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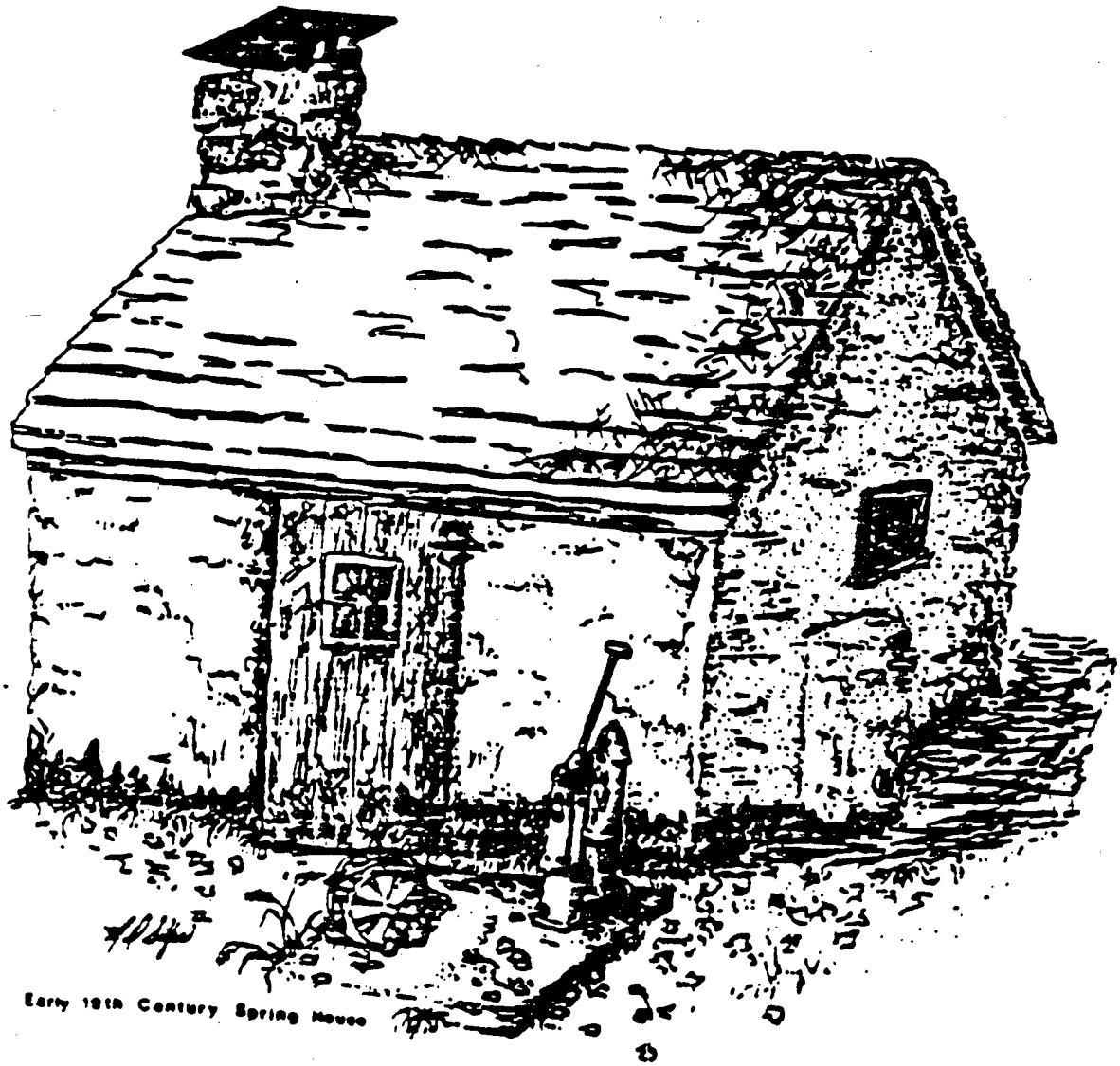
THE BURIED VALLEY AQUIFER SYSTEMS: RESOURCES AND CONTAMINATION



Early 19th Century Spring House

PASSAIC RIVER COALITION

246 Madisonville Road
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1986

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CHAPTER I

INTRODUCTION

The Buried Valley Aquifer Systems Region

Nearly one-half of New Jersey's residents rely on ground water for potable water supplies. The major aquifers of New Jersey are the Coastal Plains aquifers used by the shore communities, the Potomac-Raritan-Magothy aquifer used by Delaware River communities in southern New Jersey, and the buried valley (or valley-fill) aquifers of glaciated areas in northern New Jersey. The Buried Valley Aquifer Systems region is included within the last category.

In terms of political boundaries (see Figure G-1), the Buried Valley Aquifer Systems region encompasses the western parts of Essex and Union Counties, northern Somerset County and north, central and eastern parts of Morris County. Hydrologically, the region includes the Central and Upper Passaic River Basin, the Whippany River watershed, the Rockaway River watershed, and the Upper Lamington River watershed. The Upper Lamington River is part of the Raritan River Basin while the remainder of the region is included within the Passaic River Basin. The aquifer underlying the Upper Lamington is directly connected with the aquifer of the Rockaway River watershed and so is included within the region.

The Buried Valley Aquifer Systems region is characterized by a network of former river valleys which were filled with glacial outwash material by the Wisconson glacier which covered much of northern New Jersey until some 11,000 years ago. The **buried valley aquifers** thus formed are often contiguous and hydraulically connected to aquifers in the fractured bedrock below. The buried valley aquifers are prolific regionally, supplying over 40 million gallons per day for potable use. The bedrock aquifers are locally prolific, especially dolomite formations in the west and some shale areas in the east.

The region includes two "sole source aquifers" designated by the United States Environmental Protection Agency. The Buried Valley Aquifer Systems of the Central Passaic River Basin was designated in 1980, while the Rockaway Valley Quaternary Aquifer was designated in 1984. Recent hydrogeologic studies clearly show that the two aquifer systems are in fact one, fully connected through a formerly unknown buried valley. Therefore, this report treats the two designated areas as one, called the **Buried Valley Aquifer Systems.**

Importance of Ground Water to the Region

Ground water has played an ever-increasing role in supplying the water needs of residents and businesses throughout the Passaic River Basin and, indeed, throughout New Jersey. Within the basin, the most productive and intensively used aquifers are the buried valley (or valley-fill) aquifers. The buried valley aquifers form an extensive network of narrow-channeled sand and gravel deposits through which large quantities of water flow. They are located in many parts of the Passaic River Basin which were affected by the latest glaciation (the Wisconsin) and are most heavily concentrated in northern and eastern Morris County and western Essex County. Public water purveyors began tapping the buried valley aquifers around the turn of the century. Now, the use of the aquifers has reached major proportions, supplying the majority of water used in a number of municipalities, and providing water for over one-half million people and scores of major industries.

The intensive use of the aquifers, coupled with their high potential for contamination and loss of recharge, led municipalities and citizen organizations to pursue local, state and federal methods for protecting the ground water resources of the area. At the same time, the compilation of existing information on the buried valley aquifers was begun for use by decision-makers throughout the region. This report is the result of the second phase of efforts to understand the characteristics of the aquifers, and ground water use and contamination, so that this knowledge might be applied toward improved management of the aquifer systems. The first phase concluded in 1983 with the publication of the Hydrogeology of the Buried Valley Aquifer Systems. This second report enlarges upon the first, makes use of new findings from research of the State and federal governments, updates information on ground water diversions, and provides a first-time overview of contamination incidents and issues within the region.

TABLE I-2

MUNICIPALITIES ENTIRELY OR PARTIALLY WITH THE "BURIED VALLEY AQUIFER SYSTEMS OF THE CENTRAL PASSAIC RIVER BASIN" DESIGNATED AREA

Morris County

Boonton, Town of
Boonton Township
Chatham Borough
Chatham Township
→ Denville Township
Dover, Town of
East Hanover Township
Florham Park Borough
Hanover Township
Harding Township
Jefferson Township
Kinnelon Borough
Madison Borough
Mendham Borough
Mendham Township
Mine Hill Township
Montville Township
Morris Plains Borough
Morristown, Town of
Morris Township
Mountain Lakes Borough
Parsippany-Troy Hills Township
Passaic Township
Randolph Township
Rockaway Borough
→ Rockaway Township
Roxbury Township
Victory Gardens Borough
Wharton Borough

Essex County

Caldwell Borough
Essex Fells Borough
Fairfield Township
Livingston Township
Millburn Township
North Caldwell Borough
Roseland Borough
West Caldwell Borough

Somerset County

Bernards Township
Bernardsville Borough
Warren Township

Union County

Berkeley Heights Township
New Providence Borough
Summit, City of

Source: 45 Federal Register 91:30537, 8 May 1980.

TABLE I-3

MUNICIPALITIES ENTIRELY OF PARTIALLY WITHIN THE "ROCKAWAY QUATERNARY AQUIFER SYSTEM" DESIGNATED AREA

Municipality
Boonton, Town of
Boonton Township
→ Denville Township
Dover, Town of
Jefferson Township
Mine Hill Township
Mountain Lakes Borough
Randolph Township
Rockaway Borough
→ Rockaway Township
Roxbury Township
Victory Gardens Borough
Wharton Borough

Source: 49 Federal Register 16:2946, 24 January 1984.

and Berkeley Heights Township, New Providence Borough, Summit City in Union County (Gill and Vecchioli, 1965; Nichols, 1968a; Nemickas, 1976).

The approximately 6,000 feet-thick Brunswick Formation is composed of shale with local occurrences of sandy and pebbly consolidated beds. The sandstone ranges from a few inches to 20 feet in thickness. The many joints and fractures in the rock allow for retention and transport of a fairly large volume of ground water. Wells yield from 4 to 650 gpm in Morris County, from 35 to 820 gpm in Essex County, and from 12 to 870 gpm in Union County (Gill and Vecchioli, 1965; Nichols, 1968a; Nemikas, 1976). Wells of greatest yield are usually those between 200 and 500 feet deep where several source zones feed the well, and is usually hard.

Newark Group: Watchung Basalt

The Basalt Formation serves as an aquifer in the following communities within the study area: Florham Park Borough, Lincoln Park Borough, and Montville Township in Morris County; Essex Fells Township, Fairfield Township, Livingston Township, Millburn Township, North Caldwell Borough, West Caldwell Borough, and West Orange Town in Essex County; Warren Township in Somerset County; and Berkeley Heights Township, New Providence Borough, and Summit City in Union County (Gill and Vecchioli, 1965; Nichols, 1968a; Nemikas, 1976). The basaltic flows of the Watchung Mountains serve as a small source of ground water in the study area. Water is usually concentrated in gas-created vesicles and fractures in the rock. Wells yield volumes of 30 to 53 gpm from depths of less than 300 feet in Morris County (Gill and Vecchioli, 1965); from 7 to 400 gpm in Essex County (Nichols, 1968a); and from 20 to 164 gpm in Union County (Nemikas, 1976). Water from the Watchung rocks is usually hard, ranging from 60 to more than 180 gpm. Some wells also have high sulfate, iron and manganese levels (Gill and Vecchioli, 1965).

Pleistocene Deposits

The Pleistocene glacial deposits serve as aquifers in the following study area communities; Chatham Borough, Denville Township, Dover Town, East Hanover Township, Florham Park Borough, Hanover Township, Madison Borough, Montville Township, Morris Township, Morris Plains Borough, Mountain Lakes, Parsippany-Troy Hills Township, Rockaway Borough, Rockaway Township, Roxbury Township and Wharton Borough in Morris County; and Essex Fells Borough, Fairfield Borough, Livingston Township, Millburn Township, and West Orange Town in Essex County (NJDEP, 1985).

The stratified deposits produce the largest source of ground water in both Morris and Essex Counties (77 per cent and 81 per cent). Wells yield from 20 to 2,200 gpm and the water is of good quality. This ground water is pumped from the buried valley (valley-fill) aquifers. The valleys existed before the Pleistocene glaciation. In some areas, coarse-grained sands and gravels were washed into the valleys by melting water from the glaciers. Later some of these deposits were overlain by glacial till, by lake sediments or both. Therefore, the location of the buried valleys is difficult to ascertain by direct observation from the surface. Figure II-11 shows the assumed origin of the buried valleys.

The primary ground water resources for the Buried Valley Aquifer Systems are contained in the Brunswick Formation of eastern Morris and Western Essex Counties (shale and sandstone), the carbonate rocks of western Morris County (dolomitic limestone) and the Pleistocene deposits of the entire study area. By far the dominant producers are the buried valley aquifers for which the region is named. Chapter III presents a basic understanding of the field of hydrogeology which serves as a foundation for discussion of the buried valley aquifers in Chapter IV and of the utilization of all aquifers within the region in Chapter V.

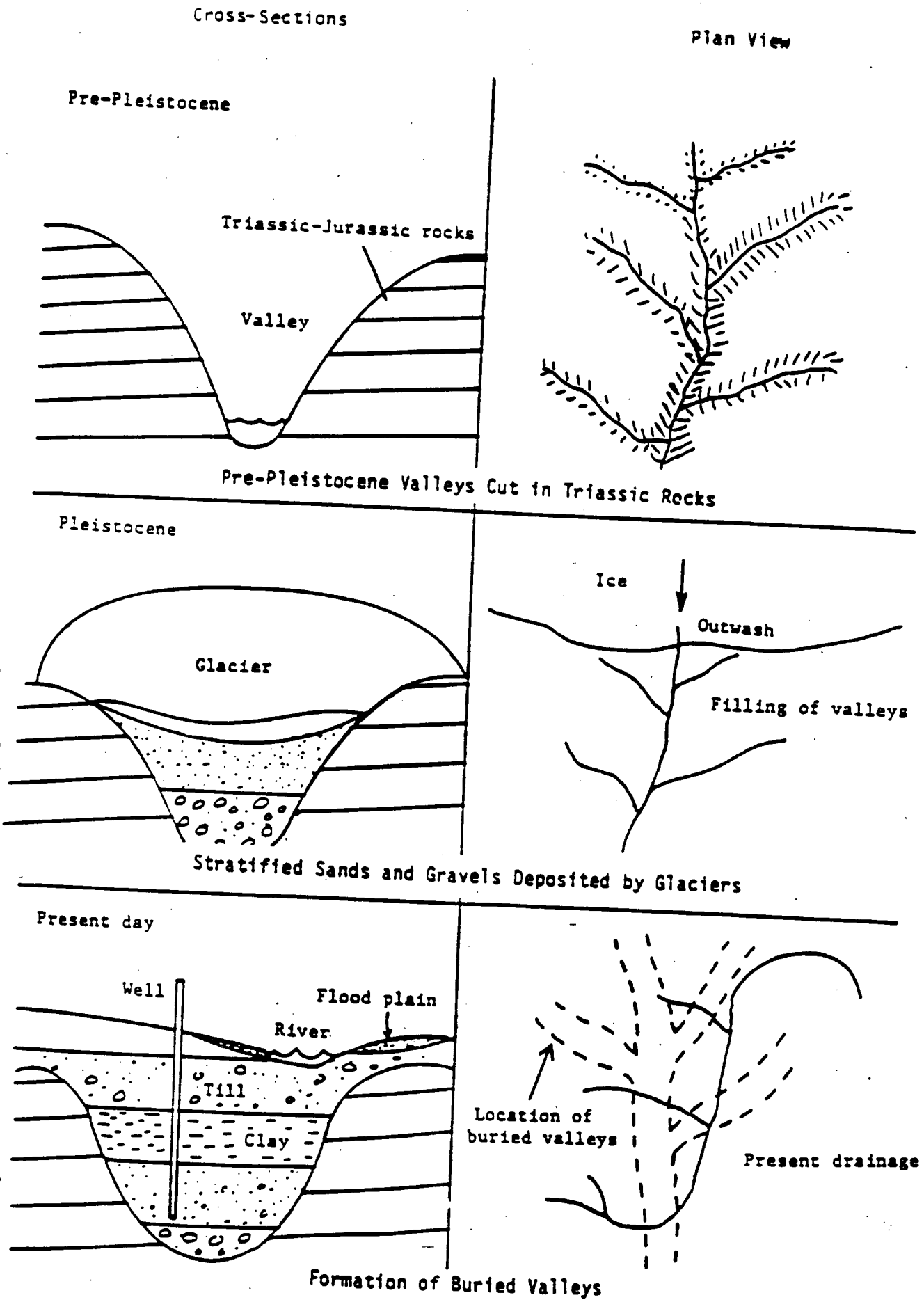

Figure II-11 Origin of the Buried Valley Aquifers
Source: Passaic River Coalition, 1981.

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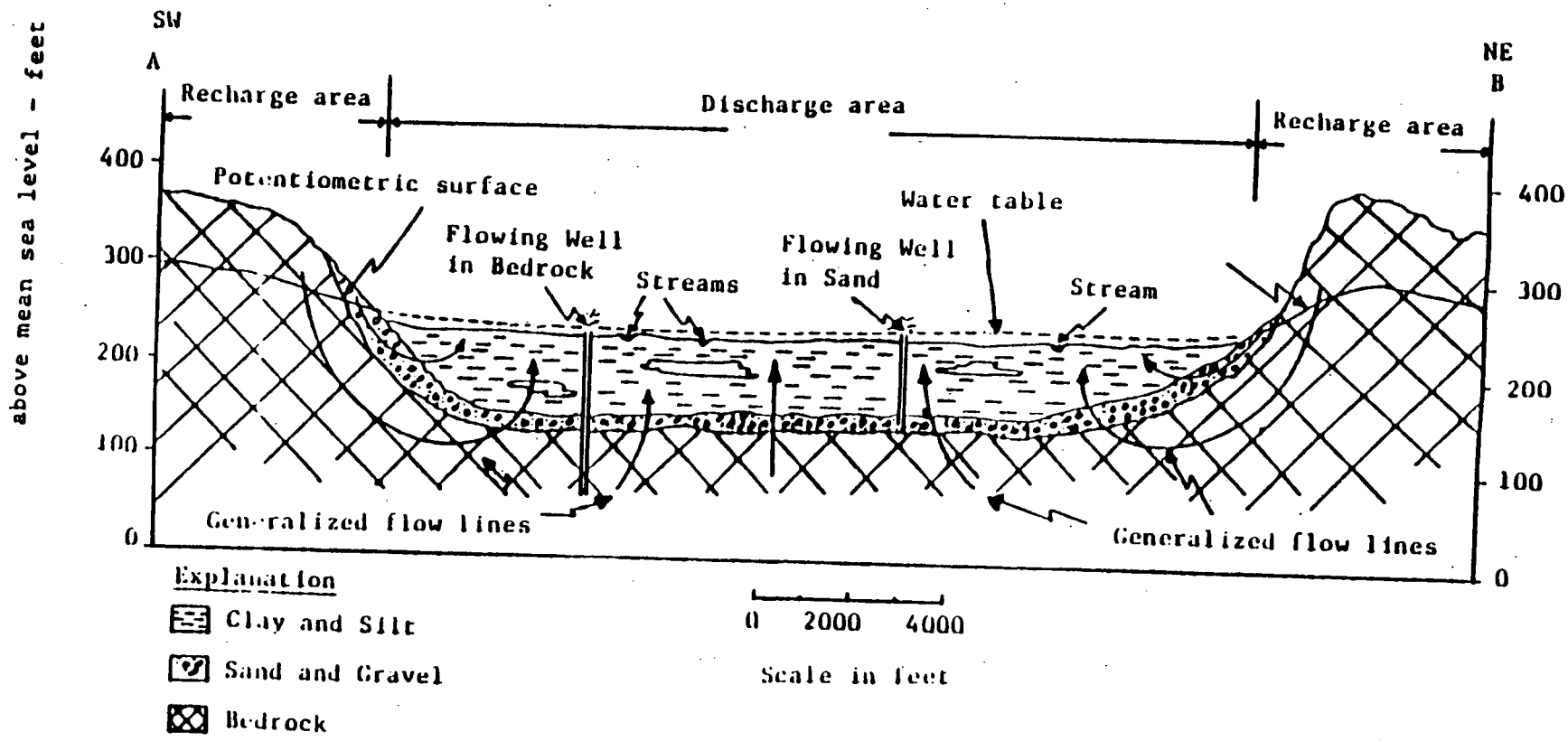

Figure III-10 Schematic Diagram Showing Movement of Ground Water in Morris County, New Jersey

Source: Gill and Vecchioli, 1965

CHAPTER IV

DELINEATION AND DESCRIPTION OF THE BURIED VALLEY AQUIFERS

Introduction

This chapter presents the information currently available on the delineation of buried valleys and buried valley aquifers in the region. Although many research reports have been prepared, much of the detailed information necessary for informed management is lacking. Even such basic steps as the complete delineation of the aquifers have not been completed. An overview of the hydrogeological investigations performed to date is presented for a sense of the progress made over the years. The buried valleys are then described in some detail, by subregion. Finally, the hydrologic characteristics of the aquifers are discussed. Chapter VIII presents information on current and planned research which is focused on the Buried Valley Aquifer Systems.

Subregions of the Aquifer Systems

Although evidence mounts that the entire valley-fill aquifer system of the Rockaway, Whippany and Passaic River watersheds are directly connected and therefore a single hydrologic system, a system of subregions is proposed for the purpose of focusing discussion (See Figure IV-1). The subregions of the Buried Valley Aquifer Systems are:

1) **Rockaway Valley Aquifers**--The entire Rockaway watershed upstream of the Jersey City Reservoir in Parsippany is considered as one system. From upstream to downstream, the municipalities of Jefferson, Rockaway Township, Wharton, Dover, Mine Hill, Roxbury, Randolph, Victory Gardens, Rockaway Borough, Denville, Boonton Town and Boonton Township are located within this subregion in part or in whole.

Within the Buried Valley Aquifer Systems, ground water problems usually are limited to iron, manganese or hardness in objectionable quantities. Sulfates are also found as natural contaminants.

Iron has been found exceeding potable limits in localized areas throughout the designated area. It has several possible sources, depending on the location: 1) leached from sand and gravel deposits by water percolating to the water table; 2) darker-colored gneisses and granites; and 3) other dark-colored rocks (Geraghty & Miller, 1978; Banino, Markewicz and Miller, 1970).

Manganese in objectionable quantities has also been found, though less frequently. It has sources similar to those for iron. Both minerals are objectionable for aesthetic reasons, such as the staining of sinks and fabrics, not for health reasons. Hard water occurs locally, especially in sand and gravel aquifers.

A small number of wells encounter high sulfate levels. Sulfates are leached from sulfate minerals in dikes of trap rock (basalt) and layers of red shale (Banino, Markewicz and Miller, 1970). Only the presence of sulfates of the four quality parameters cited is sufficient reason to avoid using the water. The remainder may be treated or, at times, ignored.

In sum, the problems of natural contamination are small both in terms of wells affected and supplies lost. Treatment is available for manganese and iron levels which exceed secondary standards. Chapter VI discusses ground water contamination and its health effects in some detail, while Chapter VII is an extensive exploration of anthropogenic ground water contamination within the Buried Valley Aquifer Systems.

aquifer, the bedrock surface when known, and the type of material penetrated by the test holes and wells. The distribution patterns of the various unconsolidated materials is interesting as well as being instructive of the geologic history of the area. The distribution of glacial till in the logs is especially peculiar: in some areas it overlies bedrock, in others it lies at the surface only, and in others the surface till is overlaid by clay and by clay and swamp muck. In the Morristown test well in Figure IV-18, till is nearly absent.

Nichols map--Nichols (1968b) combined all available data to produce a map of bedrock depth to delineate the extent of several buried valleys, some of which had been named. The Chatham, Millburn, East Hanover, Canoe Brook, and Slough Brook Buried Valleys, and a series of buried valleys in Great Piece Meadows are shown in Figure IV-19.

Meisler study--Figure IV-19 relies in part on a study by Meisler (1976), who used a variety of studies, including Nichols (1968b), to develop a generalized delineation of the buried valleys (Figure IV-20). While the valleys themselves may be delineated with some precision, it is very important to note that the deposits within them vary widely, at times extremely. Few generalizations can be made about the stratigraphy of the buried valley deposits that will apply well to any specific locations. The Meisler study did not include new information on the buried valleys, but did present a USGS computer model developed for the purpose of projecting the available yields from the buried valleys and the effects of increased ground water diversions on the system.

East Orange Water Reserve analysis--Another study on the main body of buried valleys was completed by Geraghty and Miller (1976), involving a water resources inventory and management study for the City of East Orange Water Reserve in Livingston, Millburn and Florham Park. The Reserve is the largest tract of public property in the area that is dedicated to protection of ground water resources. The study further refined the delineations of the buried valleys, developed generalized hydrogeologic sections for the Canoe Brook and Braidburn-Dickinson well fields (Figures IV-21 and IV-22), and proposed a water budget for the system.

→ **Rockaway Valley Research**--Until the late 1970's, very little was known about the buried valleys north and west of the areas discussed previously. In 1978 and 1979 Denville, Boonton Township, the Town of Boonton, Montville and Mountain Lakes commissioned four studies of the aquifers in those municipalities. Two major buried valleys were delineated - the Towaco Buried Valley in Montville and the Rockaway

Buried Valley and tributaries in Denville, Boonton Township and Mountain Lakes - with eleven areas for additional study as major water sources (Geraghty & Miller, 1978). Three studies by Geonics (1978, 1979a and 1979b) amplified on these findings using a combination of seismic refraction and reflection methods, existing well logs and test borings.

In several places the stratified deposits exceed 150 feet, the Towaco Aquifer exceeds 250 feet in some parts, and one well in Mountain Lakes exceeds 350 feet of unconsolidated materials. A cross-section through the deepest portion of the Towaco Aquifer is shown in Figure IV-23. The studies were important in their discovery that a major section (then thought to be a spur valley) of the buried valley continued into Mountain Lakes from Denville. This research set the stage for recent work by the New Jersey Geological Survey in the same area.

NJGS Upper Rockaway Valley study--The NJ Geological Survey published a 1983 report on the Rockaway Buried Valley, for the area from Denville west and north to Jefferson Township. The study delineated the general strike of the buried valley, discovering that the ancestral Rockaway River had significantly different flow patterns than the current Rockaway River in two places. The ancestral Rockaway River extended south of the Berkshire Valley in Jefferson Township, crossing the current watershed line into the upper Lamington River watershed in Roxbury and Randolph Townships. The glacial deposits bridging the watersheds were continuous and deep. At the northern end of the Berkshire Valley, the ancestral Rockaway had originally continued into what is now the Pequannock River watershed, and glacial deposits bridge the two watersheds. The discovery of these two connections with outside watersheds raised the possibility that ground water might flow between the various watersheds through the common aquifer.

NJGS Central and Lower Rockaway Valley study--A second study by the NJ Geological Survey began in 1984 to further delineate the bedrock contours of the lower Rockaway Buried Valley. Information from the Geraghty & Miller and Geonics studies, along with the known existence of a major buried valley beneath Troy Brook in Parsippany, led to an inference of a direct buried valley connection between the Rockaway River watershed and the Whippany River watershed. The NJGS report is planned for publication in 1987, and the research confirmed that the Rockaway Buried Valley is an integral part of the overall Buried Valley Aquifer Systems, directly connected with the buried valleys of the Central Passaic River Basin. This finding goes a long way toward explaining the major diversions by Parsippany from the Troy Brook well field west of Interstate 287, given the very small size of the surface

watershed. The buried valleys of the Rockaway, Whippany and Passaic watersheds may now be considered a single system.

USGS Research--The United States Geological Survey has been conducting major research projects in the Rockaway River watershed. No interpretive information is available pending internal review of the research reports. The project goals are described in Chapter VIII.

Buried Valley Delineations

Figure G-2 (in pocket) is a composite map showing the approximate delineations of the buried valleys within the Buried Valley Aquifer Systems.

A cautionary note is important at this point. While many of the deeper buried valleys have deposits that accommodate highly productive wells, the mere existence of a buried valley does not guarantee sufficient water resources for public supply (though private wells are usually possible). Productivity of wells in buried valleys varies with the character and bedding of deposits, the width and length of the channels, the thickness of permeable deposits, recharge capacity, and current use of the aquifer and any hydraulically connected aquifers. However, given the track record of buried valley aquifers in the region, buried valleys become a prime target of further research and exploration for ground water resources.

Established Buried Valley Locations

→ **Rockaway Valley Subregion**--With the two NJ Geological Survey studies on the upper and lower sections of the buried valley and the four preceding reports on the center section, the Rockaway Buried Valley is substantially defined. The buried valley runs south from its origin in the Pequannock River watershed into the Rockaway River watershed in Jefferson Township and then follows the basic line of the Rockaway River just west of Green Pond Mountain. In the southern Berkshire Valley, the buried valley meets the southern section which continues into the upper Lamington River watershed along the line of the ancestral Rockaway River. The buried valley turns east from the southern Berkshire Valley and continues to follow the general line of the Rockaway River. A spur buried valley descends from the Beaver Brook watershed at the Rockaway Township border with Denville to meet the Rockaway Buried Valley in Rockaway Borough. The main buried valley continues east through Denville.

Previous delineations postulated that the Rockaway Buried Valley swung north in line with the Rockaway River, continuing north into Boonton Township and then south through Boonton into the lower Rockaway River watershed. Glacial deposits underlying the Rockaway River and the productive well fields of Boonton in Boonton Township seemed to support this theory. However, more recent information has cast serious doubt on this delineation. The buried valley under the Rockaway River in northern Denville and Boonton Township does exist, but the assumed connection with the lower Rockaway River watershed does not exist. For instance, the Rockaway River descends from Boonton to the Jersey City Reservoir over bedrock. The NJGS has also found that the glacial deposits along the lower Rockaway are not as extensive as previously thought. Both Montville and Parsippany-Troy Hills have conducted well drilling in the lower Rockaway River area and confirm the lack of major sediments. The final discovery, as previously described, was the continuation of a major buried valley channel from southern Mountain Lakes through the Troy Brook area of Parsippany toward Troy Meadows.

A major change in the delineations is proposed based on this evidence. The buried valley channel extending north through Denville to Boonton Township, under the Rockaway River, is postulated to be a spur valley of the main channel. This raises the interesting speculation that the ground water flow may be south, toward the main channel, while the Rockaway River flows in the opposite direction. The main channel, as described by the NJ Geological Survey, continues southeast across Denville and southern Mountain Lakes into Parsippany south of Route 46, through a bedrock gap in Mountain Lakes. It then continues as a deep channel trending southeast to Troy Meadows. A well defined channel exists in Mountain Lakes which the NJ Geological Survey is tentatively calling the Mountain Lakes Gap. The connection of the main channel to the known buried valley system in the Central Passaic River basin is not known. The newly described channel is tentatively named the **Troy Brook Buried Valley.**

Upper Lamington Subregion--The upper Lamington subregion has a buried valley which lies directly over a dolomite formation. The southern portion of the buried valley has been relatively well defined through research commissioned by the Morris County Municipal Utilities Authority which operates the Alamatong well field in Randolph and Chester Townships. The northern portion, including the bridge into the Rockaway River watershed, is less known. The primary public user in the northern portion is the Roxbury Water Company.

Additional Areas of Deep Stratified Deposits

One major area of deep stratified deposits, not known to be connected with the buried valley aquifer system, exists in Lee Meadows. The site is a wetland area of approximately 400 acres including both lowlands and uplands (the uplands have been tentatively identified as direct recharge areas for the aquifer). Lee Meadows is bounded to the west by the terminal moraine, to the east by Interstate 287 and to the south by Route 10, and it straddles the border between Parsippany and Hanover. Significant glacial deposits exist beneath the area, to depths of approximately 140 feet. Two wells of the Southeast Morris County Municipal Utilities Authority (Wing and Todd) are drilled into the glacial sediments to bedrock, on the Hanover side. Parsippany also has two wells, located on its side of the wetlands. The four wells have a combined yield of approximately 5 MGD, a very large yield for a small watershed (Malapardis Brook, a tributary of the Whippany River). The full extent of the aquifer is not known, though the terminal moraine is assumed to be the western edge. No connection is known with other buried valleys, though such a connection might exist.

The Buried Valleys and the Terminal Moraine

The terminal moraine marks the farthest extension of the Wisconsin glacier, where a rough balance between the advance of the glacier and the rate of melting from its face resulting in the dumping of enormous quantities of rock and debris which had been carried in the glacier. The terminal moraine is unstratified glacial till, relatively low in permeability and generally a poor aquifer.

The buried valleys are comprised of stratified glacial drift (evenly sorted materials carried from the glacier by the action of water) and other sorted and unsorted materials. A question of continuing interest involves the relationship between the buried valleys and the terminal moraine. The three areas where the question is most critical are the Hobart Gap in Millburn, the southern edge of the Chatham Buried Valley and the Rockaway Buried Valley through Rockaway Borough, Dover and Wharton.

The Hobart Gap is of interest because the ancestral Passaic River flowed through the gap prior to the Wisconsin glacier. Geologists have long assumed that the terminal moraine completely closed the gap, forcing both surface and ground water to seek another exit from the system. Frank Markewicz, former State Geologist, has raised questions about that

assumption based on well flows in the Rahway River basin on the east side of the gap which seem to indicate a flow of ground water through the gap from the Chatham Buried Valley (Markewicz, personal communication, 1986). If so, the hydraulic connection could result in the loss of ground water to the Passaic River Basin. It is well known that buried valley aquifers exist on both sides of the gap.

The Chatham Buried Valley abuts the terminal moraine from Summit to Morris Township. Some evidence exists of channels in the bedrock going under the terminal moraine to the south, toward the Great Swamp area. The question is whether the channels contain permeable deposits or till from the terminal moraine. Some evidence compiled by the USGS seems to indicate that the terminal moraine is also the southern limit of the buried valley aquifers, but evidence from wells at Allied-Signal in Morris Township indicate that the terminal moraine and stratified drift deposits interfinger a great deal, perhaps due to fluctuations in the front of the glacier.

The Rockaway Buried Valley is especially interesting because the terminal moraine for the Wisconsin glacier varies in its relationship to the buried valley deposits.

Figure IV-25 shows two theoretical relationships for a buried valley aquifer and the terminal moraine. In column A, the terminal moraine is the terminus of the stratified deposits, a barrier to the aquifer. In column B, the stratified deposits continue under the terminal moraine. Both situations exist in the Buried Valley Aquifer Systems. The aquifers of the upper Lamington River are located south of the terminal moraine's farthest advance. However, no buried valley aquifer has been discovered in the Great Swamp south of the terminal moraine there. A third situation, not pictured, also exists where the terminal moraine lies over a buried valley aquifer from a prior glaciation, but is the terminus for stratified deposits from the Wisconsin glaciation. Such a situation could account for a flow of ground water through Hobart Gap. The variety found in the region makes any generalizations about the relationship between the terminal moraine and the aquifers very difficult. Research has been performed in some areas, but not to a sufficient extent.

Aquifer Stratigraphy

As indicated by the discussion on terminal moraines, the stratigraphy of the aquifer system is complex. Some sediments were deposited in advance

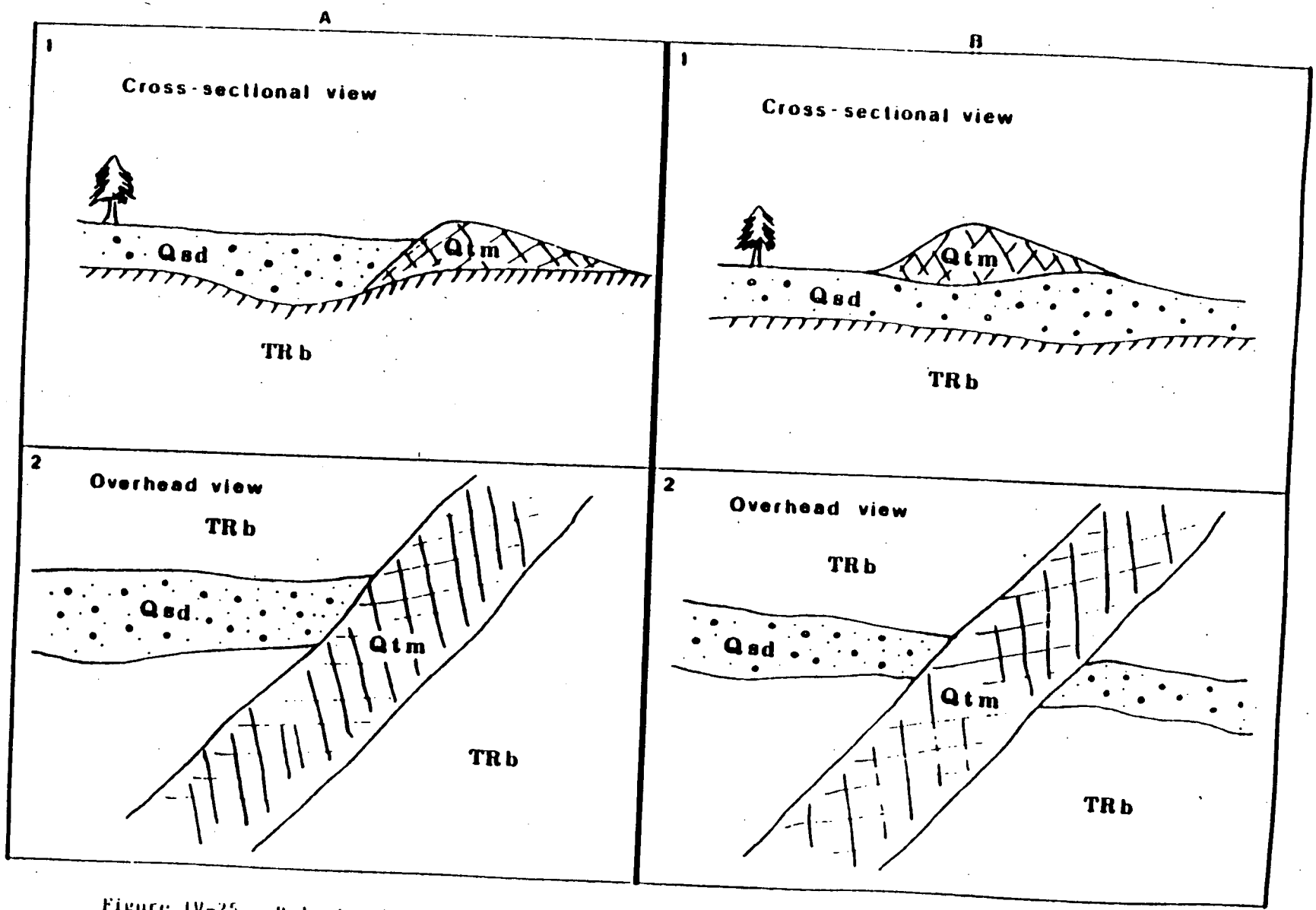

Figure IV-25. Relationships Between Buried Valleys (Qsd) and the Terminal Moraine (Qtm)

of the glacier and some during its withdrawal. The action of water resulted in a stratification of sediments in often complex patterns with just a few feet of each strata in any one place and beds of sediments which wax and wane quickly. Glacial Lake Passaic added strata of silt and clay in many areas, and a similar but smaller glacial lake acted upon the central Rockaway River area. A Geraghty & Miller study in Dover noted that "the glacial beds are not uniformly permeable over wide areas nor can individual beds be traced or correlate reliably between sites more than a few hundred feet from each other." (Geraghty & Miller 1969). Some highlights of the stratigraphy for major aquifer areas are presented in this section by subregion.

Rockaway Subregion—The major channel of the Rockaway Buried Valley varies from west to east, and is especially diverse where it coexists with the terminal moraine. Figure IV-26 is a generalized cross-section of the aquifer in the area of Rockaway Borough's wells. To the south, toward Denville Well 3 and Dover Well 4, the aquifer is better confined with a clear upper and lower aquifer. However, the confining bed is not apparent in Wharton, where a single unconfined aquifer exists in hydraulic connection with the Rockaway River.

The Beaver Brook Buried Valley is a stratified glacial drift deposit trending from north to south along the eastern side of Rockaway Township. The permeable deposits are generally unconfined in the northern part of the valley (which is in two parts, Hibernia Brook and Beaver Brook, until joining near Meridan Road). Confining clays are more prevalent toward the southern end of the aquifer, causing artesian conditions in the area of the well field, though glacial stratified deposits east of Ford Road (toward and in Denville) are unconfined.

Upper Lamington Subregion—The Alamatong well field is comprised of four aquifer units. The uppermost is a surficial stratified drift deposit, used mostly by very shallow (less than 40 feet) private supply wells. Directly underlying these deposits is a major layer of stratified drift left by the Wisconsin glacial episode. A thick clay lens separates this upper aquifer from a lower stratified drift aquifer apparently deposited by an earlier glacial episode. The clay lens thins out toward the north to the point that the upper and lower aquifers are contiguous. The fourth aquifer is comprised of dolomite which has two sections with a confining layer in between. It is in the lower of the two sections that the major fault encountered by Alamatong Well 5 is located. Below the dolomite is quartzite bedrock. The dolomite feathers up toward the surface to the south near Pleasant Valley Road, but becomes deeper and thicker toward the north near Route 46 and then

Aquifer Information From Well Logs

Figure G-3 (in pocket) identifies the geologic formations used as an aquifer source by wells drilled since 1947. To a certain extent, this map can be used to show the existence of ground water resources, if sufficient care is taken to recognize the following points:

1) Some of the wells drilled are large-diameter production wells for public or industrial supply. Most, however, are private wells for residential use, which require far less yield and storage than the production wells. (See Figure G-4 (in pocket) for the location of major production wells in the area).

