination System (NJPDDES). It was promulgated under the authority of N.J.S.A. 58:10A-1 et seq., 58:11A-1 et seq., 58:11-49 et seq., 58:10-23.11 et seq., 58-11-18.10 et seq., 13:1D-1 et seq., 13:1E-1 et seq., 58:4A-5, 58:4A-4.1, and 58:12A-1 et seq. Note that under NJPDDES, discharge of pollutants to both surface water and ground water are regulated. Furthermore, New Jersey defines "Waters of the State" as

the ocean and its estuaries, all springs, streams and bodies of surface or groundwater, whether natural or artificial, within the boundaries of this State or subject to its jurisdiction.

THE RESOURCE CONSERVATION AND RECOVERY ACT OF 1976

The Resource Conservation and Recovery Act of 1976 (RCRA) was enacted by PL 94-580, October 21, 1976; 90 Stat. 95, 42 U.S.C. 6901 et seq.; Recodified as 42 U.S.C. 6901 et seq.; Amended by PL 95-609, November 8, 1978; PL 96-463, October 15, 1980; PL 96-482, October 21, 1980; PL 96-510, December 11, 1980; PL 97-272, September 30, 1982; PL 97-375, December 21, 1982; PL 98-45, July 12, 1983; PL 98-371, July 18, 1984; PL 98-616, November 8, 1984.

Under Subtitle C, Hazardous Waste Management, the United States Environmental Protection Agency (EPA) is provided with the authority to regulate hazardous waste management facilities. The regulations are found in the Code of Federal Regulations (CFR), Title 40, Chapter I, Subchapter I, Parts 260 through 270.

NJDEP AND RCRA

Although RCRA was created in 1976, the EPA did not codify the regulations until 1980. As described previously, NJDEP was already running a ground-water protection program under the Solid Waste Management Act, the Spill Compensation and Control Act, and the Water Pollution Control Act, under the Divisions of Waste Management and Water Resources. Note that many of the ground-water programs were established before 1969 prior to the Acts. As EPA codified the regulations under RCRA, the State of New Jersey began amending their Acts to be equal to or to be more stringent than the RCRA regulations in order to become authorized under Section 3006 of Subtitle C of RCRA. Section 3006 allows the EPA to authorize State hazardous waste programs to operate in the State in lieu of the Federal Hazardous Waste Program.

The State of New Jersey received Phase I interim authorization on February 2, 1983. Phase I allowed them to operate the regulations covering 40 CFR Parts 260 through 263, and 265. Phase IIA and phase IIB interim authorizations were granted to New Jersey on April 6, 1984. However, since New Jersey's application for phase IIA and phase IIB interim authorization was submitted after the deadline for inclusion of surface impoundments (January 26, 1983), their interim authorization only included the responsibility for permitting storage and treatment in tanks, containers, and incinerators. Phase II usually covers 40 CFR Parts 124, 264, and 270.

New Jersey applied for permitting authority of land disposal facilities on August 3, 1984. Their revised and complete application for final authorization was submitted on August 20, 1984. EPA published its intent to grant final authorization to New Jersey on November 28, 1984. New Jersey's final authorization became effective on February 21, 1985.

New Jersey's RCRA program is run primarily by DWM. However, since ground-water protection is delegated to DWR, DWR takes primary responsibility for RCRA ground-water issues. New Jersey's program is more stringent than the Federal program in the following respects:

1. Waste oil is listed as a hazardous waste;
2. Consequently, more facilities are regulated;
3. No exemptions are provided from the ground-water monitoring program; and
4. No waivers are granted during interim status.

NJDEP's RESPONSIBILITIES

NJDEP is responsible for permitting treatment, storage, and disposal (TSD) facilities within the State of New Jersey's borders as well as carrying out the other aspects of the RCRA program. NJDEP is also responsible for enforcement. Further, NJDEP must assist EPA in the implementation of the Hazardous and Solid Waster Amendments of 1984 (HSWA).

EPA's RESPONSIBILITIES

EPA provides the State of New Jersey with Federal funding. EPA regularly evaluates New Jersey's administration and enforcement of its hazardous waste program to ensure that the authorized program is being implemented consistent with RCRA. EPA also retains the right to conduct inspections and request information under Section 3007 of RCRA, to take enforcement action under Sections 3008, 3013, and 7003 of RCRA, and to enforce certain provisions of New Jersey State law. Currently, under Section 3006(g) of RCRA, 42 U.S.C. 6226(g), the new requirements and prohibitions imposed by HSWA take effect in authorized States. EPA must carry out these requirements until the States are authorized for HSWA. Therefore, EPA will administer HSWA in New Jersey until New Jersey applies for and receives authorization for HSWA. Therefore, EPA's direct responsibilities include:

1. Waiver requests;
2. Solid waste management units (SWMU).

DUPONT'S GROUND-WATER MONITORING PROGRAM PRIOR TO THE ENVIRONMENTAL LAWS

Overview

Manufacturing began at the Chambers Works in the early 1900's. The plant's operations during the early years were located in close proximity to the Delaware River, along the southern and western boundaries of the property. Powerhouse # 1, the first building constructed at the plant, was built upon the highest point of the property at the time. As manufacturing and consequently, employment increased, the plant expanded and was built out in an easterly direction. Since the property was originally a marsh it had to be artificially filled-in. The artificial fill was a mixture of river dredgings and industrial waste sludges and solids (LBG, 1971). There was no hazardous waste disposal technology during that time.

Monitoring Wells M-1 through M-29

In 1966, DuPont acknowledged the potential problems of the waste disposal practices followed at the Chambers Works throughout the years. A DuPont geologist was given a project to determine the hydrogeology at the Chambers Works plant. From 1966 to 1969, twenty-nine shallow observation wells were drilled near the southeast and northeast property boundaries. Unfortunately, only the driller's logs are available for study today. Gamma ray logs are reported to have been taken by H.E. Gill, a New Jersey State geologist (J. Curry, pers. comm.). The drillers' logs do not indicate the use of a standard soil classification system or provide the necessary detail for a hydrogeologic study.

Discovery of Ground-Water Contamination

In 1969, a private water supply well adjacent to the Chambers Works' eastern corner yielded Chambers Works' characteristic waste. DuPont hired the consulting firm LBG to evaluate the problem and assist in planning a method to control the migration of contaminants.

Contamination, Additional Ground-Water Monitoring, and Early Remediation Efforts

From 1970 through 1971, additional wells were installed under the supervision of LBG. These are: M-30 through M-45, M45A, M46, 101, 102, 105, and 107. All were logged by a qualified geologist and contain the information necessary for an accurate subsurface geologic description and interpretation. LBG submitted a report, "Results of Test Drilling and Pumping Tests with Recommendations for an Interceptor Well System, Groundwater Contamination Project Chambers Works, Deepwater, New Jersey," to DuPont in January, 1971. This report described what LBG considered to be the problem:

1. Most, if not all, of the surficial plant area is highly contaminated, with some wastes currently escaping beyond plant boundaries in directions to the east, southeast, and northeast.
2. Existing disposal methods are hydrologically undesirable and should be stopped.
3. The migration of polluted groundwater to areas beyond the property could be stopped by pumping from interceptor (waste recovery) wells constructed along plant boundaries. At the same time, such pumpage would cause some escaped water to move back into plant wells.
4. An interceptor system of wells could control groundwater contamination and be more practical and less expensive than an impermeable boundary around the plant or an interceptor ditch or gallery.
5. Pumping from plant wells at locations beyond plant boundaries, such as Ranney wells 1, 2, 3, and 4, should be stopped and an equivalent supply furnished by new interceptor wells.
6. Existing groundwater contamination will take years to correct, and adequate containment will involve continuous pumping of interceptor wells. Existing centers of high contamination on the surface should be graded and sealed over to minimize continuing leaching of the stored wastes. Ditches should be lined to prevent losses of wastes into the shallow sediments.

The report further described the solution LBG recommended:

...a pattern of wells to prevent migration of contaminated groundwater beyond plant property can be accomplished by imposing a widespread cone of depression beneath the plant. The combined cone of depression of several wells must be sufficiently deep and wide to reach all plant boundaries and form groundwater gradients inward toward pumping wells...the reversal of gradient should be maximum in the areas where migration beyond the plant boundaries has already occurred...the objective is not only to stop further migration but to reclaim some of the contaminated water now underlying properties adjacent to the plant.

This interceptor well pattern was ultimately determined by LBG's pumping test data and interpretations of the hydrology and geology. This recovery system began operating in 1973.

Annual Progress Reports

Starting in 1975, progress reports of the contaminated ground-water recovery system were submitted to DWR and the Delaware River Basin Commission (DRBC). The reports submitted in March 1978 (the report discussing the events of calendar year 1977) through March 1986 are currently available in EPA-II offices.

The Monitor and Interceptor Well Network

The summaries from the Annual Progress Reports demonstrate that the LBG "corrective action program" continuously changed through time as warranted. On-site, as well as off-site wells, were installed for monitoring the progress of the "corrective action program." Even as the RCRA regulations became effective, the "corrective action program" continued on its course. Ultimately, DuPont molded the "corrective action program's" monitor well system, along with the monitor wells installed under the auspices of the Solid Waste Regulations of New Jersey, N.J.A.C. 7:26-1 et seq., to fit the 40 CFR Part 265 Subpart F ground-water monitoring regulations. This being the case, it is important to note the well drilling and installation sequence:

1966-1969: M-1 through M-29

1970: M-30 through M-45, M-45A, M-46, I-101

1971: I-105, I-107

1972: M-47, M-48, I-103

1973: M-49, M-50, M-52 through M-56

1978: M-239 through M-244, M-291

1979: M-45B, M-45C, M-45D, M-292, M-293

1980: M-91, M-92

1981: M-93, M-94, I-102A, M-215, M-218, M-245 through M-250, M-252, M-59, M-60, M-61

1984: M-62 through M-70, I-103A, I-108

1985: M-201, M-204, M-220, M-240A

1986: M-253, M-255, M-257, T-10, T-11, T-12, T-20, T-21, T-30, T-31

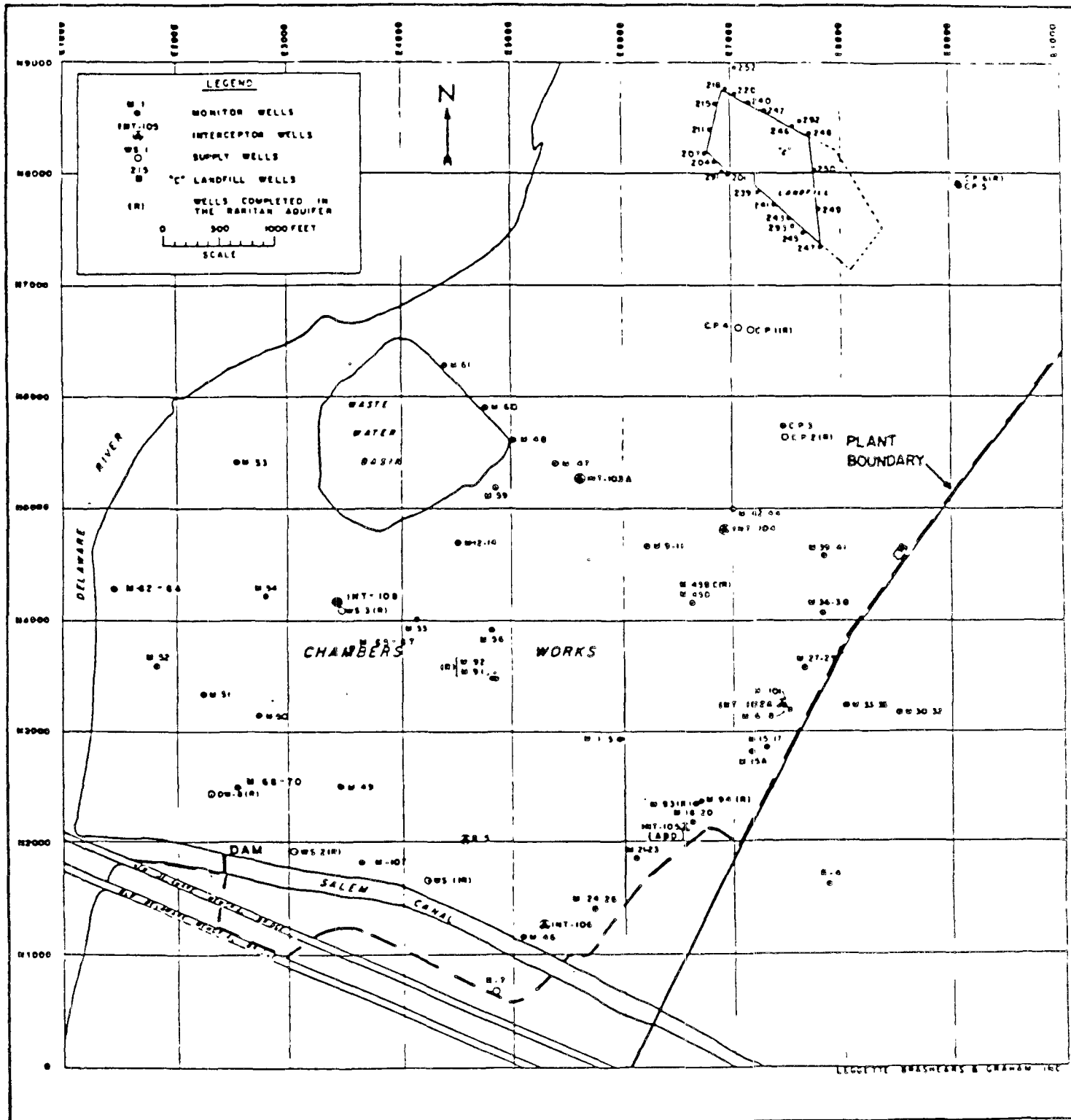
Date Unknown: I-102, I-104

Note that the wells drilled in the mid-1980's had a dual purpose:

1. Monitoring points for the "corrective action program"; and
2. RCRA monitor wells for detection and assessment monitoring programs.

Figure 27 is a site map of the entire Chambers Works showing all known on- and off-site wells. Note that a number of additional wells are located on the map. Many abandoned wells (which may not have been properly abandoned) are still in existence but their construction details and locations are unknown (J. Curry, pers. comm.). The "WS" well series were originally injection wells. They became plant water supply wells. They were inactivated for water supply purposes when the interceptor well program started (J. Curry, pers. comm.). The "DW" well series were wells used for drinking water at the Chambers Works. These were inactivated for that use when DuPont became aware of the contamination problem. Today, the source of drinking water on the plant is the Salem Canal. The Chambers Works' drainage system is designed and installed to prevent contaminated storm runoff or other waste water from draining into the canal. The "R" well series are known as Ranney wells; off-plant monitor wells. The "CP" well series are the Carneys Point wells. Carneys Point was originally the site of a DuPont explosives manufacturing plant. It was run as a separate entity from the Chambers Works. Today, Carneys Point is part of the Chambers Works property. The "CP" wells were used for water supply. Today some are used for monitoring purposes.

Figure 27. Well Location Map



As indicated, the entire universe of on- and off-site wells have been used throughout the Chambers Works' history for multiple purposes: drinking water supply, manufacturing water supply, monitoring, purging, and injection. Parts of this universe have been adapted for various State of New Jersey and Federal regulatory requirements. The following sections will describe the various adaptations, changes, and evolution of the ground-water monitoring system from its LBG "corrective action program" to the State of New Jersey pre-RCRA ground-water monitoring system to the RCRA interim status system and to the proposed Part B Permit ground-water monitoring system. It must be noted that many of the regulatory actions took place concurrently with NJDEP and EPA.

DUPONT'S GROUND-WATER MONITORING PROGRAM'S ADAPTATION TO NJPDES

Pursuant to N.J.A.C. 7:26-1.4. an "existing facility" means

a hazardous waste facility which was in operation, or for which construction had commenced, on or before November 19, 1980. Construction had commenced if the owner or operator had obtained all necessary Federal permits as well as any permit required by the Division's predecessor Solid Waste Administration (SWA) and either:

1. A continuous physical, on-site construction had begun; or
2. The owner or operator had entered into contractual obligations - which could not be cancelled or modified without substantial loss - for the construction of the facility to be completed within a reasonable time.

The Chemical Waste "C" Landfill was authorized as an existing facility by the SWA in January, 1979. It received the Certificate of Approved Registration Number 1713F. The SWA issued a number of directives regarding requirements during the calendar year 1979. DuPont requested changes as well. Ultimately, the SWA established the following ground-water monitoring requirements on April 6, 1982:

1. Sampling shall occur quarterly at ground-water monitoring wells; and
2. Each analysis shall be performed for the following:
 - A. surfactants,
 - B. phenolics,
 - C. color,
 - D. chemical oxygen demand (COD),
 - E. total dissolved solids (TDS),
 - F. total organic halogens (TOX), and
 - G. pH.

In a letter dated March 29, 1982, DuPont submitted an application for a NJPDES Permit for the "A" and "B" Sanitary Landfill, NJSWA Registration Number 1713B, pursuant to N.J.A.C. 7:14A-10.12. The SWA responded to the Chambers Works in a letter dated April 6, 1982. This letter advised the company that the Chemical Waste "C" Landfill, NJSWA Registration Number 1713F, is subject to the ground-water monitoring requirements pursuant to the NJPDES regulations (N.J.A.C. 7:14A-1 et seq.) as well. Additionally, the SWA directed that the ground-water monitoring requirements established for the Chemical Waste "C" Landfill are to be followed during the interim period pending the issuance of a NJPDES permit. The DWR issued a letter to the company on November 23, 1982 delineating DWR's actions based on N.J.A.C. 7:14A-1.4(c):

Whenever a facility or activity has more than one type of discharge covered by this chapter, processing of two or more applications for those permits should to the extent practicable as determined by the Department be consolidated. The first step in consolidation is to prepare each draft permit at the same time.

That is, DWR proceeded with consolidating all ground-water discharges into one NJPDES permit: "A" and "B" Sanitary Landfills, Chemical Waste "C" Landfill, Waste Water Basins, Nitrocellulose Waste Pile, and the unlined ditch system. Concurrently, DWR constructed an Administrative Consent Order (ACO) which would eliminate the discharges from the unlined ditches. Therefore, the consolidation approach along with the ACO would permit all ground-water discharges remaining in existence at the plant while addressing the elimination of the others (unlined ditches).

Under the conditions of the Initial Interim NJPDES Permit, the Chambers Works must monitor ground-water quality by operating and maintaining ground-water monitor wells at specific locations on the plant. These locations were chosen to enable DuPont to determine the following:

1. Leakage of contaminants from the Waste Water Basins, Chemical Waste "C" Landfill, "A" and "B" Sanitary Landfills, and Nitrocellulose Waste Pile;
2. Progress of the LBG "corrective action program";
3. Contaminant leakage from the unlined ditch system; and
4. Ground-water quality off-site.

Therefore, the monitor wells chosen for the NJPDES permit are located either in close proximity to a unit, adjacent to the plant's property boundaries, or off-site in the neighboring communities.

Six wells in the vicinity surrounding the Waste Water Basins were designated as NJPDES monitor wells. These are: M-12, M-13, M-14, M-48, M-53, and M-59.

Seven wells in close proximity to the Chemical Waste "C" Landfill were designated as NJPDES monitor wells. These are: M-60, M-61, M-204, M-241, M-243, M-249, and M-252.

Nine wells located near the "A" and "B" Sanitary Landfills were designated as NJPDES monitor wells. These are: M-5, M-8, M-11, M-17, M-29, M-38, M-41, M-44, and M-56.

Eighty-six wells, located along the plant's perimeter or off-site were designated as NJPDES monitor wells. These are: M-1 through M-4, M-6, M-7, M-9 through M-13, M-15, M-15A, M-16, M-18 through M-28, M-30 through M-37, M-39, M-40, M-42, M-43, M-45B, M-45C, M-45D, M-46, M-47, M-49 through M-55, M-91 through M-94, M-101, M-107, R-4, R-7, CP-1 through CP-7, CP-Ranney, WS-1, WS-1-1, WS-1-2, WS-1-3, WS-2, WS-2-2, WS-2-3, WS-2-4, WS-2-5, WS-3, DW-8, Layne #1, Pennsville 1, PTWD2, PTWD4, PTWD5, AEC2, AEC3, AEC5, AEC6, CL1, CL2, and CL3.

The directives of the Initial Interim NJPDES Permit require ground-water monitor wells as specified in N.J.A.C. 7:14A-6.13:

A well drillers permit, as required by N.J.S.A. 58:4A-1 et seq., shall be obtained prior to the installation of any ground-water monitoring well. A clear and accurate record or base map providing the monitoring well locations, depths, elevations and achievable pumping rates must be kept at the facility by the owner or operator and be available to the Department.

Wells must be capped to prevent precipitation from entering the well bore hole or introduction of extraneous material and substances into the well which can invalidate analytical results. All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole. Wells must be screened and packed with gravel or sand where necessary to enable sample collection at depths where appropriate. The annular space (i.e. the space between the bore hole and well casing) above the sampling depth must be sealed with a suitable material (e.g. cement grout or bentonite slurry) to prevent contamination of samples and ground water.

The elevation of the top of the well casing for each ground-water monitoring well shall be established and said elevation shall be permanently marked on the well casing. The elevation established shall be in relation to the New Jersey Geodetic Control Survey datum. Each monitor well casing shall be permanently marked with a number to be assigned or approved by the Department.

Further, the Initial Interim NJPDES Permit provides that if the ground-water monitor wells do not meet the standards of the permit, they must be replaced with new wells which meet DWR standards.

The ground-water monitoring requirements for the Chambers Works are detailed in the Initial Interim NJPDES Permit. During the time period of NJPDES permit development, the State of New Jersey was working towards obtaining their authorization for running the RCRA program. Therefore, the Initial Interim NJPDES permit requirements are derived from N.J.A.C. 7:14A-1 et seq., which are written so as to be equivalent to, or more stringent than, the Federal ground-water monitoring requirements under 40 CFR Part 265. That is, the data generated through the Initial Interim NJPDES Permit is used to evaluate the Chambers Works' compliance with subchapter 6 of the NJPDES regulations, N.J.A.C. 7:14A-1 et seq. including sections 6.1 through 6.6. These NJPDES regulations are at a minimum, the equivalents of 40 CFR 265.90 through 265.94.

The final NJPDES permit to be issued will have the equivalent, or more stringent, ground-water monitoring requirements than the RCRA permit.

DUPONT'S GROUND-WATER MONITORING PROGRAM'S ADAPTATION TO RCRA

Introduction

As previously discussed, NJDEP and EPA-II had varying and changing roles in the implementation of RCRA through time. As of February 2, 1983, NJDEP was responsible for the implementation of 40 CFR Parts 260 through 263 and 265. On February 21, 1985, New Jersey received final authorization and was additionally responsible for 40 CFR Parts 124, 264, and 270. A Memorandum of Agreement (MOA) between the State of New Jersey's NJDEP and EPA-II was drafted to establish policies, responsibilities, and procedures pursuant to 40 CFR 271.8 for the State of New Jersey Hazardous Waste Program authorized under Section 3006 of RCRA and to set forth the manner in which NJDEP and EPA-II coordinates in the State's administration of the State program. The procedures used by the Region and the State for handling the RCRA Part B application are outlined in the Cooperative Arrangement Addendum to the FY '83 MOA. Through this MOA, the Region ensures that all aspects of the RCRA program are addressed properly.

Ground-Water Monitoring Events

The DuPont Part A application was submitted to EPA-II in a letter dated November 11, 1980 in accordance with 40 CFR Part 122. From this point on, the Chambers Works was required to fulfill the interim status ground-water monitoring requirements. In a letter dated October 6, 1982, EPA-II and NJDEP made the following agreement: due to the similarity between the State and Federal regulations applying to closure/post-closure plans, NJDEP would conduct the technical review. EPA-II will approve, disapprove, or modify the submitted plans based upon the State's evaluation. A joint public notice will be issued by EPA-II in accordance with 40 CFR 265.112(d) and the applicable State regulations. NJDEP will respond to comments submitted during the public notice period with input from EPA-II.

EPA-II requested submission of the Part B application in a letter dated February 4, 1983.

On February 22, 1983, DuPont submitted the ground-water monitoring information pursuant to 40 CFR 265.94(a)(2)(ii) and (iii) for the Chemical Waste "C" Landfill and the Waste Water Basins. That is, in order to satisfy the Federal interim status ground-water monitoring requirements, the Chambers Works adapted the LBG "corrective action" ground-water monitoring program in a similar fashion to the NJPDES adaptation previously discussed. In this case, however, for RCRA interim status, two separate ground-water monitoring systems were delineated. One system is located at the Chemical Waste "C" Landfill while the other is located at the Waste Water Basins. These two ground-water monitoring systems were originally described in the ground-water monitoring plan submitted to EPA-II on July 29, 1982. A review of this ground-water monitoring plan was rendered by Ertech Atlantic, an EPA-II contractor. Ertech Atlantic also performed a site inspection at the Chambers Works on November 18, 1982. The report on the ground-water monitoring plan and site inspection was transmitted to EPA-II on February 24, 1983. Ertech Atlantic determined the following:

1. DuPont is in compliance with 40 CFR Parts 265.90 through 265.94 (no regulatory deficiencies), and
2. two technical deficiencies exist:
 - a. designated downgradient wells were actually upgradient of the landfill and not capable of detecting contaminants from the unit during and shortly previous to the site inspection, and
 - b. the outline of the ground-water quality assessment program (GWQAP) does not describe a more comprehensive program to determine whether contaminants are entering the ground water from the monitored facilities, although the determinations required under 40 CFR 265.93(a) are discussed.

Ertech Atlantic was satisfied that the locations of the landfill wells were satisfactory at the start of the ground-water monitoring program and became inappropriate during the course of the year. Evaluation of the ground-water elevation [40 CFR 265.93(f)] to assess the locations of the wells is not required before the initial year's sampling has been completed.

DuPont used the Ertech Atlantic review to change their ground-water monitoring plan. These changes were made in the Part B application, Subpart E, Exhibit A which was submitted to EPA-II on August 12, 1983.