2) From the first point, indication of a stratified drift deposit does not necessarily infer the existence of a buried valley at that point. In several areas, the stratified deposits are shallow, non-valley deposits, capable only of supplying small yields. Where both stratified drifts and a bedrock formation are shown for a single grid on the map, this usually indicates a shallow drift deposit over bedrock.

3) There are instances where a buried valley exists, but without sufficient permeable layers to supply a well. In this case, a major well would probably penetrate to bedrock. Alternately, a buried valley could exist with permeable deposits and yet be inaccessible for drilling or under lands unsuitable for development (in cases where private wells would be used).

4) Well drillers are not always familiar with or concerned about the precise identification of formations. "Rock," "blue rock," "gray rock," and "red rock" are common descriptions. Granite is sometimes indicated where basalt is more probable. For this reason, while many notations are accurate, the whole must be taken with caution.

For these reasons, Figure G-3 should be used to give a preliminary indication of the formations tapped for ground water resources.

Hydraulic and Hydrologic Aquifer Characteristics

Transmissivity of the Aquifers

Permeability and transmissivity are related parameters describing an aquifer, as defined in Chapter III. Transmissivity increases with both the average permeability of the aquifer and the thickness of the aquifer deposits. Well-sorted sand and gravel deposits are among the best aquifers.

Transmissivities have been determined for a variety of aquifers in the Buried Valley Aquifer Systems. Table IV-1 lists some of the transmissivities measured by subregion.

As can be seen, the buried valleys are far more productive areas for ground water, especially in the deepest deposits. Unfortunately, many of the aquifers have not had transmissivity values determined for them.

Permeability varies greatly throughout the buried valleys. As noted in Geraghty and Miller (1978) in reference to the stratified deposits in the buried valleys, "Some of these materials have been deposited, removed by erosion and redeposited many times. As a result, sharp changes in lithology occur both laterally and vertically over short distances." An example of this phenomenon occurred in the Great Piece Meadows, where a USGS test boring found no permeable deposits in one area of the buried valley, while another portion supported productive wells (Vecchioli and Nichols, 1966).

In such complex stratigraphies, clay, sand and gravel layers and lenses interfinger, mix and separate. Although the average permeability remains high, a single molecule of water may travel a tortuous path in reaching one location from another, especially when traveling vertically. For this reason, vertical movement of water to a well screen is often much slower than horizontal movement. To maximize productivity of the well, the screen must be open to as much of the aquifer as possible, to allow horizontal transmission of the water.

The extreme variability of buried valley deposits and the narrowness of the channels tend to limit the productivity of the aquifers. On the other hand, the highly uniform and very deep Cohansey Aquifer of South Jersey has transmissivity values quite similar to the buried valleys (Rhodehamel, 1973). The similarity of the two transmissivity values (Cohansey and Buried Valley) is due to two factors. First, the Cohansey does not have the gravel deposits that are common to the buried valleys. Gravel deposits are more permeable than the Cohansey sands. On the other hand, the Cohansey Aquifer is very wide and very deep, whereas the buried valleys are narrow and less deep. These factors combine to make the transmissivity values comparable, but the buried valleys are less extensive, lose significant recharge more easily and have a greater variability as ground water resources. However, they are far better ground water resources than any other North Jersey formations.

TABLE IV-1

AQUIFER TRANSMISSIVITIES IN THE
BURIED VALLEY AQUIFER SYSTEMS

Site or Location	Transmissivity (gpd/ft)	Source
Newark Group	18,750-27,800	Meisler,1976
Buried Valleys - average	125,700	Meisler,1976
Upper Lamington, unconfined	48,450	Well Test
Allied, Morris Twp	12,000	Site Invest.
Airtron, Morris Plains	5,610	Site Invest.
Denville Well 3	40,930	Well Test
Florham Park, Well 4	120,000	Well Test
East Hanover, Well 6	115,000	Well Test
Picatinny Arsenal	25,000-50,000	Site Invest.
Richboynton Rd. Ind. Park, Dover	80,000	Site Invest.
Rockaway Borough Well Field	34,388 avg.	Superfund
Triangle Ind. Park, E. Hanover	High	Site Invest.
Towaco Valley - average	70,000	Geonics,1979b
best	210,000	Geonics,1979b
Dolomite, Alamatong Well 5	14,000	Well Test

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Hydraulic Connection Among Contiguous Aquifers

When the Wisconsin glacier moved into New Jersey, it scraped up vast quantities of soil and rock from the land surface, carrying them forward and depositing the materials in the terminal and ground moraines, as stratified drift and as silts and clays in Glacial Lake Passaic. In the buried valleys, geologists suggest that most or all of the soil from the sides of the valleys would have been stripped off. The stratified deposits which constitute the buried valley aquifers would thus be in direct contact with the bedrock aquifers, allowing free flow of water across the boundary (Meisler, 1976). In this manner, water which is recharged to the bedrock may serve to replenish a part of the water discharged from the buried valley aquifers through swamps and marshes, stream base flow, springs and wells (Nichols, 1968a). In some cases, the flow may be reversed, where water from the buried valleys enters the bedrock (especially where large wells draw from bedrock below or beside a buried valley).

The direction of flow depends on the hydraulic gradient; in other words, which direction is "downhill" for the water. Where the bedrock serves as a recharge source for a buried valley aquifer, the long-term productivity of the system is improved, overcoming the limitations caused by the narrow channels of the buried valleys (Geonics, 1979b).

The less permeable materials of a buried valley (fine sands, silts, clays, muck soils, nonstratified till) also can serve as valuable storage areas for water which can eventually recharge the sand and gravel aquifer. Fine sands, for example, are quite porous but relatively impermeable. They can hold large quantities of water but release it too slowly for major production wells. Over a wide area, these deposits could play a significant role in aquifer recharge (Geonics, 1979b).

Regional and Local Ground Water Flow

Ground water flows at a relatively slow pace, often measured in feet per day or even feet per year. The determination of ground water flow rates and directions is critically important in ground water contamination investigations, well zone protection, water budget preparation and the understanding of aquifers as systems rather than isolated components.

Ground water flow is described in "flow nets" which describe the three dimensional aspects of flow direction and velocity. As geologic conditions change, the ground water may flow faster or slower, over a

broad area or through a restriction, up or down in elevation. However, ground water always flows along a gradient determined by gravity and pressure. Water table aquifers flow downgradient along the apparent surface of the aquifer. Confined aquifers also flow "down" but the gradient is measured differently, by the amount of pressure on the water at any point in the aquifer.

Natural ground water flow nets may change with precipitation. For instance, water may flow toward a river in wet seasons but away from the river in dry seasons. Natural flows may also be altered by pumping from the aquifer. In the vicinity of the pump, ground water will tend to flow toward the pump instead of in the natural (regional) flow direction because the pump artificially creates a depression in the aquifer. This depression becomes "down" for nearby water. Table IV-2 provides some measurements for the radius of influence of major wells in the region.

Research on ground water flow nets is lacking in the Buried Valley Aquifer Systems. Most of the data collected to date derive from contamination investigations, where mapping of the contaminant plume reveals the ground water flow. In most subregions and local areas of the aquifer systems, only the most limited understanding of flow exists. Precise flow nets have been determined in a very few areas, such as the Dover portion of the Rockaway Aquifer through USGS research.

Figure G-5 (in pocket) is a compilation of existing knowledge and inferrences about the flow of ground water to and within the buried valley aquifers. <u>This map should be used only as a general guide.</u> [1] Very little of the ground water flow information has been rigorously determined. Figure G-5 represents an initial attempt at mapping the gross flow net of the region. A final product will require considerable research, beyond the scope of this study. However, the map may be useful in defining the information needs for development and contamination review.

[1] Please inform the Passaic River Coalition of any new information which tends to support or oppose the regional flow net indicated on Figure G-5 or provides additional information in areas where no flow directions are indicated.

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TABLE V-2

PUBLIC COMMUNITY AND NONPUBLIC WATER CONSUMPTION BY MUNICIPALITY
BURIED VALLEY AQUIFER SYSTEMS, MORRIS COUNTY MUNICIPALITIES, 1980

Municipality	Total Population	Population Served by Public Supply	Per Capita Water Use	Avg. Water Use (MGD)	Population Served Nonpublic Supply	Avg. Water Use (MGD)
Boonton, Town of	8,620	8,620	132	1.14	---	---
Boonton Township	3,273	398	128	0.05	2,875	0.20
Chatham Borough	8,537	8,537	122	1.04	---	---
Chatham Township	8,883	7,540	81	0.61	1,343	0.09
Denville Township	14,380	12,942	134	1.73	1,438	0.10
Dover, Town of	14,681	14,681	161	2.36	---	---
East Hanover Township	9,319	7,428	148	1.10	1,891	0.13
Florham Park Borough	9,359	9,359	119	1.11	---	---
Hanover Township	11,846	11,846	126	1.49	---	---
Harding Township	3,236	891	127	0.11	2,345	0.16
Jefferson Township	16,413	6,602	58	0.38	9,811	0.69
Kinnelon Township	7,770	3,980	65	0.26	3,790	0.27
Madison Borough	15,357	15,357	124	1.90	---	---
Mendham Borough	4,899	4,899	131	0.64	---	---
Mendham Township	4,488	1,511	86	0.13	2,977	0.21
Mine Hill Township	3,325	1,531	91	0.14	1,794	0.13
Montville Township	14,290	6,291	155	0.98	7,999	0.56
Morris Plains Borough	5,305	5,305	111	0.59	---	---
Morristown, Town of	16,614	16,614	102	1.69	---	---
Morris Township	18,486	15,354	119	1.83	3,132	0.22
Mountain Lakes Borough	4,153	4,153	149	0.62	---	---
Parsippany-Troy Hills Twp	49,868	49,868	112	5.59	---	---
Passaic Township	7,275	6,564	81	0.53	711	0.05

TABLE V-2 (Cont'd)

Municipality	Total Population	Population Served by Public Supply	Per Capita Water Use	Avg. Water Use (MGD)	Population Served Nonpublic Supply	Avg. Water Use (MGD)
Randolph Township	17,828	10,523	116	1.22	7,305	0.51
Rockaway Borough	6,852	6,852	124	0.85	---	---
Rockaway Township	19,850	13,910	89	1.24	5,940	0.42
Roxbury Township	18,878	13,732	89	1.22	5,146	0.36
Victory Gardens Borough	1,043	1,043	161	0.17	---	---
Wharton Borough	5,485	5,485	128	0.70	---	---
	---	---		---	---	---
	325,306	271,816		31.42	53,490	4.10

Source: Adapted from Killam Associates, 1982, Water Supply Element-Morris County Master Plan, prepared for the Morris County Planning Board.

TABLE V-3

GROUND WATER WITHDRAWAL IN THE
BURIED VALLEY AQUIFER SYSTEMS,
MORRIS COUNTY MUNICIPALITIES, 1960

Municipality	Average Daily Use (MGD)				Use by Aquifer (MGD)			
	Public Supply	Commercial, Industrial Institutional	Other	TOTAL	Precambrian	Paleozoic	Triassic	Quaternary
Boonton, Town of	0	0.40	0	0.40	0.40	0	0	0
Boonton Township	1.275	0.029	0.10	1.374	0.074	0	0	1.30
Chatham Borough	0.711	0.02	0	0.731	0	0	0.020	0.711
Chatham Township	0	0	0.050	0	0	0	0.025	0.025
Denville Township	1.401	0.249	0	1.650	0.001	0	0	2.552
Dover, Town of	2.062	0.490	0	2.522	0	0	0	2.522
East Hanover Township	0	0.130	0.226	0.356	0	0	0.151	0.205
Florham Park Borough	2.108	0.555	0.050	2.713	0	0	0.075	2.638
Hanover Township	2.142	2.397	0.250	4.789	0	0	0.500	4.289
Harding Township	0.201	0	0.135	0.336	0.100	0	0.201	0.035
Jefferson Township	0.060	0	0.250	0.310	0.150	0.060	0	0.100
Kinnelon Township	0.085	0	0.130	0.215	0.115	0	0	0.100
Madison Borough	1.239	0	0	1.239	0	0	0	1.239
Mendham Borough	0.123	0	0	0.123	0.123	0	0	0
Mendham Township	0	0	0.100	0.100	0.100	0	0	0
Mine Hill Township	0.010	0.600	0.150	0.760	0.160	0	0	0.600
Montville Township	0.029	0.145	0.300	0.474	0.300	0	0.174	0
Morris Plains Borough	0	0.576	0.300	0.876	0.176	0	0.200	0.500
Morristown, Town of	0	1.826	0	1.826	0.216	0	0.120	1.490
Morris Township	0	0.272	0	0.272	0	0	0.272	0
Mountain Lakes Borough	0	0.020	0	0.020	0.010	0	0	0.010
Parsippany-Troy Hills Twp	2.038	0.386	0.300	2.724	0.600	0	0.124	2.000
Passaic Township	0	0	0.050	0.050	0	0	0.040	0.010

TABLE V-3

Municipality	Average Daily Use (MGD)				Use by Aquifer (MGD)			
	Public Supply	Commercial, Industrial Institutional	Other	TOTAL	Precambrian	Paleozoic	Triassic	Quaternary
Randolph Township	0.065	0.064	0.300	0.429	0.300	0	0	0.129
Rockaway Borough	0.781	0.131	0	0.912	0.131	0	0	0.781
Rockaway Township	0.097	0.564	0.150	0.811	0.150	0.061	0	0.600
Roxbury Township	0.429	1.631	0.325	2.385	0.085	0.300	0	2.000
Victory Gardens Borough	0	0	0	0	0	0	0	0
Wharton Borough	0.525	0.005	0	0.530	0.005	0	0	0.525
Totals	15.351	10.490	3.166	29.407	3.196	0.421	1.902	23.488

Note: The withdrawals by municipality in Table V-3 are not directly comparable with the withdrawal data in TableV-2. Table V-3 is according to the location of diversion, while Table V-2 indicates the location of use.

Source: Adapted from Gill and Vecchioli, 1965.

TABLE V-6

MUNICIPAL AND MAJOR INDUSTRIAL ALLOCATIONS
BY AQUIFER SUBREGION

	MGD	MGD
Rockaway Valley Subregion		13.993
Boonton Town	2.25	
Denville Township	2.60	
Dover Town	3.61	
Fayson Lake Water Company	0.32	
Jefferson Township (partial)	0.18	
Rockaway Borough	1.43	
Rockaway Township	1.35	
Wharton Borough	1.30	
Howmet Turbine Components Corp	0.613	
Hewlett Packard	0.34	
Upper Lamington Subregion		7.91
Hercules, Inc.	1.16	
Morris County Municipal Utilities Authority	4.40	
Roxbury Township Water Department (partial)	1.06	
Roxbury Water Company	1.29	
Towaco Valley Subregion		1.72
Montville Township MUA	1.72	
Northwest Essex Subregion		7.21
Essex Fells Water Department	5.16	
Fairfield Township	1.80	
Mountain Ridge Country Club	0.14	
Resistoflex Corp. (Crane Corp.)	0.11	

TABLE V-7

WELL PUMPING ALLOCATIONS FOR
MUNICIPAL AND MAJOR INDUSTRIAL ALLOCATIONS
BY AQUIFER SUBREGION

	GPM	Formation
Rockaway Valley Subregion		
Boonton Town		
# 1	350	Qsd
# 2	350	Qsd
# 5	375	Qsd
# 6	1000	Qsd
Denville Township		
# 1	450	Glacial Moraine
# 3	820	Glacial Moraine
# 4	550	Glacial Moraine
# 5	1000	Glacial Moraine
# 6	700	Glacial Moraine
Dover Town		
# 1	1500	Qsd
# 3	1000	Qsd
# 4 (Not in use)	1100	Qsd
# 5	1500	Qsd
Fayson Lake Water Company		
# 3	200	Unconsolidated Drift
# 4	100	Unconsolidated Drift
Jefferson Township		
White Rock #1	270	Precambrian
White Rock #2	125	Precambrian
Mary Ann	120	Precambrian
Paderewski	75	Precambrian
Aztec	12	Precambrian
Rockaway Borough		
# 1	525	Sand & Gravel
# 5	517	Sand & Gravel
# 6	800	Sand & Gravel
Rockaway Township		
# 4	175	Qsd
# 6	450	Qsd
# 7	830	Qsd

TABLE V-7 (Cont'd)

	GPM	Formation
Wharton Borough		
# 1	500	Glacial Drift
# 2	500	Glacial Drift
# 3	700	Glacial Drift
Howmet Turbine Components Corp		
# 1	300	Stratified Drift
# 2	400	Stratified Drift
R1 (contaminant recovery)	150	Stratified Drift
R2 (contaminant recovery)	150	Stratified Drift
Hewlett Packard		
# 1	535	Stratified Drift
Upper Lamington Subregion		
Hercules, Inc.		
# 1	850	Qt
# 2	850	Qt
Morris County Municipal Utilities Authority		
Alamatong 1	450	Stratified
Alamatong 2	415	Upper Aquifer
Alamatong 3	415	Lower Aquifer
Alamatong 4	1030	Lower Aquifer
Alamatong 5	500	Paleozoic Limestone
Musiker 1	300	Precambrian
Roxbury Township Water Department		
# 3	150	Precambrian
# 5	50	Precambrian
# 6	50	Precambrian
# 7	35	Qsd
# 8	15	Precambrian
Roxbury Water Company		
# 1	150	Qsd
# 2	275	Qsd
# 3	500	Qsd
# 4	500	Qsd
# 5	300	Qsd

TABLE V-8

GROUND WATER DIVERSIONS BY
MUNICIPAL AND MAJOR INDUSTRIAL ALLOCATIONS
BY AQUIFER SUBREGION

	1980		1983		1985	
	MGD Annual Avg.	MGD Av.Max. Month	MGD Annual Avg.	MGD Av.Max. Month	MGD Annual Avg.	MGD Av.Max. Month
Rockaway Valley Subregion						
Boonton Town	0.82	1.06	0.67	0.86	0.31	0.34
Denville Township	1.73	2.20	1.63	1.95	1.48	1.69
Dover Town	3.14	3.18	2.97	3.13	3.02	3.19
Fayson Lake Water Company	0.21	0.25	0.23	0.27	0.22	0.26
Jefferson Township	Inc.	Inc.	0.30	0.53	Inc.	Inc.
Rockaway Borough	1.38	1.73	1.24	1.42	1.27	1.50
Rockaway Township	0.88	1.04	1.04	1.19	0.96	1.07
Wharton Borough	0.68	0.76	0.79	1.02	0.72	0.79
Howmet Turbine Components Corp	0.32	0.47	0.26	0.39	0.26	0.40
Hewlett Packard	NA	NA	0.12	0.33	0.003	0.039
Upper Lamington Subregion						
Hercules, Inc.	NA	NA	NA	NA	0.87	1.06
Morris County MUA	1.09	1.39	1.90	2.30	2.39	2.62
Roxbury Township Water Dept	0.46	0.60	0.43	0.55	0.45	0.49
Roxbury Water Company	0.73	1.01	0.77	0.99	0.70	0.77
Towaco Valley Subregion						
Montville Township MUA	0.92	1.42	1.03	1.59	1.09	1.81
Northwest Essex Subregion						
Essex Fells Water Department	2.70	4.38	2.85	4.73	3.14	3.42
Fairfield Township	0.96	1.57	1.08	1.36	0.99	1.14
Mountain Ridge Country Club	NA	NA	NA	NA	0.05	0.08
Resistoflex Corp. (Crane Corp.)	0.10	0.10	0.08	0.09	0.08	0.09
Whippany-Lower Rockaway Subregion						
East Hanover Township	1.09	1.33	1.16	1.64	1.08	1.52
Mountain Lakes Borough	0.62	0.76	0.59	0.70	0.61	0.66
Parsippany-Troy Hills Township	5.26	6.84	5.66	7.87	5.58	6.39
Southeast Morris County MUA	7.54	8.23	7.43	9.41	8.19	9.44

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TABLE V-9

POPULATION OF MUNICIPALITIES IN THE
BURIED VALLEY AQUIFER SYSTEMS
1980 AND YEAR 2000 ESTIMATES

Municipality	1980	2000 (est.)
Morris County		
Boonton, Town of	8,620	9,605
Boonton Township	3,273	4,241
Chatham Borough	8,537	9,880
Chatham Township	8,883	11,960
Denville Township	14,380	18,043
Dover, Town of	14,681	14,537
East Hanover Township	9,319	13,108
Florham Park Borough	9,359	10,302
Hanover Township	11,846	15,600
Harding Township	3,236	4,680
Jefferson Township	16,413	20,280
Kinnelon Township	7,770	9,820
Madison Borough	15,357	16,054
Mendham Borough	4,899	7,332
Mendham Township	4,488	7,280
Mine Hill Township	3,325	4,489
Montville Township	14,290	21,709
Morris Plains Borough	5,305	6,210
Morristown, Town of	16,614	17,160
Morris Township	18,486	24,552
Mountain Lakes Borough	4,153	5,015
Parsippany-Troy Hills Township	49,868	57,280
Passaic Township	7,275	9,360
Randolph Township	17,828	29,820
Rockaway Borough	6,852	8,801
Rockaway Township	19,850	24,976
Roxbury Township	18,878	26,941
Victory Gardens Borough	1,043	1,560
Wharton Borough	5,485	6,210

Allocation Issues and Disputes

Interviews with water superintendents, engineers, administrators and consultants for the major public water supply systems of the Buried Valley Aquifer Systems revealed a close understanding of the water allocation issues faced by each supply system. The information presented in this section reflects the current knowledge and policy directions of each public water supply. Changes in state policies and regulations, increased understanding of the aquifer resources, and revisions in development projections all will play a part in changing or reinforcing the allocation issues and disputes presented here. The major purpose of this section is not a detailed understanding of each water supply system, but a general view of the allocation issues and the measures used to deal with those issues.

Rockaway Valley Subregion

Boonton Town--The well field is isolated from other public water supply systems, is a relatively minor user, and has an allocation for withdrawal which is well above the normal use of the field. There have been no disagreements with any ground water user on the current allocation. However, Jersey City objected to the construction of Well 6 based on the possibility of a reduction of base flow to the river during droughts. This allegation was not proven and Well 6 was completed. Peak use in the last three years was 20 MGM. Peaks for 1984 and 1985 were lower, approximately 10 MGM, reflecting an increased reliance on Boonton's reservoir.

Denville Township--Denville is approaching the limit of its water allocation from the NJDEP, at 70 MGM. With additional development allowed by the completion of the Rockaway Valley Regional Sewerage Authority's 12 MGD facility, Denville anticipates the need for an allocation of 90 MGM. With all five wells functional (including the new treatment system on Wells 3 and 6), the system is capable of sustaining the higher demand. A test well installed during the Geonics study may also be developed as a supply well, but not as a priority. As of early 1986 an application for an allocation increase had not been filed. Denville also plans to connect both sides of its supply system through a master tank, reducing the likelihood of service losses. No record exists of complaints by other parties over Denville's allocation.

Dover Town--Dover does not fully use its water allocation of 112 MGM. The town embarked on a water conservation program to find and repair leaks, resulting in a reduction in pumpage from 1984 to 1985. Dover need not rely on Well 4 (closed due to contamination) but wants to

correct the contamination problem so that water shortages would not result in the event of well failure. No disagreements are known with regard to allocations, despite the close proximity of Wharton Borough's Well 3 and Denville's Wells 3 and 6.

→ **Rockaway Borough**--Rockaway Borough is essentially fully developed. No disagreements over allocations exist, nor is an application for an increase in the allocation likely.

→ **Rockaway Township**--There have been no disagreements with the NJDEP or adjacent water systems with regard to allocations through 1985. Rockaway Township does anticipate the need for increased allocations to provide potable water for new development in the municipality. Most likely well locations are either within the contaminated well field area, outside of Rockaway Township's borders in the Rockaway Valley aquifer in southern Berkshire Valley (Jefferson Township), or in remote, northern reaches of the township. The possibility exists that difficulties will be encountered in securing additional allocations. The township anticipates a long-term need for 8 MGD of well capacity and a normal use of 6.5 MGD at full development, as compared to a current use of 1.0 MGD and allocation of 1.4 MGD. It is possible that some major developments may procure their water from on-site wells.

Wharton Borough--Wharton has an allocation of 1.1 MGD and generally diverts 0.7 MGD. Demand has reduced as older industries such as Thatcher Glass and Air Products have closed their manufacturing facilities. No disagreements have occurred with the NJDEP or other users over allocations. Well 3 is capable of more yield than currently allocated to the system.

Upper Lamington Subregion

Morris County Municipal Utilities Authority--Significant disagreements have arisen between the MCMUA and Chester Township on allocations from the Alamatong well field. The MCMUA had an allocation of 136.5 MGM based on a 60 MGM reserve to eventually serve Mount Olive and Roxbury Townships, with a condition that MCMUA develop a substantial artificial recharge program. Initial designs for a recharge system were developed for the MCMUA but the system was not implemented, nor did Mount Olive and Roxbury actually contract for supplies. (Mount Olive developed a separate well field for its Foreign Trade Zone.) The NJDEP, in considering the water allocation permit approved in 1984, suggested that the well field had become stressed through normal diversions of 41 MGM, and that the dependable yield might be 45-50 MGM. Consultants to the MCMUA had recommended an allocation of 90 MGM. The NJDEP set the

dependable yield is closer to the NJDEP allocation figure of 4.8 MGD. Seven of the eleven wells were not capable of meeting their allocation. However, Well 5 was thought capable of pumping 0.5 MGD above its 0.5 MGD allocation indefinitely. The NJDEP has not altered the allocation for Well 5.

Madison Borough—Madison's maximum diversion in recent years, in 1980, was approximately 75 per cent of its total allocation from the NJDEP. No additional allocation is needed or contemplated.

Public Water Supply Systems: Descriptive Information

Most public water supply systems in the region are operated by individual municipalities, primarily for local residents. However, systems which serve more than one municipality do exist, including the Morris County Municipal Utilities Authority, the Southeast Morris Municipal Utilities Authority, Commonwealth Water Company, the Essex Fells Water Department and the City of East Orange. This section describes the wells and supply systems for the public water supplies of the Buried Valley Aquifer Systems. Material for this section was gathered from interviews with water superintendents and engineers, administrators and consultants as well as from consultants reports and files of the NJDEP. The information presented may not be complete in all details, due to space limitations and unavailable information. The wells for all of the systems are shown on Figure G-4 (in pocket).

Rockaway Valley Subregion

Town of Boonton—The Town of Boonton uses both surface and ground water to supply a total of nearly 9000 people. The surface water is derived from the Stony Brook Reservoir on a branch of the Rockaway River, and is the source of choice for Boonton due to the lower costs of transporting water by gravity than by pumping from wells. Approximately two-thirds of Boonton's water is from the reservoir. The remaining one-third, approximately 10 MGM, is derived from four wells located in a sand and gravel aquifer adjacent to the Rockaway River in Boonton Township near the Denville Township border (the spur buried valley to the main Rockaway Buried Valley Aquifer). The wells are all between the river and the Morris Canal. Two are quite shallow (approximately 40 feet), one is 102 feet deep, and the last is actually a set of 30 well points drilled approximately 60 feet deep in a line and connected to the

same pump station. The first three wells have intermediate capacities of 350-375 gpm, while the last well set is capable of pumping 1000 gpm.

The total capacity of the well system is considerably beyond the average use. Boonton expects to reduce its water allocation to better reflect its usage and anticipated development potential, thus reducing the cost of allocation fees. As Boonton essentially is fully developed, little growth in demand is anticipated. However, any growth in demand could be met with the existing well field, and through the redevelopment of Well 4 in the same field.

The Boonton well field was started in the 1930's, with the last well being drilled in 1964. As part of the development, Boonton Township is guaranteed up to 9 MGM from the well field in perpetuity, but uses much less. The future water requirements of Boonton Township from public supplies are unknown.

Denville Township--Denville supplies water to 16,400 people, all but 200 of whom are Denville residents. Five wells, one of which is currently used for emergency purposes only, provide the entire supply. Three wells are close to the Rockaway River and two are in Randolph Township near the western border of Denville. The last two have been contaminated with volatile organic compounds and one of the two exhibits high manganese levels. Treatment has been implemented for both wells. All five wells are within glacial deposits.

Denville has a total allocation of 70 MGM. Of the five wells, one has a yield of 1000 gpm, with the others ranging from 450 gpm to 820 gpm. The wells are drilled to depths of 116 to 201 feet in the main Rockaway Buried Valley.

Town of Dover--The Town of Dover relies entirely upon ground water for public and private water supplies. Over 22,500 people are served by the Dover Water Board, 16,000 of whom are Dover residents. The remaining customers in portions of Randolph and Rockaway Townships, Wharton, Mine Hill and all of Victory Gardens. Dover currently has four wells, one of which is heavily contaminated and not used. Wells 1, 3 and 5 are located in Dover Water Works Park off Princeton Avenue, along the Rockaway River in an open space area. Well 4 is located in the industrial area along Rutan Street, and has been designated a National Priority Site under the Superfund (CERCLA) program. All four wells tap the Rockaway Buried Valley, with the Princeton Avenue wells drawing from approximately 40-64 feet and the Rutan Street well drawing from 95-138 feet. Each of the wells is capable of yielding 1000 gpm or more, with

two at 1500 gpm. Consultants to Dover have conducted studies of the aquifer with respect to siting new wells. The deepest part of the buried valley is nearly 140 feet with a fairly narrow channel width.

→ **Rockaway Borough**—Rockaway Borough has three wells which supply all of the potable water for the municipality with the exception of some industries. The wells draw from relatively shallow depths (50 to 90 feet) of the Rockaway Buried Valley Aquifer which underlies the borough. Wells 1 and 5 have yields of approximately 500 gpm while Well 6 yields 800 gpm. The stratified glacial deposits lie south of the terminal moraine and apparently originated from an earlier incursion of the Wisconsin glacier which pushed south, retreated, and then pushed south to a lesser extent to result in the terminal moraine, according to preliminary data from the NJGS.

Rockaway Borough's water system serves approximately 10,000 people with an allocation of 44.4 MGM. Some of the customers are in nearby sections of Dover and Rockaway Township. All three wells have been contaminated by volatile organic chemicals, and the well system as a whole is a Superfund site undergoing investigation. The source(s) of the pollution is not known. The borough uses activated carbon filters to treat the water. Treatment is highly effective. The contamination was discovered in late 1980 in Well 1, spread to Well 6 and eventually affected Well 5. The system was shut down in 1981 for four months (Well 1 was shut down in 1980) while the treatment facility was installed. Well 1 has not been used since 1980.

→ **Rockaway Township**—Rockaway Township operates three wells closely spaced in the Beaver Brook Buried Valley Aquifer, a tributary valley to the Rockaway Buried Valley. The three wells are from 150 to 160 feet in depth. One is 830 gpm (Well 7), while Wells 4 and 6 have yields less than 500 gpm. Well 4, the smallest, has not been used in recent years. The Township public water system serves approximately 10,000 people. The remainder of township residents are served by Rockaway Borough, Dover, and private wells. The township well field is near Interstate 80 and has been contaminated by gasoline fractions and TCE. The source of the gasoline contamination provided funding for an air-stripping system which effectively treats the water for potable use.

Wharton Borough--Wharton Borough's wells are located directly adjacent to the Rockaway River, two toward the western side of the borough and the third (and best producer) on the eastern side near Dover. Wells 1 and 2 are very shallow (33 and 38 feet) and capable of yields to 500 gpm, while Well 3 can yield 700 gpm from a 64 foot deep

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Dependable Yields of Aquifer Areas

This section reviews findings of several studies on the relation of use to capacity of the buried valley aquifers. Each valley is discussed separately, though most of the buried valleys are interconnected. Pumping of one can affect others, especially where the aquifers are confined beneath layers of clay and nonstratified till. Where such effects have been discovered they will be noted. The most extensive work on modelling dependable yields was the computer simulation by Meisler (1976) which attempted to model the dependable yields from the buried valley aquifers of the Chatham-Millburn Valleys Subregion and the East Hanover Buried Valley. The model has several drawbacks, especially the lack of data for the contiguous bedrock aquifers, but is the best available information in most cases. The Meisler model was updated by the NJ Geological Survey to reflect current diversions (Hoffman, 1986). Further research is planned to improve and expand the modelling. Other, more limited estimates of dependable yields and water budgets are available as well. Finally, information on static water level trends and interference effects among wells also shed some light on the aquifer conditions.

Rockaway Valley Subregion

A prime buried valley aquifer underlies much of the upper Rockaway River and its tributaries (such as the Beaver Brook Buried Valley). Use of ground water was approximately 2.9 mgd in 1979, while consultants estimated that 11 mgd of additional yield existed, 8.5 mgd of which was in the main body of the buried valley (Geonics, 1979a). However, the common presence of contaminants in parts of the buried valley limit the available drilling sites due to fears that pumping might induce the flow of contaminants to the new wells

Boonton Town—No information is available on the water budget for the well field. The aquifer is not the main Rockaway Buried Valley but rather a spur buried valley. However, the existence of the overlying Rockaway River may provide for induced recharge of the aquifer when pumped during drought periods. In any case the aquifer apparently is not being depleted locally. To the extent that static level trends have been monitored, no decline of static levels has been noted. Records of static levels were begun only recently. Wells 1 and 2 are

shallow and close together. When both are in operation, the total yield is less that the sum of their independent yields, indicating interference between the two. No other interference problems are known.

→ **Denville Township**--Static levels have been stable in both well fields. There is little interference between wells 3 and 6, but wells 1 and 4 do exhibit interference effects. No interference with other wells is known.

Dover Town--No quantified water budget for the area exists. However, Geraghty & Miller notes that the shallow aquifer and high yields of the Princeton Avenue wells indicates a hydraulic connection between the river and the wells. The induced recharge available results in a very high water budget for the well field. The USGS recently completed its major aquifer study centered on the Dover area and placed 26 observation wells in the area. Recharge to the wells from the river was confirmed. The results are expected to be released in 1987. Static levels are characterized as stable. Interference has been noted between Wells 1, 3 and 5 in the Princeton Avenue well field, but the effect is not critical and does not limit the yield of the well field significantly. It is possible that the interference effects are minimized by induced recharge from the river.

→ **Rockaway Borough**--No water budget has been estimated for Rockaway Borough. Well 6 has shown a decline of 3.5 feet recently. There is some possibility of interference with Well 5. Well 1 has not been used since it became contaminated. Interference effects are minimized by induced recharge from the Rockaway River.

→ **Rockaway Township**--Rockaway Township's consultants, Ground Water Associates, Inc., estimated the recoverable yield from various parts of the township based on the nature of the aquifers encountered. Aquifer yield tests have not been conducted, but well tests did not encounter any significant yields outside of the contaminated portion of the Beaver Brook Buried Valley. Insufficient records are available to determine the static water level trends for the Beaver Brook Aquifer. Well 4, the smallest, interferes somewhat with the other two wells.

Wharton Borough--No water budgets have been developed for the Wharton field. However, the proximity of the wells to the Rockaway River indicate that the aquifer yield is closely related to the surface water system. The USGS study in Dover has apparently confirmed that considerable recharge occurs from the river to the wells. There is no evidence of a decline in static water levels. Well 3 of Wharton causes

a 1 to 2 foot drawdown on Dover's closest well when pumped, an effect which probably increases during droughts. Monitor wells exist between the two systems. Well 1 and 2, though very close, normally have a 1 foot interference effect on each other which increases to as much as 3 feet during drought periods.

Upper Lamington Subregion

Several studies have been prepared with regard to the Alamatong well field and Upper Lamington aquifers. Morris County Municipal Utilities Authority (MCMUA) has received consultant reports from Ground Water Associates, Woodward-Clyde Consultants and Elson T. Killam Associates, Inc. In addition, the New Jersey Geological Survey prepared a report on the extent of stratified drift deposits in the Upper Rockaway watershed, extending slightly into the Upper Lamington watersheds. However, a great deal of additional information is necessary to properly delineate the aquifers in the subregion and estimate their dependable yields, according to Frank Markewicz, former State Geologist for New Jersey. There are significant disagreements over water budgets for the area and the discovery of the limestone aquifer at Alamatong Well 5 as a major ground water resource has complicated the determination of water budgets and intensified the need for buried valley aquifer investigations, according to Markewicz (personal communication, 1986).

Ground Water Associates developed a simple water budget for the entire Upper Lamington River watershed based on precipitation, runoff, evapotranspiration and maintenance of river base flow. They determined that a safe yield of 4.1 MGD could be expected from the basin during normal precipitation years, with a 3.6 MGD yield during dry years. At that time (1977) the MCMUA had developed 2.0 MGD from the Alamatong well field. Roxbury Water Company also draws from the stratified drift in locations upgradient of the Alamatong well field.

Woodward-Clyde used a similar methodology to describe a water budget of 5 MGD safe yield from the watershed aquifers. The difference is mostly due to altered assumptions. The NJDEP, meanwhile, suggested that the dependable yield of the Alamatong well field (considerably smaller than the entire watershed) might be closer to 2 MGD based on drawdown impacts on neighboring wells. Markewicz disagrees, noting that nearly all of the interference is caused by the shallow, point wells, (effects on other wells were within acceptable limits) but he also recommends that considerable research be undertaken to determine a more accurate water budget. With the development of Well 5 the MCMUA will be capable of

Rockaway Valley Subregion

Recharge areas in the subregion have not been identified specifically, but the assumed recharge locations include the hillsides on both sides of the river and outcroppings of the valley-fill aquifer where it is not confined as in Boonton's well field and other areas.

Some recharge may occur from the river, up to 50 percent in some systems with shallow wells next to the Rockaway River. Water quality tests taken by Boonton in the 1960's apparently did not show a significant correlation between surface and ground waters, indicating minimal induced recharge. Boonton did artificially recharge the aquifer through a recharge pit located between two wells, using river water. This practice was ended in the 1970's when pumping costs became prohibitive and the reservoir became the primary water source. Boonton has not noticed a detrimental impact on static water levels in the aquifer.

Induced recharge from the Rockaway River is apparently an important source of recharge to wells located adjacent to the river in Denville, Dover, and Wharton, according to various studies.

Ground water moving within the aquifer will recharge well fields, and may be the primary direct recharge source in many areas. However, recharge within the aquifer necessarily derives from surface recharge.

In the Beaver Brook Buried Valley, recharge is assumed to derive from direct infiltration through unconfined northern portions of the aquifer (though these areas are mostly active wetlands, indicating that the water table is too high for percolation), subsurface and fractured bedrock flow from the hillsides, movement through the buried valley aquifer itself, and recharge from the unconfined sediments east of the buried valley channel.

Upper Lamington Subregion

The determination of recharge areas is complicated by the lack of congruity between surface water divides and ground water divides. The limestone formation apparently bridges the Lamington/Rockaway Rivers surface water divide and may in fact discharge in the Rockaway River watershed. The stratified drift deposits may also bridge into the Rockaway River watershed and either discharge to the Rockaway River, to the Lamington River, or both, but the ground water divide may not match the surface water divide. In addition, the upper and lower aquifers may

high rainfall. Two relatively small droughts have occurred recently in 1980-81 and 1984-85. Declines in static water levels were moderate compared to the 1960's drought, in locations where static levels were recorded during both droughts.

Long term comparisons of the lag effects of well fields affected by droughts could have assisted researchers in determining changes in the recharge and capacity of aquifers over time, due to development and other actions. Unfortunately, very few major wells were monitored even as far back as the early 1970's and almost none were monitored in the 1960's and before.

Effects on Major Wells

Many of the public water supply systems lacked procedures to monitor static water levels regularly during the drought of the early 1960's. Only the relatively minor and short-lived droughts of the early 1980's have been monitored in the large portion of the region. Based on discussions with personnel and consultants, this section explores the effect of prolonged precipitation reductions (droughts) on public supply wells in the Buried Valley Aquifer Systems.

Rockaway Valley Subregion—Static water level records have been collected by Boonton only since enactment of the 1981 Water Supply Management Act. During the 1980-81 drought, no significant water level changes were noticed in the well field. A voluntary ban on outdoor water uses plus water conservation requests were implemented by Boonton to reduce demand upon the reservoir and well field. Denville reports that static level changes in its wells during the 1980-81 drought were minimal. Dover also reports that its well field is not significantly affected by drought conditions. It may be that the well field is more reliant on induced recharge from the Rockaway River during these periods. The same may be true of Rockaway Borough, which reports that no major drought effects have been seen.

Small drought effects have been documented for the Rockaway Township well field, with up to 10 feet of drawdown and then quick recovery after precipitation resumes normal levels. During the same drought period the NJDEP drew 2 MGD from deep mines in Rockaway Township to supply flow to the Rockaway River. The withdrawals caused a mine shaft drawdown to 1200 feet below grade, 1000 feet of which was recovered in the next 4-5 years after pumping ceased. The net effect on the aquifer is unknown.

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In Wharton Borough, static water levels recede as the river flow reduces during droughts. The effect occurs slowly and is not extreme. The 1960's drought resulted in a drop of 5 to 7 feet in static water level, in the presence of reduced pumping. Recovery is achieved in a matter of weeks after river flow increases.

Upper Lamington Subregion--Drought impacts have been recognized within the Alamatong well field. The effects were especially notable for point wells drilled in the surficial aquifer for private residences. The drawdown from the two shallow MCMUA wells caused the most shallow residential point wells to lose capacity during drought periods. MCMUA has redrilled some wells and has connected other residences to public water to compensate for the drawdown effects. Wells 1 and 2 initially had static water levels of 10 feet below grade, and now have static levels of 18 to 21 feet. These are the shallowest wells and most affected by drought. The deeper wells, however, do track the trends of the shallow wells for static level increases and decreases. Well 4 is least affected (there are no long-term data for Well 5). The NJDEP requires that the MCMUA draw preferentially from the lower aquifers when stream flow in the Lamington River is low, to reduce the impacts of drought in the shallow aquifers.

Roxbury Water Company did not monitor its static water levels until very recently, and therefore no record exists to determine drought impacts on the well field.

Towaco Valley Subregion--Montville experienced some supply problems during the 1984-85 drought and implemented a low-intensity water conservation program. Wells 9 and 10 are close together but do not interfere with one another, however, they require redevelopment, having lost gpm yield due to aging. Redevelopment is anticipated in 1986 and 1987. Well 11, developed in 1985 as a complementary supply, is expected to eliminate drought problems.

Northwest Essex Subregion--Unlike most systems, Essex Fells has twenty years of static water level data. Droughts effectively foreclose the use of the West Caldwell wells, and also Well 2 (in the golf course) which has a very small recharge area and limited storage capacity. Otherwise, drought impacts are seen but the wells recover after each drought period. Records from the severe 1960's drought indicate that the well system (when no wells are off-line due to contamination) can produce sufficient water during a drought.

drought effects indicate considerable water stored in the aquifer system and relatively good connection between recharge areas and the aquifer.

Water Use Management Programs

The NJDEP requires with all water allocation permits for public water supply systems that a water conservation plan be developed and implemented within the service area. The plan must be submitted annually to the department for review. However, the department has not formulated substantive standards by which to judge these plans, and so the thoroughness of the plans and the resources provided to implement them vary widely. Many public water supply systems are openly critical of efforts to conserve water when supplies are plentiful, given the loss of revenues to the system. Nearly all supply systems do acknowledge the need for water conservation in drought periods and when estimates of dependable yields indicate that conservation is required.

Alternate Supplies for Ground Water Users

A few of the public water supply systems have access to surface water supplies. The Town of Boonton has a reservoir, as does the Southeast Morris County MUA. Commonwealth Water Company derives a large portion of its supplies from surface waters, mostly through bulk purchases of water from other supply systems. Most public water supply systems in the Buried Valley Aquifer Systems do not have recourse to surface water supplies, though, and must remain heavily reliant on ground water. Surface water diversion rights are primarily allocated to major water supplies serving the cities of northeast New Jersey, including the Jersey City Water Department and the Passaic Valley Water Commission. In the event of well contamination, the only option for most areas is treatment of the contaminated supply. This lack of alternate water supplies for ground water users is one of the major criteria which led to the designation of the Buried Valley Aquifer Systems as a "sole source aquifer" by the federal government.

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should be exposed to by way of environmental contaminants. The issue is compounded in complexity by the relatively limited medical knowledge available on many of the contaminants found in ground water. Testing of contaminants is most often accomplished using laboratory animals and extrapolating data to estimate the consequences of human exposure. Testing using humans is out of the question, and inadvertent exposures of humans are often so mixed with exposures to other substances that a definitive link of exposure to disease is difficult. Still, the USEPA (and the NJDEP more recently) have been charged with the responsibility of establishing maximum contamination levels for site cleanups and drinking water standards based on health effects.

The Office of Technology Assessment in 1984 compiled a listing of substances which are known to be found in ground water, with information on the various health effects known or suspected to be caused by each. Two tables are located in Appendix E which provide the information. One table lists each substance, its range of detected concentration, examples of uses, and qualitative estimates of the carcinogenic potency and noncarcinogenic toxicity. The second table again lists the substances along with a breakdown of 24 health effects according to the organ effected by toxicity, teratogenicity, mutagenicity and carcinogenicity. A relative guide to potential health effects is provided by the two tables in combination, though more recent medical information may have become available in the three years since the data were compiled.

Substances Found in the Buried Valley Aquifer Systems--The case studies of contamination sites in the study area (Appendix F) include information on the specific, major contaminants found in each site. This information has been compiled as Table VI-3, listing the compounds in alphabetical order. By far the most frequent compounds found in the aquifer systems are trichloroethylene (TCE), tetrachloroethylene (PCE), 1,1,1 trichloroethane (1,1,1 TCEA), methylene chloride, toluene, xylene and various benzene and chlorobenzene compounds. Many of these compounds are solvents used in industrial and commercial processes, often as degreasing agents. Table VI-3 is not a complete listing of substances, but it covers all of the more common contaminants.

Known or Suspect Health Effects--The USEPA and the NJDEP have established mandatory or recommended Maximum Contaminant Levels (MCLs or RMCLs) for many common ground water contaminants, based upon the current state of understanding with regard to health effects, environmental effects, etc., and the requirements of the federal and New Jersey Safe Drinking Water Acts. Current MCLs, RMCLs and Interim Guidelines have

TABLE VI-4

DRINKING WATER CONTAMINANT
REGULATIONS AND GUIDANCE
(milligrams per liter, mg/l)

Chemical	NJDEP Interim	MCL- Primary	RMCL- Proposed	Secondary Standard
Acetone*				
Acrylamide			0**	
Alachlor			0	
Aldicarb			0.009	
Arsenic*		0.005		
Barium		1.0		
Benzene	+	0.005		
Bromoform* (THM)				
Cadmium*		0.010		
Carbofuran			0.036	
Carbon tetrachloride*	+	0.005		
Chlordane	+		0	
Chloride*				250.0
Chlorobenzene*				
Chloroform* (THM)				
Chromium*		0.05		
cis-1,2-dichloroethylene			0.07	
Copper*				1.0
Cyanide*				
DBCP			0	
Dibromochloromethane* (THM)				
o-dichlorobenzene			0.62	
Dichlorobenzene*	+			
1,1 dichloroethane*		0.007		
1,2 dichloroethane*	+	0.005		
1,1 dichloroethylene*	+			
1,2 dichloroethylene*				
Dichloromethane*				
1,2 dichloropropane			0.006	
Diethylphthalate*				
Endrin		0.0002		
Epichlorohydrin			0	
Ethanol*				
Ethyl acetate*				
Ethyl benzene			0.68	
Ethylene dibromide (EDB)			0	
Ethylene dichloride*				

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TABLE VI-4 (Cont'd)

Chemical	NJDEP Interim	MCL Primary	RMCL Proposed	Secondary Standard
Ethylbenzene*				
Freon-113*				
Hardness				250.0
Heptachlor			0	
Heptachlor epoxide			0	
Hexane*				
Iron				0.3
Isophorone*				
Isoproponol*				
Lead*		0.05		
Lindane		0.004	0.0002	
Manganese				0.05
Mercury*		0.002		
Methanol*				
Methoxychlor		0.1	0.34	
Methylene chloride*	+			
Monochlorobenzene			0.06	
Naphthalene*				
Nickel*				
Nitrate (as N)		10.0		
p-Dichlorobenzene		0.75		
Pentachlorophenol			0.22	
Phenols*				
bis(2-ethylhexyl)phthalate*				
Polychlorinated biphenyls*	+		0	
Radium* (Ra-226 and Ra-228)		5 pCi/l		
Selenium*		0.01		
Silver*		0.05		
Styrene			0.14	
Sulfates*				250.0
Tetrachloroethylene*	+			
Toluene*			2.0	
Total Dissolved Solids (TDS)				500.0
Total Trihalomethanes (THM)*		0.10		
Toxaphene		0.005	0	
Trans-1,2 dichloroethylene*	+		0.07	
1,2,3 trichlorobenzene*				
Trichloroethylene*	+	0.005		
1,1,2,2 tetrachloroethane*				
1,1,1 trichloroethane*		0.20		
1,1,2 trichloroethane*				
1,1,2 trichloroethylene*				
Trichlorofluoromethane*				
Trifluorotoluene*				
Vinyl chloride*	+	0.001		
Xylene*	+		0.44	
Zinc*				5.0
2,4-D		0.1	0.07	
2,4,5-TP Silvex		0.01	0.052	

TABLE VI-4 (Cont'd)

* Substances found in ground water within the Buried Valley Aquifer Systems, either in drinking water or at contamination sites.

** The Safe Drinking Water Act requires that a RMCL of zero be set for all chemicals which are possible, probable or known human carcinogens. MCLs are set for these substances according to the best available treatment and detection methods. A level of 0.005 or 0.001 mg/l (5 or 1 ppb) is commonly selected as the MCL for possible carcinogens.

+ The NJDEP has developed interim action levels for these chemicals. See Table VI-9 for the four levels of concern for each chemical.

- MCL - Maximum Contaminant Level, a mandatory standard.
RMCL - Recommended Maximum Contaminant Level.

Sources: 40 CFR 141 (Primary and Secondary Drinking Water Regulations); 50 FR 219:46904 (MCLs for Volatile Organic Chemicals); and 50 FR 219:46982 (RMCLs for Synthethic Organic Chemicals); NJDEP-Division of Water Resources, "Interim Action Levels and Recommendations for Response for Selected Organics in Drinking Water," January 1986.

TABLE VI-7

RESULTS OF A-280 TESTING IN THE
BURIED VALLEY AQUIFER SYSTEMS

Water Supply	Sample Type*	Date	Contaminant**	Level (ppb)
Essex County				
Caldwell Water Dept (WD)	IS	84/12/22	TCE	4.20
East Orange WD	VS	85/07/02	None detected	0.00
	IS	85/01/07	TCE	0.80
	IS	85/01/07	PCE	3.00
Essex Fells	IS	84/12/19	TCE	3.50
	IS	84/12/19	TCE	2.40
Livingston WD	IS	85/01/07	TCE	0.30
	IS	85/01/07	PCE	1.30
	IS	85/01/07	Trans-1,2 DCE	0.20
North Caldwell WD	IS	84/12/19	TCE	4.10
Roseland Public Works	IS	84/12/19	TCE	3.10
Morris County				
Boonton WD	IS	85/01/07	1,1,1 TCEA	1.50
→ Denville Twp WD	IS	85/01/02	1,1,1 TCEA	2.00
	IS	85/01/02	PCE	8.00
	IS	85/01/02	1,1,1 TCEA	40.00
	VS	85/03/14	PCE	9.00
	VS	85/03/14	1,1,1 TCEA	40.00
	VS	85/03/14	PCE	10.00
	VS	85/03/14	1,1,1 TCEA	43.00
Dover WD	IS	85/01/08	TCE	1.50
	IS	85/01/08	1,1,1 TCEA	10.00
East Hanover WD	IS	85/01/08	TCE	10.00
	VS	85/03/14	1,1 dichloroethane	3.00
	VS	85/03/14	TCE	2.00
	VS	85/03/14	TCE	7.00
	VS	85/03/14	Trans-1,2-DCE	2.00
Mountain Lakes WD	IS	85/01/04	1,1,1 TCEA	2.40
NJ Psychiatric Inst.	IS	85/05/29	PCE	32.00
Greystone Hosp.	VS	85/06/12	PCE	34.00
	VS	85/06/12	PCE	34.00
→ Rockaway WD	VS	85/07/02	None detected	0.00
	IS	85/01/16	TCE	3.20
	IS	85/01/16	PCE	2.70
Hercules, Inc.	IS	85/02/14	TCE	2.00
	IS	85/02/14	1,1,1 TCEA	1.20
Roxbury Water Co.	IS	85/01/07	TCE	2.00
	IS	85/01/07	Trans-1,2-DCE	3.00
	IS	85/01/07	PCE	37.00
	VS	85/03/15	TCE	2.00
	VS	85/03/15	Trans-1,2-DCE	2.00
	VS	85/03/15	PCE	20.00

TABLE VI-7

Water Supply	Sample Type	Date	Contaminant	ppb Level
Roxbury Water Co. (Cont'd)	VS	85/03/15	TCE	4.00
	VS	85/03/15	Trans-1,2-DCE	4.00
	VS	85/03/15	PCE	39.00
Roxbury WCo-Shore Hills	IS	85/01/07	1,1,1 TCEA	4.30

*Sample types are IS (Initial Sample) and VS (Verification Sample).

**Abbreviations for chemical names are as follows:

TCE	Trichloroethylene
PCE	Tetrachloroethylene
1,1,1 TCEA	1,1,1 Trichloroethylene
Trans-1,2-DCE	Trans-1,2-dichloroethylene

Source: NJ Department of Environmental Protection, Final Report: Results of Initial Testing for Hazardous Contaminants in Public Water Supplies Under Assembly Bill A-280 Through January 9, 1985. February 20, 1986.

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TABLE VI-8

RECOMMENDATIONS FOR RESPONSES FOR
SELECTED ORGANICS IN DRINKING WATER

Level I

No recommended action at these concentrations. However, the N.J. Department of Environmental Protection (the Department) will spot check a random sample of representative Level I results submitted by public community water systems pursuant to the Act.

Level II

The Department shall obtain confirmation of sampling results by additional testing of the water distribution system and raw water sources which may have contributed to the original sampling results. Upon confirmation of Level II concentrations, the Department shall require that the water supply system monitor its water supply sources and delivered water at intervals and for a duration determined by the Department on a case-by-case basis. The Department will also recommend investigation by the water system of alternative water sources and development of appropriate treatment techniques.

Level III

The Department shall obtain confirmation of sampling results by additional testing of the water distribution system and raw water sources which may have contributed to the original sampling results. Upon confirmation of Level III concentrations, the Department shall require that the public community water system conduct monthly monitoring of its water supply sources and delivered water for a specified time period. Also, the Department shall require within one year that a public community water system develop adequate treatment facilities or alternative water sources. (Note: blending of water supply sources, if possible, may be allowed by the Department on a case-by-case basis provided delivered water continues to be acceptable to the Department.) The Department shall recommend that within one year a nonpublic or public noncommunity water system with confirmed Level III concentrations and/or an appropriate local health agency take one or more of the following remedial actions: extend an existing public community water system; develop a new public community water system; develop point-of-use treatment; or conduct any other appropriate remedial actions. The Department shall require quarterly progress reports from public community water systems. The Department shall require appropriate progress reports on a case-by-case basis from public noncommunity and nonpublic water systems. The Department shall initiate additional enforcement action based upon unsatisfactory progress reports.

TABLE VI-8 (Cont'd)

Level IV

The Department shall obtain confirmation of sampling results by additional testing of the water distribution system and raw water sources which may have contributed to the original sampling results. Upon confirmation of Level IV concentrations, the Department shall take all necessary actions to require immediate remedial efforts on a case-by-case basis depending upon the actual confirmed concentration of hazardous contaminant. Such formal enforcement action by the Department may include directive letters, administrative orders or appropriate court actions. The Department may require remedial action in the form of sealing potable water wells, developing alternative water supplies, developing appropriate treatment techniques, restricting types of water usage, and initiating any other appropriate actions.

Source: NJ Department of Environmental Protection, Division of Water Resources, Drinking Water Guidance, "Interim Action Levels and Recommendations for Responses for Selected Organics in Drinking Water," January, 1986.

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The Drinking Water Quality Institute also was slow in being formed and implemented. The full membership was not confirmed until more than a year after passage of A-280. The Institute consists of 15 members, comprised of the Commissioner of the NJDEP, the Commissioner of Health, the Chairman of the Water Supply Advisory Council, the Director of the NJDEP-Division of Water Resources, the Director of the NJDEP-Office of Science and Research, the Director of the Office of Occupational and Environmental Health in the Department of Health, and nine appointed members. The appointees are split evenly between representatives of water purveyors (at least one relying on ground water), the academic scientific community, and the public. The public representatives must all have backgrounds in environmental health issues. The Institute works with staff members of the NJDEP and NJ Department of Health to develop recommendations for contaminants to test under the 2(b) list, maximum contaminant levels, appropriate testing techniques, testing frequencies, and general activities under the Act. The first set of recommended maximum contaminant levels are expected to be released late in 1986. For carcinogens, the Institute must devise standards that result in a probability of cancer equalling no more than 1 in 1 million over a lifetime exposure. For non-carcinogenic chemicals the Institute must devise standards which eliminate to the greatest extent feasible all harmful effects. In all cases, the limits set by the USEPA are the highest levels the NJDEP may adopt. No maximum contaminant levels are set by the NJDEP in the absence of evidence that the hazardous contaminant exists in drinking water.

In addition to the regulatory mechanism establishing the testing methodologies and schedules and maximum contaminant levels, A-280 also requires that all laboratories used for water quality testing under the act be certified by the NJDEP for their ability to correctly analyze for the 2(a) list contaminants and other contaminants required to be tested by the NJDEP. By certifying laboratories, the act intends to ensure that samples from the same source and sent for analysis to different laboratories will have the same analytical results.

Given the lack of maximum contaminant levels under A-280, and the need to set immediate guidelines for public community water systems which found contaminants in their drinking water, the NJDEP-Division of Water Resources in early 1986 released a "Drinking Water Guidance" which sets recommended contaminant levels to trigger the four action levels described in Table VI-8. An Interim Action Level is established for each recommended response levels. The NJDEP has used the drinking water guidance in prescribing responses from water systems. Table VI-9 provides the interim action levels for 14 chemicals from the 2(a) list.

TABLE VI-9

INTERIM ACTION LEVELS (ug/l) FOR SELECTED ORGANICS IN DRINKING WATER JANUARY 1986

Contaminant	Group*	Level I	Level II	Level III	Level IV
Benzene	A	0-0.68	0.68-6.8	6.8-68	>68
Carbon Tetrachloride	A	0-0.27	0.27-2.7	2.7-27	>27
Chlordane	B	0-0.8	0.8-32	32-63	>63
Dichlorobenzene(s)	C	0-94	94-425	425-750	>750
1,2 Dichloroethane	A	0-0.7	0.7-7	7-70	>70
1,1 Dichloroethylene	B	0-7	7-53	53-100	>100
trans-1,2 Dichloroethylene	C	0-27	27-148	148-270	>270
Methylene Chloride	A	0-4.8	4.8-47	47-479	>479
Polychlorinated Biphenyls	A	0-0.007	0.007-0.07	0.07-0.7	>0.7
Tetrachloroethylene	A	0-0.67	0.67-6.6	6.6-66	>66
1,1,1 Trichloroethane	B	0-20	20-110	110-200	>200
Trichloroethylene	A	0-3.1	3.1-30	30-309	>309
Vinyl Chloride	A	0-0.015	0.015-0.15	0.15-1.5	>1.5
Xylene(s)	C	0-100	100-550	550-1200	>1200

All units in Levels I, II, III and IV are presented in micrograms per liter (ug/l) which also equals parts per billion (ppb). For all but Level 4, the ranges should be read as meaning from above the lower number to less than or equal to the higher number.

*The column titled "Group" represents categorization of the listed hazardous contaminants based upon the weight of evidence of its carcinogenicity. For example, Group A refers to known or probable human carcinogens, Group B refers to possible human carcinogens and Group C refers to insufficient or negative data available on carcinaogenicity.

Source: NJ Department of Environmental Protection, Division of Water Resources, Drinking Water Guidance, "Interim Action Levels and Recommendations for Responses for Selected Organics in Drinking Water," January, 1986.

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decontamination programs in operation. Most have extensive enforcement histories during which hydrogeologic analyses were required of the involved parties to determine responsibility, feasibility of cleaning up the resource, and costs.

In a few instances, contamination from one site has been so severe and extensive as to contaminate large bodies of ground water off site. None of these "regional" contamination sites has a decontamination program in operation, though several may reach that stage within the next two years. A relatively large number of public supply wells have been affected by regional contamination incidents, in Denville, Dover, East Hanover, Fairfield, Rockaway Borough, Rockaway Township and Roseland.

While action on individual contamination sites is important from an enforcement perspective, decision makers involved in water supply planning and water quality management must consider contamination from a broader perspective. For that reason, information on contamination sites is presented in this chapter by subregion of the Buried Valley Aquifer Systems. Management of sites which have the potential for ground water contamination in the future is also a major concern for the region, and a section of the chapter discusses the categories of sites which lend themselves to contamination incidents by the nature of substances handled at the facilities. Local governments have taken actions to protect their water supplies in some cases, and these techniques are discussed generally. Finally, State and Federal policies and studies have recognized the importance of ground water pollution as a broad issue potentially affecting a vast number of people. A brief discussion of their findings concludes the chapter.

Major Studies of Ground Water Quality

The first synoptic assessment of ground water quality in New Jersey was prepared by Robert Tucker, Ph.D., of the N.J. Department of Environmental Protection, Office of Science and Cancer Research, during a study begun in 1978 and published in 1981. Most public supply wells were found to have no contamination (as is the case today) but some significant contamination incidents were discovered including the TCE contamination of the Rockaway Borough wells. Results are presented in Table VII-1, indicating the occurrence of VOCs in ground water. A total of 1118 samples from 670 wells were analyzed statewide in the study.

Ground Water Contamination in the Region

As in Chapters IV and V, the Buried Valley Aquifer Systems will be considered as seven subregions for ease of understanding. However, the subregions are interconnected through the various buried valley deposits (except for the Towaco Valley in Montville) and sites near the borders of one subregion may be of concern in the next. The discussion is in relatively general terms. Detailed information on most of the contamination sites is available in Appendix F--Ground Water Contamination Sites: Case Studies. The designation of sites is according to the major source of the contamination. "A" indicates an Accidental discharge, "I" is Industrial, "D" is Dumping and "L" is Landfill. "ECRA" sites are those undergoing site evaluation prior to sale of industrial properties, under the provisions of the Environmental Cleanup Responsibility Act (ECRA) of 1984, a New Jersey law. "A-280" sites are public water systems which have exhibited contamination at actionable levels. The sites generally are numbered according the sequence by which they were received by the N.J. Geological Survey which advises NJDEP on hydrogeological matters.

Most of the information in Appendix E and this chapter exists in public records of the New Jersey Geological Survey. A few site profiles were generated from public records of the Bureau of Ground Water Quality Management of the NJDEP. The remaining information is anecdotal, provided by local water system supervisors, engineers and consultants during interviews. None of the information in Appendix E relies on this anecdotal information.

Rockaway Valley Subregion

A concentration of aging industries and newer light industry along the Rockaway River has resulted in a related concentration of ground water contamination incidents. Many public wells in the subregion have experienced significant contamination, including the entire well fields of Rockaway Borough and Rockaway Township, Denville Well 3, Dover Well 4 (and to a lesser extent Dover Wells 1, 3 and 5, and Wharton Well 3). Some private wells have also been contaminated, though much of the developed area relies on public water supplies. The sites in Table VII-2 exist within the subregion and either may or do involve significant ground water contamination. Table VII-3 lists some of the minor contamination cases which have either been closed or do not pose a major risk. A glossary for Tables VII-2 to VII-11 follows Table VII-2.

TABLE VII-2

MAJOR CONTAMINATION CASES
ROCKAWAY VALLEY SUBREGION

ID#	Site and Description	Status	NPL
A152	Shell Gasoline Station, Rockaway Township Extensive gasoline leakage. Contamination of the Rockaway Township well field. Shell Oil Company paid for a treatment system.	C/U	N
A155	Rockaway Township Well Field, Rockaway Township Contamination both by gasoline constituents and by TCE. Treatment by air stripping.	Spill	Y
A162	Rockaway Borough Municipal Wells, Rockaway Borough TCE and PCE contamination from unknown sources in all three wells, 1980. Activated carbon filtration used for treatment.	RI/FS	Y
A163	Dover Municipal Well 4, Dover Shut down from contamination with 1,1,1 TCA and PCE. Multiple contamination from local industries possible. Wells 1, 3, and 5 exhibit low levels of VOCs.	Spill	Y
A237	Community Transit (DAYCO), Dover Major 1984 oil spill being cleaned up. Industrial park adjacent to Dover Wells 1, 3, and 5, suspect source for VOCs.	C/U Inv.	N
A238	Towne & Country Gas, Rockaway Township Gasoline constituents in plume moving toward Rockaway Township well field. Scope of contamination not defined.	Inv.	N
A	Wharton Borough Well 3, Wharton Petroleum hydrocarbon odors from unknown source resulted in shutdown. Treatment system planned.	Local	N
A	Denville Township Wells 3 and 6, Denville VOC contamination, suspect sources include Howmet (Austenal) and NJ Natural Gas. Treatment system planned.	Inv.	N
I57	L.E. Carpenter, Wharton Industrial wastes disposed of in unlined sludge lagoon, extensive contamination with many VOCs. Some free product recovery achieved.	ACO	Y
I67	ARC Avionics/Cessna Co., Boonton Township Industrial waste discharges to unlined lagoon. VOC contamination plume extending off site.	Enf.	N

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TABLE VII-2 (Cont'd)

ID#	Site and Description	Status	NPL
I68	Radio Frequency Labs, Inc., Boonton Township Industrial waste discharges to unlined lagoon. The site is next to ARC/Cessna.	Enf.	N
I90	New Jersey Natural Gas (GPU), Dover Heavy VOC contamination from former coal gasification facility in upper aquifer, some lower aquifer contamination 400 feet from Dover Well 4.	ACO	N
I125	Picatinny Arsenal, Rockaway Township Unlined lagoons with metal plating wastes, sanitary landfills. Aquifer contamination with VOCs and heavy metals in southern arsenal area.	C/U	N
I126	Radiation Technology, Rockaway Township Severe VOC contamination resulted in the loss of two wells at the site near Lake Denmark.	ACO	N
I141	Johanson Manufacturing Company, Boonton Township Industrial waste discharges to unlined lagoon. VOC contamination plume which may affect the ARC/Cessna property.	Enf.	N
I210	Howmet (Alloy Division), Dover Moderate levels of VOCs in ground water below the site, from buried drums and industrial waste discharges to lagoons and a septic system on site. Next to Howmet (Austenal).	Inv.	N
I211	Howmet (Austenal Division), Dover Extensive VOC contamination of upper and lower aquifers from industrial waste discharges to leaching field. Implicated in contamination of Denville Well 3 and possibly Dover Well 4.	Inv.	N
I	McWilliams Forge, Rockaway Borough High VOC contamination. Decontamination through pumping to treatment.	C/U	N

GLOSSARY OF TERMS USED IN TABLES VII-2 TO VII-11

A	Accidential Discharge
I	Industrial Source Discharge
D	Dumping
L	Landfill
ECRA	Environmental Cleanup and Responsibility Act
A280	Water Quality Testing Act
ACO	Administrative Consent Order
Closed	Closed Case
C/U	Clean Up of Site In Progress
Inv.	Investigation in Progress by NJDEP or USEPA
Local	Local Enforcement Case
N/A	Information on Status Not Available
NPL	National Priority List (No/Yes)
RI/FS	Remedial Investigation/Feasibility Study
Spill	Spill Fund Act
VOC	Volatile Organic Chemical

TABLE VII-3

MINOR CONTAMINATION CASES
ROCKAWAY VALLEY SUBREGION

ID#	Site and Description	Status	NPL
A90	Dover Christian Nursing Home, Dover Gasoline odors from underground tank leakage.	Closed	N
A93	Rockaway Valley Methodist Church Fuel oil in well.	Closed	N
A116	Exxon Station, Town of Boonton Gasoline tank leak.	Closed	N
A151	Jerry Jones Mack, Rockaway Township Oil spills.	Closed	N
A156	Steve's Getty, Dover Seepage pit behind station.	Closed	N
A171	Gulf Lake Telemark, Rockaway Township Gasoline tank leak.	C/U	N
A	Fernbrook School, Randolph Heating oil tank leak.	C/U	N
I42	Thatcher Glass, Wharton Phenol contamination.	Closed	N
I209	Garden State Transit, Rockaway Township Fuel oil leaks and discharge to a septic system.	Closed	N
I241	Pacific Vegetable Oil, Boonton Tanks, drums and spillages.	Inv.	N
I249	Drew Chemical, Boonton Drums and spillages found on site.	Inv.	N
I250	Jersey Plating, Boonton Discharges to a cesspool.	Inv.	N
I327	U.S. Gypsum, Boonton Downgradient of Drew Chemical.	N/A	N
I	Boonton Coal Gas Facility, Boonton Some tar and oil deposits.	Inv.	N
--	Boonton Town Well 6 Natural contamination with manganese. Treated.	--	N
--	Denville Township Well 6 Natural contamination with manganese.	--	N
--	Dover Wells 1, 3, and 5 Casting sand dump, no contamination known.	--	N
--	Rockaway Borough Failing septic systems in borough.	--	N
--	Rockaway Township Two municipal dump sites, closed, which require ground water monitoring under NJPDES.	--	N
--	Wharton Borough Chloride from former highway department salt pile. Well 3 had shown significant xylene several years ago, 100 ppb peak, dropped to none detected. Bleach dumping pit allegedly used by L.E. Carpenter near Well 3 (not active) has not apparently affected Well 3.	Closed	N

Of the major contamination cases, the primary areas of concern are the Beaver Brook Buried Valley Aquifer in Rockaway Township (gasoline constituents and TCE) and the Rockaway Buried Valley Aquifer in Dover, Randolph Township and Rockaway Borough (various VOCs, including PCE, TCE and 1,1,1 TCEA). In both cases, contamination has been severe enough to close wells or force extensive treatment prior to potable use. Four sites in this subregion (L.E. Carpenter (DAYCO Corporation), the Rockaway Township well field, the Rockaway Borough well field and the Dover Well 4) are on the National Priority List of the Superfund program for cleanup. The two contamination sites are discussed in detail later in the chapter under Regional Contamination Issues.

The minor contamination sites mostly involve leaking underground storage tanks which released gasoline or fuel oil to ground water, resulting in nonpotable private wells or fumes in structures.

Upper Lamington Subregion

Relatively few contamination incidents have occurred in the Upper Lamington subregion, reflecting the lower density of development, the more residential character and the relative absence of industry. Minor contamination of one public well has been documented and a handful of private wells have been closed due to contamination. The cases in Table VII-4 show that the primary difficulties involve leaking underground storage tanks.

Towaco Valley Subregion

The Towaco subregion includes the Towaco Valley Aquifer, which is within a small watershed area, and the Towakhow (Hook) Mountain area of Montville. Few contamination incidents have occurred in the subregion, only one of which has any potential for contamination of the major aquifer. The cases for the region are indicated in Table VII-5. The Marotta Scientific Controls case is by far the largest, involving the contamination or closure of scores of private wells, but the Bellows Lane contamination is in the vicinity of the Montville well system.

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areas will, at least for the Buried Valley region, indicate whether present laws and enforcement systems are sufficient to protect the public health and safety.

→ 1) **Dover/Denville/Rockaway Borough**—The Rockaway Buried Valley Aquifer is closely aligned with the Rockaway River from Jefferson Township to Denville Township (see Figure G-1). The three municipalities of Dover, Denville and Rockaway Borough have experienced significant levels of VOC contamination in wells in the Rockaway Buried Valley Aquifer. Dover Well 4 has been closed, Dover Wells 1, 3 and 5 are less contaminated but are affected, Denville's Well 3 requires treatment, and Rockaway Borough's three wells were shut down in 1981 and then placed back in service with treatment (see Figure VII-1). No final conclusions are available on whether the wells have the same contamination sources or have been impaired by more local sources. The likelihood is that many individual contamination sites are responsible, but the net effect is essentially that of an impaired aquifer at least from the Dover well field to the Rockaway Borough wells. The NJDEP has identified several sites which are suspected or confirmed sources of ground water contamination. The relative contribution of each site and the full extent of the contamination, by source and regionally, is under investigation. However, Wharton's Wells 1 and 2 and Denville's wells 1, 4 and 5 are west and east of the contamination area, respectively, and have not shown VOC levels of concern. The set of contaminated wells is considered as one regional contamination site, as the movement of contaminated ground water through the aquifer from Dover to Rockaway Borough is possible. The Rockaway Township well field is considered separately because of its location in the Beaver Brook Buried Valley.

The **Princeton Avenue well field** in Dover contains three wells which supply all of the town's current water supply. Wells 1, 3 and 5 exhibit levels of VOCs at approximately 10 to 20 ppb, with similar contaminants which may have a common source. Contaminated sites nearby include L.E. Carpenter (a subsidiary of DAYCO) upstream in Wharton, and an industrial area owned by DAYCO which is next to the well field.

The area geology consists of alluvial soil over glacial material, primarily stratified deposits north of the Rockaway River and morainal material to the south, within a valley of Precambrian gneiss bedrock. Up to 40 feet of clay lies on the valley floor beneath the glacial deposits. The NJDEP is concerned that contamination of the deep aquifer could result in flow of contaminants along the buried valley without regard to the river itself as a hydraulic boundary. Public wells near L.E. Carpenter include Dover Wells 1, 3, and 5 (5,500 feet downstream),

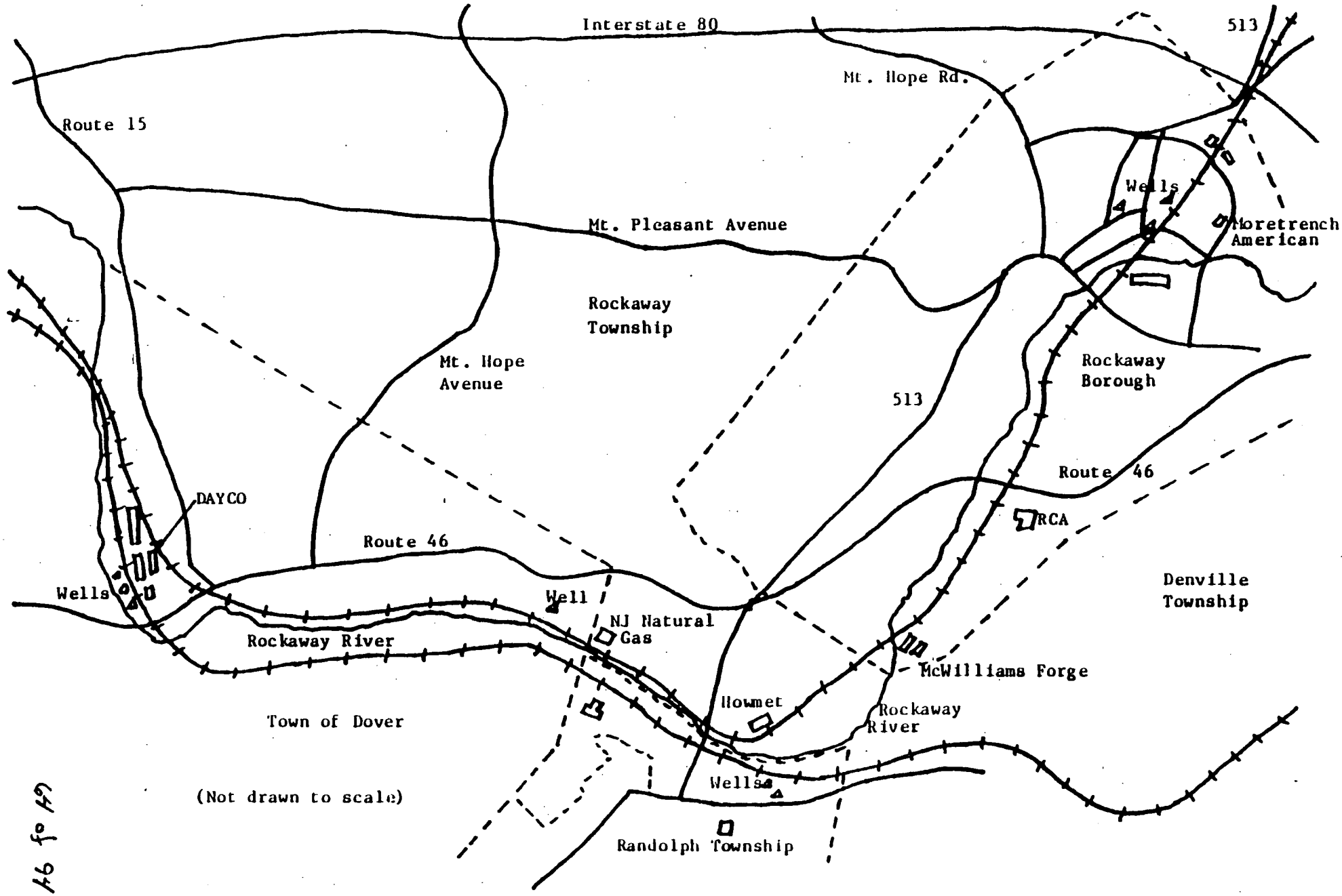

Figure VII-1. Rockaway Buried Valley Contamination Area

Wharton Wells 1 and 2 (4,000 feet upstream) and Wharton Well 3 (4,500 feet downstream). Wells next to the Rockaway River apparently draw a maximum of 50 per cent of their recharge from the river when shallow and a maximum of 20 per cent when deep. Therefore, the deeper wells have a greater potential for inducing the long distance migration of contamination in the buried valley aquifer. The ground water velocity is approximately 7 feet/day in the aquifer, with a transmissivity of 80,000 gpd/ft and hydraulic conductivity of 420 ft/day. The high velocity further encourages the migration of dissolved constituents from a site.

L.E. Carpenter produces vinyl wall coverings. Wastes including polyvinyl chloride were discharged both to a surface impoundment and to a subsurface disposal system between 1963 and 1970. 1979 NJDEP inspections found very poor waste management practices. An abandoned supply well near the river could provide a conduit for contamination to migrate to the lower aquifer. Buried drums also existed on site along with a former sludge lagoon, a filter bed, a long trench with waste liquids, many pits, film on the river banks, old storage tanks, evident tank spillage and three discharge pipes to the river. L.E. Carpenter in 1979 suggested that former tenants were primarily responsible and also suggested only removing the lagoon sludge and not implementing a ground water monitoring or recovery program. L.E. Carpenter is considered a known and sole source for the site contamination by the NJDEP.

NJDEP samples of a surface impoundment revealed several heavy metals and a wide variety of dissolved organic compounds. Ground water samples contained both free floating product, dissolved organic contaminants and several heavy metals, all of which are known discharges from L.E. Carpenter. Total VOCs ranged up to 11 ppm. In addition, up to 16.8 ppm of PCBs were found in ground water. 1986 monitor well samples show maximum contamination levels of more than 100,000 ppb of VOCs. Free product floating on the water table exceeded 10 feet in places during 1984, with over 55,000 square feet coverage of free product. The contamination became evident when consultants to the Rockaway Valley Regional Sewerage Authority began work on the main sewer interceptor through the property.

An Administrative Consent Order (ACO) was signed in 1982 based on a 1975 site inspection and continuing investigations begun in 1979. The ACO called for a ground water monitoring plan and removal of all solid and liquid wastes. An amendment to the ACO was signed in 1983 to define the contamination, remove any free product, and decontaminate the site. 4,000 cubic yards of sludge were removed from the impoundment in 1982,

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and the removal of free product began and resulted in 2,833 gallons removed by early 1986, with up to 2 feet of product remaining. The other steps were not taken, nor was removal of free product completed by 1986. A directive for L.E. Carpenter to sign a third ACO was issued in 1986. The new Administrative Consent Order, once acted upon, requires L.E. Carpenter to conduct a Remedial Investigation, Feasibility Study, Remedial Action Plan and site cleanup under a strict schedule, with financial assurances from the company allowing the NJDEP to complete the work if the company reneges. The NJDEP has committed to using public cleanup funds if L.E. Carpenter does not sign the new ACO, and would then seek reimbursement for triple damages from the firm. The site also was placed on the National Priority List in 1985 over the objections of L.E. Carpenter.

A second industrial property owned by DAYCO is the Richboynton Road Industrial Complex in Dover, adjacent to and east of the Dover Water Works Park. A commercial tenant, Community Transit, was responsible for a loss of 6,000 gallons of diesel fuel from an above ground tank 400 feet from the Dover Princeton Avenue well field. 4,000 gallons were recovered initially. The remainder created a plume with product up to one foot in depth in the water table aquifer. The site also exhibits low levels of VOCs similar to the contamination in the Dover Wells 1, 3 and 5 (2 to 10 ppb of VOCs, considerably lower than the 1981 levels of 20 to 80 ppb), consisting of TCE and 1,1,1 trichloroethane. The DAYCO wells show levels of VOCs at 170 ppb, including 105 ppb 1,1,1 TCEA.

The industrial park was occupied by DAYCO-Hose Division through 1981, then L.E. Carpenter and five other lessees. Community Transit leased property during 1984.

The oil plume is limited to the DAYCO property, extending west in a plume under a building toward (but not reaching) the Dover well field. The contamination site is more readily affected by Well 5 pumping than by Well 3. Local ground water flow is to the west toward the well field and the Rockaway River when Well 5 is pumping, and southwest when Well 5 is off. The full extent of the VOC contamination is not known. The wells are set in the upper strata of the buried valley aquifer. Because of the high ground water velocity, VOCs may migrate from the site quickly. The oil spill and the VOC contamination are not connected.