DuPont submitted the results of the first semi-annual sampling for ground-water indicator parameters on June 17, 1983 as required by 40 CFR 265.93(d) and statistically compared the parameters to background analytical data as required by 40 CFR 265.93(b). However, the company argued that the Student's t-test at the 0.01 level of significance was too sensitive and gave many false positive results. They preferred the t-test recommended by the CMA, Comments-Docket #3004, November 23, 1982. Despite the problems the company found with the required t-test, they proposed the NJPDES permit ground-water programs to be used for the RCRA Part B permit; these programs to be submitted in lieu of the ground-water quality assessment program plan as required under 40 CFR 265.93(d)2. NJDEP ultimately approved the use of the CMA statistical t-test for use at the Chemical Waste "C" Landfill's ground-water monitoring system on December 4, 1985. This approval was based on the technical decision of Barnes Johnson, the EPA Headquarter's statistician. The following requirements were mandated for the Chemical Waste "C" Landfill:

1. Sampling M-204, M-241, M-243, and M-252 quarterly for TOC, TOX, pH, and specific conductance with four replicates from each downgradient well; and
2. Sampling the latter wells for the parameters listed in N.J.A.C. 7:14A-6.4(b)1 to determine water quality yearly. These parameters are follow in table 9.

Table 9. N.J.A.C. 7:14A-6.4(b)1

As	NO - N	Mn	Toxaphene
Ba	3	Na	2,4,5-TP Silvex
Cd	NH - N	Cl	Endrin
Cr		Phenols	Radium
F	4	Lindane	Gross Alpha
Pb	SO	Methoxychlor	Gross Beta
Hg		Toxaphene	
Se	4	2,4 D	
Aq	Fe	Coliform Bacteria	

Pursuant to the State of New Jersey's Phase I interim authorization on February 2, 1983 and the FY '83 MOA between EPA-II and NJDEP, DWR and DWM were charged with implementing the regulations of New Jersey's hazardous waste program in lieu of Phase I of the Federal hazardous waste program (40 CFR 260 through 263 and 265). NJDEP notified the Chambers Works of the latter information in a letter dated August 15, 1983. Further, DWR instructed the Chambers Works that all ground-water monitoring reports required under 40 CFR Part 265 Subpart F and previously submitted to EPA-II must be sent to DWR including:

1. Quarterly reports generated by the facility during the first year of ground-water monitoring as required under 40 CFR 265.92;
2. A map showing the location of all hazardous waste management units requiring ground-water monitoring including location of all ground-water monitor wells, identifying all upgradient and downgradient wells;
3. On-going ground-water monitoring reports;
4. Notifications required under the ground-water quality assessment program;
5. Notification and description of the alternative assessment ground-water monitoring system (if the facility requests an alternative system); and
6. Any other required correspondence concerning ground-water quality.

A revision to the Part B application was transmitted to EPA-II and NJDEP on September 26, 1983. NJDEP notified EPA-II that they were conducting a completeness review of the Part B application. EPA-II and NJDEP responded to the revised September 26, 1983 Part B application with a "preliminary review" (administrative notice of deficiency [NOD]) on January 25, 1984. The following comments were provided to the Chambers Works regarding the ground-water monitoring programs:

1. DuPont informed EPA-II on May 10, 1982 that the company relied on a long-standing study conducted by LBG and data from existing wells to determine the location of ground-water monitor wells. Please provide EPA with some documentation or information which will allow EPA representatives to assess whether the placement of the wells at the Chemical Waste "C" Landfill and the Waste Water Basins conforms with the regulatory requirements.

2. For each facility, indicate, precisely and in detail, the technical basis for believing that the wells installed by DuPont will, as required by 40 CFR 265.91(a):
 - A. Yield ground-water samples that are representative of background ground-water quality in the uppermost aquifer near the facility;
 - B. Yield ground-water samples that are not affected by the facility; and
 - C. Immediately detect any statistically significant amounts of hazardous waste or hazardous waste constituents that migrate from the waste management area to the uppermost aquifer.
3. Please describe, in detail, the manner of installation of all the monitor wells being relied upon to satisfy RCRA requirements.
4. Please describe why DuPont feels the wells referred to in paragraph three have been "cased" and the annular space "sealed", as required by 40 CFR 265.91(c).
5. On May 10, 1982 DuPont informed EPA that it had commenced the sampling and analysis of ground-water samples, as required by 40 CFR 265.92. Please describe the procedures and techniques for (1) sample collection, (2) sample preservation and shipment, (3) analytical procedures, and (4) chain of custody control. [Instead of describing these procedures, DuPont may send EPA a copy of the ground-water sampling and analysis plan, required to be kept at each facility pursuant to 40 CFR 265.92(a)].
6. Has Dupont prepared an outline of a more comprehensive ground-water monitoring program, as required by 40 CFR 265.93 ? If so, please submit that outline to EPA and indicate why the proposed program satisfies 40 CFR 265.93(a)(1), (2), and (3).
7. During the June 9, 1982 inspection Mr. Al Pagano of DuPont indicated that ground-water testing had demonstrated that primary drinking water standards were being exceeded at the site. This being the case, DuPont should submit the quarterly analyses in accordance with 40 CFR 265.92 and 265.94.

8. Since DuPont knows that ground-water contamination exists and since Dupont is apparently already engaged in a well pumping program to control leachate migration, and alternate ground-water monitoring system as described in 265.90(d) appears to be appropriate, and DuPont might wish to consider submitting such a plan to EPA-II. The alternate system would be used to determine the rate and extent of ground-water contamination and allow the effectiveness of the leachate control system to be determined.

On March 3, 1984, DuPont requested, to EPA-II, an additional 45 days to respond to the "preliminary review." EPA-II responded to this request on April 20, 1984, granting them the extension.

On April 16, 1984, the Chambers Works' response to the "preliminary review" was submitted to EPA-II. The following section contains this response.

ATTACHMENT II

ANSWERS TO QUESTIONS CONCERNING

CHAMBERS WORKS GROUNDWATER MONITORING PROGRAM

AT THE "C" LANDFILL AND WASTEWATER SURFACE IMPOUNDMENTS

1. A discussion of the existing overall groundwater monitoring and recovery system at the Chambers Works Complex is attached as Exhibit B.
2. The overall hydrogeology of the Chambers Works Complex was known from the previous studies described in Exhibit B. The technical basis for the wells being used for the RCRA groundwater monitoring program for each of the facilities is described below:

"C" Landfill

This is a recently installed, "Mypalon" lined secure landfill. In order to satisfy the requirements of the New Jersey Solid Waste Administration (NJSWA), monitor wells were installed in the uppermost aquifer completely surrounding this landfill as shown in Figure 1. Based on the monthly water level measurements in these wells, the direction of groundwater flow was known and was caused by the pumping of the interceptor wells to the south. In order to have an up gradient well, which would not be affected by the facility, a new well #232 was installed in October, 1981 as shown in Figure 1. Three of the existing down gradient wells #204, 239, and 243 were chosen for the RCRA monitoring. Since these are along the down gradient boundary of the active portion of the landfill, they should immediately detect any hazardous waste constituents that migrate from the facility. A typical set of water level readings is shown on Figure 1.

Wastewater Surface Impoundments

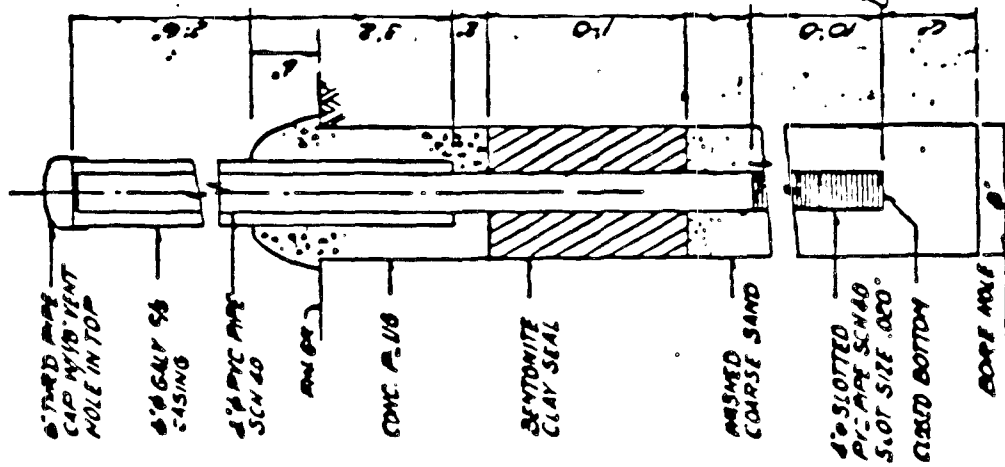
The area where these surface impoundments are located is very close to chemical manufacturing areas and has served as a drainage area for chemical contaminated wastewater for over 30 years. Thus the uppermost aquifer under this facility is known to be contaminated and the groundwater flow is being controlled by the existing recovery and treatment system. In order to determine the effect of the current operation of these impoundments on the groundwater, it was decided to use the normal RCRA groundwater monitoring program. An existing monitoring well M-53 (Spot #433) which was known to be up-flow and far enough from the impoundments to not be affected by them was chosen as the up gradient well as shown in Figure 1. Two existing wells M-14 (Spot #414) and M-48 (Spot #448) near the down flow side of

Page 2 Attachment II

the impoundments were chosen as down gradient wells and three more down gradient wells were installed in October, 1981 to provide more complete coverage of the down flow side of the impoundments. These five wells should detect any significant changes in the groundwater quality caused by hazardous wastes migrating from the facility.

3. The monitoring wells being used for these facilities are described in the attached Table 1. All of the wells were installed by A. C. Schultes and Sons, Inc., Woodbury, New Jersey, according to the diagrams in either Figure 2 or 3.
4. The monitoring wells were "cased" and "sealed" as shown in Figures 2 & 3.
5. The Chambers Works groundwater sampling and analysis plan is attached as Exhibit C.
6. An outline of a more comprehensive groundwater monitoring program was not prepared since we already had an overall groundwater monitoring, recovery and treatment system in operation at the Chambers Works as described in Exhibit B. This monitoring system is already determining and controlling the extent and concentration of groundwater contamination at the Chambers Works Complex.
7. The groundwater monitoring for the RCRA facilities did indicate that some of the primary drinking water standards were exceeded. These analytical results for the first and second quarter samples were submitted on April 15, and July 20, 1982 to the EPA Region II, Information Service Center as required by Part 265.94 (a)(2)(1). The samples for the third quarter are being analyzed and results will be submitted when they are completed.

Figure 2



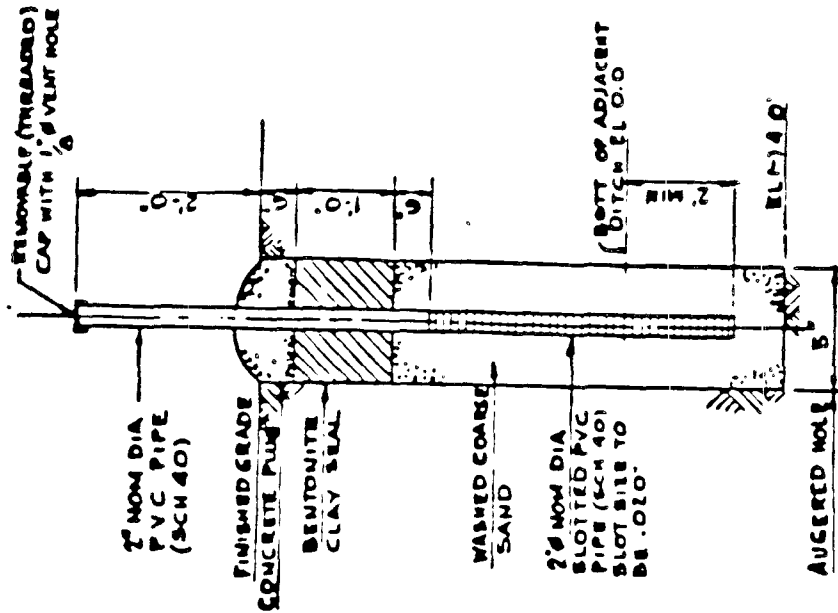
DETAIL-A MONITORING WELL

N.T.S.

NOTES-SEE NOTE:

1. SHALLOW WELLS TO BE 20' BELOW GRADE
2. DEEP WELLS TO BE 40' TO 70' - (SCREEN DEPTH ABOVE RED CLAY)
3. WELLS SHOULD BE DEVELOPED.
4. FOR DEEP WELLS USE 6\"/>

Figure 3



DETAIL 'F'
MONITORING WELL

3\"/>

Are Groundwater Levels, Aft. C&W, May, 1981 to June, 1982



DCRA Monitoring Wells

Well No.	Depth, Ft.	Casing Dia., In.	Screen Length, Ft.
252	20	4	10
204	12	3	5
239	22	4	10
240	22	4	10

Dewaterer Basin			
Well No.	Depth, Ft.	Casing Dia., In.	Screen Length, Ft.
M-53	21	2	5
M-14	21	6	5
M-48	22	6	5
M-59	20	6	5
M-60	20	6	5
M-61	20	6	5

On July 27, 1984, NJDEP notified the Chambers Works that they had also conducted a review of the RCRA Part B application to determine compliance with the State hazardous waste management regulations, N.J.A.C. 7:26-1 et seq. since the State permit application applies to the entire facility (surface impoundments, landfills, incinerators, container storage, tank storage, and tank treatment). They further clarified EPA-II's role in reviewing the Part B application; a review of the land disposal portion only (surface impoundments and hazardous waste landfill. This notification contained an NOD as well. The following comments are applicable to the ground-water monitoring portion:

1. For a facility where contamination has entered the ground water, it is required that a description of the plume of contamination which has entered the ground water that:
 - A. Delineates the extent of the plume on a topographic map; and
 - B. Identifies the concentration of each Appendix VIII, of 40 CFR 261, constituent throughout the plume or identifies the maximum concentrations of each Appendix VIII constituent in the plume.
2. It is also required that:
 - A. A characterization of the contaminated ground water, including concentrations of hazardous constituents;
 - B. The concentration limit for each hazardous constituent as set forth in N.J.A.C. 7:14A-6.1;
 - C. Detailed plans and an engineering report describing the corrective action to be taken; and
 - D. A description of how the ground-water monitoring program will demonstrate the adequacy of the corrective action.

On August 21, 1984, NJDEP held a meeting with DuPont. At this time, NJDEP notified the company that the NJDEP NOD on the land disposal portion of the Part B application supercedes the EPA-II NOD. In addition, NJDEP told the company to submit the following by September 14, 1984:

1. Appendix VIII sampling locations (monitor wells);
2. Frequency of sampling and reporting;
3. Parameters to be monitored after contaminants are identified;
4. Corrective action plan; and
5. Location, sampling, and analysis of the Potomac-Raritan-Magothy aquifer system wells.

On October 10, 1984, NJDEP informed the Chambers Works that the Part B application is administratively complete based on their submittals of September 14 and 28, 1984. The Chambers Works' responses pertinent to ground-water monitoring are as follows:

It was agreed in our meeting on 21 August 1984 that we would submit an alternative proposal with the assistance of our consultant hydrogeologist to answer the following questions:

1. What constituents are in the ground water?
2. Is the Raritan aquifer being protected?
3. Does the Raritan clay layer extend downstream of Chambers Works?

We are proposing to submit this alternative proposal by 1 December 1984. Prior to submittal, we suggest a meeting between our consultant hydrogeologist and NJDEP and EPA geologists to review our draft proposal.

NJDEP informed the Chambers Works, on October 27, 1984, that they must comply with N.J.A.C. 7:26-10.6 as applied to the existing lagoons which receive hazardous waste.

NJDEP informed the company that if they could not comply with these regulations, the Waste Water Basins would have to close at the time the Part B is issued.

In response to NJDEP's notification that the Chambers Works must comply with N.J.A.C. 7:26-10.6, DuPont took the following actions:

1. On February 18, 1985, they requested NJDEP to delist the "R" Basin; and
2. On February 25, 1985, they requested EPA-II to grant waiver from the double-liner requirements for the Waste Water Basins and requested a meeting with EPA-II.

EPA-II and DuPont met on April 4, 1985 to discuss the waiver request. It was brought to the company's attention that EPA headquarters must be involved. Waivers under Section 3005 of the RCRA amendments are not yet responsibilities delegated to the EPA regional offices. The Chambers Works and EPA-II contacted EPA Headquarters on the matter. The waiver request is presently being evaluated; EPA-II is working with DWR, DWM, and headquarters.

NJDEP transmitted their response to the "B" Basin delisting request on April 24, 1986. The request was denied due to the fact that the "B" Basin is separated from the "A" and "C" Basins by only a soil berm. NJDEP considers it likely that the waste from "A" and "C" Basins have mixed with the waste in "B" Basin since the soil berm is not an impermeable barrier. There is the potential for escape of pollutants to the environment via effluent from this unit.

The Appendix VIII sampling issue was finally resolved during a joint meeting on May 8, 1985. The participants were DuPont, NJDEP, and EPA-II. A modified sampling program was agreed upon which would effectively characterize the contaminated ground water at the site. The following wells were chosen as sampling points for the 40 CFR Part 261 Appendix VIII constituents: R-5, I-108, M-47, M-67, M-32, M-1, M-2, and M-3. Table 12 contains the pertinent well construction details of these wells. The samples from M-1, M-2, M-3 would be combined for a composite sample. The results of the sampling were sent to EPA-II in a letter dated January 17, 1986. A summary of the results follows in table 10. NJDEP had notified the Chambers Works on June 20, 1985 that submittal of the Appendix VIII data would complete the ground-water portion of the Part B permit application administratively.

Table 10 Appendix VIII Constituents in Excess of 10 ppb

CONSTITUENTS	APPENDIX VIII SAMPLING POINTS					
	M-47	M-32	I-108	R-5	M-67	M 1,2,3
Benzene	316	12	575	587	651	2620
Chlorobenzene	1340	528	2670	5950	5560	40500
Toluene	99		81	200	4840	444
Aniline	99		667	12800	225	16900
Chloroaniline	513			3710		15060
1,2 Dichlorobenzene	1580	236	930	8820	1330	24400
1,3 Dichlorobenzene				316		200
1,4 Dichlorobenzene	23		102	945	155	777
m-Dinitrobenzene	2380				152	
2,4 Dinitrotoluene	2580		13		2550	76
2,6 Dinitrotoluene	783				29100	
Nitrobenzene	599			20800	37	455
o-Toluidine	414		470		814	6600
N-nitrosopyrrolidine		77				
Freon-TF		52	3600			978
Trichloroethylene		26	1210	88		1600
1,2,4 Trichlorobenzene		16		655		
Chloroform			929	392		522
1,2 Dichloroethane			1470			1720
1,2 Trans Dichloroethylene			611			306
Methylene Chloride			267	227		833
Tetrachloroethylene			404			256
Trichlorofluoroethylene			699			
Napthalene			41			43
1-Napththylamine			75			
5-Nitro-o toluidine			194			
Calcium	38800	8800	98900	48300	126000	65500
Iron	45600	700	397000	74200	48900	69600
Potassium	6900	2000	7900	6600	6100	23000
Sodium	115000	2900	667000	135000	352000	412000
Strontium	190		620	230	320	300
Arsenic						41
Lead			200			
Osmium			630			
Chromium					20	
Cyanide					33	174
Nickel					150	
Vanadium					60	150
Zinc					1390	180
Phenol					35	49
Benzoquinione						423
Vinyl Chloride						180
Aluminum					71500	900

On June 26, 1985, DuPont submitted a revised Section E (ground-water monitoring portion) of the Part B application.

The Interim Status Ground-Water Monitoring Program

DuPont certified compliance with 40 CFR 265 Subpart F ground-water monitoring requirements on October 31, 1985. This certification fulfilled the Loss of Interim Status provision (LOIS) of the Hazardous and Solid Waste Amendments of 1984 (HSWA) [Section 3005(e)(2) of RCRA as amended]. LOIS required all interim status land disposal facilities to apply for a final determination regarding a permit and certify compliance with all applicable ground-water monitoring and financial responsibility requirements by November 8, 1985. Interim status would terminate on this date for failure to meet these requirements and affected facilities would have to stop introducing wastes into RCRA units on November 8, 1985.

As of the certification date, the interim status ground-water monitoring program at the Chambers Works was composed of two separate systems. One system is located at the Waste Water Basins while the other exists at the Chemical Waste "C" Landfill. A description of these systems follows.

Waste Water Basins:

The Waste Water Basins are three unlined contiguous surface impoundments, labeled "A," "B," and "C." The three surface impoundments are separated by dikes. However, the dikes are not impermeable. Therefore, the three surface impoundments are monitored as a single RCRA unit. Each surface impoundment serves a specific function as follows:

1. "A" Basin encompasses an area of 16 acres and is actually an extension of the ditch system used to carry the process wastes to the Waste Water Treatment Plant (WWTP). The basin itself is functionally an excess flow storage basin. Approximately 5% of the 44 million tons of wastewater generated on-site flow through the basin. This wastewater consists generally of corrosive material, spent halogenated and non-halogenated solvents, and wastewater treatment sludges from electroplating operations. The dike which separates "A" Basin from "B" Basin is composed of compacted fill and capped with bituminous concrete. The basin's other dikes are composed of compacted gravel.
2. "B" Basin covers an area of 17 acres. It acts as a containment area for once through cooling water and final effluent from the WWTP. The liquid contained in the basin is eventually discharged to the Delaware River as it is classified as non-hazardous. Dike construction is identical to that of "A" Basin.

3. "C" Basin is composed of three acres. It is used to contain treated process waste water from the lead recycle and recovery process units in the petrochemical plant. Treatment includes pH adjustment for minimum solubility of lead inorganic salts and sodium borohydride treatment to reduce any soluble ionic organic lead species to lead metal. From this point, the liquid portion is pumped to "A" Basin and eventually to the WWTP. Solids are periodically dredged from the basin bottom and dewatered. After dewatering, these solids are either passed through a reverbratory furnace for decontamination and lead recovery or landfilled. In 1984, about 2.3 million tons of waste water was discharged to the basin. Dike construction is identical to the other basins.

Physically connected to the Waste Water Basins and therefore a regulated extension of the unit, is a ditch system. This ditch system carries contaminated waste water, storm water, and non-contact cooling water. Approximately 319,000 ft² of this system is unlined and contaminated. As of December 1981, 104,500 ft² had been replaced. In 1983, NJDEP decided to issue one NJPDES permit for all discharges to ground water. Eighty-six NJPDES wells currently monitor the ditch system. An Administrative Consent Order (ACO) was written by NJDEP which included:

1. A schedule for lining or eliminating all unlined ditches and basins; and
2. A requirement for the interceptor wells to pump a minimum of 1.5 million gallons per day (MGD) and submit monthly ground-water reports.

Due to the promulgation of HSWA, NJDEP never signed the ACO. The schedule for lining or eliminating the ditches and basins does not coincide with the Federal requirements for retrofitting by November 8, 1988. Despite this, DuPont has been following the mandates of the order. Nevertheless, without an enforceable agreement such as a signed ACO, DuPont is in violation of the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq. for discharging pollutants into unlined ditches and basins, from which the pollutants may flow into the ground waters of the State. In addition, the eighty-six NJPDES wells have not been cited for RCRA purposes.

Fourteen wells in the vicinity surrounding the Waste Water Basins were designated as the RCRA interim status ground-water monitoring wells. These are: M-1, M-2, M-3, M-14, M-32, M-47, M-48, M-59, M-60, M-61, M-67, R5, and I108. The following describes the interim status system in detail:

a. Background Wells:

Two background wells are designated for the RCRA interim status ground-water monitoring program. One, M-53, is located approximately 750 ft from the western side of "C" Basin, at plant coordinates North 5421, East 2605. It was originally designated as the upgradient well for the detection monitoring program. With the on-set of the assessment program, M-32 was chosen as a background well in addition. It is located approximately 4500 ft southeast of the "A" Basin, at the boundary of the plant's property. Both M-53 and M-32 have mild steel casings and 304 stainless steel screens. The screen fittings are unknown in M-32. M-53 is fit with "MPT" at the top, and a point fitting at the bottom. M-53's screen is set from -9 ft to -14 ft CWD. The driller reports the screened interval to have a lithology of "white and black sand" and "stones." M-32 is screened from -5 ft to -10 ft CWD which is an interval described by the geologist as "sand, fine to medium, yellow to reddish-brown, and clay, yellow and greenish-gray; trace mica." M-53 has a screen slot size of .015 inch and M-32 has a screen slot size of .030 inch. Both were drilled using mud rotary and developed by air lift. The filter pack material for both wells is unknown. The annular sealant for M-53 is an unidentified cement and is unknown for M-32.

b. Downgradient Wells:

The original wells chosen as downgradient from the Waste Water Basins are M-14, M-48, M-59, M-60, and M-61. The additional assessment wells chosen are M-1, M-2, M-3, M-47, M-67, R5, and I108. M-14, M-48, M-59, M-60, and M-61 are all located along the perimeter of the "A" Basin. M-1, M-2, and M-3 are located approximately 2875 ft southeast of the basins. M-47 is located 500 ft east of the basins. M-67 is 1125 ft south of the basins. R5 is 3000 ft south of the basins. I108 is located 750 ft south of the basins. All wells were drilled by mud rotary and developed by air lift. All casings are composed of mild steel except for I108, which is 316L stainless steel. All screens are composed of 304 stainless steel except for M-67 and I108 which are 316L stainless steel. M-47, M-48, M-59, M-60, M-61, and M-67 have screens with .020 inch slot size. M-1, M-2, M-3 and M-14 have .030 inch slotted screens. I108 has a .045 inch slotted screen and R5 has a .060 slotted screen.

Chemical Waste "C" Landfill:

The "C" Landfill is composed of three areas of five acres each with contiguous sides. The areas are labeled I, II, and III and were constructed through time as needed.