Seven monitor wells and a fuel oil recovery well were installed and are in operation. Recovery is complicated by the presence of a building and foundation. These actions were taken by DAYCO when Community Transit delayed action. The tank itself was emptied. Dover Well 3 has been

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used only intermittently during summer months since the spill. The recovery well acts to contain the spill and plume from further progress toward the well field by creating a cone of depression and removing oil from the ground. The DAYCO oil spill investigation is completed. The investigation for sources of the VOC contamination had not begun as of early 1986.

The **Dover Well 4** on Hooey Street (now named Rutan Drive) had 118 ppb of 1,1,1 trichloroethane and 122 ppb of PCE in 1981. Sampling of nearby wells indicated that the contamination might have a local cause. An industrial survey found no active user or discharger of the contaminant. Well 4 is a National Priority List site through Superfund, but investigations through the Superfund program have not begun. However, NJ Natural Gas and Howmet have agreed to split the $700,000 cost of an RI/FS for Dover Well 4. The Well 4 contamination is similar to that of Denville Well 3, which may have drawn the plume affecting Dover Well 4 once the Well 4 was shut down. in 1981 VOC levels at Well 4 dropped from 170 ppb to 70 ppb by 1985, indicating that the plume may have moved.

New Jersey Natural Gas owns property adjacent to Well 4 which was used for coal gasification. Significant pollution on site makes NJ Natural Gas a probable contributor to the contamination of Well 4, according to the NJDEP. Howmet (Dover Casting Division) is also in the near vicinity. McWilliams Forge may also be within the radius of influence of the well.

McWilliams Forge was found to have ground water contamination of up to 1700 ppb of TCE in the shallow aquifer and had been pumping over 1 MGD from shallow and deep aquifers without an allocation permit. An administrative consent order from the NJDEP has required the installation of monitor wells and a water treatment system to remove the TCE. The site contamination has apparently dropped to 10 ppb of TCE. McWilliams Forge is on the east side of the Rockaway River downstream of Denville. The site was subject to dewatering for a period during 1985 to allow the construction of a new building foundation.

The New Jersey Natural Gas site (owned by General Public Utilities) was formerly used to manufacture illuminating gas from coal. Recent hydrogeologic studies show that the site's soils and ground water are contaminated by coal gasification wastes. The ground water contamination extends off-site. NJ Natural Gas is very close to Dover's Well 4. NJ Natural Gas operated the facility for coal gasification from the 1900's to the 1950's. Coal tar was created as a byproduct. Samples

of coal tar yield benzene at levels of 420,000 ppb, toluene at 1,100,000 ppb, and also ethylbenzene, naphthalene, and acenaphthene. The site is no longer actively used for coal gasification and has not been for decades.

Extensive contamination with benzene, PCE and toluene exists. The total VOC level exceeds 10,000 ppb in some locations. An on-site well exhibited significant benzene and naphthalene contamination in 1983. Off-site contamination includes soil contamination on the banks of the Rockaway River, nearby. Negotiations are underway between the owner and the NJDEP to establish a decontamination plan for the site. The possibility of public funds being used for decontamination exists, with eventual assessment of costs to the property owner. NJ Natural Gas is contributing toward the RI/FS for Dover Well #4.

The site consists of fill over unsorted glacial till, a silty, fine sand, a thick, semi-confining silt, and sand. When Well 4 is not pumping, there is an upward hydraulic gradient. Surficial ground water flow is south-southwest toward the Rockaway River, explaining the bank contamination. Although the semi-confining layer exists, the potential for flow from the contaminated upper aquifer to the lower aquifer, which is used by the Dover Well 4 only 400 feet away, could occur, especially if Well 4 is put back on line. A 1985 pump test of Well 4 caused a significant drawdown of the deep monitor well. NJDEP noted that an on-site abandoned deep well could also allow the penetration of pollutants. The only deep monitor well exhibited contamination of the lower aquifer in excess of 100 ppb total VOCs. NJDEP has required further definition of the lower aquifer contamination. Contamination of the river is anticipated due to the flow of heavily contaminated ground water.

The **Denville Wells 3 and 6** have been contaminated by relatively low levels of PCE (up to 19 ppb) and 1,1,1 TCEA (up to 50 ppb), first discovered in 1981. Possible sources include Howmet Turbine Components Corporation (Dover Casting Division), NJ Natural Gas, and McWilliams Forge. Denville has installed a treatment system while helping the NJDEP investigate the source(s) of the contamination. Howmet has agreed to help fund the treatment system, with no acknowledgment of responsibility for the contamination. The wells are located near the southwestern corner of Denville in Randolph Township next to Dover. No source for the Denville contamination has been confirmed as of early 1986. Consultants to Denville conducted a pumping test to help define the aquifer and determine the potential for induced flow of contaminated ground water to the wells.

The primary chemical of concern is PCE, which has a lower recommended maximum contamination level for potable water than 1,1,1 TCEA. Denville took Well 6 off-line voluntarily until the treatment system is installed (Well 3 has not been in use). September 1985 levels included 11 ppb of PCE and 34 ppb of 1,1,1 TCEA. One sample in 1985 also exhibited 4.5 ppb of carbon tetrachloride which has not been replicated as of early 1986. In a high flow pump test, the level of VOCs was below 40 ppb.

The full extent of contamination is not known. The geology in the area consists of a surface aquifer and a confined aquifer separated by an aquitard of clay and silt. The confined conditions extend to the Dover Well 4 site to the south, according to Denville's consultant. The aquitard is thick in the Denville well area but changes to a complex layering/lensing downstream (north) at the narrow valley where the Rockaway Borough Well 4 is located. A pumping test of Denville Well 3 led Denville's consultants to exclude McWilliams Forge as a likely contaminant source, though the 4,000 radius of influence observed did reach to the McWilliams Forge property in the deep aquifer. Denville's consultant concluded that the Howmet site surface aquifer is fully connected to the deep aquifer pumped by Well 3, based on the same test. Average transmissivity of the aquifer was measured at 40,930 gpd/ft, with a storage coefficient of 3.1 X 10-4.

Howmet (Dover Casting) has confirmed over 19 VOCs in excess of 100 ppb and 4 in excess of 1,000 ppb in the surface aquifer. The latter are 1,1 dichloroethylene, 1,1 dichloroethane, p-dichlorobenzene and 1,1,1 trichloroethane (15,970 ppb). The contaminants found in Denville Well 3 are also in test pits and both the shallow and deep aquifer at Howmet. The upper aquifer is contaminated with VOCs and heavy metals (e.g. lead, nickel, manganese, hexavalent chromium and total chromium above drinking water or ground water standards). The deep aquifer has VOC levels of 500 ppb, including 1,1,1 TCEA, TCE and PCE. A tentative conclusion exists that pumping of Well 3 induces recharge of the deep aquifer from the surface aquifer at Howmet with Howmet as a probable source of contamination. The contaminants also correlate with Dover Well 4, located 3,500 feet from Howmet. Contamination of that well includes 1,1,1 TCEA, PCE and TCE in declining order.

Howmet (Dover Casting) makes nickel and cobalt based engine parts for Rockaway Township industries. Three leaching fields were used for wastewater disposal. At Howmet, buried drums were found during the course of a sewer line inspection. Subsequent investigation showed that illegal discharges of industrial wastes had occurred through septic leaching systems. The most concentrated single contaminant was 1,1,1

TCEA. Howmet consultants have claimed that a ground water divide exists between Howmet and the Denville Well 3 due to simultaneous pumping of wells at both sites, but this is not confirmed or accepted by the NJDEP. The NJDEP concluded in 1985 that Howmet contributed at least partially to contamination of both the Dover Well 4 and the Denville Well 3, immediately across the Rockaway River. The NJDEP has approved a remedial plan based on further investigation by Howmet, which plan Howmet began implementing late in 1985. The program must include a remedial investigation, feasibility study, remedial action plan and implementation. Howmet is contributing to the RI/FS for Dover Well #4.

→ **Rockaway Borough's wells** have been contaminated by organic chemicals to varying degrees. The borough installed a granulated activated carbon filtration system to bring the water to potable standards, after closing the system for four months in 1981. The wells were placed on the Superfund National Priority List in December, 1982. The Remedial Investigation/Feasibility Study under the Superfund program began in 1985 and was released for public review in August 1986. Decontamination is continuing through pumpage to the treatment system. The Rockaway Borough wells are located in the northeastern quadrant of the borough, north of the Rockaway River. There are three wells, numbered 1, 5 and 6. Well 1 and Well 6 are the most severely affected of the wells. The contaminants include TCE, PCE, 1,1,2,2 tetrachloroethane, chlorobenzene and methylene chloride. TCE levels have been at or below 26.7 ppb. The PCE levels range from 10.2 ppb in Well 1 to 147 ppb in Well 6, though the peak level measured in Well 6 was 650 ppb. The remaining contaminants are less concentrated. As there are only three private wells in the borough, the main concern lies with the borough wells. Contamination of surface water in the Rockaway River and tributaries has not been identified except for methylene chloride at or less than 13.8 ppb.

The borough wells are located in an area of glacial sediments consisting of 50 feet of clay-rich till over 40 feet or more of stratified drift. NUS Corporation (a consultant to the USEPA) locates the borough in the middle of the terminal moraine, but geological evidence suggests that morainal material overlays valley-fill deposits from an earlier southward movement of the Wisconsin glacier. The till provides some protection for the lower aquifer. Well 5 draws from the lower aquifer and was a flowing artesian well when drilled. Wells 1 and 6 apparently are recharged partially by the river. Tetra Tech in 1979 defined the Rockaway River as gaining water from the aquifer in the borough and losing water to the aquifer downstream. Ground water movement, therefore, may be toward Wells 1 and 6 from the river, but more

generally toward the river and also downgradient (to the east) within the lower aquifer. The full extent of the contaminated aquifer is not yet known. Wells 1 and 6 have a radius of influence of up to one-half mile, while Well 5 has a radius of influence exceeding one mile (indicating that Well 5 draws from a more confined aquifer). As Wells 1 and 6 show the greatest contamination, the sources are most likely to be found within one-half mile.

There are no confirmed sources of pollution, though the RI/FS identified some probable source areas. Many possible sources exist, none of which is currently active according to a borough industrial survey. It is possible that sites with proven contamination may be victims of the regional contamination rather than causes. Further investigations will attempt to confirm suspects. The sites under investigation include an old dump 1,800 feet north of the wells, which supposedly only accepted domestic and commercial wastes and has since been developed for housing; dye pits, long inactive and covered, once operated by Liondale Dye Plant; the Moretrench American facility, which once manufactured pumps and likely used solvents for metal degreasing; the A & A Fuel Oil Company fuel storage tanks; Pettit Paint Company which mixes and packages marine paints and has underground and mixing tanks on the property (prior to acquisition of the property by Pettit Paint, Thiokol manufactured jet engines and ballistics beginning in the mid-1950's during which time the use of solvents was likely, and Rolling Mill, a foundry, used the site prior to Thiokol); the Borough garage which has handled a nominal amount of organic solvents and drums; a drum dump site behind the A & A Fuel Oil Company; the Stiles Rubber Company which had test results showing TCE contamination of 77.5 ppb and PCE contamination of 128 ppb in 1985; an industrial area 1,000 to 2,000 feet northeast of the wells which includes some of the above sites; and sources of the Rockaway Township contamination which could be implicated in Rockaway Borough's contamination if the Beaver Brook Aquifer is hydraulically connected to the Rockaway Valley Aquifer and ground water flows toward Rockaway Borough.

The RI/FS for the Rockaway Borough Well Field identified the general area contaminated by PCE and TCE through the use of soil gas concentration surveys. The results of the PCE soil gas concentration survey are shown in Figure VII-2. Based on the surveys, monitor wells were installed to sample the ground water. The results were used to develop Figure VII-3, a cross-section of the aquifer showing the inferred area of contamination. Finally, the combined results of all testing led to a designation of primary and secondary source areas for the TCE and PCE contamination (Figure VII-4) where research will occur.

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NJPDES-GW Facilities

The NJDEP-Bureau of Ground Water Quality Management also is responsible for permits under the New Jersey Pollutant Discharge Elimination System (NJPDES) program which involve facilities that do or may discharge pollutants of any type to the ground water regime. A wide variety of activities are included. Industrial septic systems require NJPDES-GW permits (residential septic systems do not), as do unlined lagoons, semi-permeable lagoons, sludge drying beds and sites that contaminate or may contaminate ground water due to past disposal practices. NJPDES-GW permits are used both to regulate and limit the discharge of pollutants to ground water and to determine what nature and level of pollutants have already been discharged to ground water in previously unregulated sites such as old landfills.

The NJPDES-GW program was first authorized under the NJ Water Pollution Control Act of 1981. Prior to that time, ground water discharges were only limited by regulatory programs addressing specific facilities such as landfills. The federal government, other than RCRA and the Solid Waste Disposal Act, has no program for ground water discharge regulation. The New Jersey program is still in its early years, and has a massive backlog of permit applications. Table VII-13 lists the facilities which have received NJPDES-GW permits within the Buried Valley Aquifer Systems region, while Table VII-14 lists applications which are being processed by the NJDEP as of August, 1986.

Major issues in the NJPDES-GW program include the level of pollutants which the NJDEP allows applicants to discharge to ground water and the difficulty of enforcing the effluent limits (measuring effluent quality in ground water is more expensive than sampling surface waters). In addition, new examples of industries which have not applied for permits are found constantly. Until these issues are resolved, the NJPDES-GW program will not fulfill its promise. Municipalities may assist in the enforcement of the program by ensuring that all existing and proposed ground discharge sources have received or at least applied for NJPDES-GW permits. The NJDEP gives highest priority to the processing of permits for proposed new discharges.

Underground Storage Tanks

The Passaic Valley Ground Water Protection Committee in 1981 introduced a major initiative to protect aquifers from leaking underground storage tanks. Beginning with a model ordinance for local implementation and

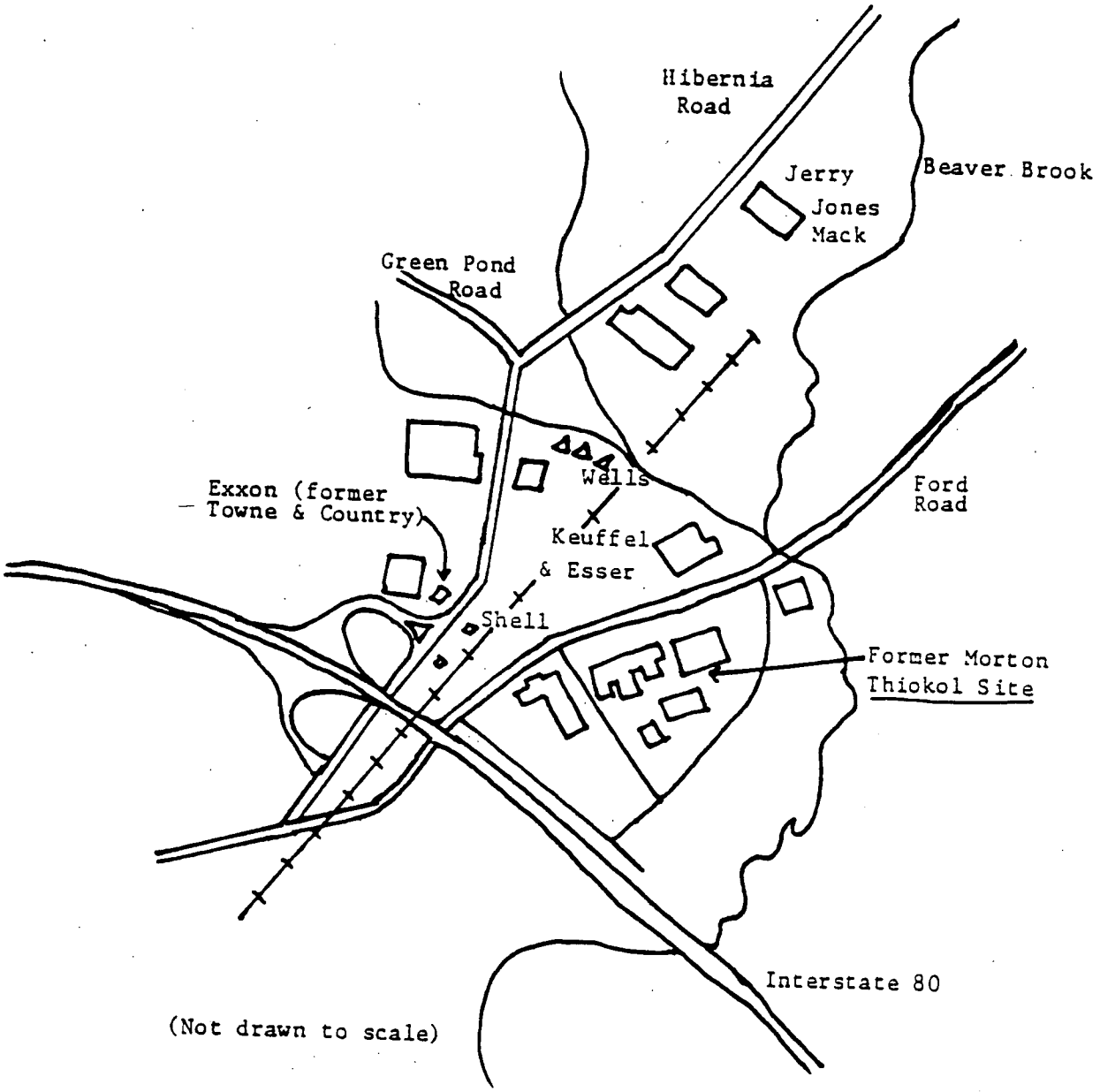

Figure VII-5. Beaver Brook Buried Valley Contamination Area

TABLE VII-13

NJPDES-GW PERMITS

Facility & Location	SIC#	Description of SIC Number
Madison-Chatham Joint Meeting Chatham Borough	4952	Sewerage Systems
Chatham Twp-Main Plant Chatham Township	4952	Sewerage Systems
Chemical Component Div. East Hanover	2821	Plastics Materials and Resins
Royal Lubricants Co. East Hanover	2992	Lubricating Oils and Greases
Orange Products Chatham Borough	3079	Misc. Plastics Products
Precision Rolled Products Florham Park	3399	Primary Metal Products
AT&T Bell Laboratories Hanover	7391	Research & Development Lab
Hanover Twp STP Hanover	4952	Sewerage Systems
NJDOT-I287 Rest Area Harding	4784	Fixed Facilities for Vehicles
Montville Twp MUA Montville	4952	Sewerage Systems
Rovi Atlantic Corp Montville	6514	Not provided
Thermal American Fused Quartz Montville	3823	Not provided
Parke-Davis-Warner Lambert Morris Plains	2834	Pharmaceutical Preparations
Morristown STP Morristown	4952	Sewerage Systems
Asco Electrical Products Co. Parsippany	3499	Fabricated Metal Products
Rockaway Valley Regional Sewerage Authority Boonton	4952	Sewerage Systems

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TABLE VII-13 (Cont'd)

Facility & Location	SIC#	Description of SIC Number
Passaic Twp STP Millington	4952	Sewerage Systems
D&A Partnership Rockaway Borough	6512	Nonresidential Bldg Operation
McWilliams Forge Co. Inc. Rockaway Township	3462	Iron and Steel Forgings
Howmet Turbine Components Dover	3369	Not provided
NJ Department of Defense Rockaway	9999	Dover Armory
U.S. Army-Armaments Development Center, Picatinny Arsenal Rockaway Township	9711	National Security
County Concrete Corp Kenvil (Roxbury Twp)	1442	Concrete Products
Hercules Incorporated Kenvil (Roxbury Twp)	2892	Explosives
L.E. Carpenter & Co. Wharton	2851	Paints and Allied Products
Mt. Hope Rock Products, Inc. Wharton	1429	Crushed and Broken Stone
Bernards Twp Sewer Auth Basking Ridge	4952	Sewerage Systems
Veterans Administration Hospital Lyons (Bernards Twp)	9711	National Security
Warren Twp Sewer Auth Stage 5 STP Warren	4952	Sewerage Systems
Reheis Chemical Co. Berkeley Heights	2833	Medicinals and Botanicals

Source: NJ Department of Environmental Protection, Division of Waste Management, Bureau of Permits Administration, 19 May 1986.

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APPENDIX F

GROUND WATER CONTAMINATION SITES
CASE STUDIES

Many ground water contamination cases in the Buried Valley Aquifer Systems have been the subject of investigation and cleanup actions. The investigation and enforcement responsibilities are shared by municipal officials, including the health officers, the NJ Department of Environmental Protection and the US Environmental Protection Agency. The cases covered in this appendix were identified exclusively from the files of the New Jersey Geological Survey (NJGS), which serves as an in-house consultant to other programs of the NJDEP with regard to complex ground water contamination cases. It was felt that cases involving the NJGS would constitute the most important ground water contamination incidents in the region.

Information in the case studies was derived from NJGS case files, discussions with the hydrogeologists on the cases, other public records and information on current activities of the NJDEP enforcement bureaus in the Northern and Metropolitan regions. Every effort has been made to minimize error of omission and commission. However, no undertaking can be perfect in such a complex field where new results are continuously arriving. Investigations costing hundreds of thousands of dollars are in progress, and the information presented here will become obsolete as new information becomes available. It is also possible that incomplete knowledge of each case may result in minor errors of fact.

Perhaps most important, every effort has been made to present findings of responsibility for pollution in terms that are supported by data. Terms such as "may be responsible" are common in the case studies. Often, a case will be concluded and cleanup obtained with no formal finding of fault. However, in most cases a responsible party will only make the necessary expenditures if a case against them is sound.

Whatever the sources of information, and no matter how thoroughly reviewed, the author is responsible for any errors in interpretation and reporting. To the extent that any errors were made, they were completely unintentional, and my apologies beforehand to any who might be misrepresented.

Terms used in this appendix are the same as those terms used in the report as a whole. Please refer to the glossary in the early part of this report.

ROCKAWAY VALLEY SUBREGION
MAJOR CONTAMINATION CASES

A152 SHELL GASOLINE STATION, ROCKAWAY TOWNSHIP July 1980

Overview--Located at Green Pond Road next to Interstate 80, west of the railroad line. Leakage of an unknown amount of gasoline affected the ground water near the station. Monitoring wells were installed. Samples indicated dissolved volatile hydrocarbons and industrial solvents. The extent of the contamination indicated a connection with the township's supply wells. Gradient of the ground water flow is apparently southeast toward the Beaver Brook valley-fill aquifer. Shell Oil has cooperated with township authorities and installed a treatment system, using granular activated carbon and air-stripping, for the township water system. Decontamination by way of pumping to treatment is continuing.

→ A155 ROCKAWAY TOWNSHIP WELL FIELD December 1979

1) Overview--Beaver Brook Aquifer contaminated by various volatile organic compounds. Ground water monitoring shows two or more contaminant plumes affecting the wells, including the Shell Station (A152). Well water is treated by a granular activated carbon and air stripping system. The site was placed on the National Priority List (Superfund) in December, 1982. Decontamination is continuing through treatment for public supply. The NJDEP investigation is continuing, while Superfund investigations are scheduled to begin in October 1985.
2) Location of the contaminated site--Southern portion of the Beaver Brook watershed, north of Interstate 80 and west of Ford Road.
3) Severity of contamination--Rockaway Township Well 6 has levels of TCE contamination at 200 ppb. The wells are also contaminated with gasoline additives (ethers). Well 7 exhibits levels of di-n-octyl phthalate of 42 ppb.
4) Extent of contamination/Ground water flow--All three of the Rockaway Township wells have been contaminated. Essentially the entire southern Beaver Brook buried valley aquifer is considered contaminated to nonpotable levels, requiring extensive treatment prior to consumption. The area consists of three Wisconsonan glacial beds, with a productive glacial aquifer at the base with up to 80 feet of coarse sand and gravel and high permeabilities, in which the Township wells are set. The second layer is glaciolacustrine clay and serves as an aquitard in the center of the buried valley. The clays are up to 60 feet thick but laterally discontinuous. The surface layer is interbedded sand and gravel up to 30 feet thick. The total glacial unit is approximately 170 feet thick. The bedrock is Precambrian gneiss with ground water flow through joints and fractures. Decomposed rock may exist between the glacial deposits and bedrock, impeding vertical infiltration.

The water table in the upper aquifer lies 20 to 30 feet below the surface, with flow toward Beaver Brook and Meadow Brook. The ground water in the deep aquifer, under pumping conditions, flows toward the well system from the north, west and southeast. Regional flow is

assumed to be from north to south along the line of the buried valley aquifer, and toward the valley from side slopes. The Ford Road area is unconfined (a condition that continues to the east) allowing easy percolation of pollutants to the confined aquifer where the Township wells are located. The radius of influence for the wells may be to either side of the glacial sediments in the valley.

5) Suspected and confirmed sources--Shell Oil has provided a treatment system for the Rockaway Township well field and may be considered a confirmed source. One additional source of gasoline contamination may be the Towne & Country station on the western edge of the buried valley. → The former Morton Thiokol facility is just east of Ford Road at the edge of the buried valley. Monitor well samples show that contamination is higher to the east of Ford Road than to the west (2500 ppb TCE versus 600 ppb TCE), indicating an eastern source of the contamination given the ground water flow to the northwest toward the well field. Keuffel & Esser Company, north and northwest of the Thiokol site along Ford Road, has discovered solvent contamination in the sediments above the confining layer, but the extent of contribution to the lower aquifer pollution, if any, is not known. Monitor wells at the Thiokol and Keuffel & Esser sites have TCE and chloroform contamination and a ground water flow direction toward the municipal wells. Gasoline and gasoline additive contamination is being investigated.

6) Mitigation actions--Underground tanks at the two gasoline stations have been removed as contaminant sources.

7) Decontamination actions--The pumping and air-stripping of the township wells constitute decontamination, but the higher concentration levels east of Ford Road indicate that pumping may actually pull more TCE contamination to the wells.

8) Continuing investigations--The NJDEP is continuing its investigations, and the Superfund program is scheduled to supply funds for additional research. An extensive ground water monitoring system is needed to determine the extent and source(s) of the TCE contamination.

A162 ROCKAWAY BOROUGH MUNICIPAL WELLS September 1981

→ 1) Overview--Rockaway Borough's wells have been contaminated by organic chemicals to varying degrees. The borough installed a granulated activated carbon filtration system to bring the water to potable standards, after closing the system for four months in 1981. The wells were placed on the Superfund National Priority List in December, 1982. The Remedial Investigation/Feasibility Study under the Superfund program began in 1985 and was released to the public in August, 1986. Decontamination is continuing through pumpage to the treatment system.

2) Location of the contaminated site--The Rockaway Borough wells are located in the northeastern quadrant of the borough, north of the Rockaway River. There are three wells, numbered 1, 5 and 6.

3) Severity of contamination--Well 1 and Well 6 are the most severely affected of the wells. The contaminants include TCE, PCE, 1,1,2,2 tetrachloroethane, chlorobenzene and methylene chloride. TCE levels have been at or below 26.7 ppb. The PCE levels range from 10.2 ppb in Well 1 to 147 ppb in Well 6, though the peak level measured in Well 6 was 650 ppb. The PCE contaminant levels fluctuate considerably

up to approximately 300 ppb, generally. The remaining contaminants are less severe. As there are only three private wells in the borough, the main concern lies with the borough wells. Contamination of surface water in the Rockaway River and tributaries has not been identified except for methylene chloride at or less than 13.8 ppb. Subaqueous sediments contain toluene and methylene chloride. (Methylene chloride is both a common solvent and a very common laboratory contaminant.)

4) Extent of contamination/Ground water flow--The borough wells are located in an area of glacial sediments consisting of 50 feet of clay-rich till over 50 feet or more of stratified drift. NUS Corporation locates the borough in the middle of the terminal moraine, but geological evidence suggests that morainal material overlays valley-fill deposits from an earlier southward movement of the Wisconsin glacier. The till provides some protection for the lower aquifer. Well 5 draws from the lower aquifer and was a flowing artesian well when drilled. Wells 1 and 6 apparently are recharged by the river. (Well 1 is not in use currently.) Tetra Tech in 1979 defined the Rockaway River as gaining water from the aquifer in the borough and losing water to the aquifer downstream. Ground water movement, therefore, may be toward Wells 1 and 6 from the river, but more generally toward the river and also downgradient (to the east) within the lower aquifer. The full extent of the contaminated aquifer is not yet known. Wells 1 and 6 have a radius of influence of up to one-half mile, while Well 5 has a radius of influence exceeding one mile (indicating that Well 5 draws from a confined aquifer). As Wells 1 and 6 show the greatest contamination, the sources are most likely to be found within one-half mile.

5) Suspected and confirmed sources--There are no confirmed sources of pollution. Many possible sources exist, none of which are currently active (adding additional wastes to the source) according to a borough industrial survey. Note well that sites with proven contamination may be victims of the regional contamination rather than causes. Only further investigations can confirm suspects. The RI/FS resulted in some narrowing of the investigation by identifying one primary area for TCE, one primary area for PCE, and one secondary area. The two contaminants appear to have separate sources. No specific source was identified. The sites under investigation included the following:

a) Old dump 1800 feet north of the wells, which supposedly only accepted domestic and commercial wastes. Residential development was placed on the dump site after the 1950's.

b) Dye pits, long inactive and covered, once operated by Liondale Dye Plant.

c) Moretrench American, which once manufactured pumps. The use of solvents for metal degreasing is considered likely. Past disposal practices, as for most of the older industrial uses, are not known. NJDEP samples taken in 1981 indicate TCE contamination at 50 ppb.

d) A & A Fuel Oil Co. has large fuel storage tanks.

e) Pettit Paint Co. mixes and packages marine paints. There are underground and mixing tanks on the property. Prior to acquisition of the property by Pettit Paint, Thiokol manufactured jet engines and ballistics beginning in the mid-1950's. The use of solvents was likely. Rolling Mill, a foundry, used the site prior to Thiokol.

f) The Borough garage has handled a nominal amount of organic solvents and drums. Some contaminated soil has been removed.

g) A dump site exists behind the A & A Fuel Oil Co. Drums have been removed.

h) Stiles Rubber Company test results showed TCE contamination of 77.5 ppb and PCE contamination of 128 ppb in 1985.

i) Industrial area 1000 to 2000 feet northeast of the wells which includes some of the above sites. Older industries, since replaced, may have caused some of the contamination.

j) Sources of the Rockaway Township contamination could be implicated in Rockaway Borough's contamination if the Beaver Brook Aquifer is hydraulically connected to the Rockaway Valley Aquifer and ground water flows toward Rockaway Borough.

6) Mitigation actions--The source is assumed to be inactive, based on industrial surveys by the borough and the NJDEP. Therefore, there is no apparent source to close. Mitigation primarily has involved treatment of the public water supply, which simultaneously protects the residents and decontaminates the aquifer. The treatment system is very effective and was selected as the preferred treatment alternative under the RI/FS.

7) Decontamination actions--Diversion to the treatment system.

8) Continuing investigations--An extensive investigation program is underway to determine the sources of the contamination within the primary and secondary source areas identified by the RI/FS. This investigation is through the Superfund program, with the NJDEP serving as lead agency. More difficult than source identification is the determination of the relative contributions to the contamination.

A163 DOVER MUNICIPAL WELL 4 December 1980

1) Overview--Water quality in Hooey Street (now named Rutan Drive) well (Well 4) degraded by organic chemicals. Sampling of nearby wells indicated that the contamination may be local. Well 4 is a National Priority List site through Superfund. Investigation has begun through Superfund, and is continuing through NJDEP.

2) Location of the contaminated site--Rutan Drive, in the southeast portion of Dover.

3) Severity of contamination--Well 4 had 118 ppb of 1,1,1 trichloroethane and 122 ppb of PCE in 1981. Oil was found in Well 2 (not used) in 1985 but was suspected to be the result of dumping rather than ground water contamination. Wells 1, 3, and 5 exhibit low levels of volatile organic chemicals (10 to 20 ppb in 1985), near A-280 action levels. Wells 1, 3, and 5 are not in the same vicinity as Well #4 and the contamination problems are not considered connected.

4) Extent of contamination/Ground water flow--The Well 4 contamination is similar to that of Denville Well 3, which may have drawn the plume affecting Dover Well 4 once the latter well was shut down. VOC levels at Well 4 dropped from 170 ppb to 70 ppb by 1985, indicating that the plume may have moved.

The contamination of Wells 1, 3, 5, and Wharton's Well 3 are similar and may have a common source.

5) Suspected and confirmed sources--New Jersey Natural Gas owns property adjacent to Well 4 used for coal gasification. See I-90. Significant pollution on site makes NJ Natural Gas a probable contributor to the contamination of Well 4. Howmet (Alloy), Howmet (Dover Casting) and the Denville Well 3 were identified as being within the radius of influence for Well 4 by Dover's consultants after a 1985 pump test. Howmet's

consultants disagree. (See I-210 and I-211).

Near Wells 1, 3 and 5, the DAYCO facility is considered a possible source of low level VOC pollution, and is confirmed as the source of oil contamination beneath their site. DAYCO is presently considered a likely source of contamination at Wells 1, 3 and 5 but not at Well 4.

6) Mitigation actions--NJ Natural Gas and Howmet (Austenal) must initiate a remedial investigation/feasibility study toward remediation of their pollution. The Dover Well 4 is the subject of a Superfund study. In response to a 15 July Spill Fund Directive, Howmet and NJ Natural Gas have agreed to pay an aggregate of $700,000 for an RI/FS of Dover Well #4. See A-237 for a description of action near Wells 1, 3 and 5.

7) Decontamination actions--No decontamination actions are in place at Well 4.

8) Continuing investigations--Investigations continue at all sites.

A237 COMMUNITY TRANSIT (DAYCO), DOVER 1984

1) Overview--A loss of 6000 gallons of diesel fuel from an above ground tank was discovered 400 feet from the Dover well field. Seven monitor wells and a recovery well were installed and are in operation. Recovery is complicated by the presence of a building and foundation. Monitor and recovery wells are located inside and outside of the building. The investigation by NJDEP is continuing.

2) Location of the contaminated site--Richboynton Road Industrial Complex in Dover, adjacent to and east of the Dover Water Works Park.

3) Severity of contamination--An estimated 6,000 gallons of diesel fuel were discharged from an above ground tank. Some contaminated soils were removed. The remainder of the fuel created a plume with product up to one foot in depth on the water table aquifer. Ground water at the site also exhibits low levels of halocarbons similar to the contamination in the Dover Wells 1, 3 and 5 (2 to 10 ppb, considerably lower than the 1981 levels of 20 to 80 ppb), consisting of TCE and 1,1,1 trichloroethane.

4) Extent of contamination/Ground water flow--The oil plume is limited to the DAYCO property, extending west in a plume 20 feet wide and 40 feet long under a building toward (but not reaching) the Dover well field. The contamination site is more readily affected by Well 5 pumping than by Well 3. Local ground water flow is to the west toward the well field and the Rockaway River when Well 5 is pumping, and southwest when Well 5 is off.

The full extent of the halocarbon contamination (unrelated to the diesel fuel) is not known. The site geology consists of a Precambrian gneiss valley filled with glacial drift to the north along the slope, up to 40 feet of clay on the valley floor, and a medium sand and gravel aquifer and coarse till above the clay. The wells are set in the upper strata. The ground water velocity is approximately 7 feet/day in the aquifer, with a transmissivity of 80,000 gpd/ft and hydraulic conductivity of 420 ft/day. Because of the velocity, DAYCO's consultant suggested that the dissolved constituents likely migrated from the site.

5) Suspected and confirmed sources--Community Transit, a lessee to DAYCO, is the source of the diesel fuel contamination. NJDEP has recommended a full industrial survey and analysis of the industrial

complex along the Rockaway River from the Dover well field to Wharton's Well 3, to discover the source(s) of the VOC contamination. The industrial park was occupied by DAYCO-Hose Division through 1981, then L.E. Carpenter and five other lessees. Community Transit leased property during 1984.
6) Mitigation actions--150 yards of oil contaminated soil were removed in 1984. 62 gallons were removed through oil booms, and additional gallonage was removed via the recovery wells and removal of contaminated soils. These actions were taken by DAYCO when Community Transit delayed action. The tank itself was removed. Dover Well 3 has been used only intermittently during summer months since the spill. The recovery wells act to contain the plume from further progress toward the well field.
7) Decontamination actions--The recovery well has operated to create a cone of depression and remove oil from the ground. By late 1985, the recovery had declined to 1.5 gpd of oil. DAYCO's consultant estimated that 100 to 200 gallons of oil remained at that time.
8) Continuing investigations--The DAYCO oil spill investigation is completed. The investigation for sources of the halocarbon contamination had not begun as of early 1986.

A238 TOWNE & COUNTRY GAS, ROCKAWAY TOWNSHIP 1984

1) Overview--Exxon leases a gasoline station owned by Towne & Country and discovered gasoline contamination on site during the course of hydrogeological examinations for the Rockaway Township Zoning Board of Adjustment. No free product was discovered but high VOC levels existed (xylene at 7,300 ppb, ethylbenzene at 2,100 ppb, benzene at 90 to 200 ppb, methylene chloride at less than 200 ppb). Definition of the plume, which has traveled off-site, is not complete. Investigation continuing.
2) Location of the contaminated site--Green Pond Road at the entrance to Interstate 80, northwest quadrant, across from the Shell Station (A-152) and southwest of the Rockaway Township well field (A-155).
3) Severity of contamination--Total VOC levels exceed 20,000 ppb in the most severe cases. No free floating product was discovered on site, but a strong odor is evident at the water table, 43 to 48 feet below grade. Gasoline contamination at 1 ppm was discovered near the two dispensing islands and approximately 140 ppb near two underground gasoline tanks.
4) Extent of contamination/Ground water flow--The contamination extends north of the Towne & Country site, but a precise delineation does not exist. The Shell Station across Green Pond Road exhibits similar contaminants. The site geology consists of glacial drift deposited over bedrock. The bedrock is greater than 60 feet below grade. Fine to medium sands exist to approximately 50 feet, underlain by silty fine sands. General ground water flow is northeast at perhaps 1/3 foot per day, consistent with conclusions at the Shell site. The ground water flow direction was confirmed by a synoptic water level and ground water quality survey of all monitor wells at the Shell and Towne & Country sites in late 1984. The gasoline contamination near the dispensing islands was 15 to 20 feet deep, according to Exxon's consultants, indicating limited spills.
5) Suspected and confirmed sources--The NJDEP suspects prior gasoline contamination from the Towne & Country station. The gasoline tanks that tested tight were excavated and removed by Exxon in 1984. Consultants

for Exxon inferred that some excursions of contamination from the Shell site to the Towne & Country site may have occurred. Towne & Country denies responsibility, given tank integrity test results. Sampling from monitor wells indicates less than 10 ppb VOCs upgradient of the site, over 20 ppm directly downgradient, and somewhat lower levels between the site and the Shell Station. A monitor well was installed at an adjacent property north of the Towne & Country site in 1985. Plume definition continues.

6) Mitigation actions--The underground gasoline tanks were removed and tested tight. No actions have been taken to halt movement of the plume.

7) Decontamination actions--None.

8) Continuing investigations--The NJDEP continues to define the plume and the level of responsibility for remediation. Enforcement continues.

A WHARTON BOROUGH WELL 3 1981

1) Overview--Wharton Borough reported a finding of 3 ppm oil and grease, 2 ppb TCE and 1.9 PCE in Well 3, which was removed from use due to objectionable odors reported by consumers. The borough suggested that a nearby oil storage facility could be the source. NJDEP retested the well in early 1982 and found no oil and grease at detectable levels, nor petroleum hydrocarbons. The Thatcher Glass well and a nearby monitor well had the same results. Case closed in 1982. Wharton has continued to avoid use of the well due to hydrocarbon odors and plans to install a treatment system for the well.

→ A280 DENVILLE TOWNSHIP WELLS 1981

1) Overview--Denville wells 3 and 6 have been contaminated by VOCs such as PCE (up to 19 ppb) and 1,1,1 trichloroethane (up to 50 ppb), first discovered in 1981. Possible sources include Howmet Turbine Components Corp, Dover Casting Division and Alloy Division, and McWilliams Forge. Denville is presently installing a treatment system while investigating the source(s) of the contamination. Howmet has agreed to help fund the treatment system, with no acknowledgment of responsibility for the contamination.

2) Location of the contaminated site--Next to the southwestern corner of Denville in Randolph Township next to Dover.

3) Severity of contamination--The primary chemicals of concern are PCE and 1,1,1 trichloroethane. Denville has taken Well 6 off-line voluntarily until the treatment system is installed (Well 3 has not been in use). September 1985 levels included 11 ppb of PCE and 34 ppb of 1,1,1 trichloroethane. One sample in 1985 also exhibited 4.5 ppb of carbon tetrachloride which has not been verified to date. Resampling for carbon tetrachloride was expected. In a high flow pump test, the level of VOCs was below 40 ppb.

4) Extent of contamination/Ground water flow--The full extent of contamination is not known. The geology in the area consists of a surface aquifer and a confined aquifer separated by an aquitard of clay and silt. According to Denville's consultant, the confined conditions extend to the Dover Well 4 site to the northwest. The aquitard is thick

in the Denville well field area but changes to a complex layering/ lensing downstream (north) at the narrow valley where the Rockaway Borough Well 4 is located. A pumping test of Denville Well 3 led Denville's consultants to exclude McWilliams Forge as a likely contaminant source, though the 4000 foot radius of influence observed did reach to the McWilliams Forge property in the deep aquifer. Denville's consultant concluded that the Howmet site surface aquifer is fully connected to the deep aquifer pumped by Denville Well 3, based on the same test. Average transmissivity of the aquifer was measured at 40,930 gpd/ft2, with a storage coefficient of 3.1 X 10-4.

5) Suspected and confirmed sources--Howmet (Dover Casting Div.) has confirmed over 19 VOCs in excess of 100 ppb and 4 in excess of 1,000 ppb in the ground water. The latter are 1,1 dichloroethylene, 1,1 dichloroethane, p-dichlorobenzene and 1,1,1 trichloroethane (15,970 ppb). The contaminants found in Denville Well 3 are also in test pits and both the shallow and deep aquifer at Howmet. Denville's consultant concluded that pumping of Well 3 induces recharge of the deep aquifer from the surface aquifer and cited Howmet as a probable source. The NJ Natural Gas site has 8 VOC over 1,000 ppb, including 1,2 dichloroethane at 67,000 ppb. McWilliams Forge had TCE contamination up to 1717 ppb and other VOCs at less than 50 ppb in 1983, and was a TCE user with a 40 gpd discharge of TCE to two unlined lagoons. Levels at McWilliams Forge have dropped below 10 ppb TCE. No source for the Denville contamination has been confirmed as of early 1986. Consultants to Denville conducted a pumping test to help define the aquifer characteristics and determine the potential for induced flow of contaminated ground water to the wells.

6) Mitigation actions--Denville has installed an air stripping system to treat the wells for potable use, at a cost of $570,000. Howmet Turbine Components Corporation voluntarily contributed $430,000 toward the system.

7) Decontamination actions--None as of early 1986.

8) Continuing investigations--NJDEP and Denville are continuing their investigations.

I57 L.E. CARPENTER, WHARTON May 1979

1) Overview--Company had an unlined sludge lagoon and underground chemical storage. There is a body of xylene solvent floating on the water table beneath the site and high-level dissolved organic contamination with the aquifer beneath the site. An administrative consent order was signed in January 1982. The sludge lagoon was removed in the spring, 1982. A program for removal of both floating and dissolved product is being prepared after repeated delays. Floating product recovery began on 11 May 1984. A new Administrative Consent Order has been issued to L.E. Carpenter and its parent company, DAYCO Corporation. Investigation by NJDEP continuing.

2) Location of the contaminated site--Eastern side of Wharton, north of the Rockaway River along the river, next to Thatcher Glass. L.E. Carpenter produces vinyl wall coverings.

3) Severity of contamination--NJDEP samples of a surface impoundment revealed several heavy metals, xylene, styrene, nonane, cumane, 1,1,2 trichloroethylene, dibromomethane, mesitylene, p-cymene, butylbenzene,

heptane, toluene, octane, TCE, chloroform and benzene. Ground water samples contained both free floating product and dissolved contaminants such as 1,1,2 TCE, TCE, toluene, ethylbenzene, styrene, dibromomethane, propylbenzene, xylene, cumene, mesitylene, cymene, chlorobenzene, nonane, PCE, perchloroethane, chlorobenzene and several heavy metals, all of which are known discharges from L.E. Carpenter. Total VOCs ranged up to 11 ppm. In addition, up to 16.8 ppm of PCBs were found in ground water. The contamination became evident when consultants to the Rockaway Valley Regional Sewerage Authority began work on the main sewer interceptor through the property.

1986 monitor well samples show maximum contamination levels of 130 ppb toluene, 3,000 ppb ethylbenzene, 59,000 ppb m-xylene, 43,000 ppb o-xylene. Free product floating on the water table exceeded 10 feet in places during 1984, with over 55,000 square feet coverage of free product.

4) Extent of contamination/Ground water flow--The site is adjacent to the Rockaway River. Two consultants have shown opposite flow conditions between the river and the surface aquifer. A NJDEP site analysis in 1979 noted that water level in pits fluctuated with the river, indicating a direct connection.

The site geology consists of alluvial soil over glacial material, primarily stratified deposits north of the Rockaway River and morainal material to the south. The NJDEP is concerned that contamination of the deep aquifer could result in flow of contaminants along the buried valley without regard to the river itself as a hydraulic boundary. Nearby public wells (Dover Wells 1, 3, and 5--5500 feet downstream; Wharton Wells 1 and 2--4000 feet upstream; Wharton Well 3--4500 feet downstream) apparently draw a maximum of 50 per cent of their recharge from the river when shallow and a maximum of 20 per cent when deep.

5) Suspected and confirmed sources--L.E. Carpenter is considered a known and sole source for the site contamination. Wastes including polyvinyl chloride were discharged both to a surface impoundment and to a subsurface disposal system between 1963 and 1970. 1979 NJDEP inspections found very poor waste management practices. An abandoned supply well near the river could provide a conduit for contamination to migrate to the lower aquifer. Buried drums also existed on site along with a former sludge lagoon, a filter bed, a long trench with waste liquids, many pits, film on the river banks, old storage tanks, evident tank spillage and three discharge pipes to the river. L.E. Carpenter in 1979 suggested that former tenants were primarily responsible and also suggested only removing the lagoon sludge and not implementing a ground water monitoring or recovery program.

6) Mitigation actions--An Administrative Consent Order was signed in 1982 based on a 1975 site inspection and continuing investigations beginning in 1979. The ACO called for a ground water monitoring plan and removal of all solid and liquid wastes. An amendment to the ACO was signed in 1983 to define the vertical and horizontal extent of the contamination, remove any free product, and decontaminate the site. 4,000 cubic yards of sludge were removed from the impoundment in 1982, and the removal of free product began in 1984. However, the other steps were not taken, nor was removal of free product completed by 1986. Over $1 million was spent by late 1984.

7) Decontamination actions--Removal of free product using a well skimmer with passive flow of free product to the well resulted in 2833 gallons removed by early 1986, with up to 2 feet of product remaining. One

A156 STEVE'S GETTY, DOVER

April 1981

1) Overview--The Dover Health Department found a seepage pit behind the station. Analyses of liquids determined that the fluids were mostly oils, greases and water. The pit was disconnected and filled as required by NJDEP. The wastes were manifested and hauled to a reclaimer. Case closed by NJDEP September, 1981.
2) Location of the contaminated site

A171 GULF LAKE TELEMARK, ROCKAWAY TOWNSHIP

December 1981

1) Overview--Several private, potable wells were affected by leakage of gasoline from underground tanks. Monitor wells were installed. Samples showed that the station is the source of the gasoline. Contaminants include gasoline and gasoline components, chiefly benzenes, toluenes and xylene (BTX). Spartan Oil of Dover manages the underground tanks. In July, 1982, NJDEP directed them to clean up the aquifer of BTX contamination and remove gasoline. A consent order was signed to that effect. The investigation is continuing.
2) Location of the contaminated site--Near Lake Telemark on Green Pond Road, in Rockaway Township.
3) Severity of contamination--Three private wells were found to be contaminated with gasoline fractions and free floating product. 53 ppb toluene and 935 ppb benzene were measured from a well near the site. Up to two feet of gasoline were observed in monitor wells.
4) Extent of contamination/Ground water flow--The contamination extends from the gasoline station northeast toward a small brook. The ground water flow is toward the north along Green Pond Road on a relatively flat gradient. The bedrock is granitic gneiss, approximately 5 feet below the surface.
5) Suspected and confirmed sources--The Gulf station is considered the source. Consultants to Spartan Oil questioned whether some contamination could be traced to underground tanks at a nearby tavern.
6) Mitigation actions--Two wells were established to pump at 0.65 gpm to contain the plume. The private wells were sealed and replaced. The three underground storage tanks were replaced in 1980 and 1981.
7) Decontamination actions--The recovery wells have caused the benzene and toluene plumes to contract, but two wells continued to show free product and high VOC levels as of mid-1985. The NJDEP requires the decontamination to continue until VOC levels are below 10 ppb.
8) Continuing investigations--Spartan Oil continues to cleanup the site under the 1984 Administrative Consent Order.

A FERNBROOK SCHOOL, RANDOLPH

1985

1) Overview--A 10,000 gallon underground tank for fuel oil leaked, with a loss of approximately 465 gallons. Some discharged to a storm sewer and some to ground water. The tank and contaminated soils were removed and a new tank installed with an improperly designed recovery well. Depth to the water table is 4.7 feet. No wells exist nearby. Monitor wells and recovery of any free product have been recommended by the

I90 NEW JERSEY NATURAL GAS (CPU), DOVER April 1981

1) Overview--This site was formerly used to manufacture illuminating gas from coal. Hydrogeologic studies (1982-84) show that the site's soils and ground water are contaminated by coal gasification wastes. The ground water contamination extends off-site. NJDEP is reviewing a modified remedial action plan prepared by the company's consultant. Investigation continuing.
2) Location of the contaminated site--NJ Natural Gas is on the northern corner of Blackwell and Carroll Streets, just east of the Dover border and not far from Dover's Well 4 on Rutan Street.
3) Severity of contamination--Extensive contamination with benzene, toluene and other base neutrals exists. The total VOC level exceeds 10,000 ppb in some locations. An on-site well exhibited significant benzene and naphthalene contamination in 1983. Off-site contamination includes soil contamination on the banks of the Rockaway River, nearby.
4) Extent of contamination/Ground water flow--The site consists of fill over unsorted glacial till, a silty, fine sand, a thick, semi-confining silt, and sand. Surficial ground water flow is south-southwest toward the Rockaway River, explaining the bank contamination. The consultant to NJNG found that the semi-confining silt was not impermeable but served as a good confining layer due to an upward hydraulic gradient. However, consultants to Dover indicate a concern that leakage to the lower aquifer, which is used by the Dover Well 4 only 400 feet away, could occur, especially if Well 4 is put back on line. A 1985 pump test of Well 4 caused a significant drawdown of the deep monitor well. NJDEP noted that an on-site abandoned deep well could also allow the movement of pollutants from the surface aquifer to the lower aquifer. A deep monitor well exhibited contamination of the lower aquifer in excess of 100 ppb total VOCs, according to a NJNG consultant. NJDEP has required further definition of the lower aquifer contamination. Contamination of the river is possible due to the flow of heavily contaminated ground water.
5) Suspected and confirmed sources--NJ Natural Gas operated the facility to produce gas from coal from the 1900's to the 1950's. Coal tar was created as a byproduct. Samples of coal tar yield benzene at levels of 420,000 ppb, toluene at 1,100,000 ppb, and also ethylbenzene, naphthalene, and acenaphthene.
6) Mitigation actions--The site is no longer actively used for coal gasification and has not been for decades. No additional contamination is occurring. No specific mitigation actions have been taken to reduce the flow of contaminants to the lower aquifer or the Rockaway River.
7) Decontamination actions--NJ Natural Gas has proposed the use of a biodegradation system which would pump shallow ground water through an above-ground reactor and reintroduce it on-site, aerated and inoculated with bacteria to digest the contaminants subsurface. The NJDEP has raised significant concerns with the effectiveness of biotreatment, the need for much larger ground water withdrawals to neutralize off-site flows, and the lack of treatment for off-site and deep aquifer contamination. A risk assessment has been required.
8) Continuing investigations--NJDEP is continuing to assess decontamination proposals of NJ Natural Gas. On 5 July 1986 the NJDEP cited NJ Natural Gas as a potentially responsible party to the

contamination of Dover Well #4. NJ Natural Gas agreed to pay $350,000 for an RI/FS of Dover Well #4. The possibility of public funds being used for decontamination exists, with eventual assessment of costs to the property owner.

I125 PICATINNY ARSENAL, ROCKAWAY TOWNSHIP December 1980

1) Overview--Ground water conditions are under investigation by federal scientists (USGS and U.S. Army). Ground water contamination, consisting of heavy metals and VOCs, has been found near lagoons and landfills. The lagoons were closed and repairs made to prevent further contamination. Investigation continuing.
2) Location of the contaminated site--North of Route 15 on the Rockaway Township/Jefferson Township boundary, at the eastern slope of Green Pond Mountain south of Picatinny Lake. The Arsenal employs 6,400 people in research and development for a full variety of armament items, including nuclear and radiological material research.
3) Severity of contamination--The highest contamination levels exceed 25,800 ppb of total VOCs, with maximum levels of 542 ppb of 1,2-trans-dichloroethylene, 386 ppb of PCE, 25,194 ppb of TCE. The VOCs were first detected by testing in 1981. Monitor wells exceed potable levels of total dissolved solids, sodium, chloride, sulfur, cadmium, lead, iron, manganese, cyanide, selenium and chromium. Iron and manganese are natural contaminants. Toluene and benzene also were detected near two underground tanks.
4) Extent of contamination/Ground water flow--The site geology consists of glacial deposits overlying Kittatiny Limestone from Picatinny Lake south and overlying Precambrian bedrock north of Picatinny Lake. The glacial deposits are primarily till north of the lake and primarily stratified drift south of the lake, with the till decreasing south of the lake and the stratified drift increasing to over 200 feet thick. The stratified drift is mostly coarse grained with a relatively high permeability and a transmissivity of 25,000 to 50,000 gpd/ft. The water table aquifer is generally 10 feet below the surface. A confining unit appears south of Picatinny Lake and increases in thickness to the south (to approximately 150 feet) as the glacial sediments increase in thickness and the bedrock elevation drops. A confined sand and gravel aquifer exists between the confining unit and the limestone. Ground water flow from the site is to the southwest (at an estimated 1 foot/day in the water table aquifer) toward Green Pond Brook and the deep aquifer. Supply wells have a radius of influence of up to 1200 feet. Four wells are commonly used, two are used infrequently, and six are abandoned. The wells are drilled to 110 to 120 feet. Estimated water use is 0.5 mgd, with an estimated dependable yield of 1.3 mgd based on USGS calculations. The terminal moraine occupies the southwestern tip of the Arsenal property.

Building 24 has a plume of TCE (the most mobile constituent) extending 1500 feet downgradient. TCE has also been detected in the confined aquifer, induced from the water table aquifer by the pumping of two supply wells. The total vertical extent of the contamination is not known, but the plume exhibits the more severe and extensive problems. Building 95 has a plume which exceeds drinking water standards for total dissolved solids, cadmium, manganese, selenium, chromium, TCE, PCE, and

levels. The overburden consists of over 40 feet of medium to very coarse sand, which is highly permeable and serves as an aquifer recharge zone. The plume had moved over 70 feet from the lagoon by 1984, toward a private residential well northwest of the lagoon. The NJDEP suspects that the contamination may have moved off-site to the Cessna property. 1984 samples of the ground water exhibit contamination with the above named compounds plus bromodichloromethane, carbon tetrachloride and 1,1,1 trichloroethane.

5) Suspected and confirmed sources--Johanson operated an electroplating facility. Instead of discharging treated wastewater to surface water, as specified in its permit of 1967, Johanson discharged to ground water through three septic systems and the unlined lagoon. Johanson has not disputed the nature of the discharge but does dispute the NJDEP's findings on its severity.

6) Mitigation actions--NJDEP required Johanson to eliminate the discharge of non-domestic wastewater to the septic systems. Eight monitor wells were added to the three existing monitor wells. Johanson was ordered to apply for a NJPDES ground water permit, which established requirements for the monitoring system.

7) Decontamination actions--The NJDEP directed the development of a complete monitoring and decontamination plan.

8) Continuing investigations--Johanson has contested the NJDEP conclusions on the extent of the pollution. Continued investigations are required under the NJPDES-GW permit. Johanson has agreed to conduct additional ground water investigations including the testing of ground water wells on Cessna's property to determine the extent of offsite contamination.

I210 HOWMET (ALLOY DIV.), DOVER August 1981

1) Overview--Buried drums were found at Howmet (Dover Casting Division) during the course of a sewer line inspection. Subsequent investigation showed illegal discharges of industrial wastes had occurred. (See Howmet (Dover Casting)). Investigation continuing.

2) Location of the contaminated site--Roy Street in Rockaway Township.

3) Severity of contamination--Monitor wells at Howmet-Dover Casting show 1,1,1 TCEA in three wells from 1.7 to 43.1 ppb, TCE in one well from 5.7 to 40 ppb, and chloroform less than 10 ppb in one well.

4) Extent of contamination/Ground water flow--The full extent of the contamination is not known. Ground water flows generally south toward the Rockaway River. The site geology consists of glacial outwash, well sorted, with a water table from 2.5 feet below the surface near the river to 17 feet below the surface at the far side of the site.

5) Suspected and confirmed sources--Howmet (Alloy) operated two lagoons and a leach field, accepting discharges from a chemical analysis lab and detergent wash of nickel alloy pellets.

6) Mitigation actions--None cited.

7) Decontamination actions--None cited.

8) Continuing investigations--NJDEP and the consultant for both Howmet sites continue their investigations.

I211 HOWMET (DOVER CASTING DIV.), DOVER August 1981

1) Overview--Buried drums were found during the course of a sewer line inspection. Subsequent investigation showed that illegal discharges of industrial wastes had occurred. A private hydrogeologic study to determine contamination effects and remedial actions required by the NJDEP are in progress. (See Howmet (Alloy)).
2) Location of the contaminated site--Next to the Howmet (Alloy) site closer to Dover.
3) Severity of contamination--Test pits near septic leaching systems showed PCE, toluene and dichloromethane. The well at Howmet had TCE levels of 13 ppb and 1,1,1 TCEA of 9 ppb. The leach ponds contained total VOCs of over 3000 ppb in 1981 and over 300 ppb in 1982. 1984 tests of the leaching systems revealed peak contamination (total VOCs) of nearly 8,000 ppb including almost 7,000 ppb of 1,1,1 TCEA, TCE at 159 ppb, and PCE at 312 ppb. Other areas contained less total VOCs but far more TCE. The lower aquifer unit has contamination of nearly 500 ppb, with 1,1,1 TCEA at 326 ppb, TCE at 50 ppb and PCE at 53 ppb.
4) Extent of contamination/Ground water flow--The Dover Well 4 is located approximately 3500 feet and a Denville well field is located approximately 1000 feet from Howmet (Dover Casting). Contamination of these wells includes 1,1,1 TCEA, PCE and TCE. Pumping tests performed at these well fields indicated that Howmet (Dover Casting) is located within the radius of influence of approximately 4100 feet (the consultant to Howmet disagrees that the radius of influence is that large). The site geology consists of two aquifers, both stratified drift deposits, segregated by an aquitard. Consultants to Denville indicate the existence of coarse sands and gravels from the surface to 10 to 40 feet down, followed by silty sand to a 60 foot depth, clay to 120 feet deep, and sand and gravel (the lower aquifer) to 140 feet deep.

Contamination of the lower aquifer confirms that flow can be induced from one to the other. This flow has been confirmed through the Dover Well 4 pump test with monitoring at the NJ Natural Gas site, and also at the Howmet site through pumping from one-half mile away. Dover Well 4 induces flow in directions other than the regional trend, as exhibited by the low contamination levels at the start of the pump tests and the twenty-fold increase in VOC levels during the test. Howmet's consultant has postulated that ground water flow is upward from the lower aquifer to the upper during non-pumping conditions. Normal ground water flow is east toward the Rockaway River.

The upper aquifer is contaminated with VOCs and heavy metals (e.g. lead, nickel, manganese, hexavalent chromium and total chromium above drinking water or ground water standards). The lower aquifer contains significant levels of VOCs.

Howmet consultants have claimed that a ground water divide exists between Howmet and the Denville Well 3 due to simultaneous pumping of wells at both sites, but this is not confirmed or accepted by the NJDEP.
5) Suspected and confirmed sources--Howmet (Dover Casting) makes nickel and cobalt based engine parts. Three leaching fields were used for wastewater disposal. The NJDEP concluded in 1985 that Howmet contributed at least partially to contamination of both the Dover Well 4 and the Denville Well 3, immediately across the Rockaway River.
6) Mitigation actions--Howmet and Denville have reached an agreement whereby Howmet will pay for the installation of an air stripping water treatment system for Well 3.

7) Decontamination actions--The NJDEP approved a remedial plan based on further investigation by Howmet, which plan Howmet began implementing late in 1985. Howmet is presently pumping from two recovery wells with air stripping units located on-site.
8) Continuing investigations--Howmet will be issued an Administrative Consent Order in the near future. Negotiations were in progress in mid-1986 with Howmet and other potential responsible parties to pay for a remedial investigation/feasibility study on Dover Well 4. Howmet subsequently agreed to split the $700,000 cost of an RI/FS for Dover Well #4 with NJ Natural Gas.

I MCWILLIAMS FORGE, ROCKAWAY BORO 1983

1) Overview--McWilliams Forge was found to have ground water contamination of up to 1700 ppb of TCE in the shallow aquifer and had been pumping over 1 MGD from shallow and deep aquifers without an allocation permit. An administrative consent order from the NJDEP has required the installation of monitor wells and a water treatment system to remove the TCE during the period of pumping for site dewatering to construct a new building foundation. The monitor wells are incorporated into a ground water monitoring permit. Pumping for site dewatering concluded in 1985. Current status unknown.
2) Location of the contaminated site--Franklin Avenue, on the east side of the Rockaway River just downstream from Denville.

IGURE G-2. DELINEATION OF BUIRED VALLEY

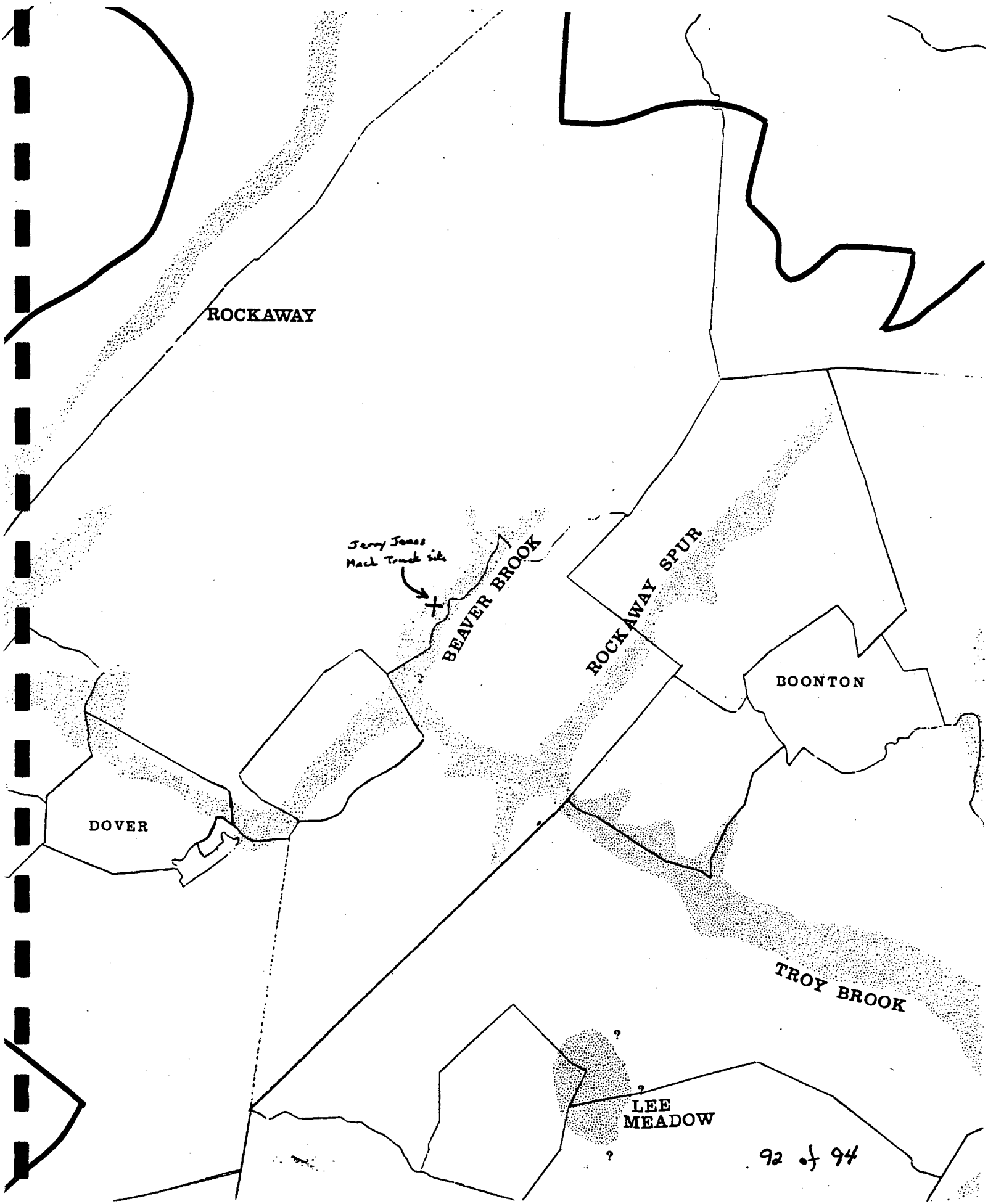


FIGURE G-4. MAJOR PRODUCTION WELLS

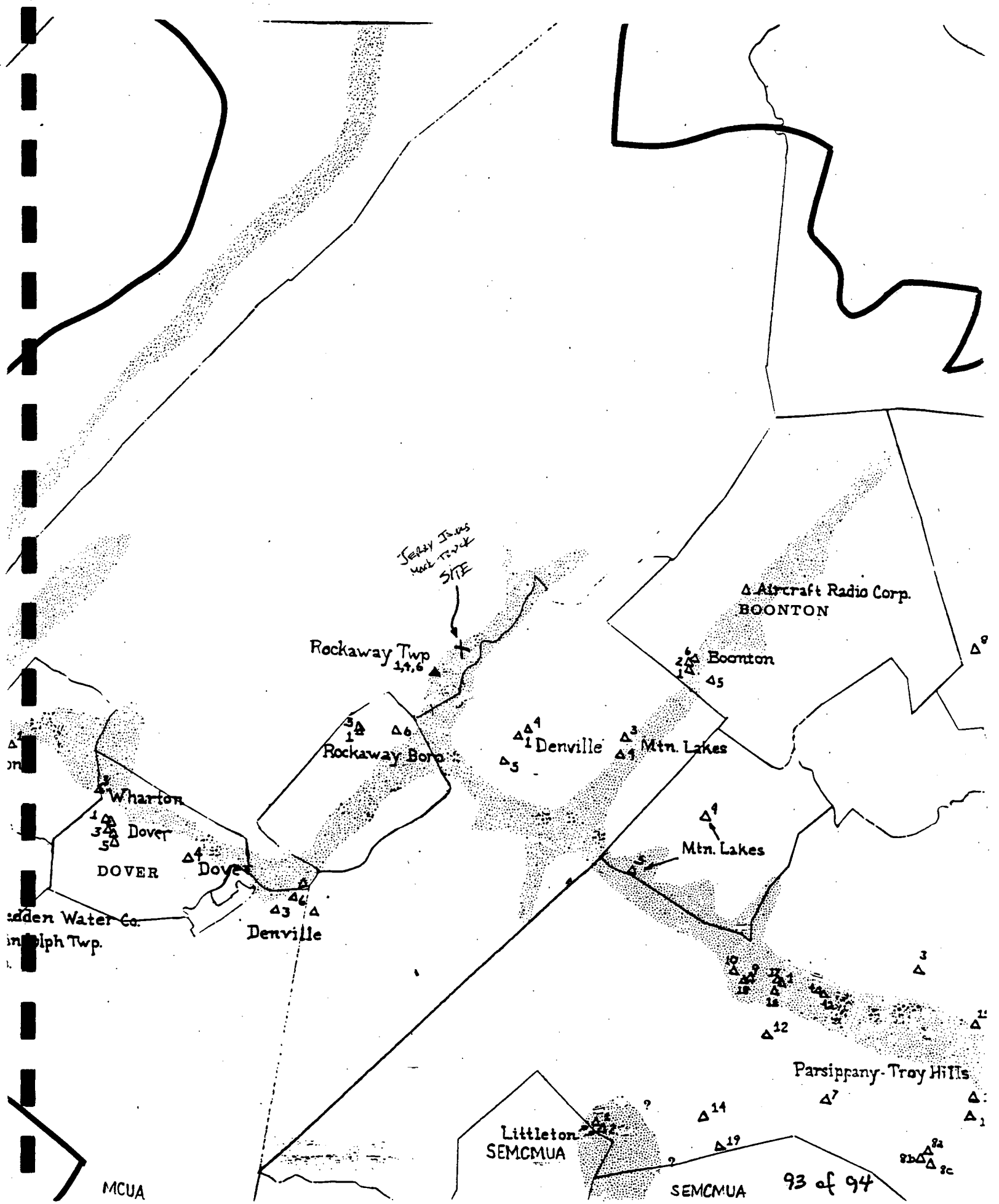
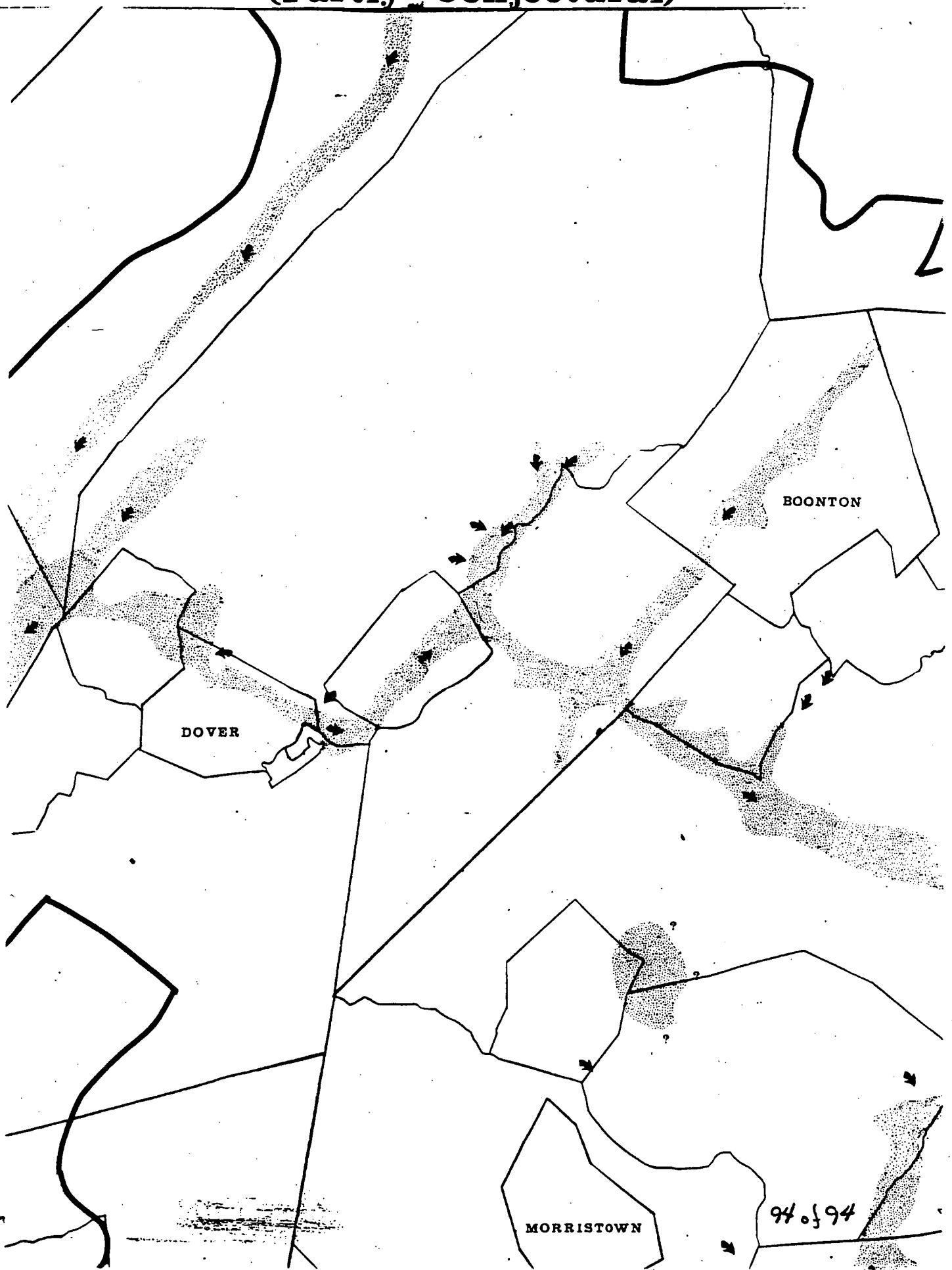


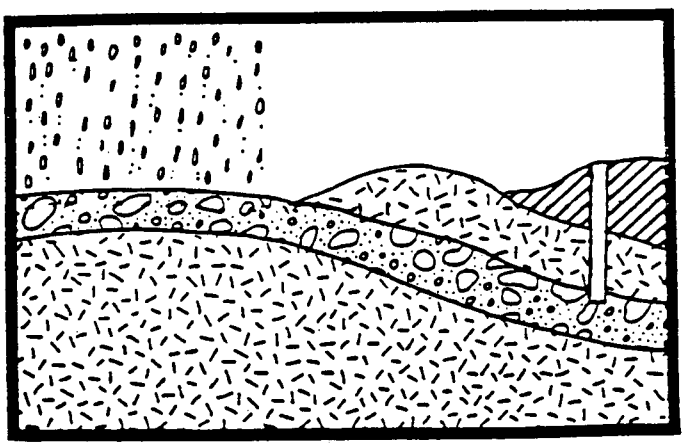
FIGURE G-5. REGIONAL GROUND WATER FLOW
(Partly Conjectural)



REFERENCE NO. 18

MORRIS COUNTY MASTER PLAN

WATER SUPPLY ELEMENT



Prepared By
Elson T. Killam Associates, Inc.

June 1982

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1.0 INTRODUCTION

This report consists of an analysis of water supply sources, facilities, consumption patterns, and future needs for Morris County. The recent drought and water supply shortage which affected northern New Jersey has illustrated the need for ample water supply reserves and the importance of long range planning. This study examines these issues in terms of the Morris County situation and presents recommendations which would improve the quality and reliability of water supply services in the County.

Water supplies within the County are derived from both surface and groundwater sources, with groundwater accounting for the greatest percentage of water consumed within the County. It is important to protect these resources from contamination and depletion, which can result from improper land use management. In spite of large withdrawals of surface water from the County to supply metropolitan areas to the east, Morris County is generally self-sufficient in terms of its water supply, and can remain so provided that vital groundwater supplies are properly managed. This report highlights the County's dependence on its subsurface aquifers, locates them, and forms a starting point from which local municipalities can take steps to further protect their drinking water supplies.

At present, the responsibility for the management and distribution of potable water in Morris County is vested in numerous independent water companies, both public and private. As such, the implementation of long term water supply management strategies can be very difficult on a County-wide basis. To help overcome this problem, the Morris County Municipal Utilities Authority (MCMUA) was organized in 1958. The role of the MCMUA will probably become greater in the years ahead as water supply needs increase in certain sections of the County and as these needs go beyond the capability and resources of the local water departments. The MCMUA could further develop its network of supply sources and transmission facilities to supply water-short areas within the County. This report will define the role of the MCMUA in meeting the long term water supply needs of Morris County.

2.0 EXISTING CONDITIONS

2.1 REGULATORY REQUIREMENTS

The control and regulation of potable water supplies in Morris County is the responsibility of several agencies. Foremost among these is the New Jersey Department of Environmental Protection (DEP). This agency has broad powers over water purveyors and has established standards, regulations, permitting procedures, and reporting procedures to carry out their regulatory charge. Another agency with significant control over water suppliers is the Board of Public Utilities (BPU). This agency has control over the rates which utilities may charge their customers. The United States Environmental Protection Agency (EPA) has nation-wide jurisdiction over water supplies through the enactment of the Safe Drinking Water Act. However, the DEP has enacted tiered regulations to implement this law, in effect taking over the responsibility for carrying out its provisions. EPA is also involved in conducting and synthesizing research for the purpose of establishing water quality standards.

The following discussion summarizes the role played by the various agencies in each of the functional areas which constitute an overall water utility operation.

Planning

This is an important step in the overall process since it establishes needs and priorities for future system improvements. On the State level, water supply planning is the responsibility of DEP's Division of Water Resources, specifically the Bureau of Water Supply Planning and Allocation. The State has recently completed a Statewide Water Supply Master Plan, which is discussed elsewhere in this report.

On a local level, the Morris County Planning Board prepared a County Master Plan for water supply in 1971. This report is an update of that plan, and is intended to reassess existing water supply conditions and future needs for the County. Several municipal water departments and planning boards have also conducted water supply planning studies but these are the exception rather than the rule.

Allocation of Water Diversion Rights

For many years, the allocation of water rights was the responsibility of the DEP Water Policy and Supply Council. This Council was an 11 member board,

comprised of laymen appointed by the Governor. In spite of the fact that the Council was provided technical support by the DEP staff, the appropriateness of a nontechnical board deciding on highly technical issues came into question. Very recently, the legislature has enacted a law (the Water Supply Management Act) which eliminates the Water Policy and Supply Council. The responsibility for the allocation of water rights has been transferred to the DEP along with additional powers over water diversions and water purveyors.

According to the Act, the DEP will have the power to issue all water diversion permits and will retain the right to modify the amount to be diverted under permits that are issued. All existing diversion rights will remain in effect until modified by DEP. The DEP may modify or suspend diversion rights for violations of its rules and regulations or when it is in the public interest to do so. During emergency circumstances, the Department is empowered to limit diversion rights and order water system interconnections and the transfer of water between water systems, whether public or private, without notice or hearing. Rates to be charged by the supplying water purveyor under these circumstances would be set by the Board of Public Utilities. In addition, during emergency or drought conditions, the DEP could order water purveyors to impose surcharges and penalties upon customers to discourage water use. Revenues from these surcharges and penalties will be distributed by the BPU.

The new law also empowers the Department to order system interconnections and water diversions during non-emergency conditions after public notice and hearings. If any purveyor is found to have insufficient supply, the DEP can mandate the construction of additional supply facilities.

Engineering Review and Approval of Water Supply Projects

Within the State, this is the responsibility of the DEP. In many cases, municipal consent and approval is also required.

Water System Operations

As indicated above, the Water Supply Management Act gives the DEP certain additional powers over the operation of water systems. Prior to this law, the DEP was still responsible for protecting the quality of water supply services in the State. Within the Division of Water Resources, this is the responsibility of the Bureau of Potable Water. The Bureau requires periodic

reports on the operation of public systems, and periodically conducts inspections of existing facilities. If the DEP finds that water systems do not meet appropriate standards, they can order the upgrading of deficient systems. In the past, many orders to upgrade systems have not been complied with due to financial reasons. In some cases, municipal systems do not have sufficient revenues to implement improvements. In the case of private companies, requests for rate increases (to cover the cost of system improvements) to the BPU have gone unresolved for long periods, resulting in little or no progress on these improvements.

Water Quality Standards

The EPA has taken the initiative in this area by publishing water quality standards in the Safe Drinking Water Act. The State has adopted these standards in its implementing regulations. The purpose of the standards is to assure the quality of drinking water in terms of its safety, aesthetic palatability, and its freedom from nuisance characteristics. Water quality standards have been divided into "primary" and "secondary" categories. Primary standards are designed to protect human health through the ingestion of water. Secondary standards are set to maintain the aesthetic quality of the water and to maintain its suitability for all normal uses.

Financial Considerations

The BPU has jurisdiction over all private investor-owned systems and over publicly owned systems which sell water on a wholesale basis beyond the boundaries of their service area. For purveyors under its jurisdiction, the BPU is responsible for setting rate structures, maintaining their financial integrity, and maintaining the quality of their service. BPU regulations establish the powers held by water companies (condemnation, extension of facilities, etc.) and set administrative operating procedures. The quality of service is addressed in these regulations in terms of specific construction standards, system inspections, water pressure/volume, and meter testing.

Financial control of publicly-owned systems not under BPU jurisdiction is lacking. At present, the New Jersey Department of Community Affairs (DCA) performs financial reviews of these systems and publishes their findings in a report. However, DCA has no regulatory control over these systems. A bill has been introduced in the State Legislature which would place these systems under the BPU. The bill is still pending.

In summary, the overall regulatory framework which governs the operations of water supply systems is piecemeal and frequently overlapping. This makes effective management difficult from any level and hinders the implementation of planning goals. Clearly, a revision in the overall governmental framework is needed. This has been recommended in the Statewide Water Supply Master Plan, and changes have been initiated with the passage of the Water Supply Management Act.

2.2 PRESENT WATER SUPPLY SYSTEM

Existing water supply facilities in Morris County can be generally divided into three categories. The first category includes "public community" water systems. These systems provide potable water to more than twenty-five persons on a year-round basis. This is the single most important type of water system in the County and accounts for most of the potable water used. Water purveyors which own and manage these systems can be public (such as a municipal water department) or private.