- I: Area I was constructed in 1975 and filled-in in late 1978. Its major design features include a single 30 mil "Hypalon" liner, a 0.3% slope, and a leachate system to pump leachate to the WWT. The top of Area I was covered with 2 feet of clay of 1×10^{-7} cm/sec permeability, 12 inches of topsoil, and seeded. The East slope was covered with 2 feet of 1×10^{-7} cm/sec clay and the South, North, and West slopes with 1 1/2 feet of 1×10^{-5} cm/sec clay, covered with 1 foot of topsoil and seeded.
- II: Area II was constructed adjoining Area I in 1978. The major design provisions are: installation of a double 30 mil "Hypalon" liner with a layer of sand between the liners and 6 inches of sand and 6 inches of gravel on top of the liner, provisions for detection of leaks in the upper "Hypalon" liner, provisions for collecting and pumping of leachate and rain run-off with the present system, and provisions for a 0.3% continuous slope. Placement of sludge on this area began in January, 1979. Dikes around the second lift were built in 1981.
- III: Revision to the Closure Plan "C" Landfill on September 28, 1984 projects that the final cover on Area III will consist of 2 feet of clay with a maximum permeability of 1×10^{-7} cm/sec overlaid with 30 mil reinforced "Hypalon" liner, overlaid with 12 inches sand ASTM C144, overlaid with "Tynar," overlaid with 18 inches earth fill SM or SC material, overlaid overlaid with 6 inches topsoil that is seeded with grass seed. (The identical final cover will be constructed on Area II). Also on Area II as well as Area III, the side slopes will be constructed with 2 feet of clay with maximum permeability of 1×10^{-7} cm/sec overlaid with 30 mil reinforced "Hypalon" liner, overlaid with 18 inches earth fill SM or SC material, overlaid with 6 inches topsoil that is seeded with grass seed.

The "C" Landfill is monitored by four RCRA wells, M-204, M-241, M-243, and M-252. A letter dated June 24, 1984, (comments on the Chambers Works public notice for NJPDES permit), noted the replacement of M-239 with M-241. The following describes the interim status system in detail:

a. Background Wells:

One background well has been designated the RCRA interim status ground-water monitoring well, M-252. M-252 is located at plant coordinates North 8900, East 7130. It is approximately 250 feet north of the landfill's Area I. Its total depth (measured from ground surface) is 20 feet (ft). It is screened from -4 ft to -14 ft Chambers Works datum (CWD). The driller completed the geologic log and reports the screened interval to consist of sand.

b. Downgradient Wells:

Three wells are designated as RCRA downgradient wells, M-204, M-241, and M-243. M-204 is located at plant coordinates North 8100, East 6900 on the southern perimeter of the landfill, Area I. Its total depth is 21 ft and it is screened at -2 ft through -12 ft CWD. The driller reports the screened interval to consist of fine brown, gray sand and red sand. M-241 is located at plant coordinates North 7670, East 7390 on the southern perimeter of the landfill, Area II. Its total depth is 20 ft and it is screened at -4 ft to -14 ft CWD. The driller does not provide a lithology for the screened interval. M-243 is located at plant coordinates North 7560, East 7540 on the southern perimeter of the landfill bordering areas II and III. Its total depth is 20 ft and it is screened at 0 ft to -10 ft CWD. The driller reports the screened interval to consist of sand.

All wells were drilled using the mud rotary method and are constructed entirely of polyvinylchloride (PVC). M-252 and M-204 have 4 inch casing and screen diameters. M-241 and M-243 have 8 3/4 inch casing diameters and 4 inch screen diameters. All top fittings of screens are coupled with the exception of M-204 which has a fitted joint. The bottom fittings of all wells have caps with the exception of M-204 which has a fitted joint. All filter packs are composed of gravel #1. All annular sealants are cement with the exception of M-204 which has unidentified pellets. The cement type is unidentified. All wells were developed by air lift. All screen slot sizes are .020 inch.

Table 11. RCRA Monitoring Wells - Waste Water Basins

WELL #	53	14	48	59	60	61
DATE INSTALLED	12/73	2/2/67	9/9/72	10/28/81	10/29/81	10/81
PLANT COORDS:						
North	5421	4701	5618	4830	4795	4400
East	2605	4590	3073	5180	5900	6290
DRILLING METHOD	MUD ROTARY	MUD ROTARY	MUD ROTARY	MUD ROTARY	MUD ROTARY	MUD ROTARY
LOGGER	DRILLER	DRILLER	DRILLER	DRILLER	DRILLER	DRILLER
GEOPHYS LOGS	-	-	-	-	-	-
GROUND ELEV*	6.73'	7.93'	9.10'	8.95'	8.12'	7.93'
TOTAL DEPTH	21'0"	20'11"	21'6"	19'6"	21'0"	21'0"
CASING:						
Material	STEEL	STEEL	STEEL	STEEL	STEEL	STEEL
Length	15'7"	19'6"	16'0"	16'0"	18'0"	18'0"
Diameter	2"	6"	6"	6"	6"	6"
Top Elevation*	7.53'	11.03'	9.80'	11.48'	10.35'	9.95'
SCREEN:						
Mat'l	304SS	304SS	304SS	304SS	304SS	304SS
Length	5'7"	5'5"	5'0"	5'0"	5'0"	5'0"
Diameter	2"	6"	6"	6"	6"	6"
Slot	.015"	.030"	.020"	.020"	.020"	.020"
Top Elevation*	-9	-8	-7	-6	-8	-8
Bot Elevation*	-14	-13	-12	-11	-13	-13
Top Fitting	MPT	T-C	FIPT	FPT	FPT	FPT
Bot Fitting	POINT	?	MIPT	PLATE	PLATE	PLATE
FILTER PACK:						
Type	-	?	GRAVEL	GRAVEL	GRAVEL	GRAVEL
Size	-	?	#1	?	#1	#1
ANNULUS:						
Material	CEMENT	?	?	CEMENT	CEMENT	CEMENT
Quantity	2 BAGS	?	?	2 BAGS	2 BAGS	2 BAGS
DEVELOPMENT	AIR LIFT	AIR LIFT	AIR LIFT	AIR LIFT	AIR LIFT	AIR LIFT
STATIC WATER:						
Level†	3.8'	-4.7'	-2.23'	-1.4'	-1.97'	-.42'
Date	3/86	3/86	3/86	3/86	3/86	3/86

KEY:

- none
- * Chambers Works Datum = USGS Datum +3.26 ft
- † water level above or below Chambers Works Datum

Table 12. RCRA Monitoring Wells - Assessment - Waste Water Basins

WELL #	1	2	3	32	47	67	R5	1108
DATE INSTALLED	6/10/66	6/12/66	6/13/66	4/15/70	9/9/72	9/16/84	7/63	11/84
PIANT COORDS:								
North	2938	2943	2948	3166	5412	3725	2020	4167
East	6006	6006	6002	8564	5450	3590	4575	3412
DRILLING	MUD	MUD	MUD	MUD	MUD	MUD	MUD	MUD
METHOD	ROTARY	ROTARY	ROTARY	ROTARY	ROTARY	ROTARY	ROTARY	ROTARY
LOGGER	DRILLER	DRILLER	DRILLER	GEOLOGIST	DRILLER	GEOLOGIST	DRILLER	GEOLOGIST
GEOPHYS LOGS	-	-	-	-	-	-	-	-
GROUND ELEV*	8.79'	8.74'	8.86'	8.14'	8.54'	8.91'	12'	8.8'
TOTAL DEPTH	113'10"	80'4"	64'2"	18'0"	21'6"	18'0"	122'0"	88'0"
CASING:								
Material	STEEL	STEEL	STEEL	STEEL	STEEL	STEEL	STEEL	316LSS
Length	108'9"	74'7"	63'7"	13'0"	16'0"	?	?	?
Diameter	6"	6"	6"	6"	6"	6"	12"	12"
Top Elevation*	10.19'	9.54'	9.76'	9.21'	9.14'	10.77'	12.58'	9.80'
SCREEN:								
Mat'l	304SS	304SS	304SS	304SS	304SS	316LSS	304SS	316LSS
Length	5'	5'	5'	5'	5'	5'	10'5'5"	15'23'
Diameter	6"	6"	6"	4"	6"	6"	12"	12"
Slot	.030"	.030"	.030"	.030"	.020"	.020"	.060"	.045"
Top Elevation*	-100	-66	-55	-5	-7	-4	-45/-67/-99	-34/-54
Bot Elevation*	-105	-72	-60	-10	-12	-9	-55/-72/-104	-49/-77
Top Fitting	T-C	T-C	T-C	?	FIPT	WELD	WELD	WELD
Bot Fitting	?	?	?	?	MIPT	PLATE	PLATE	RING
FILTER PACK								
Type	?	?	?	?	GRAVEL	GRAVEL	?	GRAVEL
Size	?	?	?	?	#1	#2	?	#2
ANNULUS:								
Material	?	?	?	?	?	CEMENT	?	CEMENT
Quantity	?	?	?	?	?	PELLETS	?	300 BAGS
DEVELOPMENT								
	AIR	AIR	AIR	AIR	AIR	4 BAGS 1P	AIR	AIR
	LIFT	LIFT	LIFT	LIFT	LIFT	LIFT	LIFT	LIFT
STATIC WATER:								
Level†	-5.71'	-5.21'	-4.64'	.86'	-2.06'	3.92'	-29.09'	-18.7'
Date	3/86	3/86	3/86	3/86	3/86	3/86	3/86	3/86

KEY: - none

* Chambers Works Datum = USGS Datum +3.26 ft
† water level above or below Chambers Works Datum

Table 13. RCRA Monitoring Wells - Chemical Waste "C" Landfill

WELL #	252	204	241	243
DATE INSTALLED	10/28/81	1/29/85	9/20/78	9/20/78
PLANT COORDS:				
North	8900	8100	7670	7560
East	7130	6900	7390	7540
DRILLING METHOD	MUD ROTARY	MUD ROTARY	MUD ROTARY	MUD ROTARY
LOGGER				
	DRILLER	DRILLER	DRILLER	DRILLER
GEOPHYS LOGS	-	-	-	-
GROUND ELEV*	5.91'	8.80'	6.70'	10.60'
TOTAL DEPTH	20'0"	21'0"	20'0"	20'0"
CASING:				
Material	PVC	PVC	PVC	PVC
Length	12'6"	13'0"	12'0"	12'0"
Diameter	4"	4"	8 3/4"	8 3/4"
Top Elevation*	8.70'	10.32'	8.10'	12.63'
SCREEN:				
Mat'l	PVC	PVC	PVC	PVC
Length	10'0"	10'0"	10'0"	10'0"
Diameter	4"	4"	4"	4"
Slot	.020"	.020"	.020"	.020"
Top Elevation*	-4'	-2'	-4'	0'
Bot Elevation*	-14'	-12'	-14'	-10'
Top Fitting	COUPLING	F.J.	COUPLING	COUPLING
Bot Fitting	CAP	F.J.	CAP	CAP
FILTER PACK:				
Type	GRAVEL	GRAVEL	GRAVEL	GRAVEL
Size	#1	#1	#1	#1
ANNULUS:				
Material	CEMENT	PELLETS	CEMENT	CEMENT
Quantity	2 BAGS	25 BAGS	5 BAGS	5 BAGS
DEVELOPMENT	AIR LIFT	AIR LIFT	AIR LIFT	AIR LIFT
STATIC WATER:				
Level†	4.52'	3.37'	2.92'	3.0'
Date	3/86	3/86	3/86	3/86

KEY:

- none

* Chambers Works Datum = USGS Datum +3.26 ft

† water level above or below Chambers Works Datum

The Interim Status Ground-Water Monitoring Program's Evolution
into the 40 CFR Part 264 Ground-Water Monitoring Program

NJDEP sent a technical NOD for the ground-water portion of the Part B application to the Chambers Works on December 31, 1985. The regulations which were not adequately technically addressed according to the NOD are:

1. N.J.A.C. 7:26-12.2(q)1b;
2. N.J.A.C. 7:26-12.2(q)1c;
3. N.J.A.C. 7:26-12.2(q)1d;
4. N.J.A.C. 7:26-12.2(q)6a;
5. N.J.A.C. 7:26-12.2(q)6b(i);
6. N.J.A.C. 7:26-12.2(q)6b(iii);
7. N.J.A.C. 7:14A-6.15(i);
8. N.J.A.C. 7:26-12.2(q)7c;
9. N.J.A.C. 7:26-12.2(q)7d;
10. N.J.A.C. 7:26-12.2(q)7e;
11. N.J.A.C. 7:26-12.2(q)7f;
12. N.J.A.C. 7:14A-6.15(j);
13. N.J.A.C. 7:26-12.2(q)8a;
14. N.J.A.C. 7:26-12.2(q)8b;
15. N.J.A.C. 7:26-12.2(q)8c; and
16. N.J.A.C. 7:14A-6.15(k).

NJDEP provided the following comments to the company:

1. It is necessary to submit the design and description of each of the following wells: M-1, M-2, M-3, M-14, M-32, M-47, M-48, M-53, M-59, M-60, M-61, M-67, R-5, I-108, M-204, M-241, M-243, and M-252. This information shall include: screen depth, casing and screen materials, screen length, well diameter and borehole logs if available.

2. It is necessary for the permit application to include copies of all ground-water data obtained during the Interim Status period. Quarterly sampling results for indicator parameters: specific conductance, TOX, TOC, and pH for the wells in detection monitoring (M-204, M-241, M-243, and M-252) for 1984 and 1985 should be submitted.
3. Results of all statistics required during Interim Status and a description of the procedure used. Student-t results for the parameters and wells mentioned in item 2 shall be submitted for the years 1984 and 1985.
4. The indicator parameters proposed are not sufficient to monitor potential ground-water contamination emanating from the landfill. The following additional sampling are being proposed by the technical reviewer: all priority pollutants except for pesticides twice per year for wells M-204, M-241, M-243, and M-252. Continue to monitor for specific conductance, pH, TOX, and TOC on a quarterly basis. As required by 7:14A-6.15 a student-t test shall be used on the four indicators mentioned above.
5. The contaminated ground water surrounding the "A," "B," and "C" Basins has not been adequately characterized. Additional wells are necessary between well M-53 and the Delaware River to determine the direction of ground-water flow and the extent and degree of contamination. New well locations to remedy this situation shall be proposed. The Department recommends that J. Tesoriero of the Bureau of Ground Water Quality Management be contacted prior to drilling to insure the proper location of the wells. Also, well M-32 was intended to serve as a background well with which the others could be compared. This well is contaminated based on the recent N.J.A.C. 7:26-8.16 sampling (received December 1, 1985). DuPont must propose a new background well or identify the source of the contamination of well M-32 as other than DuPont.
6. DuPont's proposed list of hazardous constituents for which compliance monitoring will be undertaken is grossly inadequate. The list of hazardous constituents for which compliance monitoring will be undertaken must be in accordance with N.J.A.C. 7:14A-6.15(h) and 6.15(j). As such this list shall include all parameters in N.J.A.C. 7:26-8.16 (40 CFR Part 261, Appendix VIII) which are identified in the ground water.
7. Concentration limits must be proposed for each parameter on the list of hazardous constituents for which compliance (and corrective action) monitoring will be undertaken. These limits will be based on the criteria set forth in N.J.A.C. 7:14A-6.15(e). Include a justification for establishing any alternate concentration limits.

8. The proposed sampling, analysis and statistical comparison procedures need to be revised to include the additional parameters identified in item 6.
9. The corrective action plan is deficient in the following area: it is likely that contaminated ground water in the shallow Glacial aquifer west of the equalization basins is not (and will not soon be) affected by the current pumping plan. Recently installed interceptor well 108 affects the medium and deep Glacial aquifer but not the shallow. The pumping program should be modified to address this situation. The proper location of this new interceptor well will be aided by the installation of additional monitoring wells (item 5) in this area.

NJDEP received the Chambers Works' response to the December 31, 1985 ground-water technical NOD on March 15, 1986. The responses are as follows (and were incorporated into the RCRA Part B application):

1. The additional information on the design and description of the monitoring wells has been added to our RCRA Part B application as Exhibit F.
2. The quarterly sampling results for the indicator parameters for the "C" Landfill wells for 1984 and 1985 have been added to our Part B application as Exhibit G.
3. The Student-t test results using the statistical methods recommended by the CMA have also been included in our Part B application as Exhibit G on page 9 of 9. The use of the CMA Student-t test was approved in the letter from J.J. Trela to A.J. Boettler dated December 4, 1985. The original background data for the upgradient well M-252 are for the period November 1, 1981 to December 31, 1982 as previously included in our Part B application in Exhibit A. The Student-t test results showed high, significant t values for the 1984 and 1985 results from wells M-204 and M-252. The significance of these high results is discussed in the letter from A.H. Pagano to F. Coolick dated February 26, 1986 and on revised page E-15 of our Part B application.
4. Quarterly sampling of the four RCRA wells at "C" Landfill for the indicator parameters: pH, specific conductivity, TOC, and TOX will be continued. Four replicate measurements will be run annually based on the letter from J.J. Trela to A.J. Boettler dated February 26, 1986. The significance of the results will be determined using the CMA Student-t test.

These indicators will be adequate to follow the quality of the ground water. An annual scan for priority pollutants except pesticides will also be run. Page E-14 of the Part B application has been revised accordingly.

A priority pollutant scan was run in conjunction with an EPA sampling inspection on March 5, 1985. The only constituents which were above the minimum detection limits were bis (2-ethylhexyl) phthalate at less than 20 ug./l and naphthalene at less than 3 ug./l as shown in new Exhibit H of our Part B application.

5. As discussed with J. Tesoriero, a set of monitor wells will be installed along the Delaware River to access the ground-water flow and quality. These wells include two wells that are between M-53 and the river. Page E-19 of our Part B application has been revised accordingly.

Additional sampling of M-32 was done on December 16, 1985 and the results indicate the constituents with previously high values were not detected. Thus, M-32 can continue to serve as the background well.

6. As discussed in our RCRA Part B application as revised page E-21, six well samples were analyzed for Appendix VIII constituents and the results were submitted to NJDEP on December 19, 1985. The list of constituents found in these samples have been added to our Part B application.

Although a large number of constituents were found, the history of analytical results for the past years shows very little change in these wells. Quarterly analysis of all constituents found is not reasonable or justified. We will continue quarterly sampling for the indicator parameters and add the annual analysis for the Appendix VIII constituents. Pages E-21 and E-22 of the Part B application have been revised accordingly.

7. Our goal concentration limits, for our corrective action program, will be based on the criteria set forth in N.J.A.C. 7:14A-6.15(e). If limits have not been specified by the NJDEP, the concentrations found in our background well M-32 will be used. Concentration limits based on these criteria are listed in new Table VIII pages E-21a and b of our Part B application. Also page E-23 has been revised accordingly.
8. The Sampling, Analysis, and Statistical Procedures in our Part B application page E-28 have been revised to include the hazardous constituents discussed in item 6 and listed in our Part B application as Table VIII on E-21a and b.

9. As discussed in item 5, additional monitor wells are being installed along the Delaware River to study the possible flow of contaminated ground water toward the river. Based on the results of analytical data and pumping tests on three wells, the corrective action plan will be modified and additional interceptor wells installed as required.

NJDEP responded to the Chambers Works' March 15, 1986 reply on March 27, 1986 with the following:

With regard to item 5, the location and number of additional wells proposed by DuPont to monitor the possible migration of contaminants towards the Delaware River meets with Department approval. All seven wells should be installed within 45 days of this letter. Please contact this Bureau seven days prior to the installation of these wells. While all of the remaining items in our December 31, 1985 Technical NOD have been adequately addressed, several additional area of concern need further information to complete this application.

1. M-243 at the "C" Landfill has a water level higher than M-252 the intended upgradient well. DuPont is required to assess this situation and determine the adequacy of M-243 as a downgradient well. To facilitate the review of the hydraulics of the landfill area DuPont is requested to submit water level data for all the wells surrounding the "C" Landfill on a monthly schedule. The submission of this data should continue at this frequency until this matter has been resolved.
2. Water level data for the rest of the wells on the site should be submitted to this Bureau on a quarterly schedule. This information is requested for the purposes of evaluating the adequacy of the existing purge well system.

The Chambers Works responded to the NJDEP's latter reply on May 12, 1986. Their response to the items mentioned are as follows:

1. Boundary Wells -- Four of the seven Delaware River monitor wells and all twelve 2-inch observation wells have already been installed. The remaining three monitor wells will be installed within a few weeks after their well screens are received. Because these wells will be used for future pump tests, the screens were not ordered until soil checks of the observations wells were made to determine the maximum screen slot sizes. S. Furda plans to visit the plant while these wells are being installed.

2. Well Water Level Data -- Our data clearly shows that the water level of M-243 is definitely lower than our upgradient well M-252. Thus, we request your approval to reduce the frequency for submitting monthly water level data for the "C" Landfill wells from monthly to quarterly. Further, we request your approval to reduce the frequency for the other plant wells from quarterly to annually. As S. Furda and A.J. Boettler have discussed, the first quarter "C" Landfill well levels will be submitted directly to S. Furda in a separate letter in the next few weeks rather than be attached to this letter.

In response to the May 12, 1986 request by DuPont to submit ground-water level data for the Chemical Waste "C" Landfill wells and the other plant wells on a quarterly and yearly basis, respectively, the NJDEP approved it on May 19, 1986. However, it was approved based upon well water level data showing monitor well M-243 to be a truly downgradient well. In addition, NJDEP made the determination that the Part B application is technically complete based on the Chambers Works' responses to the NOD's.

Prior to a technically complete Part B application, NJDEP had notified DuPont as to what the 40 CFR 264 (N.J.A.C. 7:14A-6.15) ground-water monitoring program would be (February 26, 1986). This program is based on the interim status ground-water monitoring data and the ground-water data submitted in the Part B application. Therefore, as of February 26, 1986, the proposed Part B ground-water monitoring program is a dual program; one system located at the Waste Water Basins and the other system located at the Chemical Waste "C" Landfill. The programs are:

1. Waste Water Basins: Compliance and Corrective Action Monitoring
2. Chemical Waste "C" Landfill: Detection Monitoring

These programs are described in the March 15, 1986 revision of Section E of the Part B application.

RESULTS AND DISCUSSION

The previous sections detail the complex regulatory history of the RCRA and NJPDES programs, the resulting intricacy of EPA-II's and NJDEP's roles, and the evolution of the Chambers Works' ground-water monitoring programs. As described, EPA-II and NJDEP found both ground-water monitoring systems to be in compliance with the minimum requirements of the interim status ground-water monitoring regulations. Where technical inadequacies existed, NJDEP and/or EPA-II prepared NOD's. As part of the HWGWTF evaluation, the "Characterization of Site Hydrology Worksheet" from the draft version of the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document was utilized as a guide for establishing the technical adequacy of the interim status programs. The worksheet answers are provided in the hydrogeologist's log book. The conclusion reached from the worksheet is that the sum total of all hydrogeologic work carried out from 1966 to 1986 enable the reviewer to gain a basic understanding of the site hydrogeology. A direct result of DuPont's early initiative in establishing a ground-water monitoring and corrective action program is that all of its components do not meet all of the standards in present EPA guidelines (see worksheet). The Task Force inspection must view those components as current inadequacies.

The deficiencies arise from the complexities of the hydrogeology at the site. For RCRA ground-water monitoring purposes, it is essential to identify the most likely zones of contaminant migration, including both horizontal and vertical flow paths. This insures proper well placement for the immediate detection of contaminant leakage in detection monitoring and the identification of the rate and extent of contaminant plumes in assessment monitoring. Due to the existence of one hundred and eight New Jersey Pollutant Discharge Elimination System (NJPDES) wells, DuPont meets physical compliance with the intent of the minimum RCRA interim status ground-water monitoring regulations. The technical problems inherent in the hydrogeologic program are described below and reflect Task Force evaluations of the on-going detection, assessment, and corrective action programs.

Hydrogeology

The hydrogeologic site investigation at the Chambers Works has been an on-going process since 1966 when the first monitor wells were drilled. However, it has never been a formalized, phased study as recommended in the EPA manual 330/9-81-002, "Ground-Water/Subsurface Investigations at Hazardous Waste Sites." Instead, over the years, as monitor wells were drilled and installed, bore logs were recorded. The lithologic information contained in the bore logs is very general and the mineralogy, petrography, and geochemistry of the geologic units are not defined. Consequently, the effects of contaminated ground water on the confining properties of the clay and silt units are unknown, permeability and porosity are unknown (although two aquifer tests were performed which

provide estimates for some regions of the uppermost aquifer), and since no grain size analyses were documented on the logs, the selection of appropriate screen slot sizes is questionable. Despite this, a general depiction of the subsurface has been ascertained with aid from the published literature.

The subsurface is a complex sequence of recent alluvial and tidal marsh deposits, Pleistocene fluvioglacial deposits, and Cretaceous marine cyclic deposits. These sedimentary environments show variable lateral discontinuity and give rise to a multi-aquifer system. Superimposed on the naturally complicated multi-aquifer ground-water flow regime is a two-fold alteration. This is the regional pumping of the Cretaceous aquifers and the site-wide pumping of the Quaternary aquifers. The regional pumping has created widespread cones of depression which are reported to elicit a forty to fifty foot decrease in head level from the natural head level. The site-wide pumping system utilizes three to six interceptor wells which combine to discharge 1.5 million gallons per day (MGD). Flow paths and gradients are dependent upon which interceptor wells are in use. These paths and gradients will vary when the centers of pumping change. Other fluxes are created by the unlined basins, unlined ditch system, the Delaware River, Henby Creek, Whooping John Creek, and the Salem Canal.

DuPont attempted to define this hydrologic system through two aquifer tests. The first was conducted in 1971 and the second in 1982. The third was performed post-Task Force and the results have not yet been transmitted to EPA-II. The 1971 test concentrated solely on the Glacial aquifer system, shallow, middle, and deep zones. The test wells were I-101, I-102, and R-5. The results demonstrated interconnection of the three zones, although the interconnections varied. An example of the variation is shown in the contrasting results for wells I-101 and I-102. Note that I-101 and I-102 are located twenty-five feet apart. I-101 is screened in the deep zone. The pumping from this zone did not affect the observation wells screened in the shallow or middle zones. However, I-102, screened in the middle zone, affected these same observation wells in the shallow and the deep zone. Therefore, in some areas, the three zones are interconnected.

The 1982 aquifer test was performed using two test wells, WS-2 and WS-3 in two separate 72 hour tests. WS-2 is screened in the shallow Potomac-Raritan-Magothy aquifer zone while WS-3 is screened in the deep Potomac-Raritan-Magothy aquifer zone. Observation wells for the tests were screened in the deep and shallow Potomac-Raritan-Magothy aquifer zones and the deep Glacial zone. The test using WS-3 did not create drawdown in the deep glacial or shallow Potomac-Raritan-Magothy aquifer wells. The test using WS-2 gave DuPont's consultant (LBG) the conclusion that there is no interconnection between the shallow and deep Potomac-Raritan-Magothy and deep Glacial aquifers. However, the report further describes a situation which indicates partial clogging of the well screens at both test wells. In 1966, the average pumping rate of WS-3 was 600 GPM. Its 24 hour specific capacity was 4.4 GPM/FT DD.

In 1982, the pumping rate was 491 GPM with a 24 hour specific capacity of 2.4 GPM/FT DD. In 1965, WS-2 yielded a 24 hour specific capacity of 19 GPM/FT DD. In 1982 the 24 hour specific capacity was 9.8 GPM/FT DD. Therefore, these aquifer tests may not be representative of the true aquifer characteristics due to partial clogging of the screens. The hydraulic or lack of hydraulic interconnection between the Glacial aquifer system and the Potomac-Raritan-Magothy aquifer system cannot, as yet, be adequately determined.

These aquifer tests, along with the general geologic information, is enough to indicate the presence of aquitards and possibly aquicludes. However, the extent and characteristics of these confining units and lenses have not been sufficiently defined for RCRA ground-water monitoring purposes. In addition, although a total of approximately 157 wells (RCRA and NJPDES) existed on site at the time of the Task Force inspection, these do not provide adequate data on all portions of the uppermost aquifer. Ground-water flow has been most accurately defined in the shallow Glacial zone along the eastern and southern regions of the site, particularly southeast of the Waste Water Basins. However, the shallow Glacial zone's flow is not defined west of the "C" Landfill and Waste Water Basins along the perimeter of the Delaware River. There is also a lack of data in the region north and east of the "C" Landfill as well as northeast of the Waste Water Basins. The middle and deep Glacial aquifer zones are more poorly defined in all of these sectors. The Potomac-Raritan-Magothy aquifer system has even fewer water level monitoring points. Of note is post-Task Force well installation on-site, along the Delaware River, to better define the hydrology and modify the corrective action program.

This complex hydrogeologic system warrants a more comprehensive ground-water monitoring program than the minimum RCRA interim status system would provide. Accurate well placement for both detection and assessment monitoring is dependent upon precise hydrogeologic data. In a hydrologic system where centers of pumping change, the ground-water monitoring system must be all encompassing or pliable enough to adjust to changes in ground-water flow directions. Upgradient (background) and downgradient well placements must be valid for all circumstances. At the time of the Task Force inspection, flow directions and interrelationships between aquifer zones were not quantified for the changing situations. This problem is documented at the "C" Landfill's background well, M-252. On various occasions, M-252 was found to have lower head elevations than a designated downgradient well. Remeasurements at other times would show no problem with the designated upgradient and downgradient wells. It is possible that different intercenter wells were operating on these different occasions, changing the hydraulic gradients. A derivative of this problem may be the significant CMA Student's t-test results at this well. Currently, technical notice of deficiencies (NOD) on the Part B application has addressed the problem at M-252 by requiring DuPont to check water level data more frequently. This is inadequate and must be amended to include a complete hydrogeologic

study of the interrelated aquifer zones and changes created due to changes in pumping conditions. Of note is a current study underway due to an information request from EPA-II with regard to a HSWA waiver request.

Detection Monitoring Program

The "C" Landfill was in the detection monitoring mode at the time of the Task force inspection. Four wells surrounding the landfill were designated the RCRA wells. The upgradient well is M-252 and the downgradient wells are M-204, M-241, and M-243. All are screened in the shallow Glacial zone. Since the shallow Glacial zone constitutes only one zone of the uppermost aquifer, additional upgradient and corresponding downgradient wells must be installed to enable monitoring of the entire uppermost aquifer. As a result, the Task Force has determined that the landfill should be in the assessment mode due to significant landfill waste contaminants found in downgradient well M-204. Inspection of past records found that both M-252 and M-204 failed the Student's t-test and CMA Student's t-test in 1983, 1984, and 1985. However, it wasn't until 1985 that EPA-HQ approved the use of the CMA test. Since that time, DuPont requested a delisting of Area I of the landfill on the basis that it was closed in 1978. Along with the delisting request, DuPont submitted a Ground-Water Quality Assessment Program plan for Area I since their consultants determined that the failed student's t-tests at M-204 was caused solely by leakage from Area I. Currently, NJDEP is evaluating the delisting request. The consequence of this determination will either trigger the entire landfill into assessment monitoring or keep areas II and III in detection while Area I will be treated as a solid waste management unit (SWMU) and undergo corrective action under the authority of HSWA.

In addition to the detection monitoring program, 18 additional wells are monitored under the auspices of the NJPDES Permit. four wells were also installed as part of the Ground-Water Quality Assessment Program plan. All of these wells are screened in the shallow Glacial zone except for three which are screened in the middle Glacial zone.

The Task Force's findings indicate a need for DuPont to monitor all zones of the uppermost aquifer under all hydraulic conditions. Additional background wells must be installed in these zones (middle and deep Glacial aquifers and shallow Potomac-Raritan-Magothy aquifer) along with corresponding downgradient wells in positions adequate for detection monitoring and/or assessment monitoring.

Assessment Monitoring Program

The Waste Water Basins/Ditch System unit was in the assessment mode at the time of the Task Force inspection. The original wells chosen as the downgradient RCRA wells, M-14, M-48, M-59, M-60, and M-61, are all screened in the shallow Glacial zone, as

is the original background well, M-53. Additional downgradient wells, M-1, M-2, M-3, M-47, M-67, R5, and I108, and a background well, M-32, were cited as RCRA wells when the unit triggered into assessment monitoring. These wells were chosen in an agreed upon modified sampling program submitted in lieu of a Ground-Water Quality Assessment Program plan as required under §265.93(d)2 between DuPont, NJDEP, and EPA-II. This modified sampling program also included the use of the NJPDES permit ground-water monitoring programs. The background wells are screened only in the shallow glacial zone. Only M-47 and M-67 of the designated assessment wells may be used to compare ground-water quality. Again, this is only one zone of the uppermost aquifer. The Task Force recommends the incorporation of the 86 NJPDES wells with adequate construction and records into the RCRA system. All aquifer zones must be represented by background wells and downgradient wells and must be valid for all the possible hydrologic circumstances (changing centers of pumping). Only when the system meets those criterias, can the assessment program adequately define the rate and extent of contaminant migration.

Well Construction

At the Chemical Waste "C" Landfill, all RCRA wells were drilled using the mud rotary method and are constructed entirely of polyvinylchloride (PVC). M-252 and M-204 have 4 inch casing screen diameters. All top fittings of screens are coupled with the exception of M-204 which has a fitted joint. The bottom fittings of all wells have caps with the exception of M-204 which has a fitted joint. All filter packs are composed of gravel #1. All annular sealants are cement with the exception of M-204 which has unidentified pellets. The cement type is unidentified. All wells were developed by air lift. All screen slot sizes are .020 inch. The bore logs were written by the driller in all cases.

At the Waste Water Basins, all RCRA wells were also drilled using the mud rotary method. All wells are cased with mild steel with the exception of I108 which is cased with 316L stainless steel. All well screens are composed of 304 stainless steel except for M-67 and I108 which are 316L stainless steel. M-53 is a 2 inch well, M-32 is a 4 inch well, R5 and I108 are 12 inch wells, and the remainder are 6 inch wells. The top and bottom fittings of the screens vary according to the wells as do the slot sizes. Slot sizes vary from .015 inch to .060 inch. Filter pack materials, where reported, are either gravel #1 or gravel #2. The annular sealants, where reported, are either an unidentified cement or unidentified pellets. As at the landfill, the wells were developed by air lift. The bore logs were written by the driller in all cases with the exception of M-32, M-67, and I108. In addition a geophysical log (gamma ray) exists for I108.

Mud rotary is an acceptable technique for drilling in unconsolidated glacial formations. However, the muds may affect ground-water quality and borehole samples. The mud used when drilling these RCRA wells was not identified on the well log. Therefore, its effects on ground water and borehole samples has not been quantified. For future mud rotary drilling, it is recommended that the mud is identified and its effects on ground water and borehole samples is ascertained. In addition, a qualified geologist or geotechnical engineer must be present to log the cores. At this site, since a driller did the majority of the logging, specific and accurate lithologies were not obtained. In addition, since no grain size analyses were documented as being performed, the selection of appropriate screen slot sizes is questionable. Field measurements obtained by the Task Force prior to collecting ground-water samples (depth to well bottom, top of casing to ground level, water level) show the possibility of either an error in the reported well depths or the silting in of some well screens. The silting in of well screens indicates a poor choice in screen slot size. However, re-development of such a well prior to sampling could be a corrective measure to be used in all future sampling events.

Well construction details on well logs do not fully correspond with the construction details submitted in the original Part B application. The well logs indicate gravel #1, gravel #2, unidentified cement and pellets as filter pack material. The Part B describes all filter packs as washed, coarse sand. The well logs indicate cement or pellets as the annular sealant. The Part B reports bentonite seals. The well logs show either PVC casings with PVC slotted screens or mild steel casings with stainless steel slotted screens. The Part B diagrams illustrate all screens to be constructed of PVC. The screen slot sizes in the Part B diagrams are uniformly .020 inch. The well logs show slot sizes varying from .015 inch to .060 inch. Future drilling and well installation must utilize both a licensed driller and geologist and complete, detailed "as-built" well diagrams and borehole logs. A Part B ground-water section re-submission was received by EPA-II after the Task Force inspection. Instead of the original Part B well construction figures were the original well logs completed in the field. However, the problems with these logs still exist. Despite this, these wells are intact and yield sufficient water for sampling. Future wells must be installed to present RCRA standards with specific and detailed "as-builts."

Appendix VIII Water Quality Data

DuPont contends that the uppermost 120' - 130' of the site's subsurface is contaminated with industrial hazardous waste and hazardous waste constituents. This contamination has been addressed by DuPont, starting with their hydrogeologic investigation in 1966. However, the 1977 annual progress report gives an account of contamination in the shallow Potomac-Raritan-Magothy aquifer zone. Monitor wells M-45 and M-45A exhibited increased TDS. DuPont believed that the cause was the migration of contaminated

Glacial aquifer system water through corroded well casings of abandoned and existing Potomac-Raritan-Magothy aquifer wells and/or through improperly sealed annular spaces of these wells. DuPont pumped M-45A for about 60 days in 1978 with the assumption that if corroded casings/leaky seals were responsible, continuous pumping would recover the contaminants. After the 60 days, however, TDS in M-45A remained high (563 mg/l). DuPont sealed both M-45 and M-45A since the integrity of the casings could not be verified by them. Subsequently, M-45B, M-45C, and M-45D were installed. M-45B is screened in the deep Potomac-Raritan-Magothy aquifer zone while both M-45C and M-45D are screened in the shallow Potomac-Raritan-Magothy aquifer zone. M-45C came up with elevated levels of TDS, TOC, DOC, and TOX. High TDS values found in M-45B were not accompanied by high TOC, DOC, and TOX values. DuPont decided that M-45B's elevated TDS was did not indicate industrial contamination. The DOC and TOX values in M-45B were at background levels (TDS \leq 200 mg/l, TOX \leq 0.1 mg/l, DOC \leq 10 mg/l). TDS values must be analyzed with TOC, DOC, and TOX because in a region influenced by salt-water encroachment, TDS values may reflect levels of salts in the ground water from natural sources.

The latest available progress report, 1985, still reports contamination at M-45C, but a decreasing trend. In 1983, TDS was at 1265 mg/l while in 1985 it was at 839 mg/l. DOC declined from 32 mg/l in 1982 to 18 mg/l in 1985. TOX decreased from 1.1 mg/l in 1982 to 0.6 mg/l in 1985. M-45B and M-45D do not show any evidence of industrial contamination. DuPont therefore concluded that M-45C is contaminated by lateral movement of contaminants from abandoned and unsealed wells. Interestingly, WS-1, WS-1-1, WS-1-2, WS-1-3 screened in the shallow Potomac-Raritan-Magothy aquifer zone have shown increasing trends in TDS, DOC, TOX, and chloride. DOC and TOX values are below background but DuPont reports that the TDS increase due to the chloride increases from salt-water intrusion from the Delaware Estuary, correlating with this worker's conclusion of the effects on salt-water encroachment at this site. Similar trends appeared at WS-2 and its observation wells. Deep Potomac-Raritan-Magothy aquifer zone well M-93 had a high TDS value but the screen became clogged and DuPont had it sealed. Shallow Potomac-Raritan-Magothy aquifer zone well M-92 also had an increase in TDS between 1983 and 1984, 235 mg/l to 550 mg/l.

It is evident at this site, which is hydraulically influenced by the Delaware Estuary, that TDS cannot be used as an indicator of industrial contamination on its own merit. TOC, DOC, and/or TOX must also be evaluated. It must be noted that DuPont uses TDS alone to illustrate the effects of the corrective action program on the site in their letter to EPA-HQ requesting a waiver on 1/17/86. Despite the questions raised about the indicator parameters and what they actually show, it is apparent that the shallow Potomac-Raritan-Magothy aquifer zone in the region of M-45C, WS-1, and WS-2 show the possibility of industrial contamination. This possibility can only be verified by sampling

for actual DuPont characteristic hazardous waste or hazardous waste constituents as was done by the Task Force. The assessment program currently in phase on the site should have included shallow Potomac-Raritan-Magothy aquifer zone wells, and even a deep Potomac-Raritan-Magothy aquifer zone well. If industrial contamination is in fact found, then these specific contaminants and their concentrations can be used to identify the source and flow path of the plume. This would also help in the determination of whether the Potomac-Raritan-Magothy aquifer system is hydraulically connected naturally, or by man-made mechanisms such as improperly abandoned wells.

Corrective Action

The interceptor well corrective action program was initially designed to remediate the effects of previous company practices. Present Agency concerns reflect all contamination, whether from past practices and SWMU's or operating RCRA interim status units. NJDEP and DRBC are in receipt of twelve annual reports from DuPont which evaluate the interceptor well corrective action program. An in depth inspection of the latest report will provide the company's case for the effect of their program; the interceptor well system effectively contains and removes contaminated ground water from the Glacial aquifer zones within the property boundaries of the Chambers Works.

The following summarizes the pertinent points made in the 1985 Annual Progress Report:

1. The flow of ground water in the shallow Glacial zone throughout a major portion of the Chambers Works is controlled by I102A and I103A. That is, ground water flows towards these wells in the northern, eastern, and most of the southern sections of the plant. However, there is westerly flow along the Delaware Estuary and some southerly flow west of the dam on Salem Canal. Therefore, in an area of approximately 0.2 square mile, ground-water flow in the shallow zone appears not to be captured by the interceptor well system.
2. The flow of ground water in the middle and deep Glacial zones is adequately controlled over the entire Chambers Works area by the operation of I102A, I103A, and R5.
3. I106 and I108 have no measurable effect on the shallow Glacial aquifer zone. However, I108 has a considerable effect on the middle and deep Glacial aquifer zones.
4. Data for the "C" Landfill wells show that the cone of depression caused by the inerceptor well system extends in a northerly direction at least as far as that unit.

5. Background indicator parameter values: TDS \leq 200 mg/l, DOC \leq 10 mg/l, TOX \leq 0.1 mg/l.
6. M-22 and M-40 (middle Glacial zone) show increasing TDS trends which contrast with the results for other peripheral wells.
7. Nearly all interior wells continue to exhibit relatively high levels of contamination. However, CP-5 shows background levels for the indicator parameters. M-1, M-49, M-9, M-10, and M-11 show declining trends. M-12, M-13, and M-14 show increasing trends in TDS, DOC, and TOX. These trends are not meaningful, however, since pumpage of the interceptor well system moves ground water from place to place and causes various chemicals to move also.
8. The eight wells located outside plant boundaries continue to show background levels of the contaminant indicator parameters.
9. A comparison of 1970 and 1985 TDS contour maps shows the positive effectiveness of the interceptor well system.
10. Conditions of the Potomac-Raritan-Magothy aquifer system:
 - a. Seven additional wells were installed since 1979, three in the deep zone (M-45B, M-91, M-93) and four in the shallow zone (M-45C, M-45D, M-92, M-94)
 - b. Although there were no changes in the Atlantic City Electric Company's (ACEC) pumping, the focus of shallow zone ground-water flow has shifted from the ACEC well field to an area somewhat to the east. It is tentatively concluded that there have been errors in measurement.
 - c. M-45C (shallow) is the only well which has consistently shown evidence of contamination by industrial chemicals. However, since 1983, there has been a reduction in TDS, DOC, and TOX. M-45B and M-45D show background levels. The conclusion is that M-45C is being contaminated by the lateral movement of contaminants from abandoned and unsealed wells.
 - d. WS-1, WS-1-1, WS-1-2, WS-1-3 (shallow) show increasing trends in TDS, DOC, TOX, and chloride. DOC and TOX are within background range. The TDS increase may be almost entirely the result of chloride increases due to intrusion from the Delaware Estuary.
 - e. WS-2, WS-2-1, WS-2-2, WS-2-3, WS-2-4, WS-2-5 show increases in TOX. Only WS-2 and WS-2-1 are above background (0.16 and 0.65 respectively). WS-2-4 shows a large increase in TDS as well as a similar increase in chloride.

- f. M-93 (deep) showed a very high TDS then became clogged. It was subsequently sealed.
- g. The off-plant Potomac-Raritan-Magothy aquifer zone wells remain uncontaminated.

Therefore, the company has concluded that their program is working overall, needs adjustment in the shallow Glacial zone in a 0.2 square mile area of the plant, and no work need be done regarding the Potomac-Raritan-Magothy aquifer system. It is the contention of the Agency that the data available at the time of the Task Force investigation does not indicate that the corrective action program is working overall. The Agency cannot make any assumptions on inconclusive data. A number of discrepancies appear between the scientific philosophies followed by the company in the twelve annual reports. These are as follows:

1. Ground-water level contour maps are drawn with the same precision for each aquifer zone. However, different numbers of data points exist for each zone. That is, 122 wells were measured. About 46 of these monitor the shallow Glacial zone, about 19 monitor the middle Glacial zone, and about 18 monitor the deep Glacial zone (these figures represent 82.8% of the 122 wells measured in March, 1986; 17.2% of the wells could not be identified by aquifer zone). The contour maps for the shallow Glacial zone are the most accurate for this reason. The middle and deep Glacial zones require more interpolation as do the contour maps for the shallow and deep Potomac-Raritan-Magothy aquifer zone wells (15 and 3 wells respectively).
2. No attempt at defining vertical gradients is made, other than discounting the interconnections between the zones by the two aquifer tests (see previous section).
3. TDS is used as the indicator parameter for industrial contamination in some cases and not in others. Salt water intrusion (increasing chloride content) is considered a factor affecting TDS levels only in the Potomac-Raritan-Magothy aquifer system. However, it is the contour maps for the middle and deep Glacial aquifer zones where recharge from the Delaware Estuary is depicted. Further, TDS trends have been used throughout the reports to demonstrate the effectiveness of the corrective action program. The latest report instructs the reader to discount the TDS trends in the interior wells due to the pumping while using it as an indicator for the peripheral and off-site wells. Up until that report, it was understood that the peripheral wells were also affected by the pumping. The company must explain how TDS trends are

reliable at the plant's property boundaries and not at the plant's interior; the contour maps show radial flow, inward toward the pumping wells, affecting all areas of the system in the same physical manner. As stated in the previous section, TDS cannot be used alone as an indicator of industrial contamination.

Since it has been determined that the TDS contour maps cannot be used solely to determine the effectiveness of the corrective action program, some other overall method must be utilized. This method must include examining the purge well volumes, the areas of influence of the cones of depression, and the concentrations and locations of the hazardous waste and hazardous waste constituents. This method should have been incorporated into the assessment monitoring program and is addressed in a post-Task Force technical NOD from EPA-II to DuPont in response to the waiver request.

It is evident from figures 21 through 26 that through time, the cones of depression influenced larger sectors on- and off-site. This effect is due to both an increase in purge volumes (almost double from 1977 to 1985) and the time span the purge wells have been operating. The purge wells, according to the theory of this corrective action program, should be pulling contamination in from off-site that previously escaped, and keep more recent contamination from escaping. Since TDS doesn't provide sufficient information on this, it is obvious that the DuPont characteristic waste must be looked at. This Task Force has two ways of looking at this. One is through an Appendix VIII sampling performed by DuPont as part of their assessment monitoring requirements and the other is through the independent sampling program carried out by the Task Force.

Table 10 provides the Appendix VIII constituents found at or in excess of 10 ppb at the assessment monitoring wells. For ease in evaluation these constituents have been subdivided into the following groups: benzene and benzene derivatives, ionic metals, other metals, nitrated hydrocarbons, and chlorinated hydrocarbons. Each constituent was then plotted up on a bar graph to illustrate its location and concentration in the glacial aquifer system. Unfortunately, no sampling points exist for this study in the Potomac-Raritan-Magothy aquifer system. The following summarizes what was found:

Benzene & Benzene Derivatives

- a. Toluene achieves its highest concentration at the shallowest sampling point (M-67) and occurs with benzene and phenol;
- b. Off-site well, M-32, only has benzene;
- c. Purge well I108 intercepts benzene, toluene, and naphthalene;
- d. Purge well R5 intercepts benzene and toluene;
- e. The deepest sampling point, the M-1, M-2, & M-3 composite (M123) shows all five constituents: benzene, toluene, naphthalene, phenol, and p-benzoquinone; and
- f. Benzene and toluene exist together at M-47.

Ionic Metals

- a. Sodium achieves its highest concentration at purge well I108;
- b. Sodium exists at the highest concentrations at all sampling points except for M-32, the off-site well;
- c. Calcium exists at all sampling points as well and achieves its highest concentration at purge well I108;
- d. Calcium is the second most prevalent in concentration of the ionic metals at all wells but M-32, where it is the highest concentrated ionic metal;
- e. Potassium exists at all sampling points and is the third highest in concentration at all points;
- f. Potassium achieves its highest concentration at the deepest sampling point, M123;
- g. Strontium shows up at all sampling points but M-32, the off-site well; and
- h. Osmium only shows up at purge well I108.

Other Metals

- a. Iron exists at all sampling points, existing at its highest concentration at purge well R5;
- b. Arsenic exists at only the deepest sampling point, M123;
- c. Lead occurs only at purge well I108;
- d. Chromium occurs only at the shallowest sampling point;
- e. Cyanide exists only at the deepest (M123) and shallowest (M-67) sampling points;
- f. Aluminum exists at only two locations, the deepest (M123) and the shallowest (M-67) sampling points. Its concentration is highest in the shallow zone;
- g. Nickel occurs only at the shallowest sampling point, M-67;
- h. Vanadium exists at only the deepest (M123) and shallowest (M-67) sampling points; and
- i. Zinc occurs only at the deepest (M123) and shallowest (M-67) sampling points.

Nitrated Hydrocarbons

- a. Aniline occurs at all sampling points except for the off-site well, M-32;
- b. m-Dinitrobenzene occurs at M-67 & M-47 only;
- c. 2,4 Dinitrotoluene occurs at only the shallowest sampling point, M-67;
- d. 2,6 Dinitrotoluene occurs at its highest concentration at the shallowest sampling point (M-67). The only other place it occurs is at M-47;
- e. Nitrobenzene occurs at M-47, purge well R5, and the deepest sampling point, M123. Its highest concentration is at purge well R5;
- f. o-Toluidine occurs at all sampling points except for R5 and M-32. Its highest concentration is at the deepest sampling point, M123;
- g. N-nitrosopyrrolidine occurs at off-site well M-32 only;
- h. 1-Naphthylamine occurs at purge well I108 only; and
- i. 5-Nitro-o-toluidine occurs at purge well I108 only.

Chlorinated Hydrocarbons

- a. Chlorobenzene occurs at all sampling points;
- b. Chloroaniline occurs at M-47, R5, and M123;
- c. 1,2 Dichlorobenzene occurs at all sampling points;
- d. 1,3 Dichlorobenzene occurs at the deepest sampling points only, purge well R5 and M123;
- e. 1,4 Dichlorobenzene occurs at M-67, purge well I108, purge well R5, and M123; that is, the shallowest and the deepest sampling points;
- f. Freon-TF occurs at off-site well M-32, purge well I108, and M123;
- g. Trichloroethylene also occurs at M-32, I108, and M123;
- h. 1,2,4 Trichlorobenzene occurs at M-32 and purge well R5;
- i. Chloroform occurs only in the deeper sampling points, purge wells R5 and I108, and M123;
- j. 1,2 Dichloroethane also shows up at only the deeper sampling points; at purge wells I108 and R5;
- k. 1,2 Trans Dichloroethylene occurs only at the deeper sampling points; at I108 and M123;
- l. Methylene chloride occurs only at the deeper points, purge wells I108 and R5, and M123;
- m. Tetrachloroethylene occurs only at I108 and M123;
- n. Trichlorofluoroethylene also occurs at only I108 and M123; and
- o. Vinyl chloride only shows up at M123.

The limiting factors of data collected for a study performed during this type of corrective action are evident when trying to evaluate the results. As standard, the data set represents the ground water matrix only at the one fraction of time that the data was collected. As only specific to this data set from this site, it is dependent upon the number, location, and purge volumes at that fraction of time. With this in context, the data will be broken down further:

Off-Site Well(M-32)/Shallow Glacial Zone

1. Benzene is the only contaminant from the benzene and benzene derivatives group;
2. All listed ionic metals are found except for osmium;
3. Iron is the only other metal found;
4. Of the nitrated hydrocarbons, only N-nitrosopyrrolidine is found;
5. Of the chlorinated hydrocarbons, only 1,2 dichlorobenzene, chlorobenzene, freon-TF, 1,2,4 trichlorobenzene, and trichloroethylene are found; and
6. The benzene and benzene derivative group, the ionic and other metals group, the chlorinated and nitrated hydrocarbon group where in existence at the off-site well, are at a considerably lower concentration than at the on-site wells (except N-nitrosopyrrolidine which is found only at the off-site well).

From this one data set, the conclusion is that the pumping system is working to some degree in the shallow glacial zone at the site of M-32. Nothing can be ascertained about the middle and deep Glacial zones or the Potomac-Raritan-Magothy aquifer system from this data on the shallow Glacial zone at the site of M-32.