The second type of public water supply system is the "public noncommunity" systems. These systems distribute water which may be used for human consumption, but do not provide a full-time supply for more than twenty-five persons. Included in this category are systems which were developed to serve a single facility, such as schools, camps, office and industrial buildings, restaurants, hospitals, etc. In many cases, these facilities are beyond the reach of public community systems.

Non-public water supply systems represent the final category which typically includes residential wells. These are very common in the less densely developed areas of the County.

2.2.1 Public Community Water Systems

The major community water supply facilities in Morris County are concentrated in the eastern and central portions of the County. This can be clearly seen on Plate 1 which shows areas served by public water supply facilities and major transmission mains. Also shown on Plate 1 are supply sources, storage tanks, and interconnections between the various water systems. Appendix C contains an index to the symbols shown on this Plate. In viewing this map it becomes obvious that there are only a few reservoirs in the County which are used to supply Morris County municipalities. The major reservoirs

shown provide service to metropolitan areas to the east, namely Newark and Jersey City. Most water supplies are derived from groundwater, in fact only about 10% of County demands are supplied by reservoirs.

The proportion of population served by community water facilities has remained fairly constant since 1971. The total population serviced in 1980 was approximately 322,159 which represents about 79% of the total Morris County population of 407,630 people. Most of this population is centered in the eastern and central portions of the County where population densities are fairly high. The western and northern areas of the County are primarily supplied by individual residential wells. These areas have experienced significant population growth in the past decade and community supply systems have begun to develop in that area.

The remainder of this section consists of a discussion of the various purveyors and municipalities in the County. Much of this information was derived from a questionnaire which was distributed to community purveyors in the County. Data on water diversions is intended to depict conditions in calendar year 1980, although the period from mid-1979 to mid-1980 was used in some cases to avoid unusually low consumption rates which resulted from water conservation measures taken during the recent drought. For many purveyors, reduced consumption was not noted in 1980.

Relying upon the data which was furnished by the purveyors, we have described service areas, volumes of water distributed, supply sources, and other information which is useful in understanding the overall water supply situation in Morris County. In general, the treatment of community water supplies in the County consists of and is limited to disinfection via chlorination. Exceptions to this include some small poorly-run private companies who fail to chlorinate, and some of the larger suppliers who also filter water or employ a specific treatment process to overcome certain water quality deficiencies. These exceptions will be noted as appropriate.

The largest single water purveyor in Morris County is the Southeast Morris County Municipal Utilities Authority (SMCMUA), formerly the Morristown Water Department. SMCMUA serves all or major portions of Morristown, Hanover, Morris Township, Morris Plains, and smaller portions of Mendham Township and Harding. The total population served by SMCMUA is over 51,000. In addition, the Authority serves many large office and industrial complexes. The average

volume of water diverted by this system was approximately 8.5 million gallons per day (MGD) in 1980. Approximately 80% of this supply is derived from twelve wells, which are located in the Passaic River Watershed. Diversion rights associated with these wells totalled 8.9 MGD as of 1977. Diversion rights refer to the amount of water which the State Department of Environmental Protection (DEP) has permitted to be withdrawn from a water source. SMCMUA also has a reservoir supply in the Clyde Potts Reservoir, located in Mendham Township, on the upper reaches of the Whippany River in the Passaic Watershed. The Authority has been ordered by the DEP to provide treatment of the surface water from Clyde Potts. This reservoir has diversion rights of 2 MGD giving SMCMUA a total allowable water withdrawal of 10.9 MGD. In a 1979 report prepared for the SMCMUA, it was estimated that a supply of 15 MGD would be required by the year 2000 to provide proper service to the area at that time. Recently, a pipeline was installed on Old Brookside Road in Mendham, interconnecting the MCMUA system with SMCMUA. This pipeline is being used to transfer 1 MGD from MCMUA's Alamatong Well Field to the SMCMUA system. The SMCMUA proposes other improvements to their system such as new transmission mains in needed areas, new storage tanks and a filtration plant for the Clyde Potts supply.

Morris County Municipal Utilities Authority - The MCMUA operates regional water supply facilities in Morris County and supplies water to other purveyors on a wholesale basis. At present, the MCMUA operates the Alamatong Well Field and supplies water to the Randolph Township Municipal Utilities Authority (RTMUA), Mine Hill and SMCMUA. The Alamatong Well Field is located in Randolph and Roxbury Townships and is 535 acres in area. Three production wells are now operating in the Well Field, each can produce 450 gallons per minute (GPM) (equivalent to 0.65 MGD each). The Well Field also includes a 3.0 million gallon storage tank and a booster pumping station. In 1980, approximately 1.1 MGD was diverted from Alamatong. Presently an additional 1 MGD is being diverted to SMCMUA. Present diversion rights total 4 MGD, with the safe yield of the Well Field estimated at 5 MGD.

MCMUA has scheduled the construction of an additional production well at Alamatong. As determined by regional water demands, the Authority will implement other regional water supply projects in Morris County. Feasibility studies on the proposed Washington Valley Reservoir are currently underway.

Boonton - The Town of Boonton Water Department diverts an average of 1.2 MGD, providing service to over 9,000 residents in Boonton and Boonton Township. Two-thirds of the water supplied is pumped from wells along the Rockaway River in Denville. This groundwater supply is treated for iron and manganese removal. The remainder is diverted from a reservoir in Kinnelon near Fayson Lakes and is provided treatment by a recently constructed facility. Total diversion rights of about 2.5 MGD have been granted to the Department.

Boonton Township - Except for approximately 400 residents served by the Boonton Water Department, the entirety of this Township relies on private wells.

Butler - Butler is the only Morris County municipality that relies on surface (reservoir) supplies for all its needs. The water department supplies all 7,600 residents of Butler, a small section of Kinnelon, and customers in Passaic County. In 1980 the average use for Morris County customers was approximately 0.8 MGD. Treatment involves chlorination and filtration. Butler's Kikeout Reservoir is located in the Pompton/Pequannock Watershed, and Butler has diversion rights to 4 MGD.

Chatham - From groundwater supplies the Chatham Borough Water Department services the entire community of about 8,500 people. The wells are located in the Upper Passaic Watershed and are used to supply an average of just over 1 MGD. Diversion rights of about 1.7 MGD have been granted Chatham Borough for their present wells.

Chatham Township - Most of Chatham Township (7,500 out of 8,900 residents) is served by the Commonwealth Water Company. Sixty-two residents are served by SMCMUA, with the balance of the population relying on private wells. Commonwealth is a large purveyor in Essex and Union Counties and serves a limited section of Somerset County as well as a small section of Morris County. The Morris County customers (Chatham and Passaic Townships) consume about 1 MGD. The main source of supply for Commonwealth is the Canoe Brook well field located in Millburn Township just outside of Morris County. These wells are used to pump about 7 MGD from the aquifer.

Chester - The Chester Water Company provides the only community water service to Chester Borough. Approximately 300 people are served with an average use of 0.02 MGD in 1980. Supplies are derived from a single well in the Black River Watershed. Another well is planned. Of the 1,400 persons residing in the Borough, 1,100 rely on individual wells.

Chester Township - Nearly all of Chester Township's 5,200 residents rely on private water supplies. The Peapack-Gladstone Water Department supplies 85 Township residents with water. This company previously owned and operated a reservoir in the Township. In July of 1981, Chester Township purchased the reservoir and may develop it as a park.

Denville - Most of Denville's 14,380 residents are serviced by the municipal water department. Approximately 1.75 MGD is diverted, this supply originating from a well field (five wells) in Randolph Township (Upper Rockaway Watershed). The Township also supplies the Randolph Township Municipal Utilities Authority with a relatively small amount of water (4.5 million gallons per year).

Dover - The Dover Water Department diverts approximately 3 MGD with service provided to over 17,000 people. In addition to serving the Town of Dover, individuals in Victory Gardens, Mine Hill, Rockaway Township, Randolph and Wharton are also served. All of this water is supplied by three wells located in the Princeton Avenue well field. Diversion rights for this system are presently for 3.3 MGD. The Hooey Street well has recently been taken out of service as a result of contamination. Proposed improvements to the Dover system include new mains and service connections.

East Hanover - Approximately 1,500 residents in this southeastern Morris County community are served by private wells. The municipal water department supplies water to about 7,400 people with total consumption under 1.2 MGD. Two wells constitute the source of supply for East Hanover and they are located in the Whippany River Watershed. Currently these wells have diversion rights totalling 2 MGD. Problems involving elevated hardness and manganese levels have been plaguing this system for several years. Therefore present water treatment involves manganese removal in addition to chlorination.

Florham Park - Water supply in the borough is provided by the municipal water department which serves over 9,000 residents. All borough residents are served by the community supply. The Florham Park Water Department distributes slightly under 1.2 MGD. All water diverted by the department originates from three wells in the Whippany River Watershed.

Greystone Park is a State institution located within Parsippany-Troy Hills. Greystone is served by their own community water system. Approximately 0.35 MGD is diverted by this system, serving approximately 1,600 patients and residents.

Hanover - Presently served by SMCMUA.

Harding - Most of Harding's 3,200 residents obtain their potable water supply from individually-owned wells. Approximately 600 persons are connected to and serviced by the SMCMUA, and approximately 300 persons are served by the Lakeshore Water Company.

Hercules Incorporated also operates a community system within Roxbury, serving 25 company-owned houses and providing for their industrial needs. The average diversion for 1980 was 0.9 MGD.

Jefferson - Approximately 6,000 of the 16,000 persons residing in Jefferson Township are served by community water supplies. Service is provided by small water companies located around the major lakes in the Township. Many of these systems were developed to serve what were originally summer resort communities. With the conversion of many of these homes to permanent residences and with the present poor financial condition and inadequate management of the water companies, water supply services are inadequate in many of these systems. Numerous problems have plagued these systems in recent years including inadequate supplies, inadequate storage capacity, lack of proper treatment and disinfection, and inadequately sized pipelines. The Township has recently organized a water department to begin the difficult process of upgrading and consolidating these systems. In 1980, approximately 0.3 MGD was diverted to supply system users. The Township is also establishing its own supply wells to provide service to Township residents. Existing public supply wells throughout the Township tap aquifers in the Rockaway, Pequannock and Musconetcong Watersheds.

Kinnelon - This municipality has recently organized a municipal utilities authority to help provide adequate water supplies for Borough residents. The Butler Water Department supplies the Authority with water for distribution. The Fayson Lakes area is served by a private water company. A total of 4,000 residents are supplied via community systems. In 1980, the total diversion for all water companies was approximately 0.3 MGD. Nearly 4,000 other Borough residents rely on private wells for their potable supply.

Lincoln Park - The municipal water company purchases most of its water from the Pequannock Water Department. A low yielding well is also used by Lincoln Park to supplement the water supplies provided by Pequannock. The remaining 2,300 residents rely on private wells. In the future, Lincoln Park

is considering the development of additional supply wells in order to become self-sufficient. If this is not feasible, they will purchase water from Pequannock and/or the Passaic Valley Water Commission.

Madison - The Borough is completely served by community water facilities. The Madison Water Department serves nearly all borough residents with a few connections serviced by SMCMUA. The water department obtains water from its five wells located within the Borough. Current water usage is nearly 2 MGD, with diversion rights granted for 3.5 MGD.

Mendham - The Mendham Water Department serves virtually all of the Borough and a portion of Mendham Township. The utility employs both wells and a reservoir with wells comprising 70% of the supply. All of these supply sources are located in the Raritan Watershed. In 1980 consumption averaged about 0.65 MGD. Diversion rights have been granted the Mendham system for 2 MGD. However, the Water department is experiencing difficulties with the well supply at the present level of pumpage. The Borough has recently installed a new well and is considering an additional one.

Mendham Township - Residents of the Township are provided with water by SMCMUA, the Borough of Mendham and the Randolph MUA. Fifteen hundred of the 4,500 residents of this municipality are served. Usage averages 0.13 MGD.

Mine Hill - The Mine Hill Township Municipal Utilities Authority oversees the distribution of water in this municipality. There are 1,500 residents served by the community system, with the remainder of the population supplied by private wells. The Township supply is provided by the Morris County Municipal Utilities Authority (MCMUA). In 1980, the average use was 0.14 MGD.

Montville - The Montville Township Municipal Utilities Authority services approximately 6,200 people with an average diversion of about 1 MGD. Water supply is obtained from wells located in the Passaic Watershed. The Township has diversion rights to 1.77 MGD from the wells. An additional supply of 1 MGD is available to Montville from the Jersey City Reservoir through an earlier agreement. Additional wells are proposed at the Township's Indian Lane Well Field. In addition to the Municipal Utilities Authority, water is supplied by the Lake Valhalla Club and Plausha Park water companies. A significant number of residents also rely on private wells.

Morris Plains - Presently served by SMCMUA.

Morristown - Presently served by SMCMUA.

Morris Township - Presently served by SMCMUA.

Mountain Lakes - The Mountain Lakes Water Department uses groundwater supplies from four wells to serve all of the Borough's 4,200 residents, except for a small area near Arrowhead Lake, which is served by Denville. The Borough has been granted diversion rights of 1.5 MGD while 1980 use averaged approximately 0.6 MGD. In addition to chlorination, softening agents are used when hardness levels are elevated.

Mount Arlington - A small private water company and the Roxbury Township Water Department currently provide service to approximately 900 people. In 1980, 0.05 MGD was the average usage by Borough residents using community supplies. Water is derived from groundwater sources. Approximately 3,400 residents in the Borough rely on individual supplies.

Mount Olive - Service within Mount Olive Township is provided by the Municipal Utiliites Authority plus fifteen other public and private purveyors. Included in this group are a number of water systems which were constructed in conjunction with residential developments. These "builder agreement" systems are set up to be taken over by the utilities authority at no cost and at the Township's discretion. In addition to six additional small franchised water companies, water is provided by three adjacent public water purveyors, the Hackettstown Municipal Utilities Authority, the Stanhope Water Department and the Netcong Water Department. All three of these purveyors maintain sources of supply (wells and reservoirs) in Mount Olive. In all, 11,700 residents are served by community water supply facilities. Approximately 1.0 MGD is supplied. Many of the smaller systems are plagued with a variety of operating problems.

The remaining 7,000 residents of the Township use private wells for water supply. A 1975 water supply master plan, prepared for the Township, recommends the upgrading, acquisition and interconnection of the various water systems by the municipal utilities authority. Additional well supplies are also recommended.

Netcong - All 3,557 Borough residents are served by the water department. The water used is derived from three wells located in the Musconetcong Watershed. In 1980 average use was approximately 0.5 MGD. Netcong has recently experienced difficulties in terms of the sufficiency of its water supply.

Parsippany-Troy Hills - The Parsippany-Troy Hills Water Department serves about 50,000 people in the most populated municipality in the County.

The average water use of this system is over 5 MGD, all of this supply derived from groundwater utilizing nineteen wells in the Township. These wells are located in the Whippany Watershed and have current allowable diversion rights of approximately 10 MGD. This system presently serves only Parsippany-Troy Hills. SMCMUA also services about 100 accounts in the southwestern section of the Township. Proposed system improvements include a new well.

Passaic Township - As noted above, Passaic Township is served by the Commonwealth Water Company. Most of the Township is provided with community water supplies. Approximately 10% of the Township residents are not connected to the central system and use private wells.

Pequannock - The Pequannock Water Department obtains its water supply from two wells and from Newark's supply system. Most of Pequannock is served by the water department. Current water diversions by the department are slightly over 2 MGD, of which 0.8 MGD is distributed to Lincoln Park residents. Current diversion rights from Newark total 1 MGD. The water department has indicated its intent to expand its supply facilities. The department proposes to conduct a drilling program to locate additional groundwater supplies and to construct a new storage tank.

Picatinny Arsenal, a major Federal installation, is located in Rockaway Township. This facility operates a community supply system which serves on-site residents and provides water for industrial use. This facility uses an average of 2.09 MGD.

Randolph - The responsibility for public water supply in Randolph Township is vested in the Randolph township Municipal Utilities Authority. All of the water used by this Authority is purchased from other purveyors. The MCMUA supplies over 1 MGD to Randolph. In addition, water is obtained from SMCMUA, Denville and Dover. A total of 10,500 people are served by community water facilities in Randolph. At present, an average of 1.3 MGD is distributed to the serviced population in Randolph.

Riverdale - The majority of Riverdale's population is serviced by a community water supply, which is provided by the Borough's Water Department. In 1980, the water department diverted an average of 0.25 MGD. The department has two wells in the Pompton Watershed. These wells have been granted diversion rights of 0.64 MGD.

Rockaway - The Borough Water Department operates three wells, located in the Upper Rockaway Watershed, to serve 7,000 residents in and around the Borough. The wells are pumped at a rate slightly less than 1 MGD. Contamination of these wells by volatile organic chemicals forced the closing of these wells in 1980. The wells are now operational following the installation of an activated carbon filtration system.

Rockaway Township - Within the Township, 14,000 residents are served by public supplies. A significant number of these are served by the Dover Water Department or the Rockaway Borough Water Department. Present use within the Township is approximately 1.2 MGD. The Township Water Department derives its water supply from three wells located in the Beaver Brook (Upper Rockaway) Watershed. In 1980 these wells were found to contain high levels of certain volatile organic chemicals which had leached into the aquifer. These wells were removed from service until an activated carbon filtration system was installed and operating. In the more rural northern areas of the Township, over 6,000 residents rely on individual wells.

Roxbury - The Township is serviced by the Roxbury Water Company and the Roxbury Township Water Department. These two purveyors provide 13,700 Township residents with 1.2 MGD of potable water. All water is derived from wells located in the Black River Watershed. Diversion rights for both purveyors total 1.8 MGD. Approximately 5,000 Township residents rely on private wells.

Victory Gardens - All of the 1,043 persons residing in this Borough are serviced by the Dover Water Department.

Washington Township - The only water purveyor in this rural municipality is the Washington Township Municipal Utilities Authority. The Authority supplies approximately 5,000 people from groundwater sources. The average usage in 1980 was approximately 0.6 MGD. The State has granted the Authority diversion rights of 1.1 MGD and is currently reviewing applications from the Township for additional diversions. The Authority has encountered difficulty in developing high yielding wells and therefore supplies water from 15 relatively low yielding wells. Approximately 6,000 Township residents are supplied by individual private wells.

Wharton - The Wharton Water Department supplies water to most of the 5,500 Borough residents. Residents not served by Wharton are served by the

Dover Water Department. In 1980, average pumpage by the Wharton system was approximately 0.7 MGD. The entire supply is furnished from three wells which are located in the Upper Rockaway Watershed. The Borough of Wharton has been granted diversion rights of 1.3 MGD from these wells. Traces of contamination have been detected in one of the Borough's wells. Fortunately, that well is not normally in use.

2.2.2 Public Non-Community Water Systems

Non-community water systems, defined as public systems which serve less than 25 year-round residents, constitute an important category of water supply facilities in the less densely developed sections of the County. These systems serve facilities which are commonly beyond the reach of community systems. Typically, they serve schools, shopping centers, industry, health care facilities, and recreational facilities. Research in the files at the New Jersey Department of Environmental Protection (DEP) yielded a listing of 91 non-community systems in Morris County. This data was obtained from inspection reports on these systems over the last several years. The list (contained in Appendix B) is felt to be reasonably complete with respect to non-community facilities serving the public (restaurants, recreational facilities, institutions) but incomplete in terms of industrial facilities. Appendix B includes an estimate of daily water consumption for the 91 known non-community purveyors. These estimates total 2.6 MGD. The total for non-community water use is not known, but is felt to be significantly higher.

2.3 WATER DEMANDS

The analysis of water demands is a key element of this study. An accurate evaluation of present and past water consumption patterns was done to determine present water supply needs which also provided a basis for projecting future requirements. Data for this analysis was obtained from water purveyors through the use of a questionnaire and from files at the offices of the DEP.

2.3.1 Public Water Supply Systems

Water consumption data was collected for all Morris County municipalities for three years spanning the past decade. The year 1980 was chosen to represent current conditions. Recognizing that the recent drought could significantly affect water consumption patterns, data was collected for the period

from mid-1979 through 1980. Data from the very dry second half of 1980 could therefore be eliminated from the analysis if a significant reduction in water demands was noted. The other years chosen were 1971 and 1975. A check of precipitation records indicated that rainfall was above average in 1971 and 1975.

Water consumption data used in this analysis is invariably reported as a total for a specific area serviced by a given water purveyor. In some cases, the limits of a water supply service area coincide with municipal boundaries. However, more often they do not. It should be noted therefore, that the data presented in this report represents the result of adjusting and recombining the raw data as reported by the various purveyors. Where raw data was sketchy, estimates were made to round out and complete the analysis.

Table 1 represents a summary of water consumption data for public community supply systems in 1971, 1975 and 1980. The Table indicates the population of each municipality, the population served by the public systems, the average water use, and the per capita use. These figures include water consumed by residents, commercial establishments, and industry.

Reviewing Table 1, several factors are significant. First, the proportion of the population served by public systems was the same in 1980 as it was in 1971. This is symptomatic of the general inattention paid to water supply development in the past decade. Certain areas of the County were and are still best served by individual wells. However, in other cases such as certain lake communities, the extension of public supplies is a long-standing need.

During the past ten years, total public water demand increased to a present level of 39.6 MGD. This increase has been a gradual one, with the percentage increase equal to approximately 13% over the 1971 total of 34.9 MGD. The population increase over the same period was 6%. Therefore, the trend of water demand growing at a rate faster than population growth has continued from the 1960's through the 1970's. However, the increases in both population, per capita water use, and total water demand have been significantly less than was projected ten years ago. During the 1970's, a significant change in the previous trends of rapidly escalating water use and population growth became apparent.

Variations in the per capita usage of water can be attributed to several

TABLE 1

1971

PUBLIC COMMUNITY WATER CONSUMPTION BY MUNICIPALITY

	Total Population	Population Served	Per Capita*	Average Water Use (MGD)
BOONTON	9,197	9,197	146	1.34
BOONTON TOWNSHIP	3,090	444	113	0.05
BUTLER	7,108	7,108	104	0.74
CHATHAM	9,463	9,463	104	0.98
CHATHAM TOWNSHIP	8,172	6,624	82	0.54
CHESTER	1,312	300	63	0.02
CHESTER TOWNSHIP	4,358	85	63	0.01
DENVILLE	14,078	12,388	142	1.76
DOVER	15,003	15,003	132	1.98
EAST HANOVER	7,892	3,408	134	0.47
FLORHAM PARK	9,372	9,372	90	0.84
HANOVER	10,715	10,715	150	1.61
HARDING	3,248	1,128	86	0.10
JEFFERSON	14,351	7,420	57	0.42
KINNELON	7,617	2,714	59	0.16
LINCOLN PARK	9,011	5,251	76	0.40
MADISON	16,575	16,575	110	1.83
MENDHAM	3,746	3,746	99	0.37
MENDHAM TOWNSHIP	3,776	1,560	62	0.10
MINE HILL	3,534	1,484	49	0.07
MONTVILLE	12,090	5,355	94	0.50
MORRIS PLAINS	5,516	5,516	108	0.60
MORRISTOWN	17,557	17,557	118	2.07
MORRIS TOWNSHIP	18,170	17,890	112	2.01
MOUNT ARLINGTON	3,656	881	57	0.05
MOUNTAIN LAKES	4,680	4,680	92	0.43
MOUNT OLIVE	11,229	5,475	78	0.43
NETCONG	2,928	2,928	107	0.31
PARSIPPANY-TROY HILLS	54,588	54,588	89	4.84
PASSAIC TOWNSHIP	7,381	6,393	82	0.52
PEQUANNOCK	14,293	12,721	79	1.01
RANDOLPH	13,749	6,018	109	0.65
RIVERDALE	2,709	2,384	88	0.21
ROCKAWAY BOROUGH	6,430	6,430	129	0.77
ROCKAWAY TOWNSHIP	19,045	13,126	108	1.42
ROXBURY	16,066	9,632	77	0.74
VICTORY GARDENS	1,028	1,028	132	0.14
WASHINGTON TOWNSHIP	7,406	2,405	70	0.17
WHARTON	5,530	5,530	148	0.82
PICATINNY				2.72
HERCULES				0.71
	385,669	304,522	103**AVG.	34.91 31.48**

* Average consumption per person per day in gallons. Includes a portion of local commercial and industrial use.

** Excludes Picatinny & Hercules

TABLE 1 (Continued)

1975

PUBLIC COMMUNITY WATER CONSUMPTION BY MUNICIPALITY

	Total Population	Population Served	Per Capita*	Average Water Use (MGD)
BOONTON	8,941	8,941	115	1.03
BOONTON TOWNSHIP	3,170	423	118	0.05
BUTLER	7,334	7,334	101	0.74
CHATHAM	9,051	9,051	106	0.96
CHATHAM TOWNSHIP	8,488	7,209	79	0.57
CHESTER	1,366	300	63	0.02
CHESTER TOWNSHIP	4,731	85	63	0.01
DENVILLE	14,213	12,650	149	1.89
DOVER	14,860	14,860	133	1.98
EAST HANOVER	8,526	4,720	148	0.70
FLORHAM PARK	9,366	9,366	96	0.90
HANOVER	10,773	10,733	186	2.00
HARDING	3,243	866	94	0.08
JEFFERSON	15,267	8,165	65	0.53
KINNELON	7,685	3,275	64	0.21
LINCOLN PARK	8,920	6,700	72	0.48
MADISON	16,033	16,033	107	1.72
MENDHAM	3,814	3,814	115	0.44
MENDHAM TOWNSHIP	4,093	1,545	66	0.10
MINE HILL	3,441	1,403	64	0.09
MONTVILLE	13,068	5,553	96	0.53
MORRIS PLAINS	5,422	5,422	92	0.50
MORRISTOWN	17,138	17,138	88	1.51
MORRIS TOWNSHIP	18,210	16,760	132	2.22
MOUNT ARLINGTON	3,920	881	91	0.08
MOUNTAIN LAKES	4,446	4,446	101	0.45
MOUNT OLIVE	14,571	6,793	76	0.52
NETCONG	3,208	3,208	50	0.16
PARSIPPANY-TROY HILLS	52,490	52,490	95	4.97
PASSAIC TOWNSHIP	7,334	6,405	79	0.51
PEQUANNOCK	14,063	12,516	93	1.16
RANDOLPH	15,561	8,191	105	0.86
RIVERDALE	2,629	2,314	69	0.16
ROCKAWAY BOROUGH	6,618	6,618	106	0.70
ROCKAWAY TOWNSHIP	19,042	13,929	96	1.35
ROXBURY	17,316	12,243	69	0.84
VICTORY GARDENS	1,035	1,035	133	0.14
WASHINGTON TOWNSHIP	9,182	3,652	93	0.34
WHARTON	5,510	5,510	114	0.63
PICATINNY				2.17
HERCULES				0.77
	394,078	312,577	102**AVG.	35.07 32.13**

* Average consumption per person per day in gallons. Includes a portion of local commercial and industrial use.

** Excludes Picatinny & Hercules

TABLE 1 (Continued)

1980

PUBLIC COMMUNITY WATER CONSUMPTION BY MUNICIPALITY

	Total Population	Population Served	Per Capita*	Average Water Use (MGD)
BOONTON	8,620	8,620	132	1.14
BOONTON TOWNSHIP	3,273	398	128	0.05
BUTLER	7,616	7,616	97	0.74
CHATHAM	8,537	8,537	122	1.04
CHATHAM TOWNSHIP	8,883	7,540	81	0.61
CHESTER	1,433	300	63	0.02
CHESTER TOWNSHIP	5,198	85	63	0.01
DENVILLE	14,380	12,942	134	1.73
DOVER	14,681	14,681	161	2.36
EAST HANOVER	9,319	7,428	148	1.10
FLORHAM PARK	9,359	9,359	119	1.11
HANOVER	11,846	11,846	126	1.49
HARDING	3,236	891	127	0.11
JEFFERSON	16,413	6,602	58	0.38
KINNELON	7,770	3,980	65	0.26
LINCOLN PARK	8,806	6,517	125	0.81
MADISON	15,357	15,357	124	1.90
MENDHAM	4,899	4,899	131	0.64
MENDHAM TOWNSHIP	4,488	1,511	86	0.13
MINE HILL	3,325	1,531	91	0.14
MONTVILLE	14,290	6,291	155	0.98
MORRIS PLAINS	5,305	5,305	111	0.59
MORRISTOWN	16,614	16,614	102	1.69
MORRIS TOWNSHIP	18,486	15,354	119	1.83
MOUNT ARLINGTON	4,251	881	57	0.05
MOUNTAIN LAKES	4,153	4,153	149	0.62
MOUNT OLIVE	18,748	11,743	88	1.03
NETCONG	3,557	3,557	117	0.42
PARSIPPANY-TROY HILLS	49,868	49,868	112	5.59
PASSAIC TOWNSHIP	7,275	6,564	81	0.53
PEQUANNOCK	13,776	12,195	112	1.37
RANDOLPH	17,828	10,523	116	1.22
RIVERDALE	2,530	2,237	103	0.23
ROCKAWAY BOROUGH	6,852	6,852	124	0.85
ROCKAWAY TOWNSHIP	19,850	13,910	89	1.24
ROXBURY	18,878	13,732	89	1.22
VICTORY GARDENS	1,043	1,043	161	0.17
WASHINGTON TOWNSHIP	11,402	5,212	107	0.56
WHARTON	5,485	5,485	128	0.70
PICATINNY				2.09
HERCULES				0.89
	407,630	322,159	114*AVG.	39.64 36.66**

* Average consumption per person per day in gallons. Includes a portion of local commercial and industrial use.

** Excludes Picatinny & Hercules

factors. One reason is that the per capita figure reported in the table includes non-residential (i.e. industrial and commercial) water consumption. The proportion of non-residential to residential use is different for each municipality, thereby resulting in significant variations in the "overall" per capita consumption. Another factor is the size and age of the water supply system. As systems become older, leakage tends to increase. In municipalities with significant industry, this effect is difficult to indentify. However, in other areas, such as the Boroughs of Mendham and Mountain Lakes, the significant increase in per capita usage may be a result of system leakage. Another factor may be the socio-economic character of a municipality. This could affect the volume of water used for "non-essential" uses such as lawn sprinkling and swimming pool filling.

Finally, water use in some of the small, private water systems tends to be lower than average. This may be due to the public's awareness of the unreliability of these systems, and to the presence of some seasonal homes in certain areas.

In summary, the average per capita water use in Morris County falls in the range of 100 to 110 gallons per capita per day (GPCD). At the low end of scale are communities with small, primarily residential service areas. Per capita usage in these areas is frequently less than 80 GPCD. Older communities with significant industrial development and perhaps significant system leakage report per capita consumption rates in excess of 130 GPCD.

In order to better evaluate the proportion of non-residential use in the total volume of water diverted in the public community systems, the various water purveyors were contacted and asked to list the ten largest users in their system. The major users are typically industries, therefore this information provides an approximation of total industrial use. While many small industrial and commercial concerns could not be identified through this procedure, the major users probably account for 80 to 90% of the total non-residential use. In total, 10.8 MGD of the 39 MGD (or 28%) of public community water demand in 1980 can be attributed to non-residential uses.

Public non-community water consumption represents a separate category of water use. This is invariably non-residential in nature. As discussed in Section 2.2, this category accounted for at least 2.6 MGD of water use in 1980.

Considering both community and non-community water consumption in 1980, the total non-residential water use which was identified through this study was at least 13.4 MGD. Due to the limitations in the data base, many small com-

mercial users and a number of industrial non-community users were not included in this figure. Therefore, the actual non-residential use may be significantly higher.

2.3.2 Non-Public Water Supply Systems

Non-public water supplies consist of private wells used to supply individual residences and industrial/commercial wells not used for human consumption. Estimates of the number of residents which rely on individual supplies were made by deducting the population served by public community systems from the total population of each municipality. Twenty-one percent of the County's residents were found to rely on individual supplies. The amount of water consumed in these private systems on a daily basis was estimated by multiplying the number of persons served times 70 gallons. This per capita estimate was made based on a review of the literature and an analysis of certain small, strictly residential water systems in the County.

Table 2 contains a listing of all municipalities in which private wells constitute a significant source of supply. For each municipality listed, the amount of water delivered through public community systems is also listed. As this table indicates, approximately 6 MGD of water was obtained from private, nonpublic sources in 1980. Much of this demand occurs in the less densely developed sections of the County. Municipalities in which 5,000 or more residents obtain water from private wells include Chester Township, Jefferson, Montville, Mount Olive, Randolph, Rockaway Township, Roxbury and Washington.

With respect to non-public industrial and commercial wells, data is not available to estimate use within this category. Of the entire volume of water used within the County in 1980, approximately 48 MGD can be accounted for, as follows:

Public Community	39.6 MGD
Public Non-community	2.6 MGD
Non-public	6.0 MGD
TOTAL	48.2 MGD

Of this amount, approximately 13.4 MGD was used for non-residential purposes. As noted above, certain industrial and commercial wells in the latter two categories could not be accounted for, therefore actual usage is significantly higher.

For planning purposes, the public community demand is the most important of these elements since it accounts for the majority of residential use in

TABLE 2

NON-PUBLIC WATER CONSUMPTION BY MUNICIPALITY - 1980

Municipality	Residents Served By Non-Public Supply	Residential Volume Consumed (MGD)	* Volume Diverted Through Public Supply (MGD)
Boonton Township	2,875	0.20	0.05
Chatham Township	1,343	0.09	0.61
Chester Borough	1,133	0.08	0.02
Chester Township	5,113	0.36	0.01
Denville Township	1,438	0.10	1.73
East Hanover	1,891	0.13	1.10
Harding	2,345	0.16	0.08
Jefferson	9,811	0.69	0.26
Kinnelon	3,790	0.27	0.26
Lincoln Park	2,289	0.16	0.81
Mendham Township	2,977	0.21	0.13
Mine Hill	1,794	0.13	0.14
Montville	7,999	0.56	0.98
Morris Township	3,132	0.22	1.83
Mount Arlington	3,370	0.24	0.05
Mount Olive	7,005	0.49	1.03
Passaic	711	0.05	0.53
Pequannock	1,581	0.11	1.37
Randolph	7,305	0.51	1.22
Riverdale	293	0.02	0.23
Rockaway Township	5,940	0.42	1.24
Roxbury	5,146	0.36	1.22
Washington	6,190	0.43	0.56
	85,471	5.99	

* For purposes of comparing the amount of water supplied privately with the amount of community supply provided in the same municipality.

Morris County. In addition, projections of public community demand are vital if the required facilities are to be planned and implemented.

2.3.3 Water Costs

The cost of water supplied through public community water systems varies widely in Morris County. Most of the variation results from the need for various water purveyors to recover costs for capital improvement programs. Long established systems which are stable and have not required major system improvements tend to have the lowest rates. Newer systems with recent system expansions and more newly developed supplies have higher rates. When water is supplied to a purveyor in bulk from another, the contracted water cost has a major impact on user costs.

Eighteen purveyors in Morris County were contacted concerning the rates which they charge their users for water. In some cases, a flat fee is charged for a residential connection. In others, the charge depends on the amount of water used. By assuming that an average dwelling unit uses 100,000 gallons of water per year, it is possible to compare water rates on these different bases. Of the eighteen purveyors contacted, the average cost per dwelling per year was $137.00 (1981 cost). Rates ranged from a low of $51.00 to a high of $235.00.

2.4 HYDROLOGY

Since Morris County is self-sufficient with respect to its water supply, existing hydrological conditions are a key element in this study. Of particular importance are the existing geological and groundwater features of the County, which are detailed below:

2.4.1 Geology

The geology of Morris County is complex and highly variable. As a result, the potential for groundwater development changes significantly with the specific locality. This section summarizes the local geological characteristics which exist within Morris County and relates these conditions to water supply potential. Source material for this section includes Gill and Vecchioli (1965) and Lucey (1972).

In general terms, the County can be divided into two distinctly different regions. The first, called the Piedmont Province, includes the southeastern third of the County. This area is characterized by gently rolling

topography. The area is underlain by soft shales and sandstones. Several hard basaltic ridges interrupt this rolling plain, these ridges being the remnants of several lava flows which occurred during the Triassic Era. These ridges are now elevated because the basalt is much more resistant to weathering and erosion compared to adjacent shales and sandstones. These ridges are known as Towaco Mountain, Long Hill, and Mount Kemble. The elevation in this province averages 250 feet above sea level, with the basalt ridges averaging 500 feet.

The northwestern two-thirds of the County is included in the Highlands Province. This province contains a series of parallel flat-topped ridges separated by narrow valleys. These ridges run in a generally northeast to southwest direction. The ridges are composed of hard, igneous and metamorphic rocks which are resistant to weathering. These rocks are the oldest in the County, being of PreCambrian Age. The valleys frequently consist of recent glacial deposits underlain by shale and limestone. The ridges occur at an average elevation of 1,000 feet, with the valleys several hundred feet below the ridge elevations.

The major geological formations which occur in the County are discussed below, together with their hydrological significance.

PreCambrian Deposits

PreCambrian rocks underlie approximately two-thirds of Morris County (see Plate 2). These rocks are over 600 million years old and are of unknown thickness. They outcrop in the western part of the County in areas not covered by glacial till or other younger deposits. PreCambrian rocks were originally deposited as sedimentary or igneous rocks and have been metamorphosed over time by heat and compressional forces into gneisses and schists. Extensive folding and faulting of these deposits has also occurred. While these rocks occur within several recognized sub-groups, their hydrological characteristics are similar. Hence, they will be discussed here as a unit.

The primary permeability of unweathered PreCambrian rocks is negligible. Instead, water is stored and passes through these formations via fractures and faults. For the most part, groundwater occurs under water table conditions. In some cases, surficial deposits contain clay beds which confine the water, resulting in localized artesian conditions.

The yields of wells drilled into the PreCambrian bedrock vary considerably, depending on the number and size of fractures encountered by the well. Most large diameter public supply, commercial and industrial wells average

approximately 50 gallons per minute, although a few approach 400 GPM. There is no apparent correlation between yield and the depth of wells drilled into this formation. Most are 300 feet in depth or less, as it appears that the probability of finding substantial water-bearing fractures decreases markedly below that level. Because of the tendency to draw from fractures, adjacent wells drilled into this formation have a high potential to interfere with one another. This is evidenced by the tendency of nearby wells pumping simultaneously to have a lower yield than the sum of each well operated independently.

Recharge to the PreCambrian aquifers frequently occurs through the overlying soils and surficial deposits. In this case, areas of thin soil cover and areas of highly premeable soils have the greatest recharge potential. Where PreCambrian rocks are covered with substantial layers of younger deposits, recharge reaches these rocks in a lateral direction, originating at higher elevations where the overburden is thinner. Since the occurrence of high-yielding water zones in the PreCambrian rocks is widely distributed and mainly unknown, the concept of identifying the protecting specific recharge zones is generally not feasible. Good land use practices and controls, generally applied, constitute a reasonable approach.

The quality of water found in the PreCambrian rocks is variable with respect to pH and hardness, but is generally of good quality and is suitable for most uses.

In general, the PreCambrian formation is important from a water supply viewpoint because of its extensive occurrence in Morris County. It is particularly important as a supply source for individual self-supplied homes scattered throughout the rural areas in the western part of the County. The importance of the PreCambrian as a water source for public water purveyors is lower than for the more productive aquifers due to the relatively low yields commonly encountered.

Paleozoic Deposits

Paleozoic deposits within Morris County occur over only a limited area. These rocks range in age from 450 to 600 million years old. During the Paleozoic Era, the seas advanced and retreated over the County several times. Hence, Paleozoic deposits are sedimentary in origin. Several distinct geologic events and consequently differing rock formations were deposited during the Paleozoic Era. However, for the purposes of this report, we have separated one

specific formation (the Kittatinny Limestone) from the rest on the basis of its importance as a water bearing aquifer. The balance of the Paleozoic Rocks in the County are shales and sandstones and generally possess poor water bearing capabilities. Plate 2 shows the present occurrence of Paleozoic deposits in Morris County. They are present in the western part of the County as narrow belts paralleling the ridges.

The Kittatinny Limestone deposits present within Morris County have a large potential for storing and yielding groundwater to wells. While the limestone itself has little primary permeability, it is extensively weathered by moving groundwaters, which slowly dissolve the limestone. Over extensive periods of time, this has resulted in the formation of solution cavities and channels which course through the deposits. A well which intersects one of these channels has a high probability of yielding substantial amounts of water. Public supply and commercial wells tapping the Kittatinny Limestone have developed yields from 40 to 400 GPM.

Groundwater occurs in these limestone deposits under water table and aratesian conditions. Recharge occurs through vertical leakage from the overlying surficial deposits, and also through direct precipitation in outcrop areas. In Morris County, limestone deposits are commonly overlain by glacial drift deposits which is probably the primary method of recharge.

Paleozoic sandstones in some localized cases support moderate rates of groundwater pumpage due to both primary and secondary permeability. In most circumstances, however, cementation of the sedimentary particles is sufficiently high to eliminate the sandstone's primary permeability.

In summary, the Kittatinny Limestone formation offers a good potential for groundwater supply development. To date, this formation has not been extensively utilized.