With the application for the double-liner waiver request for the Waste Water Basins, EPA-II demanded that DuPont perform a more comprehensive study to show the effectiveness of their "corrective action program" in order to demonstrate compliance with the requirements of section 3005(j)(13). As previously stated, this was the technical NOD in response to the DuPont letter to EPA-HQ of 1/17/86.

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Review of DuPont's Sampling and Analysis Plan

A review of DuPont's ground-water sampling and analysis plan, titled "RCRA Ground Water Monitoring Plan, Chambers Works, E.I. DuPont de Nemours & Co., Inc." and dated June 1, 1982, has been conducted to determine compliance with 40 CFR §265.92 requirements.

Although Dupont is operating under a New Jersey Department of Environmental Protection (NJDEP) approved ground water assessment program, the sampling and analysis plan itself does not meet the requirements of §265.92. The plan does not adequately describe the sampling and analysis program of the facility in that little information is provided regarding specific details of how the facility tries to assure the quality of its ground water data. Detailed below are the inadequacies of the plan:

1. The plan states that water levels are determined once per month in all wells. In order to determine proper purge volumes, this should be done at the time of sampling. However, as long as five volumes are being purged, as stated in the plan, the required quantity of water will be removed in any event.

The plan does not include procedures used for measuring static water level elevations and total depth of wells. The plan needs to provide the device and procedure used for measuring water levels. A steel tape or an electronic device, capable of measuring to 0.1 foot, must be used. This is critical at a site such as this where there is a small hydraulic gradient present. Decontamination procedures used for the device between wells also need to be specified.

The plan also should contain provisions for measuring total depth. Aside from being used to calculate purge volumes, this measurement can be used to check the structural integrity of the well, i.e., determine whether or not the well has silted in.

2. The plan states that 20 gpm submersible pump is used to purge wells prior to sampling. A detailed description of the type of pump and its material of construction needs to be provided. Decontamination procedures for evacuation equipment also need to be provided.

Additionally, the plan needs to describe procedures that ensure all stagnant water in the wells is being replaced by fresh formation water. Procedures also need to be provided for the sampling of low recovery wells.

3. The plan does not contain provisions for detecting immiscible contaminants in the ground water, such provisions are necessary since the permittee manages wastes of this type. The plan needs to include the device, as well as the procedures, used for sampling and detecting such contaminants.

4. The same submersible pump apparently is used for sampling wells as is used for purging wells. As previously mentioned, the plan needs to fully describe the type of pump and its materials of construction.

Additionally, no consideration apparently is given to the use of a dedicated sampler, and decontamination procedures are not described. These matters need to be addressed fully in the plan.

5. The plan must, but does not, include procedures for minimizing the degassing of sample during collection and minimizing the contamination of equipment prior to insertion into the well.
6. The plan states that samples will be collected in the proper containers and preserved according to the recommendations in "Procedures Manual for Ground-Water Monitoring at Solid Waste Disposal Facilities", EPA/530/SW611, August 1977. Current Region II EPA policy on ground-water monitoring is that, with the exception of the holding time for specific conductance, Table II of 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act", needs to be used for container, current EPA policy is that it is to be measured immediately at the time of collection in the field.

Also, for total organic halide analysis, an amber glass container with Teflon-lined septum should be used and the maximum holding time is seven days. Headspace in the container must be eliminated to protect samples against the loss of volatiles.

7. The plan describes chain-of-custody procedures for samples analyzed by on-site Dupont laboratories. However, it does not provide any information about procedures, e.g., the use of sample seals, for samples shipped offsite to contract laboratories. Such information needs to be provided in the plan.
8. The plan states that analytical procedures will be those approved by EPA, and described in EPA/600-4-79-020, March 1979 or other EPA approved alternate methods. This information is inadequate. The plan must reference specific methods used, not entire documents.

The plan also states that analytical methods used are provided in Table IV. The information provided in Table IV is inadequate in that the methods listed have Dupont identification numbers and no other distinguishing characteristics, such as the EPA methods that they represent. The plan needs to provide either a complete method description or a specific EPA method reference, including method of sample preparation, for each parameter analyzed.

9. The plan does not provide any details of the facility's and facility contractor's quality assurance/quality control program(s) for

sampling and analytical activities. At a minimum, information needs to be provided regarding:

- a. QA organization and responsibilities;
- b. Procedures used to assess the completeness of data;
- c. Procedures used to assess the precision, accuracy, and overall reliability of data, e.g., frequency and types of spikes, the use of surrogates, duplicates (field and lab), frequency and types of blanks

(e.g., laboratory glassware, sample container, trip, equipment, etc.), internal and external performance evaluation samples, and systems audits;
- d. Calibration and quantifications procedures;
- e. Data validation and corrective action procedures;
- f. Preventive maintenance of instruments and equipment;
- g. Education, training, experience requirements for personnel involved in analytical and sampling activities; and
- h. Field and laboratory documentation processes.

It should be noted that the facility is responsible for the quality of all of its ground-water data, whether it is generated by the facility or its contractor(s).

10. The plan does not provide any information on the procedures used to determine statistically significant increases (and decreases, in the case of pH) over background measurements. The statistical procedures must be detailed fully in the plan.

Review of E.I. DuPont's Ground-Water Sampling Activities

On April 7, an oversight of E.I. DuPont's contractor, W.C. Services, was conducted by ESD personnel to determine what techniques are actually being used to monitor the ground water.

The contractor used a truck with a submersible pump on a pulley system to purge/sample the wells. The truck was backed up to the well and the pump lowered to either as far down as the hose allowed (100 feet), or to the bottom of the well. Throughout the purging/sampling, the truck was idling with the exhaust only several feet away from the well casing.

The pump was a three wire submersible from Franklin Electrical, rated at 20 gallons per minute. It was approximately three feet long, constructed of steel, and was attached to a thick rubber hose, through which the groundwater was pumped. There was black electrical tape around the top of the pump, leading to the hose for several feet. The pump intake was rusted, and the internal wires were all exposed.

As mentioned previously, purging was conducted with the pump either set at the bottom of the well, or to the maximum length of the hose. Tables are provided to the contractor with the time necessary to remove five volumes from each of the wells. These tables are based on static heads and well depths measured some time previously. If a well is pumped dry, it is sampled upon recovery. Upon completion of purging, the well was then sampled immediately through the same pump and at the same depth in the well. The samples were drawn from a tap off the pumping system. These included two POA (purgeable organics) vials, one plastic jar for; pH, specific conductivity, total dissolved solids, dissolved organic carbon and chlorides, and one glass jar for TOX. No field measurements were conducted on-site. Samples were kept on ice in the back of the truck with the rest of the sampling containers. If necessary, they are pre-preserved, according to the contractor. All samples are held in the vehicle until the end of the day when monitoring activities have been completed. This usually takes approximately eight hours. The pump was then raised from the bottom of the well and lowered into the next well without any type of cleaning or rinsing in between wells.

The contractor demonstrated how the wells are measured monthly. A device with a beeper, which sounds when the water level is reached, was used for static levels. Total depth measurements were not made. E.I. DuPont provides this from information developed when the wells were installed.

Within the above mentioned procedures, the following problems were noted:

1. Total depth measurements of the well were not taken. Aside from being used to calculate purge volumes, this measurement can be used to check whether or not the well has silted in;
2. The positioning of the contractor's truck near the well casing may introduce exhaust fumes into the system;

3. Placement of the submersible pump at the bottom of the well may result in not all of the stagnant water being removed from the casing of a fast recharging well, thus resulting in a sample not representative of the aquifer. The water should be drawn from above the screen, in the uppermost part of the water column, to ensure fresh water from the screen will move upward;
4. Pumping at a rate of 20 gpm may result in the well going to dryness, and in turn, possibly recharging at a rate which causes the formation water to vigorously cascade down the intake screen and accelerate the loss of volatiles. This would also result in a drawdown of the water level in the aquifer around the well, thus causing the sample to not be representative of the ground water at the screened portion of the well;
5. The submersible pump and its attachments were made of improper materials. Rusted metal, exposed wires, rubber hose and black electrical tape are all routes of possible contamination to the water in the well casing. This is an important factor since the same pump was used to obtain the samples from the wells. There was no decontamination of any kind between the wells. Use of this type of submersible pump introduces variability in the analysis of pH, specific conductance and volatile organic samples. Also, samples are drawn with the pump sitting at the bottom of the well;
6. Sufficient time was not allowed to allow the water to stabilize in the well casing prior to sampling;
7. specific conductivity, pH, and temperature were not measured in the field. This is necessary since these parameters are pressure and temperature sensitive. Although specific conductivity is relatively stable, it is recommended that it be determined in the field; and
8. Purge water removed from the wells was pumped directly to the ground.

Audit of Currently Used Laboratories

As part of the HWGTF's investigation of Dupont, an audit was performed in May 1986 on Dupont's Laboratories located in Deepwater, New Jersey. These laboratories have performed all past Dupont analyses and will continue to perform analyses of the drinking water suitability parameters (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, fluoride, nitrate, endrin, lindane, methoxychlor, toxaphene, 2,4-D, and 2,4,5-TP); parameters establishing ground water quality (chloride, iron, manganese, phenols, sodium, sulfate); and parameters used as indicators of ground-water contamination (pH, specific conductance, total organic carbon [TOC], total organic halogen [TOX]). This audit was performed in order to determine the reliability of the analytical work currently being performed as part of Dupont's ground-water monitoring program.

Additionally, Environmental Testing and Certification Corporation (ETC), located in Edison, New Jersey has been contracted by Dupont in the past and apparently will continue to be contracted in the future to perform analysis of well samples for RCRA's "Appendix VIII" parameters. Due to the fact that ETC was audited in July 1985 by EPA's National Enforcement Investigation Center (NEIC), it was not audited during this Dupont investigation. However, the deficiencies found during NEIC's audit were investigated for correction, as part of this Dupont investigation. The findings are discussed later in this section.

Dupont Laboratories

Several inadequacies were found in the areas of parameter selection and application of analytical methods.

Samples analyzed for metals presently are filtered, and in the past have been filtered, prior to analysis. Consequently, dissolved rather than total metals have been determined. This practice may result in data biased low and is contrary to EPA policy of analyzing and reporting both total and dissolved metals. Similarly, all pesticide analyses have been performed on filtered samples and dissolved organic carbon is analyzed rather than total organic carbon. The samples are and have been filtered with a .45 micron filter prior to analysis. This is unacceptable.

We explained to Dupont personnel that all metal, TOC, and pesticide work must be done on non-filtered samples.

Regarding analytical methods, the carbon column capture efficiency is not checked as part of the TOX analyses procedure. This check is included in the laboratory's written standard operating procedure for TOX and is an EPA method requirement. Standards are not run through the carbon column process, so analyses of standards do not serve as checks.

Based on records observed by us, the TOX method requirement, that the second column results cannot be greater than 10% of that recovered on the first column, was not being followed at the time of the inspection. Apparently, an observed amount of over 200 ug on the second column is used as the criterion for a breakthrough problem. This is not acceptable. The EPA method requirement of 10% needs to be followed.

Also, the 5 ug/l detection limit reported by Dupont for TOX cannot be correct since the data observed by us indicate that approximately 10 ug/l appears to be a routine amount of blank contamination. Additionally, based on the data observed by us, approximately ± 5 ug/l appears to be the routine variation in precision.

The use of a volatile organic standard is not used by Dupont in its TOX analysis. This is not an EPA method requirement, but we recommend that one be incorporated into the method.

Regarding the measurements of pH and specific conductance, Dupont attempts to measure these parameters within six hours of sample collection. Measurement within the same day reportedly is the absolute maximum holding time. EPA policy is that both of these measurements be made, immediately, at the time of sample collection. We clearly explained this policy to Dupont personnel.

A quality control manual was not available at the time of our audit, as it was in the process of being revised.

Several creditable laboratory practices are worth noting:

1. A five point calibration is used for metal and organic analyses;
2. Standard operating procedures exist for most activities;
3. Control charts are used routinely; and
4. Sample preservation checks are performed and recorded.

Additionally, the physical facility is excellent and the laboratories are certified by the State of New Jersey for various analytical activities.

Environmental Testing and Certification Corporation (ETC)

During NEIC's audit of ETC in July 1985, several inadequacies were found. Most of these inadequacies do not apply to the parameters of interest in this Dupont investigation. The inadequacies that do relate to work performed by ETC for Dupont essentially were investigated by us and no problems currently exist.

It should be noted that, due to the difficult nature of the analyses involved, some of the RCRA Appendix VIII parameter work performed by ETC is considered by EPA as developmental. Consequently, our assessment of this work has not resulted in the noting of problems with ETC's activities.

TASK FORCE SAMPLING AND MONITORING DATA ANALYSIS

GROUND-WATER SAMPLE ANALYSES RESULTS

Ground-water samples taken at E.I. Dupont, Chambers Works, by the Task Force were analyzed for the parameters listed in Appendix 1. Although samples were collected for dissolved metals, they were not analyzed. None of the samples were analyzed for tin. Two field duplicates were taken during the survey (M-1 and M-47) and are both tabulated in Tables 14 and 16. The results of the field and equipment blanks can be found in the raw data sheets from the respective laboratories. Measurements for pH, temperature, specific conductivity, and turbidity were taken in the field and are presented in Table 30.

All data for inorganics, metals, and indicator type parameters are tabulated. For the organics, only those compounds which were detected in at least one of the wells are listed. The data qualifiers used for Tables 14 through 30 are listed in a key at the beginning of the tables. All results reported as "U" were analyzed for but not detected. However, some of the detection limits were higher than normal due to dilutions or interferences (referenced from laboratory data sheets). Some of these samples were also outside of control limits for the spike recovery (represented by "UN"). If the detection limit was estimated, this was qualified with a "UJ".

Inorganic and Indicator Type Parameters Analyses Result

Tables 14 through 19 summarize the results of the inorganic and indicator type parameters analyses on ground-water samples obtained from monitoring wells at the Chambers Works facility. All of the nitrate and nitrite sample results were rejected due to holding times having been exceeded. Sulfate and chloride values were estimated high due to spike recoveries outside of the established limits. Bromide values were all estimated due to the lack of adequate QC data. TOC and ammonia values were all estimated due to the laboratory's use of field blanks for spike recoveries. All POC sample results (high and low level) were rejected due to inadequate QC data and holding times having been exceeded. TOX values for four of the samples (MOA030, 037, 047, 050) were estimated low due to POX values having been found at higher levels. Samples for TOX (3) and Phenols (3) were rejected due to high levels of contamination in the corresponding equipment and/or field blanks.

In general, the highest levels of inorganic and indicator type parameters were found in the samples from wells near the centers of the interceptor pumping system (M-1, M-3, M-12, and M-14). These wells cover the whole spectrum of the Glacial aquifer, but are primarily situated in the middle and deep portion of the aquifer. Although the highest level of TOX contamination was found in the sample from M-14 (46,200 ug/l), the levels of TOX found in samples from M-1 and M-3 may actually be higher than shown (see previous paragraph).

The sample from monitoring well 204, downgradient from Area I of the landfill, had the third highest concentration of TOC found in any of the ground-water samples (66,000 ug/l).

The highest levels of total phenols were found in samples from M-1 (MQA047 - 258 ug/l, MQA048 - 314 ug/l) and M-47 (242 ug/l). Notable concentrations of TOC (16,000 ug/l) and total phenols were found in the sample from M-45c.

Metals Analyses Results

Tables 20 through 22 summarize the results of the metals analyses on ground-water samples obtained from monitoring wells at the Chambers Works Facility. Reported detection limits (DL) were contractor required detection limits (CRDL) or lower for all metal parameters except total arsenic, mercury and thallium. Reported DL's for mercury were 1.5 to 5 times CRDL in twelve samples, and for arsenic and thallium they were 5 times CRDL in one sample (MQA041). Lead values were all estimated due to apparent interference from excessive levels of chloride and sulfate. There is a negative bias of 40% or more if detectable, and a higher than indicated detection limit if non-detectable. Samples for mercury (6), iron (4), barium (4), sodium (2) and manganese (1) were rejected due to high levels of contamination in the corresponding equipment and/or field blanks.

Elevated concentrations of some Appendix VIII metals (total) were found in a number of ground-water samples. Table 32 charts the occurrence of these metals in the samples taken by the Task Force.

Table 32 : Occurrence of Hazardous Metal Constituents in Ground-Water Samples

Metal Constituent	# of Wells Constituent Present	Range of Concentrations Present (ug/l)
Barium	14	8.0 - 2200
Lead	6*	2.3 - 61.8
Chromium	5	10 - 225
Mercury	3	0.2 - 1.75
Beryllium	3	4.0 - 50
Antimony	2	5.8 - 31.2
Arsenic	2	12 - 12.4
Cadmium	2	2.1 - 3.7
Nickel	2	27 - 416
Silver	2	13 - 42

* - May be present in other wells also (see above paragraph)

The following results were also noted

1. Barium was present at all levels of the Glacial aquifer and in the shallow Potomac-Raritan-Magothy (PRM) aquifer zone
2. Lead was present in the highest concentrations in the deep Glacial aquifer and in the shallow PRM aquifer zone (aside from M-63 and M-64 located near the Petrochemical area)
3. Chromium was present in the highest concentration in the shallow Glacial aquifer;
4. Mercury was present in the highest concentration in M-64
5. Beryllium was present in the highest concentration in Well 204;
6. Antimony and arsenic were present in the highest concentration in M-3
7. Cadmium was present in the highest concentration in M-63; and
8. Nickel and silver were present in the highest concentrations in Well 204.

Of the non-Appendix VIII metals aluminum (12), manganese (17), and zinc (12) were present at the greatest number of wells. Aluminum concentrations ranged from 127 ug/l (M-13) to 19,600 ug/l (M-63), with the highest concentrations occurring in the shallow Glacial aquifer. Manganese concentrations ranged from 278 ug/l (M-64) to 19,800 (M-63), with high concentrations occurring at all levels of the Glacial aquifer. Zinc concentrations ranged from 19 ug/l (M-47) to 406 ug/l (Well 291), with the highest concentrations occurring in the shallow Glacial aquifer but the majority of the points were present in the deep Glacial and shallow PRM aquifer zones.

Organic Analyses Results

Tables 23 through 25 summarize the results of organic analyses on ground-water samples obtained from monitoring wells at the Chambers Works Facility. Reported DL's were CRDL or lower for all organic parameters except those mentioned below. The reported DL for semi-volatile compounds was 2 times CRDL in all samples except Q1134, 1137, 1141, 1147, 1148, 1151. In these samples the DL was 10 to 200 times CRDL. For seven samples (Q1134, 1137-1139, 1147, 1148, 1151) the reported DL for all pesticides was 2 to 4 times CRDL. The reported DL for volatile organics was from 2 to 500 times CRDL in seven samples (Q1125, 1134, 1137, 1141, 1147, 1148, and 1151). Semi-volatile organic results for four samples (Q1147, 1148, 1153, 1155) were estimated due to inadequate QC information. Blank contamination of any significance was not found in the organic scans.

In general, the highest levels of hazardous organic constituents were found in the samples from monitoring wells near the centers of the interceptor pumping system (M-1, M-3, M-12, M-13, M-14). The sample from M-1 (deep Glacial aquifer) indicated the highest concentrations of acetone (1100 ug/l).

trichloroethene (870 ug/l), benzene (12,000 ug/l), toluene (260 ug/l) and o-toluidine hydrochloride (4,000 ug/l) and the second highest concentrations of chloroform (220 ug/l), chlorobenzene (15,000 ug/l), 1,4 dichlorobenzene (760 ug/l), 4-chloroaniline (3,300 ug/l), and aniline (6700 ug/l). The sample from M-3 indicated the highest concentrations of chlorobenzene (79,000 ug/l), 1,4 dichlorobenzene (1,000 ug/l), 1,2 dichlorobenzene (34,000 ug/l), 4-chloroaniline (11,000 ug/l), and aniline (12,000 ug/l). M-12 (deep Glacial aquifer) and M-14 basically had similar constituents present, however, at lower levels in most cases. The ground-water sample from M-1 contained low level concentrations of two pesticides; Beta-BHC (1.6 ug/l), and Delta-BHC (.71 ug/l). M-14 indicated low level presence of two herbicides; Dichloroprop (9.0 ug/l), and 2,4-D (9.7 ug/l).

The majority of the hazardous organic constituents were found in ground-water samples from the shallow and middle Glacial aquifers. Table 33 charts the occurrence of these Appendix VIII constituents in the ground-water samples taken by the Task Force.

Table 33: Occurrence of Hazardous Organic Constituents in Ground-Water Samples

Organic Constituent	# of Wells Constituent Present	Range of Concentrations Present (ug/l)
Chlorobenzene	12	10 - 79,000
1,2-Dichlorobenzene	11	7.2 - 34,000
4-Chloroaniline	11	4.2 - 11,000
Benzene	10	1.6 - 12,000
o-Toluidine hydrochloride	9	9.0 - 2,500
Acetone	8	7.5 - 1,100
Trichloroethene	7	5.3 - 870
Toluene	6	2.5 - 260
1,4-Dichlorobenzene	6	2.4 - 1,000
Aniline	5	3.2 - 12,000
Chloroform	4	2.8 - 270
1,2-Dichloroethane	4	16 - 470

LEACHATE AND SURFACE WATER ANALYSES RESULTS

Leachate and surface water samples taken at E.I. DuPont were analyzed for the same parameters as the ground-water samples, except for the field measurements. Results are presented in Tables 26 through 29. The leachate results indicate high TOC values, as was to be expected from this type of sample. The corresponding TOX values however, were relatively low. Sump #274, from Areas II and III, showed higher TOC and TOX concentrations than Sump #200 from Area I. Magnesium, sodium, and potassium were present in the highest concentrations.

All other metals were detected in the samples except for aluminum, beryllium, cadmium, mercury, silver, and thallium. The organic hazardous constituents found in the leachate (Table 29) parallel those found in the majority of the monitoring wells, including Well 204.

Two surface water samples were collected at the facility. Acetone (8.9 ug/l) and o-toluidine hydrochloride (12 ug/l) were detected. Additional studies are necessary to determine the relationship between surface water and ground water at the site.

DISCUSSION

LANDFILL MONITORING WELLS

Well 204 revealed the highest level of contamination with respect to TOC (66,000 ug/l) and TOX (1,310 ug/l). Monitoring wells 291 and 241 both revealed higher than background values for TOC and TOX. Upgradient well 252 indicated a sample concentration for TOC of 3500 ug/l. The data for TOX was invalidated for Well 252 due to blank contamination. The significance of these increases in concentration relative to background can not be fully assessed without a statistical analysis. It should be noted that Well 291 is 70 feet deep, whereas the other wells are approximately each 20 feet deep. Also, Wells 204 and 291 are adjacent to Area I of the landfill (inactive since 1978), whereas Well 241 is adjacent to Area II.

Well 204 also showed indications of the highest levels of aluminum (3800 ug/l), barium (2200 ug/l), beryllium (50 ug/l), chromium (225 ug/l), cobalt (515 ug/l), copper (260 ug/l), cadmium (50 ug/l), nickel (416 ug/l), silver (42 ug/l), vanadium (527 ug/l), zinc (264 ug/l) and cyanide (43 ug/l); with the exception of the zinc level (406 ug/l) at Well 291. Arsenic, barium, and mercury were found at lower levels at Well 241. Calcium, magnesium and sodium were found at high levels in most of the monitoring wells at this site, however this to be expected in a saline environment such as is present underneath the Chambers Works facility. It should also be noted that the primary sludge buried in the landfill (53,000 tons/year) is mostly made up of calcium and magnesium oxides, and that the wells around the landfill, in particular Well 204 and 252, had the highest concentrations (with the exception of two wells near the Delaware, M-63 and M-64) of these two metals.

The upgradient well (252), and Well 241, showed no quantification of any specific organic compounds. Table 31 lists several tentatively identified compounds found in these wells; however, confirmation would require the use of authentic standards. Well 291 indicates the presence of acetone (120 ug/l). Well 204 contained the greatest indication of hazardous organic constituents (11), ranging from 2.6 ug/l of 2-nitrophenol to 140 ug/l of n-nitrosodimethylamine (see Tables 23 and 24 for summary of results).

Figure 21 (High Water Levels in Shallow Glacial Zone), the most accurate potentiometric map constructed by DuPont's contractor due to the number of wells available for measurement, indicates that ground-water movement is towards the Delaware River on the west side of the landfill (highest contamination relative to background).

Based on this data it seems that ground-water contamination is occurring in the vicinity of Area I of the landfill (single liner), in particular the west side, and that migration is towards the Delaware River. Data generated eastward of Well 204 show minimal signs of contamination at this time. However, leachate sampling results from areas II and III indicate higher organic concentrations at this point. It is recommended that additional piezometers be installed to better delineate ground-water flow directions in the vicinity of the landfill.

DELAWARE RIVER WELLS

Two monitoring wells, M-63 and M-64, located on the west side of the facility, adjacent to two tanks containing sulfuric acid (TS-34, TS-36) and another series of tanks containing No. 6 fuel oil, were sampled. The facility's wharf is situated due west of these wells.

The ground water removed from M-64, the shallower of the two wells (15 feet), was pitch black in color throughout evacuation and sampling. Prior to evacuation, a thin, immiscible layer was detected using the interface probe. The sampling team was required to don respirators due to indications of organic vapors using air monitoring equipment. Analytical results (see Table 18) indicate slightly elevated levels of TOC (6500 ug/l), however, relatively low values of TOX (46 ug/l). Quantification of specific hazardous organic constituents ranged from 2.5 ug/l of toluene to 64 ug/l of 1,2-Dichloroethane. The highest levels of chromium (82 ug/l), mercury (1.75 ug/l) and zinc (364 ug/l) were found in M-64; not including wells sampled from around the landfill (see Table 24). M-64 also contained the second highest concentration of aluminum (4,050 ug/l), and the third highest concentration of lead (34.8 ug/l).

The ground water removed from M-63 (36 feet deep) was greyish, with a strong organic type odor. Once again, respiratory protection was warranted for the sampling personnel. Analytical results indicate higher levels of TOC (13,000 ug/l) and TOX (10,000 ug/l) at this location as compared to M-64. Quantification of specific hazardous constituents was considerably higher; ranging from 140 ug/l of benzene to 2,000 ug/l of 1,2-Dichloroethane. The sample from M-63 also contained the highest levels of aluminum (19,600 ug/l) and cobalt (66 ug/l), and the second highest levels of lead (37 ug/l); not including wells sampled from around the landfill.

M-63 had the highest level of iron present in any of the wells (937,000 ug/l), almost 4 times that of the next highest concentration. The iron content in M-64 was 156,000 ug/l. Field measurements at both M-63 and M-64 indicated a low pH; 4.60 and 5.40, respectively. Samples from M-63 also had the highest readings of specific conductivity (4,000 umhos/cm) and the lowest reading of turbidity (11.1 NTU). These facts seem to indicate that a larger percentage of the metals present in the ground water at this location are in a dissolved state.

Ground-water movement in the shallow aquifer at the location of M-64 is unaffected by the interceptor pumping system, and thus flows in a westerly direction towards the Delaware River. It is recommended that additional studies be conducted in this area to define possible migration of hazardous constituents towards the Delaware River. Physical observations (color, odor, and an immiscible layer), along with the presence of several hazardous organic constituents, tend to point to a floating hydrocarbon in that area; either from the nearby storage tanks or the petrochemical products area. Records show that a past disposal area was located approximately 400 feet south-south east of M-64; in the vicinity of TEL-563. Although flow is towards the Delaware River, the influence of the tide may be spreading the floaters parallel to the shore.

There is some question as to the reliability of ground-water flow information in the middle glacial aquifer (lack of data points), and to what extent contaminant movement is influenced in the screened interval of M-63. The conditions described above seem to indicate high percentages of dissolved metals in the ground water, which may be flowing in a westerly direction.

POTOMAC-RARITAN-MAGOTHY AQUIFER WELLS

Three monitoring wells screened in the shallow Potomac-Raritan-Magothy (PRM) aquifer zone were sampled (M-45c, 92, 94). Task Force sampling verifies the presence of contamination at M-45c, as does data generated in the past by E.I. DuPont. Results indicate a TOC concentration of 16,000 ug/l (TOX data invalidated). Quantification of specific hazardous organic constituents (15) ranged from 2.0 ug/l of di-nbutylphthalate to 83 ug/l of chlorobenzene. The majority of the organic constituents found are typical of those present in the Glacial aquifer (see Table 33 - Occurrence of Hazardous Organic Constituents). The highest concentration of lead (61.8 ug/l), and the second highest concentration of barium (193 ug/l) were found at M-45c.

M-92 and M-94 both showed indications of the presence of hazardous organic constituents: M-94 more so than the former. The TOX concentration of the sample from M-94 was 107 ug/l. Quantification of specific hazardous organic constituents (7) ranged from 1.6 ug/l of benzene to 38 ug/l of 1,2-dichlorobenzene. Once again, the majority of the constituents are typical of those present in the Glacial aquifer. The sample from M-92 had an acetone concentration of 140 ug/l.

The following organic hazardous constituents were found in the samples only from the PRM aquifer; 1,4-naphthaquinone, bis-(2 chloroethyl) ether, 2,4-dinitrotoluene, bis (2-ethylhexyl phthalate), and o and p phenylenediamine.

Of the current EPA Interim Primary Drinking Water Standards the only parameter of concern at this time in the shallow PRM aquifer is lead (61.8 ug/l). The analytical results indicate a negative bias of 40% for lead (see Metals Analyses Results). The Drinking Water Standard is 50 ug/l. Appendix F of "Regulations Implementing the New Jersey Water Pollution Control Act" (N.J.S.A. 58:10A) entitled, "Values for the Determination of NJPDES Permit Toxic Effluent Limitations" lists requirements for drinking water in New Jersey. One of the parameters Total Volatile Organics (TVO) has a limitation of 50 ug/l. However, there are not any final standards as of yet. Incidentally, concentrations of TVO in all three of the monitoring wells sampled in the shallow PRM aquifer, a drinking water source, exceed 50 ug/l.

Both M-92 and M-45c are located in the central area of the facility. M-94 is situated on the southeast border. The constituents of M-94 are similar to those of M-18 and M-21 above it, but at lower concentrations. It also contained 2,4-dinitrotoluene, and bis (2-ethylhexyl phthalate). Ground-water movement in the PRM aquifer at this time seems to have shifted from a southwesterly to a southeasterly direction. However, more monitoring points (piezometers) are needed to better define the ground-water flow of the PRM aquifer beneath the site. It is also necessary to delineate the rate and extent of contamination in the PRM aquifer.

INTERIOR MONITORING WELLS

The remainder of the monitoring wells sampled were all situated in the vicinity of the central area of the facility (M-1, 3, 12, 13, 14 47). with the exception of M-18 and M-21. Both of these wells are located on the southeast boundary of the facility, near the town of Deepwater.

M-18 and M-21 are screened in the deep Glacial aquifer, approximately 700 feet apart from each other. Of the two, M-21 indicated the higher levels of TOX contamination (1,060 ug/l). Quantification of the hazardous organic constituents (12) in M-21, ranged from 4 ug/l of 2-chlorophenol to 350 ug/l chlorobenzene. The sample from M-18 showed fewer of these constituents (4) and at lower concentrations; but of the same ones. All of the organic constituents found in these two wells are similar to those found in other wells in the facility and the leachate. Concentrations of metals in these samples were lower than in M-94 (shallow PRM aquifer zone).

As was discussed previously the interior wells (M-1, 3, 12, 13, 14), were the most highly contaminated wells on-site. At the M-12, 13, 14 cluster, the highest levels of organic contamination occurred in the screened portion of the shallow Glacial aquifer. Contamination levels were similar in both the middle and deep Glacial aquifers. At the M-13, cluster, organic contamination was highest in the deep aquifer, although contaminant levels were also very high in the middle aquifer. Results of metals analyses indicate that these contaminants are distributed mostly in the middle and deep Glacial aquifers.

M-47, screened in the shallow aquifer, is located approximately 500 feet due east of the Waste Water Basins and 250 feet northwest of interceptor pump 103-A. Sample results indicate relatively low levels of TOC (6300 ug/l) and TOX (1180 ug/l). The total phenol concentration (242 ug/l) was the second highest found at the site. Low levels of chromium (9 ug/l) and zinc (28 ug/l) were also found. Quantification of hazardous organic constituents (9) in M-47 ranged from 2.2 ug/l of 2,4-dinitrotoluene to 40 ug/l of chlorobenzene. Duplicate results for 4-chloroaniline were 75 ug/l and 23 ug/l.

Ground-water movement at M-47 is influenced by interceptor pump 103-A towards the east. Past reports seem to indicate the possibility of "exfiltration" from the Waste Water Basins into the cone of depression caused by Int-103A. If this is the case, M-47, which is directly in the path of the ground-water flow, is an indicator of the contamination migrating from the Waste Water Basins into the ground water.

Aside from the area around the landfill, it is difficult to assess the source(s) of ground-water contamination and its movement due to the effect of the pumping for contaminant removal. This is true at both the interior portion of the plant, as well as the property boundary wells on the east side. Ground-water contamination in the plant area may be occurring from the ditch system or from past practices, or both; this is difficult to determine. However, two factors that predominate are the similarity and wide spread distribution of the organic contaminants in the monitoring wells, including those screened in the shallow PRM aquifer zone. Vertical gradients seem to indicate possible flow from the Glacial aquifer to the shallow PRM aquifer zone. The majority of these contaminants parallel those present

in the leachate from the landfill, which is a "fingerprint" of the previous and present types of chemicals used at the facility, and the types of wastes generated on-site and entering the ditch system; prior to flowing to the waste water treatment plant.

Key to Results of Sample Analysis

- J - estimated value due to the presence of interference
- M - duplicate injection results exceed control limits
- N - spike sample recovery is not within control limits
- S - value determined by Method of Standard Additions
- U - parameter analyzed, but not detected
- II - indistinguishable isomers
- na - parameter not analyzed
- + - correlation coefficient for Method of Standard Addition is less than 0.995
- * - high relative percent difference (RPD) values
- - data did not pass QA/QC review

Table 14 : Results of Inorganic Analyses of Ground-Water Samples for Shallow Glacial Aquifer Wells
(< 40 feet) at E.I. Du Pont (3/31/86 - 4/10/86)

Parameter (mg/l)	Well No./Sample No.							
	#14 MQA 041	#47 MQA 038	#47 MQA 039	#63 MQA 025	#64 MQA 028	#204 MQA 036	#241 MQA 043	#252 MQA 033
Ammonia	8.2 J	0.52 J	0.53 J	7.1 J	3.2 J	3.9 J	0.24 J	U J
Bromide	2.15 J	0.43 J	0.33 J	26.0 J	2.0 J	12.0 J	0.7 J	1.25 J
Chloride	384 JN	390 JN	390 JN	732 N	57 JN	94 JN	93.5 J	396 JN
Nitrate	----	----	----	----	----	----	----	----
Nitrite	----	----	----	----	----	----	----	----
Sulfate	110 *JN	150 *JN	130 *JN	3500 *JN	122 *JN	475 *JN	103 *JN	480 *JN

Table 15 : Results of Indicator Type Analyses for Shallow Glacial Aquifer Wells

Parameter (ug/l)	#14 MQA 041	#47 MQA 038	#47 MQA 039	#63 MQA 025	#64 MQA 028	#204 MQA 036	#241 MQA 043	#252 MQA 033
POC	----	----	----	----	----	----	----	----
TOC	51000 J	6300 J	5600 J	13000 J	6500 J	66000 J	5600 J	3500 J
Phenols, Total	218	242	67	----	----	50	74	60
PDX	13100 J	285 J	283 J	1250 J	30 J	9 J	U J	6 J
TOX	46200	1180	1140	10000 J	46 J	1310	----	----

Table 16 : Results of Inorganic Analyses of Ground-Water Samples for Middle and Deep Glacial Aquifer Wells (40-120 feet) at F.I. Du Pont (3/31/86 - 4/10/86)

Well No./Sample No.								
Parameter (mg/l)	#1 MQA 047	#1 MQA 048	#3 MQA 037	#12 MQA 256	#13 MQA 034	#18 MQA 029	#21 MQA 024	#291 MQA 032
Ammonia	22.0 J	23.0 J	20.0 J	1.1 J	2.1 J	U	1.32 J	U J
Bromide	U J	U J	43 J	5.0 J	2.5 J	0.10 J	0.6 J	0.20 J
Chloride	388 JN	384 JN	388 JN	768 JN	384 JN	18.8 JN	114 JN	100 JN
Nitrate	----	----	----	----	----	----	----	----
Nitrite	----	----	----	----	----	----	----	----
Sulfate	700 *JN	1360 *JN	320 *JN	32.4 *JN	55.0 *JN	0.2 *JN	1.9 *JN	80.0 *JN

Table 17 : Results of Indicator Type Analyses for Middle and Deep Glacial Aquifer Wells

Parameter (ug/l)	#1 MQA 047	#1 MQA 048	#3 MQA 037	#12 MQA 256	#13 MQA 034	#18 MQA 029	#21 MQA 024	#291 MQA 032
POC	----	----	----	----	----	----	----	----
TOC	na	93000 J	86000 J	17000 J	14000 J	4500 J	5000 J	6400 J
Phenols, Total	258	314	U	50	50	U	----	U
POX	54200 J	26200 J	61900 J	1020 J	890 J	16 J	980 J	U J
TOX	43400 J	34200 J	33900 J	1980 J	4040 *	29 J	1060 J	21

Table 18 : Results of Inorganic Analyses of Ground-Water Samples for Shallow Potomac-Raritan-Magothy Aquifer Zone Wells (>120 ft.) at E.I. Du Pont (3/31/86 - 4/10/86)

Parameter (mg/l)	Well No./Sample No.		
	#45-C MQA 050	#92 MQA 046	#94 MQA 049
Ammonia	2.9 J	0.36 J	0.53 J
Bromide	1.35 J	0.33 J	0.30 J
Chloride	730 JN	38.4 JN	138 JN
Nitrate	----	----	----
Nitrite	----	----	----
Sulfate	500 *JN	2.77 *JN	11.0 *JN

Table 19 : Results of Indicator Type Analyses for Shallow Potomac-Raritan-Magothy Aquifer Zone Wells

Parameter (ug/l)	#45-C MQA 050	#92 MQA 046	#94 MQA 049
POC	----	----	----
TOC	16000 J	3400 J	3900 J
Phenols, Total	102	15	17
POX	99 J	U J	65 J
TOX	----	8.3 J	107 J

Table 20 : Results of Metals Analyses of Ground-Water Samples for Shallow Glacial Aquifer Wells (<40 ft.)
at E.I. Du Pont (3/31/86 - 4/10/86)

Parameter (ug/l)	Well No./Sample No.							
	#14 MQA 041	#47 MQA 038	#47 MQA 039	#63 MQA 025	#64 MQA 028	#204 MQA 036	#241 MQA 043	#252 MQA 033
Aluminum	353 *N	U *N	U *N	19600 *N	4050 *N	3800 *N	U *N	563 *N
Antimony	U N	U N	U N	U N	U N	U N	U N	U N
Arsenic	U	U	U	U	U	U M	12	U
Barium	231	----	----	8	45	2200	27	----
Beryllium	U	U	U	4	U	50	U	U
Cadmium	U N	U N	U N	3.7 N	U N	U N	U N	2.1 +NS
Calcium	61100 J	56900 J	56300 J	140000 J	137000 J	178000 J	43800 J	118000 J
Chromium	----	9	10	U	82	225	U	11
Cobalt	U	U	U	66	U	515	U	21
Copper	U	U	U	U	U	260	U	U
Iron	38700 J	13500 J	13000 J	937000 J	156000 J	5510 J	54900 J	723 J
Lead	U JN	U JN	U JN	37.0 JN	34.8 NS	U JN	U N	U JN
Magnesium	37100 J	27900 J	27400 J	122000 J	10900 J	278000 J	14800 J	101000 J
Manganese	1640 J	1370 J	1350 J	19800 J	436 J	3630 J	1910 J	3220 J
Mercury	U	----	U	U	1.75	U	0.2	U
Nickel	U	U	U	U	U	416	U	27
Potassium	11200	6680	7600	30400	12600	64000	U	7310
Silver	U	U	U	U	U	42	U	U
Sodium	255000 JN	157000 JN	158000 JN	1030000 JN	141000 JN	187000 JN	9200 JN	106000 JN
Thallium	U JN	U N	U JN	U	U N	U N	U N	U N
Vanadium	U	U	U	U	U N	527	U	U
Zinc	U N	28 N	19 N	51 N	364 N	264 N	U N	33 N
Cyanide	U	U	U	U	U	43	U	U

Table 21 : Results of Metals Analyses of Ground-Water Samples for Middle and Deep Glacial Aquifer Wells
(40-120 feet) at E.I. Du Pont (3/31/86 - 4/10/86)

Parameter (ug/l)	Well No./Sample No.							
	#1 MQA 047	#1 MQA 048	#3 MQA 037	#12 MQA 256	#13 MQA 034	#18 MQA 029	#21 MQA 024	#291 MQA 032
Aluminum	255 *N	188 *N	873 *N	U *N	127 *N	U *N	142 *N	282 *N
Antimony	5.8 NS	6.6 NS	31.2 NS	U N	U N	U N	U N	U N
Arsenic	U	U	12.4 S	U	U	U	U	U
Barium	59	58	----	56	187	27	54	55
Beryllium	U	U	4	U	U	U	U	U
Cadmium	U N	U N	U N	U N	----	U N	U N	U N
Calcium	104000 J	103000 J	57900 J	109000 J	109000 J	7800 J	15700 J	14600 J
Chromium	U	U	30	11	U	U	U	U
Cobalt	U	U	U	U	U	U	U	U
Copper	U	U	U	U	U	U	U	U
Iron	161000 J	158000 J	83200 J	19000 J	238000 J	15200 J	7410 J	1120 J
Lead	U JN	U JN	----	U N	U JN	2.4 N	2.3 N	U N
Magnesium	73500 J	72300 J	42300 J	65400 J	56400 J	3800 J	10800 J	10100 J
Manganese	5100 J	5040 J	2260 J	2100 J	10400 J	659 J	554 J	338 J
Mercury	---	U	U	U	U	1.2	U	U
Nickel	U	U	U	U	U	U	U	U
Potassium	28100	28700	19200	7100	7420	2570	3350	5970
Silver	U	U	U	U	U	U	U	U
Sodium	493000 JN	488000 JN	395000 JN	213000 JN	282000 JN	18600 JN	53500 JN	22900 JN
Thallium	U N	U N	U N	U N	U JN	U N	U N	U N
Vanadium	23	U	U	U	U	U	U	U
Zinc	U N	U N	46 N	42 N	U N	20 N	U N	406 N
Cyanide	U	U	U	U	U	U	U	U

Table 22 : Results of Metals Analyses of Ground-Water Samples for Shallow Potomac-Raritan-Magothy Aquifer Zone Wells (>120 ft.) at E.I. Du Pont (3/31/86 - 4/10/86)

Parameter (ug/l)	Well No./Sample No.		
	#45-C MQA 050	#92 MQA 046	#94 MQA 049
Aluminum	U *N	745 *N	359 *N
Antimony	U N	U N	U N
Arsenic	U	U	U
Barium	193	56	47
Beryllium	U	U	U
Cadmium	U N	U N	-----
Calcium	71700 J	12400 J	10600 J
Chromium	U	U	U
Cobalt	U	U	U
Copper	U	U	15
Iron	94800 J	18500 J	13100 J
Lead	61.8 JN	U N	10.4 N
Magnesium	27700 J	3100 J	3940 J
Manganese	1700 J	688 J	278 J
Mercury	U	U	U
Nickel	U	U	U
Potassium	15300	4540	5490
Silver	U	U	13
Sodium	154000 JN	79000 JN	79200 JN
Thallium	U N	U N	U N
Vanadium	U	U	U
Zinc	137 N	62 N	242 N
Cyanide	U	U	U

Table 23 : Results of Organic Analyses of Ground-Water Samples for Shallow Glacial Aquifer Wells (<40 ft.)
at E.I. Du Pont (3/31/86 - 4/10/86)

Parameter (ug/l)	Well No./Sample No.									
	#14 Q 1141	#47 Q 1138	#47 Q 1139	#63 Q 1125	#64 Q 1128	#204 Q 1136	#241 Q 1143	#252 Q 1133		
Vinyl Chloride	U	U	U	U	U	U	U	U		
Methylene Chloride	U	U	U	U	U	U	U	U		
Acetone	U	U	U	U	U	U	U	U		
Carbon Disulfide	U	U	U	U	8.0	U	U	U		
1,1-Dichloroethene	U	U	U	U	U	U	U	U		
trans-1,2-Dichloroethene	U	U	U	U	U	U	U	U		
Chloroform	270	U	2.8 J	U	U	U	U	U		
1,2- Dichloroethane	U	U	U	2000	64	U	U	U		
Trichloroethene	260	U	U	U	U	U	U	U		
Benzene	56	U	U	140	36	3.8 J	U	U		
Tetrachloroethene	U	U	U	U	U	U	U	U		
Toluene	200	U	3.1 J	U	2.5 J	U	U	U		
Chlorobenzene	1400	42	40	370	U	10	U	U		
Xylenes, Total	U	U	U	U	12	U	U	U		
Trichlorofluoromethane	U	U	U	U	U	U	U	U		
Phenol	U	U	U	U	U	U	U	U		
bis(2-Chloroethyl) ether	U	U	U	U	U	U	U	U		
2-Chlorophenol	U	U	U	U	U	U	U	U		
1,3-Dichlorobenzene	U	U	U	U	U	U	U	U		
1,4-Dichlorobenzene	260 J	U	U	U	U	U	U	U		
1,2-Dichlorobenzene	26000 J	37	23	---	U	7.2 J	U	U		
Nitrobenzene	U	13 J	12 J	U	U	U	U	U		
1,2,4-Trichlorobenzene	U	U	U	U	U	U	U	U		
2-Nitrophenol	U	U	U	---	U	2.6 J	U	U		
Napthalene	U	U	U	U	U	U	U	U		
4-Chloroaniline	1100 J	75	23	---	U	20	U	U		
2,4-Dinitrotoluene	U	U	2.2 J	---	U	U	U	U		
N-nitrosodimethylamine	U	U	U	---	U	140	U	U		
Di-n-butylphthalate	U	U	U	U	U	U	U	U		
bis(2-ethylhexyl)phthalate	U	U	U	U	U	U	U	U		
Aniline	U	34	3.2 J	U	---	5.0 J	U	U		

(cont.)

Table 23 : Results of Organic Analyses of Ground-Water Samples for Shallow Glacial Aquifer Wells (<40 ft.)
at E.I. Du Pont (3/31/86 - 4/10/86)

Parameter (mg/l)	Well No./Sample No.							
	#14 Q 1141	#47 Q 1138	#47 Q 1139	#63 Q 1125	#64 Q 1128	#204 Q 1136	#241 Q 1143	#252 Q 1133
Paraldehyde	U	U	U	U	U	U	U	U
N-nitrosodiethylamine	U	U	U	---	U	9.8 J	U	U
o-Toluidine hydrochloride	680 J	42	33	---	U	15 J	U	U
N-nitrosodipiperidine	U	U	U	---	U	70	U	U
alpha, alpha-Dimethyl phenethylamine	U	U	U	---	U	31 J	U	U
o-Phenylenediamine	U	U	U	U	U	U	U	U
p-Phenylenediamine	U	U	U	U	U	U	U	U
1,3,5-Trichlorobenzene	U	U	U	U	U	U	U	U
1,4-Naphthoquinone	U	U	U	U	U	U	U	U
2-Naphthylamine	300 J	U	U	U	U	U	U	U
Beta - BHC	U	U	U	U	U	U	U	U
Delta - BHC	U	U	U	U	U	U	U	U
Dichloroprop	9.0	U	U	U	U	U	U	U
2,4-D	9.7	U	U	U	U	U	U	U

Table 24 : Results of Organic Analyses of Ground-Water Samples for Middle and Deep Glacial Aquifer Wells
(40-120 feet) at E.I. Du Pont (3/31/86 - 4/10/86)

Parameter (ug/l)	Well No./Sample No.							
	#1 Q 1147	#1 Q 1148	#3 Q 1137	#12 Q 1151	#13 Q 1134	#18 Q 1129	#21 Q 1124	#291 Q 1132
Vinyl Chloride	U	U	U	25	U	U	U	U
Methylene Chloride	U	U	U	17	20	U	U	U
Acetone	1100	1000 J	U	47	U	57	34	120
Carbon Disulfide	U	U	U	U	U	U	U	U
1,1-Dichloroethene	U	U	U	8.8 J	U	U	U	U
trans-1,2-Dichloroethene	U	U	U	360	94	U	U	U
Chloroform	220	U	U	27	U	U	U	U
1,2-Dichloroethane	380	470	U	16	U	U	U	U
Trichloroethene	740	870	U	90	20	U	11	U
Benzene	11000	12000	U	140	130	U	53	U
Tetrachloroethene	U	170 J	U	18	U	U	U	U
Toluene	230 J	260 J	U	17	15	U	U	U
Chlorobenzene	13000	15000	79000	210	330	26	350	U
Xylenes, Total	U	U	U	U	U	U	U	U
Trichlorofluoromethane	U	U	U	3.8 J	U	U	U	U
Phenol	U	U	U	U	U	U	U	U
bis(2-Chloroethyl) ether	U	U	U	U	U	U	U	U
2-Chlorophenol	U	U	U	U	U	U	4.0 J	U
1,3-Dichlorobenzene	U	U	260 J	U	U	U	29	U
1,4-Dichlorobenzene	720 J	760 J	1000 J	18 J	U	U	66	U
1,2-Dichlorobenzene	15000 J	18000 J	34000 J	900	580 J	18 J	190	U
Nitrobenzene	U	U	U	U	U	U	U	U
1,2,4-Trichlorobenzene	8000 J	9900 J	2900 J	U	U	U	270	U
2-Nitrophenol	U	U	U	U	U	U	U	U
Napthalene	U	U	U	U	U	U	4.8 J	U
4-Chloroaniline	3300 J	3000 J	11000 J	310	840 J	4.2 J	140	U
2,4-Dinitrotoluene	U	U	U	U	U	U	U	U
N-nitrosodimethylamine	U	U	U	U	U	U	U	U
Di-n-butylphthalate	U	U	U	U	U	U	U	U
bis(2-ethylhexyl)phthalate	U	U	U	U	U	U	U	U
Aniline	6700 J	5000 J	12000 J	U	U	U	U	U

(cont.)

Table 24 : Results of Organic Analyses of Ground-Water Samples for Middle and Deep Glacial Aquifer Wells
(40-120 feet) at E.I. Du Pont (3/31/86 - 4/10/86)

Parameter (ug/l)	Well No./Sample No.							
	#1 Q 1147	#1 Q 1148	#3 Q 1137	#12 Q 1151	#13 Q 1134	#18 Q 1129	#21 Q 1124	#291 Q 1132
Paraldehyde	U	U	U	28 J	U	U	U	U
N-nitrosodiethylamine	U	U	U	U	U	U	U	U
o-Toluidine hydrochloride	4000 J	2500 J	260 J	700	390 J	U	9.0 J	U
N-nitrosodipiperidine	U	U	U	U	U	U	U	U
alpha, alpha-Dimethyl phenethylamine	U	U	U	U	U	U	U	U
o-Phenylenediamine	U	U	U	U	U	U	U	U
p-Phenylenediamine	U	U	U	U	U	U	U	U
1,3,5-Trichlorobenzene	U	U	U	U	U	U	U	U
1,4-Napthoquinone	2200 J	1900 J	300 J	U	U	U	U	U
2-Napthylamine	U	U	U	76 J	180 J	U	U	U
Beta - BHC	1.6	U	U	U	U	U	U	U
Delta - BHC	.71	U	U	U	U	U	U	U
Dichloroprop	U	U	U	U	U	U	U	U
2,4-D	U	U	U	U	U	U	U	U

Table 25 : Results of Organic Analyses of Ground-Water Samples for Shallow Potomac-Raritan-Magothy Aquifer Zone Wells (>120 feet) at E.I. Du Pont (3/31/86 - 4/10/86)

Parameter (ug/l)	Well No./Sample No.		
	#45-C Q 1150	#92 Q 1146	#94 Q 1149
Vinyl Chloride	U	U	U
Methylene Chloride	U	U	U
Acetone	7.5 J	140	U
Carbon Disulfide	U	U	U
1,1-Dichloroethene	U	U	U
trans-1,2-Dichloroethene	U	U	U
Chloroform	U	U	U
1,2-Dichloroethane	U	U	U
Trichloroethene	5.3	U	U
Benzene	14	U	1.6 J
Tetrachloroethene	U	U	U
Toluene	U	U	U
Chlorobenzene	83	U	23
Xylenes, Total	U	U	U
Trichlorofluoromethane	U	U	U
Phenol	U	U	U
bis(2-Chloroethyl) ether	2.6 J	U	U
2-Chlorophenol	U	U	U
1,3-Dichlorobenzene	U	U	5.4 J
1,4-Dichlorobenzene	2.4 J	U	U
1,2-Dichlorobenzene	49	---	38
Nitrobenzene	U	U	U
1,2,4-Trichlorobenzene	U	U	U
2-Nitrophenol	U	U	U
Napthalene	U	U	U
4-Chloroaniline	10 J	U	13 J
2,4-Dinitrotoluene	61	U	3.4 J
N-nitrosodimethylamine	U	U	U
Di-n-butylphthalate	2.0 J	U	U
bis(2-ethylhexyl)phthalate	2.8 J	2.0 J	3.6 J
Aniline	U	U	U

(cont.)