Triassic Deposits

Triassic rocks are younger than the PreCambrian and Paleozoic rocks discussed previously and consist of sandstones, shale, and basalt. These rocks occur as a bedrock formation in the southeastern third of Morris County. The sandstones and shale, occurring as alternating beds, were deposited at a time when an uplift in the Highlands to the west resulted in a relatively depressed basin where the Triassic rocks now lie. Heavy seasonal rains resulted in the deposition of eroded sediments in this area. During Triassic time, volcanic activity resulted in three discrete lava flows which interrupted the deposition

of the sedimentary shale and sandstone beds. Following their deposition, these rocks have been tilted, and now gently dip to the northwest. Subsequent weathering has eroded these rocks. However, the basalt layers are much more resistant than the shale and sandstone and have formed several ridges through differential erosion. The deepest and oldest basalt sheet forms the First Watchung Mountain, the next formed the Second Watchung Mountain, and the third formed a now discontinuous ridge comprising Towaco Mountain, Mount Kemble and Long Hill. The latter basalt sheet is the only one exposed in Morris County.

With regard to their hydrological properties, the sandstones and shale beds can yield moderate to large quantities of water due to their primary and secondary permeability. The basalt is capable of yielding only small quantities of water. Because of this and its limited areal extent in Morris County, it is unimportant as a regional water supply source.

Water in the Triassic rocks occurs under both water table and confined (frequently artesian) conditions. The latter occurs when more recent surficial deposits overlie the sandstone and shale beds. Groundwater is stored and moves through the sandstone and shale beds in rock fractures and along bedding planes. As these constitute a relatively small volume of the rock, their absolute capacity to store water is limited.

Large diameter wells drilled into the Triassic sedimentary rocks yield approximately 150 GPM on the average. Specific wells tend to vary in yield significantly around this mean, with a significant number of low yield wells (less than 50 GPM) occurring. These wells average over 300 feet in depth and range up to 1,000 feet. Production wells generally tap more than one water bearing zone in the rock strata.

Triassic rocks are primarily recharged through overlying soils in their upland outcrop zones. Recharge through overlying glacial deposits is possible where clay beds are lacking and the groundwater pressure in the aquifer would not result in a discharge condition.

The quality of water obtained from the Triassic rocks is generally good except that the water tends to be hard and sometimes contains iron in significant concentrations.

Quaternary Deposits

Quaternary deposits are the youngest of the major geological formations present within Morris County. These deposits originate from glacial activity occurring within the last million years. They are very important from a water

supply viewpoint as they store and yield large quantities of water to wells.

During the Quaternary period, it is believed that three glaciers reached Morris County. The greatest amount of existing glacial evidence, namely drift and till, was left by the Wisconsin glacier, the most recent of the three. This period of glacial activity resulted in many changes to the physical characteristics of Morris County. The glaciers blocked pre-existing drainage channels, resulting in several permanent alterations in drainage patterns. For example, it is believed that the Lamington River Valley originally drained north to the Rockaway River. After glacial deposits blocked this route, the drainage pattern changed, with waters flowing south into the Raritan Basin. Similarly, the area around Lake Hopatcong formerly drained into the Raritan Basin and now drains to the Musconetcong. Budd Lake was formerly in the Musconetcong Watershed and now forms the headwaters of the Raritan (South Branch). The glaciers also formed several lakes in the County, the now extinct Lake Passaic being the largest. The original Lake Hopatcong and Budd Lake are two present day examples of lakes formed by glacial activity.

Glaciers also modified the landscape by scraping material from the land surface and transporting it elsewhere. Material deposited by glacial activity can generally be divided into two categories - glacial till and glacial drift. Till refers to a mixture of soil, sand and stone which is carried and deposited by the ice flow. Till is frequently present in an unsorted condition. Glacial drift, on the other hand, refers to material which is deposited by meltwaters during the advance, stagnation, and retreat of the glacier. It is frequently sorted by flowing water into homogeneous-layers. The layers alternate due to changes in stream flow velocity during the glacial period. Warmer or wetter periods often resulted in a higher velocity stream flow leaving coarse sediments. Finer sediments, even clay beds, resulted from periods of sluggish stream flow.

Since the Wisconsin glacier stagnated in Morris County for a considerable period of time, the amount of glacial material deposited by the constantly moving but melting ice sheets was extensive. Estimates of the time during which the glacier stagnated in Morris County vary between 200 and 2,000 years. This resulted in a large terminal moraine which marks the southernmost advance of the glacier in this area. As the glacier melted and retreated, relatively thin ground moraine was left north of the terminal moraine. Both of these deposits are relatively unimportant as sources of large water supply as the

unsorted nature of the till results in limited porosity and permeability. The ground moraine is also too thin to form a major water bearing unit.

On the other hand, the stratified drift deposits present in many of the area's valleys and basins are excellent water supply aquifers. These drift deposits contain extensive beds of sand and gravel. As such they can store large quantities of water and yield water readily to wells. In 1965 it was reported that three quarters of the total groundwater pumped in Morris County was withdrawn from these Quaternary aquifers. The geology map (Plate 2) shows the extent of Wisconsin (and earlier) stratified drift deposits and the location of the terminal moraine. This map shows that stratified drift deposits are present both south and north of the Wisconsin terminal moraine, and are therefore an important water supply source throughout the County.

Groundwater in these drift deposits is present under both unconfined or water table conditions and under confined conditions where the drift was covered with less permeable glacial till. Confined drift deposits occur in the areas around Chatham and Morris Plains. Recharge to these deposits occurs laterally from adjacent rocks and from upland unconfined recharge areas. Because of the distance which infiltrating groundwater must pass to reach these deposits, the rate of recharge is lower than for unconfined deposits.

Unconfined deposits recharge from adjacent rock formations and through overlying soils. As such, the recharge potential is greater. In some cases, these unconfined drift deposits are hydraulically connected with associated streams. Under non-pumping conditions the direction of groundwater flow is from the drift deposits to the stream. Under pumping conditions, this condition can become reversed, with the stream recharging the aquifer. This situation is known to occur in the Rockaway Basin, near Dover. While the unconfined drift deposits offer a greater recharge potential, they are subject to contamination from land use abuses or other sources over a wide area. Recent cases of well closure from contaminated drift deposits in the Rockaway Basin illustrate this point. Land use controls are important to protect both the quality of this water as well as the amount of recharge. It is well known that increasing impervious land cover through development in prime recharge areas increases the proportion of rainfall which runs off and decreases the amount of recharge.

The average yield of wells which tap these deposits is approximately 500 GPM. Many wells yield over 1,000 GPM, with few wells yielding less than 50

GPM. These figures illustrate the capability of this aquifer to transmit water to wells. In areas of concentrated pumping of confined deposits, caution must be exercised so that the recharge capability of the aquifer is not exceeded. Declining water levels in the aquifer in the Florham Park - Chatham area through the late 1960's and in the 1980 drought is evidence of excessive pumping.

Water from this aquifer is of generally good quality and is suitable for most uses. Some areas contain hard to very hard water, and, most significantly, the aquifers have become contaminated in certain localized areas resulting in the use of alternate supplies or the need for expensive treatment.

In summary, the stratified drift deposits are the primary source of potable groundwater for Morris County. The development of additional supplies from this source is feasible, although care must be taken to avoid overpumping and jeopardizing existing supplies. Of great concern is the vulnerability of this source to pollution, especially where the drift is unconfined and overlain by permeable soils. These areas should be identified and protected from improper forms of development and land use practices.

2.4.2 Major Watersheds

Three major drainage basins exist within Morris County (See Plate 3). Two of these, the Raritan and the Passaic Basins, drain eastward toward the Atlantic Ocean. The third, the Delaware, is represented by the Musconetcong River which drains southwestward into the Delaware River. As such, Morris County straddles the ridge which separates the eastward from westward flowing waters. This ridge runs along and parallel to the northwestern border of the County, which is formed by the Musconetcong River. Ten percent of the County's area lies west of this divide within the Musconetcong Watershed.

Portions of the greater Raritan Watershed occupy 25% of the County's area. This area is divided into three smaller basins, the South Branch, North Branch and the Black River (or Lamington River). All three of these basins are oriented in a northeast-southwest direction which parallels the direction of the ridges in that part of the County.

The bulk of the County (roughtly two thirds) is included within the Passaic Basin. This basin can also be subdivided into major sub-units, these being the Upper Passaic, Whippany, Upper Rockaway, Lower Rockaway, Upper Pequannock and Pompton-Pequannock. The streams which drain this area are arranged in

a branched, fan-like arrangement with several streams cutting across the northeast-southwest trending ridges.

Land areas are frequently divided along watershed boundaries for purposes of study, discussion and management. This is frequently done since watersheds are distinct and frequently autonomous hydrological units. However, some of the watersheds within Morris County may not be completely isolated from one another, but may be connected by sub-surface groundwater flows. Many of the surface drainage divides which determine the course of present rivers were formed by glacial activity. In some cases, as has been discussed previously, the glaciers have altered the alignment of pre-historic rivers by damming gaps in the bedrock ridges with glacial till or drift. While glacial deposits can alter the course of surface streams, the movement of groundwater can sometimes follow pre-glacial or other drainage directions.

In addition to the above case, groundwater can cross ridge lines by migrating through limestone deposits, or through fault zones. The watershed map shows, via dotted ridgelines, places where groundwater may migrate from basin to basin. This may be significant in some areas because it may result in a groundwater potential which is greater or smaller than that estimated from the size of a given watershed. The location of these underground "rivers" may also be helpful in determining feasible locations for additional groundwater development.

2.5 GROUNDWATER QUALITY

The following section of this report deals with the issue of existing groundwater quality. With the extensive use of groundwater resources for public supply, present trends in groundwater quality are a pressing concern in Morris County's water supply outlook.

2.5.1 Water Quality Inventory and Problem Areas

Groundwater quality within Morris County generally reflects local subsurface geological conditions. As water moves through an aquifer, it dissolves various mineral constituents and assumes a particular character. In certain areas, groundwaters are considered "hard", a condition resulting from high concentrations of calcium, magnesium and other ions. This occurs under various geological conditions and can result in nuisance conditions when the water is untreated. The build-up of scale deposits in domestic plumbing and inter- ference with soaps and detergents is characteristic of hard water areas. The recommended upper limit for hardness in potable supplies is 150 parts per

million (PPM); and as Table 3 indicates, values as high as 258 PPM are encountered in Morris County. Removal of hardness is effectively accomplished through the use of water softeners.

Iron and manganese, elements often occurring together, are also found at levels which sometimes exceed the recommended drinking water standards. This commonly results from mineral deposits which contact groundwaters, although the presence of organic contaminants in groundwater can greatly increase the concentrations of iron and manganese. These elements are also nuisance parameters (as opposed to toxic compounds) in a domestic supply as they can stain laundry and plumbing fixtures. Roxbury, Jefferson, East Hanover, Boonton and Kinnelon are known to have high concentrations of either iron or manganese in local groundwaters. East Hanover, Boonton and Florham Park operate treatment facilities for removal of iron and manganese.

In the western portion of the County, groundwaters pumped from wells drilled into hard Pre-Cambrian Rock formations are frequently acidic, with pH values less than 6.0. This causes erosion of domestic plumbing with subsequent copper staining of plumbing fixtures. This water quality condition is correctable through the use of chemical neutralizers.

In general, the background quality of groundwaters in Morris County produces water which is potable, although local nuisance conditions are sometimes encountered. In most cases, primary water quality standards (designed to protect human health) are met. Table 3 represents a summary of water quality data for approximately twenty-five water purveyors in the County.

In reviewing this data, certain indications of low level groundwater contamination are present in several cases. This is evidenced by the presence of certain water quality indicators which are either absent or present in trace quantities under background conditions. For example, a number of public supply wells show positive levels of nitrate, an indicator of organic pollution. One purveyor (Pine Crest in Mount Olive) reported a level of nitrate of 22.1 PPM, a violation of the primary standard.

Nitrate in groundwaters is often a result of contamination caused by septic systems. It is therefore a concern in areas where residents have both a well and a septic system. Through system malfunction, poor ground conditions, or small lot sizes, cross-contamination between wells and adjacent septic systems can occur. In a recent study in Montville Township (Anderson and Denzler, 1982) all private wells within the Township (over 2,000) were tested.

TABLE 3

MORRIS COUNTY GROUNDWATER QUALITY SUMMARY

Parameter	Standard	Range	Average	Number Of Responses
COLOR	10.0	0-7.5	1.60	20
ODOR		0-1	0.27	22
TURBIDITY	5.0	0-7	2.80	19
pH	6.0-8.5	6.2-8.1	7.20	25
ALKALINITY		19-190	89.00	23
NITRATE	10.0	0-22.1	2.48	14
CHLORIDE	150.0	0-80	35.90	15
DISSOLVED SOLIDS	500.0	83-419	209.00	21
DETERGENTS	0.5	0-0.3	0.04	13
HARDNESS	150.0	2-258	118.00	22
IRON	0.3	0-0.57	0.12	21
MANGANESE	0.05	0-0.3	0.04	16
SODIUM	50.0	0.15-17.7	7.50	6
SULFATE	250.0	6-111	38.30	15
FLUORIDE	2.0	0-0.89	0.28	14
ZINC	5.0	0.02-0.13	0.06	5
CONDUCTIVITY	5.0	117-372.5	270.60	4
CYANIDE	0.2	0.01 K	0.01 K	4
COLIFORMS	0.0	0-0.1	0.01	7
MERCURY	0.002	0-0.005		6

NOTE: "K" means "less than"

All results expressed as parts per million

Of that number, 13% were judged to be polluted, based on contaminant levels which exceeded standards or were determined to be above background. The program included tests for bacterial levels, nitrate, and chloride. The ratio of polluted to non-polluted wells was not uniform throughout the Township, but was abnormally high (up to 47%) in certain areas, presumably where local soil and site conditions are unfavorable. Montville Township is not unique in this respect. Many areas throughout the County rely on the septic system/private well combination under less than ideal circumstances. Notable examples are densely developed lake communities which often have small lot sizes and shallow depths to bedrock or water table.

Recently, great interest has been focused on the presence of detectable levels of a number of toxic organic chemicals in New Jersey drinking water supplies. The widely-publicized problems which were experienced in 1980 in Rockaway Township and Rockaway Borough are a graphic example of the effect that groundwater contamination can have on a municipality. While these cases are extreme, involving sufficiently high levels of contaminants to warrant the closing of a municipal supply, similar organic contaminants are present at lower levels in a number of other wells in Morris County. The recent 208 studies emphasized testing for toxic compounds in their water quality analysis programs, in an effort to better document this problem. Table 4 is a compilation of analyses which show the presence of volatile organic compounds in several Morris County wells. Other than the Rockaways and Dover Well No. 4 (which has been removed from service), these results do not indicate any threat to public health.

Public controversy over the issue of landfill operations has resulted in better documentation of groundwater quality surrounding the recently-closed Combe Fill South landfill in Chester and the closed Combe Fill North landfill in Mount Olive. Recent data has indicated that these unlined disposal sites are having an adverse impact on adjacent groundwaters. This supports the contention that existing landfilling techniques are an obsolete method of dealing with our solid waste problem and that new landfills must be designed to collect and treat leachate in order to adequately protect our water supplies.

In summary, while the quality of groundwater in Morris County is generally good, evidence of varying degrees of groundwater contamination exists at

TABLE 4

VOLATILE ORGANIC CHEMICALS IN SELECTED MORRIS COUNTY WELLS

Parameter	Rockaway Borough 10/15/80-Well #1	Rockaway Township 10/15/80-Well #1	Dover 9/3/80-Well #4	Par-Troy Hills 7/1/80-Well #18	Roxbury Water Co. 10/23/80
Carbon Tetrachloride	1.0	2.6			
Benzene	8.6				5.9
Methyl Chloride	2.0		6.0		
Chlorobenzene	5.1				10.5
Trichlorofluoromethane					
Tetrachloroethylene	387.0		122.0		
Trichloroethylene	4.1	362.0	2.0	1.6	
1,1,1 Trichloroethane	2.6	4.2	118.0	1.1	
Chloroform	3.4	2.6			
1,2 Dichloroethylene	8.4	9.7	9.4		20.2
1,1 Dichloroethylene		1.6			
Toluene				1.5	
Ethylbenzene				1.2	

NOTE: Results expressed as parts per billion

SOURCE: DEP, Passaic River Coalition, and Purveyor Reports

TABLE 4, CONTINUED

VOLATILE ORGANIC CHEMICALS IN SELECTED MORRIS COUNTY WELLS

Parameter	Picatinny Arsenal	Mennen Company	Southeast Morris County MUA	Denville 4/8/80	Madison 1978
Carbon Tetrachloride					1.0
Benzene					
Methyl Chloride					
Chlorobenzene					
Trichlorofluoromethane					
Tetrachloroethylene		15.5			
Trichloroethylene		101.5			
1,1,1 Trichloroethane	5.1	6.8	5.8	1.3	1.0
Chloroform	2.0	3.5	12.3		17.0
1,2 Dichloroethylene				3.7	
1,1 Dichloroethylene					
Toluene					
Ethylbenzene					

NOTE: Results expressed as parts per billion

SOURCE: DEP, Passaic River Coalition, and Purveyor Reports

several locations. It is important that municipal officials and the general public recognize the need to protect water supplies from contamination and maintain this concern as a priority in local decision making.

To illustrate the consequences of the loss of a water supply through groundwater contamination, the case of groundwater contamination in Rockaway Borough is worth discussing.

In September, 1980 the presence of tetrachloroethylene, also known as perchloroethylene (PCE) was detected in Rockaway Borough's three wells. This was discovered by the State, which conducted testing in municipalities near Rockaway Township where a similar problem was experienced earlier. Subsequent testing of the Borough's wells indicated increasing levels of PCE which finally resulted in a notice by Mayor Robert Johnson in February, 1981 which advised the Borough's residents to discontinue using tap water for drinking and cooking. Emergency supplies were provided via Civil Defense and National Guard tank trucks.

After considering several options, the Borough opted to install an activated carbon absorption system, similar to the system previously installed in Rockaway Township. The cost to the Borough for the absorption system was $136,000. However, significant site and system modifications were necessary for the proper installation and integration of the system. Total capital costs totalled $700,000. The efficiency of the system is excellent, removing volatile organics to a level below one part per billion.

Another significant cost of this system is the cost of activated carbon which must be replaced periodically. The approximate cost for carbon replacement in the Borough's system is $40,000. It is hoped that carbon replacement will not be necessary more than once per year, the interval depending on the amount of contaminants which are removed by the adsorbers.

The cost of the adsorption system has had a significant impact on the Borough's water rate structure. Water rates have tripled although it is not known at present if this increase will be sufficient to cover the capital and operating cost of the system.

Overall, the occurrence of this problem and the implementation of a solution was a traumatic and costly experience for this community. The Borough was fortunate in that the nature of the problem was effectively managed by the type of treatment system selected. Unfortunately, whatever cost was saved by improper disposal of the chemicals which caused the contamination will be spent many times over in public funds to correct the problem.

2.5.2 Water Quality Planning

Water quality planning is important in the context of a water supply study since proper and effective water quality management can help to maintain the suitablility of both surface and groundwater resources as potable water supplies. The purpose of this discussion is to briefly summarize the status of water quality management programs and projects in Morris County.

Water quality management has been an on-going process for many years. However, the passage of the Water Pollution Control Act Amendments in 1972 and the Clean Water Act in 1977 served to greatly accelerate the process. These laws set national wastewater treatment goals and set dates by which these goals would be achieved. In order to accomplish this, planning procedures were established and grant funds were provided. In the face of evertightening restrictions on the discharge of treated wastewater and with the availability of 75% Federal planning and construction funding plus State funding, water quality management planning activities were greatly stimulated.

Three important types of wastewater planning activities resulted from this legislation, including Areawide Water Quality Planning (Section 208), Basin Planning (Section 303e), and Facilities Planning (Section 201).

The 208 planning is performed on a relatively large scale, often encompassing several river basins and frequently defined by County boundaries. Twelve 208 planning areas have been designated in the State of New Jersey, with the planning work undertaken by a designated agency in each area. Morris County is included within four 208 planning areas, the perimeters of which generally correspond with major drainage basin limits. The bulk of the County is included in the "Northeast New Jersey" Water Quality Management Plan which encompasses those portions of the County within the Passaic River system. In the western part of the County, the "Upper Raritan" and "Upper Delaware" planning areas take in areas within the Raritan and Musconetcong Watersheds, except for portions of Jefferson, Mount Arlington and Roxbury located in the Musconetcong (Lake Hopatcong) Watershed. In order to avoid splitting the Lake Hopatcong drainage basin between two 208 planning areas, the entire basin has been included in the "Sussex" planning area. The DEP is the designated planning agency for the Northeast, Upper Raritan and Upper Delaware planning areas. The County of Sussex has been designated as the planning agency for the Sussex planning area.

The purpose of 208 planning is to develop an areawide strategy for the

management of water quality. These studies consider pollution from point (sewage discharges) and non-point (landfills, farms, urban areas) sources, and they deal with both structural and non-structural solutions. The 208 plan serves to evaluate water quality conditions, define water quality goals, and provide an overall strategy for the attainment of these goals. The 208 plans point out deficiencies in the area's data base, propose continued monitoring programs, and provide for long-range planning to follow up on the implementation of the Plan's recommendations. Draft 208 Water Quality Management Plans were published by the State in Spring of 1979.

Another type of planning conducted in recent years was 303(e) basin planning. Planning areas are defined by discrete river basins. One of the prime objectives of 303(e) planning is to develop a strategy which defines the amount and quality of wastewater which can be discharged to a stream by existing and proposed treatment plants or other point sources. This is called a wasteload allocation strategy and is based on a technical analysis of the assimilative capacity of a given stream. The 303(e) plans also serve to coordinate and direct State and local water quality decisions on a river basin scale. The plan attempts to mitigate short-term water quality problems by establishing specific effluent limits, water quality standards, and control strategies. Basin planning also helps to provide a basis for awarding grants and establishing priorities for 201 Facility Planning projects.

The 201 Facilities Planning is planning which is performed by municipalities, sewerage authorities, or other entities which are responsible for the management, construction, and operation of wastewater treatment facilities. The end product of the 201 Facilities Planning process in a local area is the construction of feasible, cost-effective, and environmentally-sound sewerage facilities. These facilities may be local collection systems, regional wastewater transmission facilities, sewage treatment plant, or sewage sludge treatment and disposal facilities.

The planning process is divided into three phases or steps. Step I is the planning phase in which needs are assessed, alternatives are evaluated, and projects are formulated and adopted. Step II consists of the design of proposed projects, and Step III is actual construction.

The process as a whole is very complex. The regulatory and administrative obstacles which must be overcome before a project is placed into

operation are enormous. As a result, many projects for which planning was begun ten years ago are not yet in the construction stage. Still, many projects have been completed and progress toward the attainment of Clean Water Act goals is being made. The future of this program depends on the amount of Federal funding which is allocated to this program and the Federal policies which affect the types of projects to be funded.

The 201 Planning is frequently conducted on a regional level, with planning areas defined along drainage basin lines. Regional planning efforts normally result in the construction of facilities to serve two or more municipalities. Individual municipalities within such a planning area often conduct local 201 planning to develop and construct local facilities within the framework of the regional strategy.

Nine regional 201 planning agencies have been designated in Morris County. These are listed below along with a short discussion regarding the limits of their planning areas and the status of their projects.

Pequannock River Basin Sewerage Authority - The area served by this authority includes Butler, portions of Kinnelon and Riverdale, plus areas within Passaic County. The major existing facility which serves sewered portions of the area is the Butler-Bloomingdale plant which has a design capacity of 1.4 MGD. The plant is currently overloaded. The 201 Planning activities within the area would result in an upgraded plant and an extended service area. Design on regional improvements has begun, and it is projected that facilities will be ready to receive construction funds in 1982.

Pequannock, Lincoln Park and Fairfield Sewerage Authority - The planning area includes the municipalities of Pequannock, Lincoln Park, and Fairfield. A new plant has been constructed in Lincoln Park with a capacity of 7.5 MGD. Additional municipal collector systems will be constructed to extend the area served by sewerage facilities.

Parsippany-Troy Hills - The facility planning area includes Parsippany-Troy Hills, Mountain Lakes, and Montville. It is expected that East Hanover will also be connected to the Parsippany system in the future. The treatment plant has been expanded to a 16 MGD facility employing secondary treatment. More advanced treatment is proposed to comply with current regulatory requirements.

Rockaway Valley Regional Sewerage Authority - The planning area includes the limits of the Rockaway River Watershed upstream of the Boonton Reservoir. All or part of the following municipalities are included with the facilities planning area: Boonton, Boonton Township, Denville, Rockaway Township, Rockaway, Dover, Wharton, Randolph, Mine Hill, Victory Gardens, Jefferson, Roxbury and Kinnelon. The Rockaway Valley Regional Sewerage Authority operates a treatment plant which has a design capacity of 9.0 MGD. The plant is overloaded and a limited ban on new connections to the treatment plant has been in effect for thirteen years. The Rockaway Valley Regional Sewerage Authority has recently completed the construction of a new interceptor sewer and has completed the design of a new 12.0 MGD treatment facility.

Whippany River Basin - This planning area includes portions of the following municipalities within the Whippany Basin above the Whippany's confluence with Troy Brook: East Hanover, Hanover, Morris Plains, Morristown, Morris Township, Mendham Township, Parsippany-Troy Hills, Denville, Mountain Lakes, Randolph, Harding, Florham Park and Madison Borough.

Three municipal treatment plants currently serve the planning area. They are the Hanover, Morristown and Morris township-Butterworth facilities. Of these, the Morristown and Hanover plants have been recently expanded. A facilities plan for the entire planning area has been submitted, but additional design and construction of facilities awaits resolution of a number of Step I issues, primarily related to the required treatment capacity.

Livingston-Florham Park - This facilities planning area includes both of the above-named municipalities. Each municipality operates its own wastewater treatment facility. Lack of treatment capacity has not been a major problem in this area, although excessive inflow and infiltration of surface and groundwaters has been experienced in the Livingston system. Facilities planning has not yet been initiated in this area.

Upper Passaic River Basin - This planning area includes the drainage basin of the Passaic River upstream of the Canoe Brook Reservoir. Included in the study area are portions of sixteen municipalities of which the following nine are within Morris County: Passaic Township, Chatham Township, Chatham Borough, Madison, Morris Township, Harding, Mendham Borough, Mendham Township and Morristown.

The area is currently served by nine municipal treatment facilities.

Most of these plants are small, the largest being the Madison-Chatham Joint Meeting plant at 4.0 MGD. A Facility Plan was prepared for this area and was submitted to the State for review. EPA subsequently prepared a draft Environmental Impact Statement due to the presence of substantial issues in the planning process. At this time, the basin-wide strategy for the control of effluent discharges has not been finalized. In the interim, facility planning on a more local level is proceeding in some of the sewerage jurisdictions within the planning area.

Mount Olive/Washington Township - This facilities planning area is situated at the headwaters of the Raritan River drainage basin, and in addition to the two townships named above, includes portions of Roxbury. Those portions of the planning area which are not served by individual septic systems are sewered by small municipal and package plants. A facility plan was prepared and submitted by the Washington Township Municipal Utilities Authority. Proposals for more centralized treatment facilities are contained within this study. However, the overall project is still within Step I.

Roxbury - This planning area is at the headwaters of the Lamington River Watershed, which is a tributary of the Raritan. At this time, no agency has been designated to conduct this planning and no planning has been initiated.

Musconetcong Sewerage Authority - This Authority operates a 1.0 MGD facility which discharges to the Musconetcong Watershed outside of Morris County. However, portions of Mount Olive and Roxbury are served by this facility. Also, areas within Mount Arlington and Jefferson are included within the planning area. The Authority has submitted a Facility Plan which proposes the expansion and upgrading of its treatment facility.

2.6 WATER SUPPLY PLANNING

As discussed in a previous section, the current availability of water supply planning studies on a municipal level is the exception rather than the rule. Where specific plans have been proposed, they have been discussed in Section 2.2.

The State of New Jersey is now finalizing a Statewide Water Supply Master Plan (SWSMP). This is the culmination of a comprehensive five year study on New Jersey's water supply needs. This study presents recommendations regarding the governmental structure which regulates water suppliers and also recommends specific projects for the improvement of water sources and distri-

bution facilities. A package of five bills emerged from this study and was introduced to the State legislature, and was enacted. Two of the more important pieces of legislation resulting from this process are the Water Supply Management Act and the Water Supply Bond Act of 1981.

Due to the importance of the SWSMP, we will briefly summarize here some of the important aspects of this study as they relate to Morris County. This study divides the State into six major planning regions. Needs and recommendations in this study have been evaluated on a region-wide basis. Regions were chosen based on major river basin boundaries, areas of common characteristics, and political boundaries. Unfortunately, the delineation of regions did not greatly benefit Morris County in that the County was split between two major regions. Most of the County was placed in Region I, which includes the populous northeast section of the State. Morris County differs from these areas enormously, with respect to the type of water supply problems encountered and the type of improvements which might overcome these problems.

A small portion of the County (lying within the Musconetcong Watershed) is included in Region 6. However, those portions of the County are reasonably similar to other areas within Region 6.

Within Region 1, a further division was made in the report issued by the State's consultants, but not by the State in its Draft Summary document. Apparently, the consultants thought that the further division was appropriate due to the size of Region 1 and the differences between the suburban and urban areas which make up the region. Morris County and portions of Somerset and Hunterdon Counties were also included in the West division of Region 1. The SWSMP reports that a critical deficit of water supplies exists in Region 1, with probable deficits as follows:

1980 - 63 MGD deficit
1990 - 107 MGD deficit
2000 - 150 MGD deficit

In the consultants report, these deficits are broken down further as follows:

	North	West*	South	Total
1980	55	3	5	63
1990	70	12	25	107

* includes Morris County.

This further breakdown is significantly more useful to Morris County as the County's needs are quickly lost when combined with the urban northeast. By far the majority of Region 1 needs are located in the North sub-area. Nonetheless, the following capsule summary of the Region's supplies and demands, extracted from the consultants' report, is useful.

> "In 1976, demands in Region 1 totaled 756 mgd. A unique condition exists in this region, since some purveyors are operating with supply surpluses and others are overdrafting their resources well beyond safe levels. In 1976, several water utilities overdrafted their sources to a combined deficit of 55 mgd.
>
> The majority of the surplus water that could be supplied in the region is committed to normal and seasonal peaking conditions, emergency back-up supply, and for meeting future needs. In addition, supplies which are available for export are limited by transfer capabilities among the various purveyors. The existing supply deficits, combined with increases in demands in Region 1, are estimated to total 63 MGD in 1980. This quantity of water represents a critical, immediate need in Region 1 and, since new supply projects will not be operational for several years, the available surplus supplies existing in some purveyor systems must be transferred to those with deficits."

The SWSMP discusses the major categories of water resources which can be used for supplying future demands. Near term (1980-1985) and long term (1985-2020) planning horizons are discussed. The report concludes that the further development of intra-state waters is necessary over the short term, with the optimization of distribution networks (including interconnections) being necessary to balance surpluses and deficits within a Region. A Passaic-Raritan pipeline is proposed as an intra-Region project in this context.

Over the long term, additional local development of water systems is recommended. In addition, the option of utilizing interstate waters is given a high priority.

In the State summary document, the following water system improvement projects are considered for the region:

1. A combined pumping and storage project called Wanaque South.
2. The Elizabethtown-Newark Interconnection, and the Raritan-D&R Canal Interconnection.

3. A Raritan-Passaic pipeline.
4. The Confluence Reservoir, pumping station, and force main.
5. Other interconnections.
6. Rehabilitation of existing water systems.
7. Additional storage reservoirs, namely Washington Valley, Dunkers Pond, Longwood Valley, Monksville, and Six Mile Run.
8. Other minor projects.

In the consultant's report, the near-term recommendation for the "West" area of Region 1 is the construction of a Raritan-Passaic pipeline and associated appurtenances.

Current estimates indicate that this pipeline can provide 60 to 80 MGD to the Passaic Basin at a cost of over $60 million. While many variations of this pipeline have been discussed, the currently favored concept calls for a pipeline and pumping station with an intake point on the Raritan at its confluence with the Lamington River and extending eastward over the Watchung Mountains to the Dead River. The pipeline would discharge at that point, utilizing the existing river channel to transport water to the Passaic River at East Hanover. Another pumping station and pipeline, slightly smaller than the first would transport water west to the Jersey City Reservoir. While detailed alignments have yet to be developed, it is reported that the pipeline would be placed above ground in certain locations.

The purpose of this project as indicated by the DEP, is solely one of drought relief. That is, the facilities would only be utilized during drought periods (less than 10% of the time). During periods in which it is operational, the project would provide additional water to northeast purveyors through the Jersey City system and would bolster supplies diverted from the Passaic River itself.

This project offers the State a means through which significant supplies could be made available to water-short purveyors within a reasonably short period of time. This was of significant importance during the 1979-1980 drought given the uncertainty of how long the drought would last and what its ultimate effects would be. At that time, the need for the project was very nearly an emergency response.

At this time, the drought has subsided and a number of significant actions have occurred which have improved and will further improve the State's

ability to respond to a drought. These include an expansion of the DEP's emergency powers through the Water Supply Management Act, and the design and/or construction of several interconnections and diversion pipelines which can now move significant water supplies to areas of potential major deficits. Authorization of funds via the Water Supply Bond Act of 1981 allows the implementation of a variety of projects which can improve supply capabilities and reduce demand via rehabilitation of leaky systems.

Given these circumstances, it is perhaps proper for the State to reconsider its "fast-track" approach to implementing the Raritan-Passaic Pipeline project in order to evaluate more efficient and versatile methods of insuring the safe yield capacity which is necessary in a drought.

For Morris County, the pipeline project is not responsive to the day to day water supply needs which will be experienced in the future. High capital and pumping costs make this an inefficient source of supply to satisfy daily demands. An alternative approach utilizing an expanded reservoir network might accomplish the same objectives as the pipeline while offering other significant advantages, such as flood control, increased groundwater recharge, and opportunities for local water supply use.

For Region 6, the SWSMP states that future water supply needs (11 MGD by 1990) can be met by additional diversions from available ground and surface supplies.

In addition to the technical proposals which are described in this report, recommendations are made which would unify and restructure the existing policies and regulations concerning water supply. The package of five bills and resulting legislation mentioned earlier is an attempt to implement some of these recommendations. The key recommendations of the study concerning the existing governmental structure are as follows:

1. A proposed new diversion law.
2. A revised administrative review process.
3. Revised operating standards for water purveyors.
4. Operation of State utility operations on a self-sustaining basis.
5. Municipal responsibility for the inadequate operation of small water companies.
6. Strengthening the role of large investor-owned companies.
7. State responsibility for the implementation of revised water management programs. These programs to be self-sustaining.

3.0 FUTURE DEMANDS

3.1 PROJECTED GROWTH AND WATER DEMANDS

A reasonable estimate of future water demands is essential if water supply facilities are to be properly managed. Therefore, water demands were projected, by municipality, for 1990 and 2000.

In order to estimate future water demands, several factors must be determined. These include growth projections; the percentage of the population served by community supplies; and the rate of consumption per capita. Growth projections, broken down by municipality, were obtained from the Morris County Planning Board for 1990. For the year 2000, the population projection, by town, was derived from the trends established for the 1980 to 1990 decade and the projected County total of 520,000 persons.

Estimates of the population served and per capita consumption were made based on historical consumption patterns and the nature of the various communities. While the latter two estimates are somewhat subjective in nature, the existing data base provides a reasonable method for establishing local conditions and trends. It should be noted that the per capita consumption figures, both present and projected, include non-residential water consumption. An attempt was made to segregate industrial water demands from residential demands through projections of industrial growth by the Morris County Planning Board. Based on limited data available, this approach was not feasible in the context of this study.

Estimates of the percentage of population served were based on the premise that some extension of water service would be made in municipalities which have unserved residences at present. The increase in the percentage of the population served depended on the location of developed but unserved areas, their density, and the nature and circumstances known about each particular municipality.

Estimates of the per capita consumption were made based on trends observed in the past decade as well as current thinking regarding water conservation, water use, and water system leakage and rehabilitation. In general, an eight percent increase in per capita consumption was assumed by 1990. Certain communities in which significant new non-residential development is expected were alloted an additional 15 gallons per capita per day. These municipalities included Rockaway Township, Mount Olive and Morristown.

Communities with very small systems, which report very low per capita consumption were alloted a larger percentage increase. Present per capita demands in the vicinity of 60 to 70 GPCD are partially due to inadequate supplies, transmission facilities, and sometimes inadequate water quality. As these problems are overcome, the per capita usage will increase significantly.

For the decade 1990 to 2000, a six percent increase in per capita demand was projected in most cases.

Table 5 contains the projections of 1990 community demand by municipality and includes the factors which were used to calculate the projected figures. As this table indicates, the County-wide community demand in 1990 is estimated to be 47.9 MGD, compared with 36.7 MGD in 1980. This represents a 31% increase over the ten year period.

Regarding the use of private wells by County residents, this demand was estimated for 1990 by deducting the population served from the total population and multiplying the difference by 70 gallons per capita per day. This yields a demand of 5.3 MGD, a figure slightly less than the 1980 demand. This is due to a projected net decrease in the number of persons to be served by private wells.

Table 6 contains the projections of community demand by municipality for the year 2000. These projections total 60.8 MGD. Between 1990 and 2000, these projections indicated an increase in demand of 12.6 MGD, or 27%. For the period 1980 to 2000, increase in demand is projected at 66%. By 2000, it is estimated that approximately 3.9 MGD will be diverted by residents through private wells in the unserved portions of the County.

One of the most significant factors in these projections is the increase in the percentage of the population served. As the population density has increased in the past and will continue to increase in the future, the need for extending water supply service to presently unserved areas has become recognized. It is expected that major additions to water system service areas will occur. In a number of municipalities, local utility authorities have been set up to upgrade, consolidate, and expand water services. In many cases, developments now in place have already installed "dry" water lines in anticipation of future connection.

New development patterns have changed from those of the early seventies resulting in more construction of clustered and multiple family units, invariably connected to a community water supply. Most new development over the

TABLE 5

PROJECTED PUBLIC COMMUNITY WATER CONSUMPTION BY MUNICIPALITY - 1990

	Projected 1990 Population	Projected Population Served 1990	1990 Per Capita	1990 Average Water Use (MGD)
BOONTON	8,840	8,840	143	1.26
BOONTON TOWNSHIP	3,720	558	138	.08
BUTLER	7,950	7,950	105	.83
CHATHAM	8,770	8,770	132	1.16
CHATHAM TOWNSHIP	10,440	9,187	87	.80
CHESTER	1,860	1,116	80	.09
CHESTER TOWNSHIP	5,880	882	80	.07
DENVILLE	16,110	15,305	145	2.22
DOVER	13,460	13,460	174	2.34
EAST HANOVER	11,470	9,979	160	1.60
FLORHAM PARK	9,810	9,810	129	1.27
HANOVER	14,080	14,080	136	1.91
HARDING	3,970	1,174	137	.16
JEFFERSON	17,960	8,980	80	.72
KINNELON	8,560	5,564	80	.45
LINCOLN PARK	8,770	7,016	135	.95
MADISON	15,740	15,740	134	2.11
MENDHAM	6,510	6,510	141	.92
MENDHAM TOWNSHIP	6,240	3,120	93	.29
MINE HILL	3,870	2,903	98	.28
MONTVILLE	17,650	10,509	167	1.76
MORRIS PLAINS	5,750	5,750	120	.69
MORRISTOWN	15,240	15,240	125	1.91
MORRIS TOWNSHIP	21,350	19,215	129	2.48
MOUNT ARLINGTON	4,270	2,135	80	.17
MOUNTAIN LAKES	4,560	4,560	161	.73
MOUNT OLIVE	25,820	19,365	110	2.13
NETCONG	3,720	3,720	126	.47
PARSIPPANY-TROY HILLS	54,980	54,980	121	6.65
PASSAIC TOWNSHIP	8,210	7,800	87	.68
PEQUANNOCK	14,500	12,905	121	1.46
RANDOLPH	24,050	18,038	125	2.25
RIVERDALE	2,680	2,358	111	.26
ROCKAWAY BOROUGH	7,790	7,790	134	1.04
ROCKAWAY TOWNSHIP	22,300	16,725	111	1.86
ROXBURY	23,360	18,688	96	1.79
VICTORY GARDENS	1,410	1,410	174	.25
WASHINGTON TOWNSHIP	14,410	8,700	116	1.01
WHARTON	5,620	5,620	138	.78
	461,680	386,452	124*AVG.	47.9

* Average consumption per person per day in gallons. Includes a portion of local commercial and industrial use.

Note: Figures exclude Picatinny Arsenal and Hercules Powder.