Table 25 Results of Organic Analyses of Ground-Water Samples for Shallow Potomac-Raritan-Magothy Aquifer Zone Wells (>120 feet) at E.I. Du Pont (3/31/86 - 4/10/86)

Parameter (ug/l)	Well No./Sample No.		
	#45-C Q 1150	#92 Q 1146	#94 Q 1149
Paraldehyde	U	U	U
N-nitrosodiethylamine	U	U	U
o-Toluidine hydrochloride	10 J	U	U
N-nitrosodipiperidine	U	U	U
alpha,alpha-Dimethyl phenethylamine	U	U	U
o-Phenylenediamine	33 11	U	U
p-Phenylenediamine	33 11	U	U
1,3,5-Trichlorobenzene	U	U	U
1,4-Napthaquinone	6.8 J	U	U
2-Napthylamine	U	U	U
Beta - RHC	U	U	U
Delta - BHC	U	U	U
Dichloroprop	U	U	U
2,4-D	U	U	U

(2 of 2)

Table 26 : Results of Inorganic Analyses of Leachate and Surface Water Samples at E.I. Du Pont
(3/31/86 - 4/10/86)

Parameter (mg/l)	Sample Type/Sample No.			
	Leachate sump #1 MQA 259	Leachate sump #2 MQA 260	Surface Water #1 MQA 044	Surface Water #2 MQA 258
Ammonia	72.0	344	U J	U J
Bromide	90	60	0.33 N	0.25 N
Chloride	----	----	88	161 JN
Nitrate	----	----	----	----
Nitrite	----	----	----	----
Sulfate	2400 J	2700 J	130 *J	100 *J

Table 27: Results of Indicator Type Analyses of Leachate and Surface Waters at E.I. Du Pont
(3/31/86 - 4/10/86)

Parameter (ug/l)	Leachate Sump #1 MQA 259	Leachate Sump #2 MQA 260	Surface Water #1 MQA 044	Surface Water #2 MQA 258
POC	----	----	----	----
TOC	1240000	1490000	8600 J	18000 J
Phenols, Total	5000	9500	46	22
POX	14300	6050	U J	U J
TOX	32100	46800 J	30 J	48 J

Table 28 · Results of Metals Analyses of Leachate and Surface Water Samples at E.I. Du Pont
(3/31/86 - 4/10/86)

Parameter (ug/l)	Sample Type/Sample No.			
	Leachate sump #1 MQA 259	Leachate sump #2 MQA 260	Surface Water #1 MQA 044	Surface Water #2 MQA 258
Aluminum	U N	U N	1020 *N	1480 *N
Antimony	32.2 NS	3.4 MN	U N	3.5 NS
Arsenic	17.7 S	318	U	U
Barium	28 N	239 N	42	88
Beryllium	U N	U N	U	U
Cadmium	U N	U N	2.5 N	U N
Calcium	-----	-----	78500	59200
Chromium	14 N	24 N	U	U
Cobalt	44 N	U N	U	U
Copper	98 N	15 N	U	U
Iron	3800 JN	-----	34000	3150
Lead	U JN	37.5 JNS	9.2 N	26.5 JN
Magnesium	982000 J	928000 J	27700	24500
Manganese	-----	-----	2150	-----
Mercury	U N	U N	U	U
Nickel	64 N	397 N	U	U
Potassium	230000 JN	168000 JN	6460	8680
Silver	U	U	U	U
Sodium	495000	1020000	47900 N	12700 N
Thallium	U N	U N	U N	U N
Vanadium	37 N	77 N	U	U
Zinc	53 N	38 N	58 N	23 N
Cyanide	684	180	U	U

Table 29 : Results of Organic Analyses of Leachate and Surface Water Samples at E.I.Du Pont
(3/31/86 - 4/10/86)

Parameter (ug/l)	Sample Type/Sample No.			
	Leachate sump #1 Q 1154	Leachate sump #2 Q 1155	Surface Water #1 Q 1144	Surface Water #2 Q 1153
Methylene Chloride	360 J	820	U	U
Acetone	22000	22000	8.9 J	U
Chloroform	U	2400	U	U
Benzene	300 J	270 J	U	U
4-Methyl-2-pentanone	U	2600	U	U
Toluene	650	1000	U	U
Chlorobenzene	6500	2100	U	U
Acrolein	-----	-----	U	U
Phenol	2100	4100 J	U	U
1,2-Dichlorobenzene	10000	1100 J	U	U
2-Methylphenol	230 J	100 J	U	U
4-Methylphenol	U	4600 J	U	U
Benzoic Acid	1000 J	6200 J	U	U
1,2,4-Trichlorobenzene	880 J	U	U	U
4-Chloroaniline	14000	19000 J	U	U
4-Nitrophenol	490 J	U	U	U
N-nitrosodimethylamine	6400	U	U	U
Aniline	6800	19000 J	U	U
N-nitrosodiethylamine	400 J	U	U	U
o-Toluidine hydrochloride	24000	51000 J	U	12 J
N-nitrosodipiperidine	6200	U	U	U
1,3,5-Trichlorobenzene	170 J	U	U	U

Table 30 : Analytical Field Measurements Conducted at E.I. Du Pont
(3/31/86 - 4/10/86)

Sample Location	Temperature (C°)	pH (SU)	Specific Conductivity (umhos/cm)	Turbidity (NTU)
Well #1	8.0	6.45	1440	129.0
Well #3	17.5	6.00	2400	59.2
Well #12	8.0	6.40	1300	46.0
Well #13	17.9	6.10	2000	na
Well #14	17.5	6.30	1370	na
Well #18	13.5	6.80	168	69.0
Well #21	15.1	7.05	80	32.0
Well #45-C	10.0	6.40	1450	43.0
Well #47	14.6	5.80	1350	64.9
Well #63	14.1	4.60	4000	11.1
Well #64	11.9	5.40	1300	41.8
Well #92	15.2	6.70	350	122.0
Well #94	13.7	6.40	370	24.0
Well #204	15.4	6.53	1500	96.8
Well #241	na	6.00	400	35.5
Well #252	12.9	5.50	1750	na
Well #291	17.0	5.80	450	46.5
Surface Water #1	na	6.30	475	na
Surface Water #2	na	7.00	375	na

Table 31 : Tentatively Identified Compounds Requiring Confirmation Using Authentic Standards

Sample Location	Sample #	Compounds	Concentration, ug/L
Well 21	1124	Benzene, Chloro-	320
		Benzenamine, 2-Chloro-	530
		Benzenamine, 4-Chloro-2-Methyl-	110
		3,6,9,12-Tetraoxahexadecan-1-01	2,100
		Ethane, 1,2-Dichloro	240
		Butane, 2-Methyl	15
		Ethane 1,1-Dichloro-2, 2-Difluoro-	49
		Ethene Trichloro	20
		Benzene, 1,3-Bis(Trifluoromethyl)- (Scan No. 528)	13
		Benzene, 1,3-Bis(Trifluoromethyl)- (Scan No. 540)	25
Well 63	1125	Ethane, 1,1'-Oxybis-	2,100
		Benzene, Chloro-	220
		3,6,9,12,15-Pentaoxanonadecan-1-01	110
Well 64	1128	Ethane, 1,1'-Oxybis-	400
		Ethane, 1,1'-Thiobis-	50
		Sulfur Dioxide (DOT)	12
Well 18	1129	Benzene, Chloro-	24
		Aziridine, 1-Hexyl-	15
		Ethanol, 2-(2-Butoxyethoxy)-	270
		Benzothiazole	12
		Ethanol, 2[2-(2-Butoxyethoxy)Ethoxy]-	12
		2(3H)-Benzothiazolone	27
		3,6,9,12-Tetraoxahexadecan-1-01	7,200
Well 291	1132	4-Penten-2-01	7
		Ethane, 1,1,1'-Oxybis	6
		Ethanol, 2-(2-Butoxyethoxy)-	190
		3,6,9,12,15-Pentaoxanonadecan-1-01 (Scan No. 953)	16
		3,6,9,12,15-Pentaoxanonadecan-1-01 (Scan No. 1041)	80
		3,6,9,12,15-Pentaoxanonadecan-1-01 (Scan No. 1131)	2,000
		3,6,9,12,15-Pentaoxanonadecan-1-01 (Scan No. 1298)	10
			120
Well 252	1133	2-Piperidinecarboxylic Acid, 1-Formyl-	26

continued-

Sample Location	Sample #	Compounds	Concentrations, ug/L
Well 13	1134	Ethane, 1,2-Dichloro-1,1,2,-Trifluoro-	11
		Ethane, 1,1'-Oxybis-	32
		Benzene, Chloro-	220
		Ethanol, 2(-(2-Butoxyethoxy)-	250
		Benzenamine, 4-Chloro-2-Methyl-	300
		Benzenamine, 2,3-Dichloro	88
		Benzenamine, 2,4-Dichloro-	140
		Benzenamine, 4 (4Morpholinyl)-	140
		Benzenamine	1,600
		Benzenamine, 3-Methyl-	650
		Benzenamine, 2-Chloro	1,400
Well 204	1136	Methanamine, N-Methyl-N-Nitro-	580
		2,5-Cyclohexadiene-1,4-Dione	33
		Piperidine, 3,5-Dimethyl-	13
		Furan, Tetrahydro-3-Methyl-	27
		Benzene, 1-Methyl-2-Nitro-	48
		1H-Imidazole, 4,5-Dihydro-2-Methyl-	560
		1H-Indole, 2,3-Dihydro-1,2-Dimethyl-	19
		2-Pentanamine, N-Ethyl-4-Methyl-	31
		Benzenamine, 2,3-Dichloro-	16
		2-H-Indol-2-One, 1,3-Dihydro-3,3-Dimethyl-	22
		Benzo[B]Thiophene, 7-Ethyl-2-Methyl-	150
		Benzenemethanamine, 4-Methyl-	18
		Benzene, 1-Methyl-4-(1 Methyleneethyl)-2-Nitro-	12
		Piperazine, 2-Methyl-	4
		Butanedioic Acid, Phenyl-, Dimethyl Ester	5
		1-Indanone, 5,6-Dimethyl-	35
		2H-1-Benzopyran, 3,4-Dihydro-	6
		1H-Indole-1-Acetaldehyde, 2,3-Dihydro-	
		3,3-Methyl-2	39
		Hydrocarbon	390
		Hydrocarbon Substitute	16
Well 3	1137	Ethane, 1,1,2-Trichloro-1,2,2-Trifluoro-	3,700
		Methane, Dichloro-	700
		Ethane, 1,1,2-Trichloro-1,2 2-Trifluoro-	400
		Ethene, Trichloro-	100
		Benzene, Chloro- (Scan No. 524)	100
		Benzene, Chloro- (Scan No. 402)	66,000
		Benzenamine	8,300
		Benzenamine, 2-Chloro-	5,200

continued-

<u>Sample Location</u>	<u>Sample #</u>	<u>Compounds</u>	<u>Concentration, ug/L</u>
Well 47	1138	Ethane, 1,1,2-Trichloro-1,2,2-Trifluoro-	64
		Benzene, Chloro	51
		1,4-Cyclohexanedione	11
		Benzenamine	25
		Benzenamine, 3-Methyl-	77
		Benzenamine, 2-Chloro-	780
		1,3-Dioxane, 4,6-Bis(2,2-Dimethylpropyl)-	16
		Benzene, 1-Methyl-2-Nitro-	960
		Pyridine, 2-Chloro-6-Methyl-	96
		Benzene, 1-Methyl-3-Nitro-	45
		Benzene, 1-Chloro-2-Nitro- (Scan No. 687)	12
		Benzene, 1-Chloro-2-Nitro- (Scan No. 693)	99
		Benzene, 1-Chloro-2-Nitro- (Scan No. 700)	1,900
		Benzene, 1,2-Dichloro-4-Nitro-	220
		Benzenamine, 2,4-Dichloro-	41
Well 47	1139	Ethane, 1,1,2-Trichloro-1,2,2-Trifluoro-	52
		Benzene, Chloro-	36
		Benzenamine, 3-Methyl-	72
		Benzenamine, 2-Chloro-	690
		1,3-Dioxane, 4,6-Bis(2,2-Dimethylpropyl)-	15
		Benzene, 1-Methyl-2-Nitro-	970
		Benzene, 1-Methyl-3-Nitro- (Scan No. 669)	59
		Benzene, 1-Methyl-3-Nitro- (Scan No. 679)	42
		Benzene, 1-Chloro-2-Nitro- (Scan No. 687)	11
		Benzene, 2-Chloro-2-Nitro- (Scan No. 693)	94
		Benzene, 1-Chloro-2-Nitro- (Scan No. 700)	1,800
		Benzene, 1,2-Dichloro-4-Nitro	220
		Benzenamine, 2,3-Dichloro-	39
Well 14	1141	Ethane, 1,1,2-Trichloro-1,2,2-Trifluoro-	120
		Benzenamine, 3-Methyl-	1,000
		Benzenamine, 2-Chloro-	2,200
		Benzenamine, 4-Chloro-2-Methyl-	3,400
		Benzenamine, 2,3-Dichloro- (Scan No. 733)	12,200
		Benzenamine, 2,3-Dichloro- (Scan No. 770)	2,800
Well 241	1143	Piperidine, 1-Ethyl-2-Methyl- (Scan No. 410)	28
		Benzene, Methyl-	12
		Piperidine, 1-Ethyl-2-Methyl- (Scan No. 513)	27
Surface Water #1	1144	2-Piperidinecarboxylic Acid, 1-Formyl-	22
Surface Water #2	1144RE	1,4-Cyclohexanedione	27

continued

Sample Location	Sample #	Compounds	Concentration, ug/l
Well 92	1146	Thiazole, 2-Ethyl-4-Methyl- Ethanol, 2-(2-Butoxyethoxy)- 2(3H)-Benzothiazolone 3,6,9,12-Tetraoxahexadecan-1-01	17 240 10 5,300
Well 1	1147	Ethanol, 2,2,2,-Trifluoro- (Scan No. 127) Ethane, 1,2-Dichloro-1,1-Difluoro- Ethane, 1,1-Dichloro-2,2-Difluoro- Ethanol, 2,2,2-Trifluoro (Scan No. 112) Chlorobenzene	5,300 1,200 1,700 21,000 5,400
Well 1	1148	Ethanol, 2,2,2-Trifluoro- (Scan No. 126) Ethane, 1,2-Dichloro-1,1-Difluoro- Ethane, 1,1-Dichloro-2,2-Difluoro- Ethanol, 2,2,2-Trifluoro- (Scan No. 112) Benzene, Chloro- Benzenamine, 4-Chloro-2-Methyl	6,500 1,700 2,500 23,000 7,600 1,400
Well 94	1149	Benzenamide, 2-Chloro- Benzene, Chloro	11 13
Well 45-C	1150	Ethane 1,2-Dichloro- Ethane, 1,1'-Oxybis- Ethane, 1,1-Dichloro-2,2-Difluoro- Ethane, 1,1'-Thiobis- Benzene, Chloro- Benzamine, 4-Chloro-2-Methyl- 1,3-Benzenediamine, 4-Methyl- Benzamine, 4-Methyl- Benzenamine, 4-Ethoxy- Benzamine, 2-Chloro-	71 12 15 7 43 32 30 10 15 220
Well 12	1151	Methane, Dichlorofluoro- Ethane, 1,1,2-Trichloro-1,2,2-Trifluoro- Benzene, Chloro- Benzenamine, 2-Chloro- Ethanol, 2-(2-Butoxyethoxy)- Benzenamine, 4-Chloro-2-Methyl- Benzenamine, 2,6-Dichloro- Benzenamine, 3,5-Dichloro- Benzenamine, 4-(4-Morpholinyl)- 3,6,9,12,15-Pentaoxanonadecan-1-0L	10 36 150 990 800 160 32 36 25 2,800

continued-

Sample Location	Sample #	Compounds	Concentration, ug/l
Leachate Sump #1	1154	Phenol	2,000
		Benzene, Chloro-	4 200
		Methanamine, N-Methyl-N-Nitro-	2,300
		Benzenamine, 2-Chloro-	14,000
		Benzenamine, 3,4, Dimethyl-	2,400
		1,3-Diazabicyclo [3.1.0]Hexane	1,600
		Benzeneacetic Acid	680
		Benzene, 1-Chloro-2-Nitro	810
		L-Threonine, Ethyl Ester	1,200
		Benzenamine, 2,3-Dichloro- (Scan No. 718)	470
		Benzenamine, 2,3-Dichloro- (Scan No. 760)	920
		Benzo[B]thiophene, 7-Ethyl-2-Methyl-	1,800
		1H-Indole-1-Acetaldehyde, 2,3-Dihydro-3,3-Dimethyl-2	3,200
Leachate Sump #2	1155	Ethanol	2,000
		Benzenemethanol, .Alpha.-(1-Aminoethyl)-, [R-(R*,S*)]-	14,000
		2-Propanol	10,000
		Acetamide, N,N-Dimethyl-	4,000
		Phenol	2,000
		Benzenamine	1,000
		Benzene, Chloro-	3,700
		Propanedioic Acid	13,000
		Hexanoic Acid, 2-Methyl-	5,900
		Hexanoic Acid	2,200
		Oxirane, 2,3-Bis (1-Methylethyl)-, Trans-	1,700
		Hexanoic Acid, 2-Ethyl-	13,000
		Benzenamine, 2-Chloro-	10,000
		1,3-Pentanediol, 2,2,4-Trimethyl-	8,700
		Benzenamine, 2,6-Dimethyl-	3,200
		Benzenacetic Acid	8,000
		Benzenamine, 2-Chloro-4-Methyl-	2,000
		Benzenepropanoic Acid	3,200
		Benzenamine, 2,3-Dichloro-	2,200
		1,3-Benzenediamine, 4-Methyl-	1,000
		Cyclopropanecarboxylic Acid, 3-(2,2-Dichloro-ethenyl)	450
		Benzenamine, 3,4-Dichloro-	2,200
		Phenol, 3,4,5-Trimethyl-	430
		1,2,4-Triazolo[4,3-B]Pyridazine, 6-Chloro	460
		Pentane, 1-Propoxy-	4,100
		Hexanoic Acid	2,300

I. Comprehensive Evaluation Inspection

This section presents observations made in a review of E.I. DuPont's facility operation in accordance with 40 CFR Part 265 Subparts B, C, D, G, R and New Jersey subchapters 7,8,9 and 11.

These requirements address the administrative non-technical and technical regulations and included a visual observation of current waste management units and a review and evaluation of records maintained at the facility

1. Waste Management Units/Observations

Pet Chem Container Storage Area (S01)

This container storage area is used for holding lead flue dust prior to shipment off-site. The containers used for storage are made of reinforced cardboard, with a polyethylene bag on the inside and outside. The material is shaken from the baghouse filters directly into the containers in a enclosed system. The baghouse filters are maintained at a temperature warm enough to prevent any water formation.

The lead fule dust is shipped to a secondary refiner for further processing. In the past, shipments were made to Brazil, Italy and West Germany.

The surface area is approximately 1900 square feet (60'x 30'). The surface is black top. No secondary containment was observed; however, the area was graded so runoff enters the lead recovery ditch system.

At the time of the inspection the following was noted:

- ° 161 Palletized cardboard gay lords (2000 lbs. each) with plastic (not stacked) Waste number-K069
- ° Adequate aisle space
- ° Containers in good condition
- ° Inspections being accomplished daily

Pet Chem Rubble Container Storage - has a surface area of approximately 27,000 square feet (265'x 105', 35'x 60'). The surface is crushed stone. No secondary containment observed; however, the Part B describes this area as follows: "...constructed by excavating to a depth of 30" and backfilling with 6 oz. sheet of Typer, 4 1/4" layer of crushed stone and 1 1/2" layer of crushed limestone (top). The area is sloped in the northern direction with a 8" PVC pipe at the lower elevation which feeds to the "A" ditch."

At the time of the inspection the following was noted:

- ° Two storage areas were observed:

- 112 Palletized cardboard gay lords (2000 lbs each) with plastic covers. Waste number-K069
- 8 (55) gallon containers (UN 1325) waste oil
- ° No daily inspection of waste oil storage

Chemical Waste Container Storage Area - The Chemical waste container storage area is divided into three principal sections: Area A-drum and truck trailer storage and areas B and C (truck spots). In container storage area "A" both liquids and solids are stored. This area has a surface area of approximately 23,000 square feet of actual storage space for 55 gallon drums and approximately 7200 square feet for six truck pads. Area A was divided into five sections: Area A-1 (limited access area) can hold 300 drums, Area A-2 (Liquid storage area) 2,940 drums, Area A-3 (solid storage area) 4,080 drums, and Area A-4 (staging area) 3,360 drums. Total drum storage capacity is approximately 10,680 drums. Area A-5 is for 6 tank tractor spots.

At the time of the inspection the following was noted:

- ° 1017 (55) gallon containers in storage
- ° Staging area waste not segregated by waste type (i.e. 18 drums formic acid, 4 drums phenols, 2 drums solvents. Waste was received on 3/4/86 and was observed in storage on 4/3/86.
- ° Approximately 29 (55) gallon containers did not have manifest labels, of these; 8 were known to have come from Finish & Fabricated Products Division, DuPont, Philadelphia.
- ° Overall area appeared to be extremely clean and properly monitored.

PPD Lab Waste Container Storage - This unit is described in Part A as a 50'x 30' area. This unit was delisted 4/13/83 as a protective filer.

PPD Area Waste Container Storage - This unit is described in Part A as a 50'x 30' container storage area. This unit was delisted on 4/13/83 as a protective filer.

Telomer "A" Container Storage - had approximately 800 square feet of covered storage in building 1050. Closure for this unit was approved on 1/23/86. No waste was observed in storage, floor area appeared to be clean and sloped toward a central drain. Final closure pending results of wipe test and a Professional Engineer (PE) and facility certification of closure.

Freon Spent Catalyst Container Storage - waste was previously stored in a 5916 gallon vessel (railroad car) and considered D003/D004. Closure was approved by NJDEP on 1/23/86.

Tank Storage (S02)

Chemical Waste Management Area

Two tanks are presently in use at the Chem Waste Management area. These include TS-1 (10,000 gallons) and TS-2 (7,000 gallons) for storing waste amines and waste solvents respectively. Tanks are unlined and constructed of carbon steel. Tank (TS-7) is out and Tank (TS-1) has been permanently removed. Approximately a 1' dike with a sump was observed around the tank storage area. Weekly and daily inspections are being accomplished.

Nitrocellulose Waste Pile (S03)

The waste pile consists of residues from past nitrocellulose production. The waste is ignitable when moisture free. This unit is currently under closure. A large fenced area in a remote section of the facility was observed. The closure plan for this unit was approved in 1/83 and the last annual report was prepared in 1/86. Closure involves tiling soil, allowing it to dry and igniting it.

Treatment in Tanks (T01)

Telomer "A" Waste Treatment Tank. This treatment tank on the second floor of building 1205 is a 840 gallon vessel used to neutralize waste generated at Packersburg (DuPont) during the manufacturing of Telomer "A". The spent catalyst major constituent is antimony pentafluoride. The precipitate from this process is drummed and landfilled and the filtrate is sent via the ditch to the WWTP. The reaction is run as a batch. At the time of the inspection, no waste was being treated. All paper work was in order.

Incineration (T03)

FR-1 Hazardous Waste Incinerator - The incinerator is used to destruct liquid wastes generated at the permittee's facilities. The combustion furnace is a horizontal cylindrical steel chamber lined with firebrick. The burner is supplied by fuel lines and an atomizing steam line. The high pressure steam is used to atomize the waste liquid as it exits the burner nozzle. Combustion air is supplied to the burner nozzle via a windbox. On the other end, combustion gases pass through an ash trap to a countercurrent gas scrubber. Any ash and liquid solution from the trap is collected in a sump and overflows to a collection ditch. Solids are disposed of in the landfill. Flue gas is then subjected to a jet scrubber and an electrostatic precipitator prior to being emitted into the atmosphere.

Liquid waste from on-site activities include spent halogenated and non-halogenated solvents, corrosive wastes, lead contaminated wastes and a wide variety of "U" and "P" wastes. In 1984, over 740 tons of this

liquid waste were burned. Off-site E.I. DuPont wastes accounted for approximately 475 tons. The chemical wastes are brought to the area in either drums, trailers or tanks. These are then preregistered with the proper authorities, and stored prior to burning. Wastes are fed from storage tanks and tank trailers.

At the time of the inspection, the incinerator was not in operation. A paperwork review and visual inspection was accomplished. Waste analysis calls for spot BTU, ash and chlorides for feeds. The facility recently started testing for mercury and lead. Record for waste analysis only go back six months.

Ethyl Chloride Incinerator - The ethyl chloride waste incinerators (FR-1A and FR-1B) are operated as a unit. One is kept in a standby mode while the other is operating in case of failure. This is necessary since the ethyl chloride process is partially dependant on the incinerator's availability to destruct the waste stream. Each incinerator is connected to the two scrubbers used for reducing the acidic combustion products and particulate matter.

The combustion furnace is a horizontal steel chamber lined with firebrick. The burners are supplied by natural gas, waste fuel lines and an atomizer. The waste fuels contain constituents such as nitrotoluene, chloronitrobenzen and chlorodinitrobenzene. A primary air blower provides combustion air to the burner wind box and the secondary air blower is controlled by the burner chimney temperature.

A record review and visual inspection was performed. Waste analysis does not address BTU value. The facility applied for delisting of this unit on 4/4/86. At the time of the inspection, all equipment was operating.

Thermal Treatment T04

The thermal treatment unit consist of a furnace, afterburner, cooler and baghouse. This unit is authorized to decontaminate DuPont tanks, process vessels, drums and piping. The item(s) to be decontaminated are heated to a sufficiently high temperature and length of time to decompose or volatilize any organics. Vapors and particulates flow from the furnace to an afterburner where oxidation takes place. Particulates (lead dust) are collected at the baghouse. All equipment was operating at the time of the inspection.

Surface Impoundments

The permitte has three surface impoundments (Basins A, B and C) which are regulated under RCRA and subject to groundwater monitoring requirements.

"A" Basin - This basin encompasses approximately 16 acres of water surface and has a circumference of 2600 feet. The impoundments water surface elevation is at an average of 3.1' with a hard pan at the bottom of -3.5'. Dikes on the southerly and easterly sections are composed of compacted gravel approximately 3 1/2' deep, receives water from the "A" ditch which is utilized as an excess flow basin to handle heavy rainfall and DOC concentration. Freeboard was adequate at the time of the inspection.

"B" Basin - This basin, with a circumference of 3500', encompasses approximately 17 acres of water surface and is approximately 4' deep. The hard pan bottom composed of sand and clay is at an average elevation of -3.5' and the water surface has an average elevation of 7.2'. The dike construction is the same as A basin. The water which enters this unit consist of noncontact cooling water and effluent from the WWTP. Discharge from this basin is to the Delaware via a 78" line. Freeboard was adequate at the time of the inspection.

"C" Basin - This basin, put in service in 1970, encompasses approximately 3 acres of water surface. The water surface has an elevation of approximately 10.4' and the bottom elevation is -3.5'. The basin is approximately 18' deep. The approximate dimensions are 225'x 800'x 250'x 600'. This basin receives process water (pretreated ph-adjusted) from the Petchem area. Within this area some precipitation, coagulation and settling of lead metals or salts occur classifying this unit as a treatment impoundment. The extent of additional reactions in this impoundment has not been quantified. However, since some reaction and physical seperation processes occur, this basin is considered a treatment impoundment. The unit is dredged which facilitates the recovery of lead. Water from this basin is pumped to the "A" ditch and then to the WWTP. Freeboard was adequate at the time of inspection.

At the present time this facility is operating three surface impoundments with a capacity of approximately 91,000,000 gallons.

Chemical Waste "C" Landfill

The Chemical Waste "C" Landfill consists of three areas of approximately five acres each with adjoining sides. Waste solids from the wastewater treatment plant and bulk waste solids from manufacturing operations at Chambers Works and other E.I. DuPont facilities are landfilled at this site.

About 80 tons of sludge are removed daily from the treatment plant, filtered and landfilled in the "C" landfill. The sludge contains high concentrations of magnesium and calcium from primary neutralization, and organic wastes and precipitated heavy metals. the sludge is classified by the type of wastes which flow through the treatment plant; spent solvents, treatment sludges from electroplating operations, cyanide plating bath solutions, and sludge and tank bottoms from the petroleum refining industry. In 1984, over 70,000 wet tons of primary sludge were removed from the treatment plant.

Bulk waste solids from manufacturing operations include; dry hazardous and non-hazardous chemical waste, contaminated equipment and containers, oil, spill clean-up wastes and oil sludges. Typical drummed wastes include organic residues, tars, inorganic salts, cyanates, resins and waxes, laboratory samples, organometalics, incinerator ash, and ditch cleanings. On-site manufacturing operations, laboratory research and general house cleaning resulted in the generation of 116 tons of a wide variety of hazardous waste (89 tons of this material was liquid laboratory packages). The waste received from off-site E.I. DuPont facilities for landfilling consists of mainly corrosive solids.

This first area, Area I, was constructed in 1975. Major design features of area I included:

- ° 30 mil. "Hypalon" liner
- ° 0.3% slope
- ° Leachate collection and pumping system
- ° Ground-water monitoring wells

Area I was filled in 1978. At which time, the landfill was covered with 2 feet of clay with a permeability of 1×10^{-7} cm/sec followed by 12 inches of top soil. The cover was then seeded. The East slope, which is contiguous with area II, was covered with 2 feet of clay with a permeability of 1×10^{-7} cm/sec. The South, North and West slopes were covered with 1.5 feet of clay with a permeability of 1×10^{-7} cm/sec, all of area I was then covered with 1 foot layer of top soil and seeded.

The second five acre section, Area II, was constructed adjoining Area I in 1978. Major design features include the following:

- ° Double 30 mil. "Hypalon" liners with provision for leak detection in the upper liner. The bottom liner slopes to a separate sump for leak detection.
- ° 0.3% continuous slope
- ° 6 inches of sand and 6 inches of gravel above the top liners. Due to poor drainage a 20 foot section of the sand was removed and replaced with gravel to improve drainage at the South end of the area.
- ° Leachate collection and pumping system
- ° Ground-water monitoring wells

The placement of wastes into this area started in 1979. The second lift was constructed in 1981.

At the current rate of disposal, there is approximately 58 months of landfill life left. Leachate from the landfill is sent to the WWTP. Lifts are approximately 8' and 11' high. Cover and operating records appeared to be adequate.

Waste Water Treatment Plant (WWTP)

The WWTP is currently operating at approximately 30 mgd. The commercial part of the operation accounts for less than 1% of the flow; however, this comprises approximately 1/2 of the RCRA treated waste and a higher percentage of TSS. The WWTP is operating under New Jersey Pollutant Discharge Elimination System (NJPDES) permit #0005108. The flow in the plant is as follows: tank trucks pump waste into concrete lined pump pits (approximately 100 trucks/day). Water then enters the plant to one of 3 neutralizer tanks. From this point the flow passes by a flow splitter, then to one of 4 flocculators and primary clarifiers. The influent then goes to another flow splitter and one of three aeration tanks. Flow then passes to another splitter where it is divided between two secondary layers (secondary clarifiers). The supernatant is the treated H₂O. Tanks are constructed of steel or prestressed concrete.

Capacities of the major components of this system are:

- Neutralizers (3) 215,000 gallons
- Flow Splitter 28,900 gallons
- Primary Clarifiers (4) 1,000,000 gallons each
- Aerators (3) total volume 4,624,000 gallons full, 26,400 gpm.
- Secondary Clarifiers (2) 2,800,000 gallons each
- Sludge Storage Tanks (2) 94,933 gallons
- Sludge Feed Tank 10,600 gallons

Storage Areas Less Than 90 Days

Numerous areas within the plant store waste for less than 90 days. Five areas of these were chosen for inspection. Three of five were found to be storing hazardous waste out of compliance with New Jersey Hazardous Waste Regulations.

White Products Area (A, B, C), inspected 4/18/86

- Waste in storage consisted of 3 (55) gallon drums of D001 (characteristic - ignitable waste) placed in storage on 4/7/86.
- Weekly inspections being performed
- Reportedly generates/stores 30/40 drums/2 weeks.

Building 4066, inspected 4/10/86

- Waste in storage consisted of 55 gallon drums:
 - 14 drums of nitro toluene/benzene
 - 3 drums Para Choroaniline (PO24), accumulation start dates 2/23/86, 3/21/86, 2/23/86
 - 4 open drums unlabeled looked like PO24
 - 4 drums, PO24, no accumulation start dates

- No daily inspections

Jackson Labs, Inspected 4/10/86

- Waste in storage consisted of approximately (200) 55 gallon drums
- Approximately (100) 55 gallon drums consisting of K025, P077, U133 with accumulation start dates 3/19-3/24 stored on a flat bed truck
- 8 drums (lab packs) of which 2 were open,, i.e. rings missing, with accumulation start dates of 3/19-4/1/86
- 4 rusted unknown drums including 1 overpack leaking, no label and open
- No daily inspection
- Inadequate aisle space. Drums (approximately 100) were stored 4x3 pallets and 3 high on asphalt
- Drums reportedly are stored a "couple of months".

Landfill (non-hazardous) - This landfill was inspected to insure that only non-hazardous waste was being disposed at the site. No hazardous waste was found at the site.

2. Review and Evaluation of Facility Records

Waste Analysis

The Waste Analysis Plan (WAP) used at DuPont can be divided into three different plans including; a WAP for DuPont Chambers Works waste, intra-company waste and outside business (commercial) waste.

- ° WAP - DuPont Chambers Works - All generators of waste have their own WAP. In most cases these plans are complete with the exception of insuring a generator take into account the Appendix VIII constituents. Any generator specific comments are contained with the section titled "Unit Description".
- ° WAP - Intra-Company Waste - This plan is a combination of Chambers Works WAP and Outside Business WAP.
- ° WAP - Outside Waste Business - This facility has extensive operating procedures to insure that only waste for which the facility is authorized and capable of handling is accepted. Important features of this plan include seal security program, sampling all shipments, complete waste analysis comparisons on early shipments. The business can be broken down into two phases acceptance protocol with the customer completing a waste characterization questionnaire. Information on this questionnaire include RCRA hazardous waste number, major components and process generating the waste. Dupont then collects a sample and analyzes it. A decision is then made whether to accept or not to accept this waste. If the waste is accepted, specifications and a contract are drawn up. At this point, delivery and disposal takes place. Delivery involves scheduling tank trucks at thirty minute intervals for dumping into the ditch. Trucks are weighed and sample manifests are checked. The first delivery of a waste stream involves extensive analysis. Future deliveries of the same waste only require analysis such as DOL, TSS, and total acidity. The only problem noted with this plan is that it does not address Appendix VIII constituents. It addresses priority pollutants

Closure Plan/Cost Estimate Review (Interim Status)

General Comments

- ° Milestone chart and cost estimate needed for closure of the entire facility. (i.e. Certain units must be closed after other units. The sequence of closure will greatly effect the cost estimate.)
- ° Decontamination procedures for most units are too vague (i.e. methods of decontamination, test parameters to insure decontamination is complete, soil sampling plans etc.)
- ° Certification of closure by an independent registered professional engineer and the owner or operator must be submitted to the NJDEP for all units. Additionally, cost estimates for certification must

be taken into account.

- ° Closure cost estimates not broken down adequately to allow for analysis of cost estimate adequacy.
- ° Closure of the ditch system not addressed in closure plan.

Individual Unit Comments

- ° Landfill
 - Parameters to test to insure decontamination is complete.
- ° FR-65 and Rubble Storage Area
 - Methods to insure decontamination is complete for unit, decontamination equipment and grounds (i.e., soil sampling plan, parameters, wipe test, etc.).
 - Maximum inventory of drummed waste and cost of disposal (is the drummed waste going to be landfilled at DuPont?)
- ° Pet Chem Area/Lead Flue Dust Storage Area
 - Maximum inventory of waste, cost of disposal (at closure the plan reports that the area will contain no hazardous waste; however, in the Milestone Chart, "Step 2" states, "Sample and analyze storage material").
 - Methods to insure decontamination is complete for decontamination equipment and grounds (i.e. soil sampling plan, parameters, wipe test).
- ° Chem Waste Area, FR-1 Incinerator, Container and Tank Storage
 - Method and procedures used to decontaminate the FR-1 incinerator, all tanks loading and unloading areas, containers storage area, sumps, etc.
 - Method and procedures used to insure decontamination is complete (i.e. wipe test, soil sampling plan, parameters).
 - Cost estimate for closure of this unit not delineated sufficiently to allow review.
 - Ethyl Chloride Incinerator
 - Method and procedures used to decontaminate equipment grounds.
 - Method and procedures used to insure decontamination is complete (i.e. soil sampling plan, wipe test)

- A & B Basins

- Soil sampling plan and parameters which will be used to test underlying soil

WWTP

- Parameters and test method for all equipment, grounds, etc. to insure decontamination is complete.

Plus the indicator parameters

total and dissolved metals
cyanide

TOC

TOX

chloride

total phenols

sulfate

nitrate

ammonia

POx

POC

<u>CASRN</u>	<u>Substance</u>	
<u>METHOD</u>	<u>8240</u>	
107-02-8	Acrolein	A
67-64-1	Acetone	A
107-13-1	Acrylonitrile	A
71-43-2	Benzene	A
75-27-4	Bromodichloromethane	A
75-25-2	Bromoform	A
74-83-9	Bromomethane	A
108-90-7	Chlorobenzene	A
75-00-3	Chloroethane	A
110-75-8	2-Chloroethyl vinyl ether	A
67-66-3	Chloroform	A
74-87-3	Chloromethane	A
96-12-8	1,2-Dibromo-3-chloropropane	A
124-48-1	Dibromochloromethane	A
106-93-4	1,2-Dibromoethane	A
75-34-3	1,1-Dichloroethane	A
107-06-2	1,2-Dichloroethane	A
156-60-5	trans-1,2-Dichloroethene	A
156-60-5	1,2-Dichloroethene	A
75-09-2	Dichloromethane	A
78-87-5	1,2-Dichloropropane	A
10061-01-6	cis-1,3-Dichloropropene	A
10061-02-6	trans-1,3-Dichloropropene	A
123-91-1	1,4-Dioxane	A
100-41-4	Ethylbenzene	A D
78-93-3	Methyl ethyl ketone (MEK)	A
110-86-1	Pyridine	A
100-42-5	Styrene	A
95-94-3	1,2,4,5-Tetrachlorobenzene	A
	1,2,3,4-Tetrachlorobenzene	A D

METHOD 8240 (continued)

79-34-5	1,1,2,2-Tetrachloroethane	A
127-18-4	Tetrachloroethene	A
56-23-5	Tetrachloromethane	A
108-88-3	Toluene	A
75-25-2	Tribromomethane	A
120-82-1	1,2,4-Trichlorobenzene	A
71-55-6	1,1,1-Trichloroethane	A
79-00-5	1,1,2-Trichloroethane	A
79-01-6	Trichloroethene	A
75-01-4	Vinyl chloride	A
79-06-1	Acrylamide	A
624-83-9	Isocyanic acid	A

METHOD 8240-DI

123-91-1	1,4-Dioxane
107-02-8	Acrolein
107-13-1	Acrylonitrile
79-06-1	Acrylamide
110-42-5	Pyridine

A

CASRN Substance

METHOD 8270

83-32-9	Acenaphthene	A	D
208-96-8	Acenaphthalene	A	D
62-53-3	Aniline	A	D
120-12-7	Anthracene	A	D
56-55-3	Benz[a]anthracene	A	
92-87-5	Benzidine	A	
56-55-3	Benzo(a)anthracene	A	
205-99-2	Benzo[b]fluoranthene	A	
207-08-9	Benzo[k]fluoranthene	A	D
50-32-8	Benzo[a]pyrene	A	
191-24-2	Benzo[g,h,i]perylene	A	D
100-44-7	Benzyl chloride	A	
111-91-1	Bis(2-chloroethoxy)methane	A	
108-60-1	Bis(2-chloroisopropyl) ether	A	
117-81-7	Bis(2-ethylhexyl)phthalate	A	
101-55-3	4-Bromophenyl phenyl ether	A	
85-68-7	Butyl benzyl phthalate	A	
106-47-8	p-Chloroaniline	A	
59-50-7	p-Chloro-m-cresol	A	
91-58-7	2-Chloronaphthalene	A	
95-57-8	2-Chlorophenol	A	
7005-72-3	Chlorophenylphenyl ether	A	D
218-01-9	Chrysene	A	
53-70-3	Dibenz[a,h]anthracene	A	
132-64-9	Dibenzofuran	A	D

METHOD 8270 (CONT'D)

100-01-6	4-Nitroaniline	A	
98-95-3	Nitrobenzene	A	
89-75-5	2-Nitrophenol	A	D
100-02-7	4-Nitrophenol	A	
62-75-9	N-Nitrosodimethylamine	A	
621-64-7	N-Nitrosodipropylamine	A	
603-93-5	Pentachlorobenzene	A	
62-68-8	Pentachloronitrobenzene (PCNB)	A	
87-86-5	Pentachlorophenol	A	
120-12-7	Phenanthrene	A	D
108-95-2	Phenol	A	
129-00-0	Pyrene	A	D
95-94-3	1,2,4,5-Tetrachlorobenzene	A	
	1,2,3,4-Tetrachlorobenzene	A	D
120-82-1	1,2,4-Trichlorobenzene	A	
95-95-4	2,4,5-Trichlorophenol	A	
88-06-2	2,4,6-Trichlorophenol	A	

*2,3,7,8-Tetrachlorodibenzo-
p-dioxin

*Scanned for but no standard available

METHOD 8270 (CONT'D)

84-74-2	Di-n-butyl phthalate	A	
95-50-1	1,2-Dichlorobenzene	A	
541-73-1	1,3-Dichlorobenzene	A	
106-46-7	1,4-Dichlorobenzene	A	
91-94-1	3,3'-Dichlorobenizidine	A	
120-83-2	2,4-Dichlorophenol	A	
94-75-7	2,4-Dichlorophenoxyacetic acid	A	
84-66-2	Diethyl phthalate	A	
105-67-9	2,4-Dimethylphenol	A	
131-11-3	Dimethyl phthalate	A	
534-52-1	4,6-Dinitro-o-cresol	A	
51-28-5	2,4-Dinitrophenol	A	
121-14-2	2,4-Dinitrotoluene	A	
606-20-2	2,6-Dinitrotoluene	A	
117-84-0	Di-n-octyl phthalate	A	
122-39-4	Diphenylamine	A	D
206-44-0	Fluoranthene	A	D
7782-41-4	Fluorene	A	D
87-68-3	Hexachlorobutadiene	A	
77-47-4	Hexachlorocyclopentadiene	A	
67-72-1	Hexachloroethane	A	
193-39-5	Indeno(1,2,3-cd)pyrene	A	
78-59-1	Isophorone	A	D
95-48-7	2-Methyl Phenol	A	D
106-44-5	4-Methyl Phenol	A	(CRESOLS) D
91-20-3	Naphthalene	A	

METHOD 8080

Aldrin
alpha BHC
Beta BHC
Delta BHC
Gamma BHC (Lindane)
Chlordane
4,4'-DDD
4,4'-DDE
4,4'-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Endrin aldehyde
Heptachlor
Heptachlor epoxide
Methoxychlor
Toxaphene
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260

D

Appendix VIII METALS

METHOD 6010

Aluminum	B D
Barium	B
Beryllium	B
Boron	B D
Cadmium	B
Chromium	B
Iron	B D
Lead	B
Nickel	B
Thallium	B
Vanadium	B D
Zinc	B D
Selenium*	B
Arsenic*	B

*These elements are not approved for 6010 but they are approved for CLP metals ICP method. The CLP metals ICP method is identical to the SW-846/6010.

Method 7470

Mercury	B
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Appendix VIII METALS (B status but determined in Phase I)

METHOD 6010

Aluminum	B D
Barium	B
Beryllium	B
Boron	B D
Cadmium	B
Chromium	B
Iron	B D
Lead	B
Nickel	B
Thallium	B
Vanadium	B D
Zinc	B D
Selenium*	B
Arsenic*	B

*These elements are not approved for 6010 but they are approved for CLP metals ICP method. The CLP metals ICP method is identical to the SW-846/6010.

CASEN Substance

METHOD 8240

75-15-0	Carbon disulfide	B
4170-30-3	Crotonaldehyde	B
764-41-0	1,4-Dichloro-2-butene	B D
75-71-8	Dichlorodifluoromethane	B D
75-35-4	1,1-Dichloroethene	B
10061-02-6	trans-1,3-Dichloropropene	
57-14-7	cis-1,1-Dimethylhydrazine	B
591-78-6	Hexanone	B
74-88-4	Iodomethane	B
	Pentachloroethane	B
	1,2,3,5-Tetrachlorobenzene	B D

METHOD 8240 (continued)

630-20-6	1,1,1,2-Tetrachloroethane	B
75-70-7	Trichloromethanethiol	B
96-18-4	1,2,3-Trichloropropane	B
95-35-4	Trinitrobenzene	B (1,3,5-)
75-01-4	Vinyl Acetate	B D
75-05-8	Acetonitrile	B
75-69-4	Fluorotrichloromethane	B
542-75-6	1,3-Dichloropropene	B D
		B

METHOD B270 (CONT'D)

87-65-0	2,6-Dichlorophenol	B	
60-11-7	p-Dimethylaminoazobenzene	B	
57-97-6	7,12-Dimethylbenz[a]anthracene	B	
122-09-8	alpha, alpha-Dimethylphenethylamine	B	
122-66-7	1,2-Diphenylhydrazine	B	
97-63-2	Ethyl methacrylate	B	D
62-50-0	Ethyl methanesulfonate	B	
1888-71-7	Hexachloropropene	B	
120-58-1	Isosafrole	B	
148-82-3	Melphalan	B	
91-80-5	Methaperylene	B	D
79-22-1	Methyl chlorocarbonate	B	D
101-14-4	4,4'-Methylene-bis-(2-chloroaniline)	B	B
108-10-1	4-Methyl-2-pentanone	B	D
66-27-3	Methyl methanesulfonate	B	
91-57-6	2-Methyl Naphthalene	B	D
56-04-2	Methylthiouracil	B	
130-15-4	1,4-Naphthoquinone	B	
134-32-7	1-Naphthylamine	B	
91-59-8	2-Naphthylamine	B	

CASRN Substance

METHOD 8270

98-86-2	Acetophenone	B D
17364-30-6	2-Acetylaminofluorene	B
92-67-1	4-Aminobiphenyl	B
2763-96-4	5-(Aminomethyl)-3-isoxazolol	B
140-57-4	Aranite	B
108-98-5	Benzenethiol	B
65-85-0	Benzoic Acid	B D
106-51-4	p-Benzoquinone	B D
100-51-6	Benzyl alcohol	B D
88-85-7	2-sec-Butyl-4,6-dinitrophenol	B D
542-76-7	3-Chloropropionitrile	B
131-89-5	2-Cyclohexyl-4,6-dinitrophenol	B
226-36-8	Dibenz[a,h]acridine	B

METHOD 8270 (CONT'D)

88-74-4	2-Nitroaniline	B D
99-09-2	3-Nitroaniline	B D
924-16-3	N-Nitrosodi-n-butylamine	B
1116-54-7	N-Nitrosodiethanolamine	B
55-18-5	N-Nitrosodiethylamine	B
10595-95-6	N-Nitrosomethylethylamine	B
615-53-2	N-Nitroso-N-methylurethane	B
59-89-2	N-Nitrosomorpholine	B
100-75-8	N-Nitrosopiperidine	B
930-55-2	N-Nitrosopyrrolidine	B
99-55-2	5-Nitro-o-toluidine	B
76-01-7	Pentachloroethane	B
62-44-2	Phenacetin	B
109-06-8	2-Picoline	B D
94-59-7	Safrole	B
	1,2,3,5-Tetrachlorobenzene	B D
52-90-2	2,3,4,6-Tetrachlorophenol	B
636-21-5	o-Toluidine hydrochloride	B
75-70-7	Trichloromethanethiol	B
95-35-4	Trinitrobenzene	B
126-72-7	Tris(2,3-dibromopropyl) phosphate	B
61-82-5	Anitrole	B
504-24-5	4-Aminopyridine	B
98-07-7	Benzotrichloride	B
357-57-3	Brucine	B
1338-23-4	2-Butanone peroxide	B
510-15-6	Chlorobenzilate	B
106-89-8	1-Chloro-2,3-epoxypropane	B

METHOD 8270 (CONT'D)

50-18-0	Cyclophosphamide	B	
2303-16-4	Diallate	B	
311-45-5	O,O-Diethylphosphoric acid	B	
55-91-4	Di-isopropylfluorophosphate (DFP)	B	
60-51-5	Dimethoate	B	
119-90-4	3,3'-Dimethoxybenzidine	B	
119-93-7	3,3'-Dimethylbenzidine	B	
77-78-1	Dimethyl sulfate	B	
298-04-4	Disulfoton	B	
541-53-7	2,4-Dithiobiuret	B	
96-45-7	-Ethylenethiourea	B	
62-74-8	Fluoroacetic acid (Salt)	B	
64-18-6	Formic acid	B	D
70-30-4	Hexachlorophene	B	
53-86-1	Indometacin	B	
16752-77-5	Methomyl	B	
75-55-8	2-Methylaziridine	B	
56-49-5	3-Methylcholanthrene	B	
70-25-7	N-Methyl-N'-nitro-N-nitrosoguanidine	B	B
56-57-5	4-Nitroquinoline-1-oxide	B	
684-93-5	N-Nitroso-N-methylurea	B	
145-73-3	Endothal	B	
123-63-7	Paraldehyde	B	D
108-45-2	Phenylenediamine (o,m,p)	B	D
1120-71-4	1,3-Propane sultone	B	
108-46-3	Resorcinol	B	
57-24-9	Strychnine	B	
3689-24-5	Tetraethyldithiopyrophosphate	B	
76-00-2	Tetraethyl lead	B	
126-72-7	Tris(2,3-dibromopropyl) phosphate	B	
108-31-6	Maleic anhydride	B	
123-33-1	Maleic hydrazide	B	D
109-77-3	Malononitrile	B	
81-81-2	Warfarin	B	

METHOD 8240-DI

107-18-6	Allyl alcohol	B
100-51-6	Benzyl alcohol	B D
75-87-6	Chloral	B D
	Chloroacetaldehyde	B
460-19-5	Cyanogen	B
	Dichloropropanol	B
	Ethyl Cyanide	B
75-21-8	Ethylene Oxide	B
765-34-4	Glycidylaldehyde	B
302-01-2	Hydrazine	B
78-83-1	Isobutyl alcohol	B
126-89-7	Methacrylonitrile	B
60-34-4	Methyl hydrazine	B
75-86-5	2-Methylactonitrile	B D
80-62-6	Methyl methacrylate	B
107-19-7	2-Propyn-1-ol	B

METHOD 8080

Kepone

B

METHOD 8150

Herbicides

2,4,5-T

B

Dinoseb

B