TABLE 6

PROJECTED PUBLIC COMMUNITY WATER CONSUMPTION BY MUNICIPALITY - 2000

	Projected 2000 Population	Projected Population Served 2000	2000 Per Capita*	2000 Average Water Use (MGD)
BOONTON	9,605	9,605	152	1.46
BOONTON TOWNSHIP	4,241	982	146	.14
BUTLER	8,640	8,640	111	.96
CHATHAM	9,880	9,880	140	1.38
CHATHAM TOWNSHIP	11,960	10,884	92	1.00
CHESTER	2,080	1,664	90	.15
CHESTER TOWNSHIP	6,360	2,544	90	.23
DENVILLE	18,043	17,293	154	2.66
DOVER	14,537	14,537	184	2.67
EAST HANOVER	13,108	12,190	170	2.07
FLORHAM PARK	10,302	10,302	137	1.41
HANOVER	15,600	15,600	144	2.25
HARDING	4,680	2,340	145	.34
JEFFERSON	20,280	14,196	90	1.28
KINNELON	9,820	7,365	90	.66
LINCOLN PARK	8,980	7,633	143	1.09
MADISON	16,054	16,054	142	2.28
MENDHAM	7,332	7,332	149	1.09
MENDHAM TOWNSHIP	7,280	4,732	99	.47
MINE HILL	4,489	3,815	104	.40
MONTVILLE	21,709	16,280	177	2.88
MORRIS PLAINS	6,210	6,210	127	.79
MORRISTOWN	17,160	17,160	133	2.28
MORRIS TOWNSHIP	24,552	24,060	137	3.30
MOUNT ARLINGTON	4,680	3,510	90	.32
MOUNTAIN LAKES	5,015	5,015	171	.86
MOUNT OLIVE	33,210	28,230	117	3.30
NETCONG	4,060	4,060	134	.54
PARSIPPANY-TROY HILLS	57,280	57,280	128	7.33
PASSAIC TOWNSHIP	9,360	9,080	92	.84
PEQUANNOCK	15,225	14,615	128	1.87
RANDOLPH	29,820	25,350	133	3.37
RIVERDALE	2,840	2,700	118	.32
ROCKAWAY BOROUGH	8,801	8,801	142	1.25
ROCKAWAY TOWNSHIP	24,976	21,230	118	2.51
ROXBURY	26,941	23,440	102	2.39
VICTORY GARDENS	1,560	1,560	184	.29
WASHINGTON TOWNSHIP	17,120	11,985	123	1.47
WHARTON	6,210	6,210	146	.91
	520,000	464,364	131 *	60.8

* Average consumption per person per day in gallons. Includes a portion of local commercial and industrial use.

Note: Figures exclude Picatinny Arsenal and Hercules Powder.

coming decades will be served by community water systems.

Based on these projections, the largest increases in water demand will be felt in the following communities: Montville, Mount Olive, Parsippany-Troy Hills, Randolph, Rockaway Township and Roxbury. Most of these communities have a high growth potential and (with the exception of Parsippany-Troy Hills) have substantial areas of existing but presently unserved development.

3.2 IMPLICATIONS OF GROWTH

Additional population growth in Morris County will result in a number of indirect or secondary effects. In the context of this report, effects on available water resources are of interest since the County relies on these resources for existing water supplies. In addition, future demands will likely be met by intra-County water resources.

In general, population growth and associated development (commercial and industrial) can affect the quality and quantity of available water resources. With the development of presently undeveloped land areas, the amount of impervious surfaces will tend to increase. This affects hydrologic patterns by increasing surface runoff and decreasing recharge. The balance of surface water to groundwater is therefore affected. Most of the increased runoff occurs during wet weather periods. In some cases, this runoff can be trapped and stored in reservoirs, but these are frequently at or near capacity during these periods. In addition, most of the reservoirs in Morris County have been developed to yield water supplies for out of County use. Therefore, the loss of recharge to the groundwater system represents a net loss of water to the County.

An associated effect is the increase in peak flood flows which result from the added runoff. This can cause flooding problems or aggravate existing ones.

While nearly any form of development will result in an increase in the amount of impervious areas, the location of development and also the type of development can have a significant effect on the actual loss of recharge. For example, development on prime aquifer recharge areas will cause a greater loss to the groundwater system as compared to the development of marginal recharge areas. Development on steeply sloped areas will more quickly cause flooding than the same development on slightly sloped areas.

For a given site, construction techniques and design features can have a significant effect on site hydrology. The use of detention areas, minimizing

unnecessary pavement, proper lot sizes, and other techniques can effectively reduce adverse hydrologic effects.

Increases in the amount of impervious surfaces also result in effects on water quality. As precipitation flows across these surfaces, pollutants are entrained and carried into nearby receiving waters. Primarily, these include suspended solids, decomposable organic compounds, and various nutrients. This is the "non-point" source pollution which is associated with increased urbanization. Again, measures to mitigate these effects are known and can be utilized. The 208 Areawide Wastewater Management Studies discussed previously address this issue in some detail, and present "best management practices" which are specifically designed to minimize non-point source pollution from various land use activities.

In addition to the generic effects which population growth has on the quality and quantity of groundwater resources, the issue of improper waste disposal techniques causing gross contamination of valuable aquifers has become a major and pressing concern. This is a product of abusive land use practices over long periods of time, and a lack of understanding as to the long term consequences of such actions. Indirectly, the siting of potential generators of toxic waste by-products in areas which we now know are underlain by valuable and vulnerable stratified drift aquifers is also a factor which has resulted in the present problem of groundwater contamination. Presently, the awareness of the problems associated with the use of toxic substances has resulted in regulations which are now beginning to closely control the use and disposal of these substances. While municipalities cannot easily undo the decisions or reverse the patterns which were established in earlier times, the availability of our current knowledge, technology, and awareness should certainly be applied in making better land use decisions in the future. Municipal officials now and in the years to come cannot take for granted the fact that an ample and high quality supply of water will be available within their towns. On-going and active efforts to preserve and protect this valuable resource must be made. With proper constraints on new development (zoning patterns, building codes, and enforcement) additional growth in the County can be compatible with our goal of water resource protection.

4.0 ALTERNATIVE WATER SUPPLY STRATEGIES

While this Master Plan Element addresses a number of different issues relating to water supply in Morris County, one of the most important questions to answer concerns the quantitative adequacy of water supplies compared to future demands. Where existing supplies are inadequate, questions of resource availability and alternatives for providing supplies arise. This chapter of the report will address these central issues.

Table 7 lists the 1980 water demands for community purveyors in Morris County. These demands are grouped and listed by town, except for SMCMUA. Since SMCMUA is a multi-municipal retail level distributor in the County, all of the Authority's customer municipalities are considered as a group. Greystone Hospital, Picatinny Arsenal, and Hercules Powder have also been omitted from the Table. Table 7 includes incremental demands for the ten year interval from 1980 to 1990, and for the 20 year interval from 1980 to 2000. Projections to 1990 are considered to be significantly more reliable than projections to 2000.

This Table allows a quick comparison between existing water supply development and additional demands over the next ten and twenty years. Combining this information with data on purveyor safe yields and geological features, judgements can be made regarding the adequacy of water supply capabilities.

In general, we conclude that most purveyors and communities in the County have adequate supplies on a local basis to meet present demand. A few of these municipalities also appear to have adequate supplies to meet future demands.

For other towns and purveyors, regional assistance may be desirable or necessary in developing future supplies. This is a result of various factors, such as high demand, unfavorable geology, potential groundwater contamination, and regional opportunities for the development of an efficient supply source. The purveyors and municipalities which might be involved in a regional supply strategy are discussed in the following section, along with an evaluation of alternatives for providing adequate water supplies.

4.1 REGIONAL WATER SUPPLY ALTERNATIVES

This analysis will begin with an evaluation of the needs of the existing

TABLE 7

PRESENT PUBLIC COMMUNITY USE AND PROJECTED INCREMENTAL DEMANDS BY MUNICIPALITY

Town	1980 Use (MGD)	Incremental Demand (MGD) 1980-1990	Incremental Demand (MGD) 1980-2000
BOONTON	1.14	.12	.32
BOONTON TOWNSHIP	.05	.03	.09
BUTLER	.74	.09	.22
CHATHAM	1.04	.12	.34
CHATHAM TOWNSHIP	.61	.19	.39
CHESTER	.02	.07	.13
CHESTER TOWNSHIP	.01	.06	.22
DENVILLE	1.73	.49	.93
DOVER	2.36	-.02	.31
EAST HANOVER	1.10	.50	.97
FLORHAM PARK	1.11	.16	.30
JEFFERSON	.38	.34	.90
KINNELON	.26	.19	.40
LINCOLN PARK	.81	.14	.28
MADISON	1.90	.21	.38
MENDHAM	.64	.28	.45
MINE HILL	.14	.14	.26
MONTVILLE	.98	.78	1.90
MOUNT ARLINGTON	.05	.12	.27
MOUNTAIN LAKES	.62	.11	.24
MOUNT OLIVE	1.03	1.10	2.27
NETCONG	.42	.05	.12
PARSIPPANY-TROY HILLS	5.59	1.06	1.74
PASSAIC TOWNSHIP	.53	.15	.31
PEQUANNOCK	1.37	.09	.50
RANDOLPH	1.22	1.03	2.15
RIVERDALE	.23	.03	.09
ROCKAWAY BOROUGH	.85	.19	.40
ROCKAWAY TOWNSHIP	1.24	.62	1.27
ROXBURY	1.22	.57	1.17
SMCMUA *	8.18	2.02	4.67
VICTORY GARDENS	.17	.08	.12
WASHINGTON TOWNSHIP	.56	.45	.91
WHARTON	.70	.08	.21

* SMCMUA serves Morristown, Morris Township, Hanover, Mendham Township, Morris Plains and Harding. Figures include "unaccounted for" water.

users of the regional water system operated by the MCMUA. The existing users include SMCMUA, Randolph, and Mine Hill. The feasibility of connecting other nearby municipalities to the County system is also evaluated. Candidates include Mendham Borough, Dover, Denville and other towns in the Rockaway Basin. Based on need and reasonable proximity to the County well field, the alternative of constructing a pipeline to the Chester/Washington area is discussed.

The needs of Passaic and Chatham Townships are considered in this section as they are currently customers of the Commonwealth Water Company, a regional water purveyor.

Based on existing conditions and projected demands, the northwestern section of the County might benefit from the development of regional supply sources. In this context, water supply options in Rockaway Township and the Musconetcong corridor municipalities (Jefferson, Mount Arlington, Roxbury, Netcong, and Mount Olive) are evaluated.

The remaining municipalities in the County are not discussed here as they possess the local resources to deal with the problem of water supply needs or they can obtain the necessary supplies from adjoining municipalities.

Southeast Morris County Municipal Utilities Authority - This Authority services a large population in Morris County and largely depends on groundwater supplies generated in its service area. Further groundwater development is possible in this area, but groundwater sources are already extensively developed. The Clyde Potts Reservoir provides 1.0 MGD of surface water.

Additional demands for the SMCMUA system are projected at 4.7 MGD by the year 2000. Recognizing the dangers of overdrafting available aquifers and the potential difficulty in developing new large capacity well supplies, the Authority has elected to contract with MCMUA for an additional 1 MGD to be immediately supplied by the Alamatong well field. This water is now being delivered to the Southeast system through an interconnection recently constructed in Old Brookside Road in Mendham. An additional interconnection on Sussex Turnpike and West Hanover Avenue is proposed.

Alternatives for the SMCMUA include the development of additional well supplies or the purchase of additional water from the County Authority. SMCMUA is cautious with respect to reliance of its system on groundwater

sources in the future. It is recommended that detailed hydrogeological studies be conducted prior to the development of additional well supplies. Since SMCMUA's incremental demand over the next 20 years is 4.7 MGD, and 1.0 MGD from the Alamatong well field is now available to the Authority, an additional 3.7 MGD will be needed to satisfy the demands of this system.

At present, Alamatong provides water to nearby Randolph and Mine Hill. This source should be used to satisfy the future demands of these two municipalities and should be available as a regional supply source for central to western Morris County municipalities in the future. Considering these commitments, Alamatong cannot be used to satisfy the demands of the Southeast system over the next 20 years.

With a significant future demand developing in the SMCMUA system, the development of a new surface supply to the east of Alamatong is a more optimal arrangement. The proposed Washington Valley Reservoir fills this need and together with the Alamatong well field and the proposed Sussex Turnpike interconnecting water main, will form the essential backbone of a central and flexible County system. The Sussex Turnpike water main will connect two major supply sources which consist of both surface and groundwater sources. This diversity of supply sources will provide stability during droughts or other times of system stress. The Sussex Turnpike interconnection will allow water to be moved from Alamatong to Washington Valley or vice versa in the event of supply stress, to "rest" an overdrafted well or reservoir, or to balance average supplies and demands. Under normal circumstances, however, Southeast would be supplied from Washington Valley with Randolph and Mine Hill supplied from Alamatong.

The estimated cost of the Washington Valley Reservoir and filtration plant is $25 million. At a yield of 7.0 MGD, this project will cost $3.6 million/MGD safe yield. The Sussex Turnpike Transmission Main, which will interconnect Washington Valley Reservoir and the SMCMUA system with the MCMUA system is estimated at $3.0 million. This facility will form an integral link in the County system and may be used to move water in either direction.

Regarding the cost estimates which are presented in this section, the following comments should be noted. The MCMUA, as a regional Authority, is charged with the responsibility to develop some projects which, while feasible and essential over the long-term, may not be economical in the short term

given conventional rates of debt retirement. It has been the Authority's practice to charge its direct customers a water rate which does not reflect the true cost of debt retirement, especially over the short term when the total volume of water distributed by the County is low. This has resulted in water rates which are lower than might be charged by a municipal or private water company given equivalent facilities and operating costs. It is the County's philosophy that this is a proper approach which is necessary for the development of long-term, costly regional facilities. It is anticipated that a similar approach will be taken for new County-constructed facilities. Therefore, in this report, the cost of facilities is presented as a total cost, and as a rate per million gallons of safe yield where applicable. All costs reflect 1981 economic conditions. The rates which would be charged to a customer municipality would depend on financing arrangements and the long term outlook for a specific project. Hence these rates cannot be estimated at this time.

Randolph and Mine Hill - These two municipalities have agreements with MCMUA for supplying water on a wholesale basis and they are currently connected to the regional system. The 20 year combined incremental demand of 2.4 MGD can be supplied from the Alamatong well field. This will raise the total diversion for these two municipalities to 3.8 MGD from the Alamatong well field.

Mendham Borough - This municipality has experienced difficulties regarding the sufficiency of its supplies. Declining well yields have been noted and siltation has reduced the storage capacity of the Borough's reservoir. The Borough has also experienced difficulty in the development of new well supplies. Incremental demands over the next 20 years are expected to total 0.5 MGD.

Due to the Borough's proximity to the MCMUA system, an interconnection can be constructed in the vicinity of the Clyde Potts Reservoir. This would involve a pipeline approximately 4,700 feet in length. We recommend that this connection be constructed on a near term basis as it provides back-up for the Mendham system and can be used for long term supplementary supply. This interconnection and supply well would cost approximately $500,000 to construct and might deliver 0.5 MGD, or $1.0 million/MGD.

Rockaway Basin - Denville is expected to experience a significant increase in demand in the future. However, geological conditions are con-

ducive to the development of additional supplies. Dover, on the other hand, is not expected to see a major demand increase. It is likely that both towns can provide for local supplies over the next twenty years. However, episodes of groundwater contamination have occurred in the vicinity of both towns and the possibility exists that the migration of contaminants through the aquifer could impact their water supplies.

Dover's Well No. 4 has been contaminated and has been removed from service. In neighboring Wharton, a well which is not actively used has shown xylene contamination. Both Rockaway Township and Rockaway Borough have suffered significant solvent contamination. These events document the fact that the Rockaway Valley has experienced scattered episodes of contamination of the glacial drift aquifers which run beneath the valley floor. Time will tell if these episodes are random, if their recent occurrence is a result of our newly-developed technical ability to measure these chemicals in trace quantities, or if these events are the first in a long term trend of pollutant dispersal and migration through the aquifer system. With the Dover and Denville wells located in two clusters, their potential for drawing pollutants into the respective fields is even higher. Denville's wells also lie downstream and downgradient from the areas in which contamination has been noted.

We therefore feel that vigilance on the part of the valley towns is required. Water samples should be tested periodically and the results should be plotted to give an early warning of the appearance of any pollutants. The provision of a regional water supply connection which could bring in water from a source outside the basin would also be desirable.

We recommend that both Denville and Dover continue their use of local groundwater supplies. However, the construction of interconnections with the regional system is also recommended to guard against the possibility of the loss of a supply through contamination. Dover can be connected to the County system near Mt. Fern in Randolph. This interconnection would involve approximately 2,000 feet of pipeline. The estimated cost is $130,000. Through the use of this interconnection, limited amounts of County-supplied water could also be provided to the Rockaway Township system through an existing interconnection with Dover.

Included in the plans for the proposed Sussex Turnpike Transmission main is a branch pipeline which would connect the County main to the Denville system.

In the event that groundwater contamination in the Rockaway Basin continued to spread and affected a number of municipal supplies, a large volume transmission main may be required. Such a transmission main, extending from the existing MCMUA main at Dover-Chester Road and Randolph Avenue to the Mountain Lakes Well Field could serve (with some adjustments) any Rockaway Valley municipality. Such a pipeline would cost approximately $4.4 million. While this pipeline would probably not provide water in quantities which would make this facility cost-effective, it may be justified because of a lack of alternative supply sources. This is ironic since the Rockaway Basin is well endowed with both ground and surface water resources.

Chester Borough - This municipality is only partially served by a small private water company. Extension of water supply service within the Borough would be desirable and population densities seem to warrant such improvements. Regionally-supplied water could be transported to the Borough from the Alamatong Well Field through an interconnection with the County system at Dover-Chester Road. Such an interconnection would be 5.3 miles in length and would cost approximately $2.1 million to construct. However, this alternative does not appear to be cost effective as projected demands for the Borough are small (0.13 MGD by 2000).

Alternatively, the relatively small demand could be met by one or more wells developed locally. If possible, these should be located in the adjacent Black River Valley where high yielding drift deposits may be encountered.

Washington Township - Washington Township is expected to experience significant growth in the future with total water demands at 1.5 MGD in 20 years. While most wells developed within the Township for public water supply have relatively low yield, they are primarily located on the elevated ridges and tap low-yielding PreCambrian bedrock. Development of potable supply wells in the valley would tap the available stratified drift deposits which overlie limestone. Good yields should be obtainable in this area.

Extending a County water main through Chester to Long Valley could be accomplished. This would allow Chester Borough to obtain water from the County and might satisfy a total demand of 1.6 MGD by the year 2000. The total cost of this pipeline is estimated at $4.4 million, or $2.8 million per MGD. These costs indicate that a better approach is for Washington Township and Chester Borough to develop available local supplies.

Summary of the Washington Valley/Alamatong System - Totalling supplies and demands for the proposed and interconnected Washington Valley/Alamatong system, we have:

Supplies (safe yield):	
Washington Valley	7 MGD
Alamatong	5 MGD
TOTAL	12 MGD
Demands	
Randolph	3.4 MGD
Mine Hill	0.4 MGD
Mendham Borough	0.5 MGD *
SMCMUA	4.7 MGD *
Dover/Denville	?
TOTAL	9.0 MGD

* Only incremental demands are assumed to be satisfied by regional sources, existing demands to be satisfied locally.

Therefore, we project a 3.0 MGD surplus in the year 2000 based on the above system demands. This water is available for possible use by Dover, Denville, or any other municipalities which may need this supply on a routine or emergency basis. It will also be used to satisfy additional demands for years beyond 2000.

Chatham and Passaic Townships - These municipalities are served by the Commonwealth Water Company. Incremental demands for these municipalities total less than 1 MGD. However, the Commonwealth system will need to seek new supply sources to satisfy its future system demands. As Commonwealth primarily services customers in other Counties, Morris County need not be actively involved in planning or implementing new supply sources for this purveyor.

Rockaway Township - Rockaway Township is projected to be a major growth area in the County. The availability of land, good access via Route 80, and proximity to the commercial development surrounding the Townsquare Mall are major factors which influence this area's development potential. Water demands are projected to nearly double in the next twenty years. The Township's existing well field along Beaver Brook has suffered from groundwater contamination and the remainder of the Township, does not contain the type

of geological deposits which typically support major water supply wells. However, the municipality has recently hired a groundwater consulting firm to evaluate potential water supply sources in the Township. Considering the future water supply needs for this area, the Township is wise in initiating steps toward the development of future supplies. If, at the conclusion of this study, the Township determines that it cannot feasibly or economically develop adequate water supplies within the municipality, a prime water source just beyond the Township's borders lies in the lower Berkshire Valley. The New Jersey DEP has conducted an exploratory drilling program in this area and potential groundwater reserves are significant. A well field here could be developed by Rockaway Township, Jefferson Township, or by the MCMUA as a regional supply source.

Assuming that a well field producing 3.0 MGD could be developed at this location, the estimated cost of development and construction is $3.6 million, or $1.2 million/MGD. Water could be transported to Rockaway Township via a transmission main approximately 2.7 miles in length. The cost of this pipeline would be approximately $1.5 million or $750,000/MGD if 2.0 MGD were delivered to the Township. Since these costs are feasible, it is recommended that this option be explored in more detail if the Township is unable to locate suitable supplies within the municipality.

Jefferson - The citizens of Jefferson Township have experienced a long history of problems with their water supply. Many of these problems are a result of the presence of numerous small, poorly managed water companies. In many cases, supplies are inadequate. Shallow wells within a few feet of recreational lakes are still in use. Storage and distribution systems are commonly below standard.

In spite of this, the Township is well-endowed with surface and groundwater supplies. Groundwaters are readily available from the glacial deposits which lie along the Berkshire Valley floor, running through the Township from north to south. Surface waters are present in numerous lakes and ponds including Lake Hopatcong in the south and Oak Ridge Reservoir in the north. While significant water reserves are present, a number of factors limit their use for local potable supply.

First, surface waters are either dedicated for use by urban areas beyond Jefferson, or are managed exclusively for recreational use. Second,

the Township is quite large and areas where water is present and available do not always coincide with areas of need. Finally, the topography of the Township is rugged with major ridgelines running in a northeast-southwest direction.

The projected water demands for Jefferson Township will require the development of additional water supplies in the future. Due to the factors discussed previously, these supplies would best be located in reasonable proximity to the areas of demand. In the northern part of the Township, water demands are concentrated along the Berkshire Valley where suitable supplies could be developed. In the areas surrounding Lake Hopatcong, the supply situation is more difficult. The Lake itself cannot be considered as a major long-term supply source. This Lake is managed exclusively and utilized intensively for recreational purposes. Herbicides are sprayed in the Lake on an annual basis for aquatic weed control and the water level is significantly drawn down every five years for dock maintenance. It is doubtful that the State would permit routine surface water diversions from the Lake for potable use.

Several alternatives for supplying this area of Jefferson Township exist. One alternative is the development of a supply (1 MGD) at the Weldon Mine with a transmission main extending to Route 15 in the vicinity of Lake Shawnee. The cost of these facilities is estimated at $1.8 million, or $1.8 million/MGD. This cost is within the feasible range.

Alternatively, wells could be developed in the glacial drift deposits south of Lake Shawnee. Since these wells are closer to the areas of demand, they could be developed at a somewhat lower cost.

A third alternative would involve the pumping of 1 MGD from a well field in the Berkshire Valley (discussed previously) along Route 15 to the same area. A preliminary analysis of this alternative indicates that the associated costs are significantly higher than for the first two options. In addition, pumping water from Berkshire Valley requires transporting water out of the Rockaway Basin. This may pose difficulties with respect to obtaining the required diversion permit. For these reasons, this alternative is not recommended.

A fourth alternative involves the development of a surface water supply at Weldon Brook. This reservoir has been identified as a water supply alternative in previous County Plans. The reservoir could produce a safe yield

of 3.5 MGD at a cost of approximately $15 million (including a water filtration plant). This is equivalent to $4.3 million/MGD. At this time and at present levels of demand, the use of alternative and more economical sources of water is preferable to the development of this reservoir. If Jefferson is unable to develop more efficient supply sources, it might consider developing a smaller and less costly reservoir at this location. It should be noted that developing this supply will be significantly more expensive than the use of Weldon Mine or other groundwater resources.

A final alternative involves a regional transmission main along the Musconetcong corridor from Jefferson to Mount Olive. This pipeline could be supplied by a reservoir at Weldon Brook or by in-basin groundwater supplies developed along the route. The need for such a system will depend on the intentions and ambitions of local communities in this corridor. In some areas, rugged topogprahy, scarce groundwater, and large demands make a regional system appealing. However, if local communities decide to take an active role in developing their own systems, the resources, for the most part, are there. The development of these resources by local communities would largely eliminate the need for a regional option.

Looking briefly at a regional scenario, we can approximate the incremental demands for those areas lying within the Musconetcong corridor:

YEAR 2000 Water Demand - Musconetcong Corridor

Jefferson	0.5 MGD
Mt. Arlington	0.3 MGD
Roxbury	0.3 MGD
Netcong	0.1 MGD
Mount Olive	1.3 MGD
TOTAL	2.5 MGD

The cost of the regional pipeline is approximately $5.2 million or $2.1 million/MGD. Considering that this cost is for transmission alone, the regional alternative does not appear feasible at this time at the levels of demand currently projected. Ultimately, in the period beyond 2000, a regional system consisting of a pipeline from Jefferson to Mount Olive with one or more supply sources may be necessary. This system could be interconnected through Roxbury with the Alamatong/Washington Valley system to form a regional system which would serve to supply, supplement, or provide emergency assistance to most of the municipalities in the County.

Mount Olive - With an incremental demand of 2.3 MGD, this municipality is another major growth center in Morris County. The impending development of a Foreign Trade Zone and associated support facilities will exert a major additional demand. In the past, the Township has considered the purchase of water from the MCMUA. This water would be pumped from the Alamatong Well Field and transported to Mount Olive through a water main 5.7 miles in length. In 1974, the cost of water delivered to Mount Olive was estimated at $430/M.G. In the Mount Olive water supply master plan, this option is recognized, but the plan's recommendation calls for the development of local groundwater sources based on reasonable availability at lower cost. Based on higher construction costs and reduced demands, the cost of water supplied to the Township would be significantly higher today. Current estimates for the pipeline, a storage tank, and a booster pump station total $6.5 million, or $3.25 million/MGD at a consumption rate of 2 MGD. It is therefore recommended that the Township pursue the development of local sources based on the level of water demands anticipated over the next 20 years. The Musconetcong and South Branch/Drakes Brook valleys are areas in which geological mapping indicates the presence of productive glacial drift deposits overlying limestone.

4.2 PREVIOUS COUNTY PLANS

In 1971, the Morris County Planning Board prepared a Water Supply Master Plan Element. This plan projected water demands which were significantly higher than those published in this report. These projections were a result of trends which were documented through the late 1960's. These trends showed rapidly escalating population growth and per capita water consumption. During the past decade, we have witnessed a significant change in these trends, resulting in the downward revision of both population and water demand projections. Based on these changes, the previous recommendations warrant discussion and revision.

The previous Master Plan projected that, by 1980, water demands in Morris County would reach 75 MGD. As this report indicates, water consumption for 1980 was approximately 40 MGD. The previous plan recommended that the following supply sources be implemented by the 1980 to 1990 decade:

1. Alamatong Well Field and Recharge Basin
2. Washington Valley Reservoir

3. Pulaski Reservoir
4. Tourne Reservoir
5. Weldon Brook Reservoir
6. Supply from Point View Reservoir

Of these, only the Alamatong Well Field has been implemented. The MCMUA has purchased and now holds title to the Washington Valley and Pulaski sites. Feasibility and conceptual design studies are currently progressing with respect to the development of the Washington Valley Reserovir.

The Tourne and Weldon Brook sites have been acquired by the County Park Commission for eventual use as reservoirs. However, the Board of Freeholders subsequently deleted the Tourne as a reservoir site.

During the 1960's, the County had obtained the rights to withdraw 2.0 MGD from the Point View Reserovir in Wayne. This right was contingent upon the use of this water within seven years. It was anticipated that this supply would serve adjacent municipalities in Morris County, but would not be interconnected with the central county system. Since a significant demand for this water did not develop, the supply was not utilized and the diversion rights have presumably expired.

The Pulaski Reservoir, intended to be a part of the interconnected County system, may not be feasible at this time. Several reasons account for this. The reservoir would have a very limited watershed area, relatively low storage capacity, and a high cost of development. Two dams would be necessary to create the impoundment and a pump station and pipeline would be necessary to connect the reservoir to the Musconetcong River which would act as a source of supply. Since the reservoir has an extremely limited watershed area, virtually all water to be stored in the reservoir would be derived from the Musconetcong by pumping. The resultant electrical demands would further add to the cost of water delivered from this site.

Since this reservoir is located in the Musconetcong Watershed, permits to divert water must be cleared through the Delaware River Basin Commission (DRBC). In view of the low flow problems which are being experienced in the Delaware, the DRBC has set a restrictive allocation which limits the volume of water which may be transported out of the greater Delaware Basin. We therefore feel that a reservoir at the Pulaski site could only be used to satisfy water demands within the Musconetcong Basin. The areas involved

include a portion of Mount Olive, Netcong and perhaps a small portion of Roxbury. Over the next 20 years we estimate that the areas which could be served by the reservoir will require an additional 1.5 to 2.0 MGD above present consumption levels. The cost of reservoir development at this site for the anticipated level of demand is not cost effective. Alternatively, groundwater supplies can be economically developed to satisfy the local in-basin demand.

The proposed Weldon Brook Reservoir, an on-stream impoundment, is estimated to develop a safe-yield of 3.5 MGD. Since this is also a Delaware Basin impoundment, it is subject to the out-of-basin diversion restrictions of the DRBC. Based on projected demands within the Musconetcong corridor for the next 20 years, this reservoir, like Pulaski, is not recommended for implementation. The low projected water demands do not justify the regional transmission facilities which would be necessary. At present, development of groundwater resources appears to be a preferable alternative. However, if a regional system were necessary in the period beyond 2000, the Weldon Brook site would be preferable to Pulaski for reservoir development. Weldon Brook is an on-stream impoundment; it has a much larger capacity (3.0 billion gallons versus 0.65 billion gallons for Pulaski) and watershed area; and it is located high in the watershed, thus facilitating water distribution.

In summary, previous planning efforts anticipated high water demands in the future and proposed an interconnected County system consisting of four reservoirs and one well field. Present projections have reduced the anticipated water demands which, in most cases, can be met by local groundwater development. Increasing reliance on groundwaters must be accompanied by greater efforts to preserve and protect this resource.

The Washington Valley Reservoir is recommended as a surface supply to serve the southeastern portion of the County for several reasons:

1. It will serve an area of high and concentrated demand.
2. It will serve an area already highly dependent on groundwater supplies.
3. It is strategically located with respect to the County system and areas of short-term demand increases.

4.3 EMERGENCY WATER CONTINGENCY PLANNING

Recent experience in Morris County and in northern New Jersey has

illustrated some of the consequences of water system failures. Within a one year period, Rockaway Township and Rockaway Borough suffered the loss of their water supply sources through groundwater contamination. The entire northeast portion of the State was severely impacted by an intense, but short drought. Finally, the City of Newark experienced severe damage to its aquaduct as a result of an act of vandalism. In addition to the above, system failures can result from mechanical malfunction, power failure, floods, and other phenomena.

In an emergency, the duration of a water system failure and the severity of its impact are highly dependent on the speed with which corrective action is taken and the degree of preparedness which has been provided by the purveyor, the County and the State. Recognizing that water system emergencies can be local or regional in extent, it is important that response planning be conducted on several levels. The heart of emergency response efforts should remain at the purveyor level, with the County and State taking supportive roles except where the appropriate response is beyond the capability or jurisdiction of the purveyor.

The individual purveyor is the logical first line of defense against system failure since the purveyor is most familiar with the system and is best equipped to maintain it. The presence of a problem can be detected most quickly on the local level and corrective measures can be quickly implemented. In the event of a mechanical failure in the local system, such as a water main break or pump station failure, local response efforts should be adequate to manage and remedy the situation.

The State of New Jersey in its Statewide Water Supply Master Plan has prepared emergency response plans to deal with various types of system failures including long term droughts. The State's approach emphasizes a two level planning strategy focusing on a strong purveyor planning effort and an associated State role. The recently enacted Water Supply Management Act directs the Department of Environmental Protection to prepare an Emergency Water Supply Allocation Plan. This Plan, to be adopted as regulation, together with specific provisions of the Act, gives the DEP broad powers to order general water use restrictions and specific purveyor actions to deal with water supply emergencies. These powers include:

1. Ordering reductions in water usage by specified amounts;
2. Ordering the construction of emergency interconnections;
3. Ordering the transfer of water supplies among systems;

4. Establishing water use priorities;
5. Imposing cost surcharges as penalties for exceeding use restrictions;
6. Suspending laws, rules, or regulations of any State or local body when such rules affect water supply and interfere with the management of a water use emergency.
7. The ability to enlist the resources of any State agency as needed to deal with the emergency.

The Statewide Water Supply Master Plan also provides detailed guidance to the local purveyors including the steps necessary for adequate Emergency and Drought response plans. Appendix D includes the elements of an Emergency Response Plan and a Drought Response Plan.

In Morris County, the two level State approach falls down somewhat since much of the County is served by small to medium sized purveyors. These organizations have staffs which range from several personnel down to only part-time help. Many of these purveyors are only marginally able to provide basic water supply services. Their ability to plan and cope with water emergencies is doubtful. In this case, the County should play a support role in the planning and management of water emergencies. Specifically, the County should prepare a detailed regional response plan fashioned after the State guidelines. This plan should develop appropriate responses for system failures among the small water purveyors. The County should also maintain a current listing of emergency equipment (pumps, tank trucks, generators, pipes, etc.) which is available on a regional basis. This will allow purveyors to quickly obtain the resources necessary for a swift response to emergency conditions. In general, the County role should be one which fits in with the State's strategy. As such, the designated County agency would serve as a central communication link and coordination point. Such a role would not be necessary if Morris was served by a handful of large purveyors. However, the presence of many small purveyor systems makes a County-wide focal point necessary to better prepare for and manage water crises. Where the responsibility for water supply falls to a municipal water department and the municipality is willing and able to manage local water problems, the responsibility should remain on the municipal level. Nonetheless, the centralization of a regional data bank which includes emergency equipment, alternate water supplies, and interconnection options would be invaluable

during periods of crisis. A regional contact with the State would serve to better represent the County in the development and implementation of the State Emergency Response Plan.

The County agency best suited to assume this regional responsibility for emergency planning and coordination would be the MCMUA. This Authority is presently involved in the provision of regional supplies, and is in the best position to plan and implement a regional emergency response strategy.

4.4 WATER CONSERVATION MEASURES

Reductions in water demand have the same effect as the development of new supplies and will allow existing supplies to serve additional customers or will provide a greater margin of safety for peak demand periods.

Several approaches to water conservation can be identified. These include the use of residential water conservation devices; repair of leaky distribution systems; industrial water conservation; and price modifications.

Residential Water Conservation Devices

In Morris County, residential water consumption is the largest single component of the overall water demand. When considering public water supply systems, the importance of residential use as a component of the total use becomes even greater. It follows then that reductions in residential demand will have a significant impact on overall water consumption.

Within the home, the two largest uses of water are toilet flushing and bathing. A significant potential for water conservation exists in the flushing cycle of common toilets. This can be accomplished by employing a toilet which is specially designed to use less water or through the use of a device (in a conventional toilet) which restricts the amount of water discharged during flushing. The latter can be a single displacement device, such as bricks, or water-filled plastic bottles, or equally simple plastic "dams" which retain water in the tank during flushing. Conventional toilets use over five gallons of water per flush. Through the use of the devices mentioned above, one to two gallons of water can be saved per flush. Water saving toilets are required for installation in new construction but may not be appropriate as replacement equipment in buildings designed for conventional toilets. The use of displacement or damming devices is also recommended, but these should be adjusted so that the flushing efficiency

is not adversely affected.

Flow restricting devices can also be employed in showerheads, resulting in a significant water savings. Either special low-flow shower heads can be used or in-line flow restrictors can be used with existing showerheads. The former approach yields a better shower for a given flow rate. Conventional showerheads typically use over five gallons per minute as compared with flow rates less than three gallons per minute with the water saving devices. The New Jersey State Uniform Construction Control Act, recently amended, requires that low-flow showerheads be installed in all new construction. Homeowners should be encouraged to retrofit these devices in their homes considering their cost and effectiveness.

Another area in which water savings can be effectively accomplished is in the various faucet fixtures found in the home. Faucet aerators reduce flow by 25% without significant effect. Aerators are very inexpensive and are now provided with most quality faucet fixtures. In addition, they save fuel resulting from the use of hot water.

As is apparent from the above discussion, cooperation on the part of residents is important in achieving significant reductions in water use. Public education is vital in establishing an awareness of the necessity of water conservation and the benefits to the homeowner. For example, the installation of a toilet displacement device, low-flow showerhead, and faucet aerators might cost a homeowner $20.00 to $25.00. Combined, these three approaches to water conservation can potentially reduce an individual's domestic water consumption by approximately 30%, depending on circumstances and habit. In addition to saving thousands of gallons of water per year, this would result in an appreciable net savings in utility costs for metered customers.

The State Building Code has required, since 1979, that all new buildings be equipped with water saving fixtures. This will help to limit per capita consumption in the future. However, the Code does not apply to replacement fixtures.

Repair of Leaky Distribution Systems

Significant water losses commonly occur through leaks in water distribution systems. According to the New Jersey State Water Supply Master Plan, a system in which 12 to 15% of water pumped is "unaccounted for" can

be considered a tight system. In many of the older and larger systems, "unaccounted for" water losses are much higher.

Each purveyor should assess the status of each water system by comparing metered flows with production. Where records do not permit this type of comparison, the per capita consumption can provide an indication of the rate of leakage if these figures are compared to historic values.

Since Morris County relies heavily on groundwater supplies, system leakage in some case may act to recharge aquifers which are used for public supply. Hence, water leakage does not represent a gross loss to the County, as is the case in many other areas (for example, the urbanized northeast) where water is imported from other basins. Nonetheless, we recommend that individual purveyors evaluate their systems with respect to loss through leakage and take corrective action where unaccounted for flows exceed 20%.

Industrial Water Conservation

Industrial water use in Morris County constitutes a major demand on the County's water resources. Studies on industrial water use have typically shown that a large potential for conservation exists. Current economic factors provide a strong incentive for internal water conservation and reuse in those industrial concerns which are large consumers.

One such factor is the high cost of wastewater treatment. Industries which utilize large volumes of water must discharge wastewaters either directly to a stream under a Federal discharge permit, or indirectly to public sewerage facilities. In either case, signfiicant costs for treatment, pre-treatment, or user fees are involved. User fees are invariably based on the volume of wastewater treated with surcharges for wastes with excessive strength.

Another factor is the cost of water. Those firms which are served by public supply systems must, of course, pay for this service based on the amount of water consumed. Where water for industrial use is self-supplied, the cost of water is less of a factor, although demands for self-supplied water are not included in the public supply demands discussed in earlier chapters.

With the costs of water and wastewater treatment rapidly escalating, many industries have made in-plant modifications and significantly reduced their water use. We believe that these economic incentives will continue to provide impetus to implement water conservation measures.

Pricing Modifications

Pricing modifications are considered in the context of water conservation because the cost of water has been shown to be a factor in determining the amount of use. The degree to which water demands respond to changes in cost depends on the "elasticity" of the demand. Examples of inelastic demands include water use for drinking, bathing, cooking. etc. Inelastic demands are not significantly reduced with increases in cost. Elastic demands include outdoor water uses (lawn sprinkling, car washing, etc.) and industrial uses.

In addition to the cost itself, the method computing cost is a highly significant factor. Rate structures can be divided into those which charge a flat rate for an unmetered residential connection and those which compute an individual charge based on usage. In the first case, there is no incentive to conserve water, as any excess usage can be considered "free". In the latter case, the customer pays for each gallon used, therefore an economic incentive for water conservation is built in to the system. It is no surprise then that installing meters in previously unmetered areas can reduce consumption by approximately 40%.

Within the metered category, several variations are possible. By far the most common is the declining rate system. In this system, a rate is established for water usage up to a specified volume. Beyond that, the rate (per unit volume) declines in a series of one or more steps. This type of structure reflects the "economy of scale" philosophy that is basic to our economic system. However, relative to other rate options in the metered category, it encourages additional use by lowering the rate per gallon.

From a resource conservation standpoint, a level rate structure would be more effective. This type of system might involve a small base charge with an additional charge computed on metered use at a level rate. Individual purveyors should evaluate the suitability of this type of structure in their respective systems.

Other types of rate structures include increasing rate systems and the use of a higher rate in summer. An increasing rate structure, while offering the advantage of a strong incentive to conserve, presents a host of associated problems. This system is unfair to larger users (industries/com-

mercial establishments) and would require arbitrarily establishing a different base water volume for various users.

The use of a higher summer rate can be justified in the sense that systems must be designed to meet the peak summer demand. Much of this demand results from elastic seasonal uses, such as lawn sprinkling. Those customers who primarily contribute to this peak would pay a greater share of the cost of maintaining facilities on a year round basis which are sized to meet the summer peak. This rate option has been shown to be effective in reducing the summer peak demand. However, it is not now in use in New Jersey and its fairness to seasonal residents and seasonal businesses might be questioned.

5.0 WATER SYSTEM RECOMMENDATIONS

5.1 REGIONAL ACTIONS

This analysis of regional water demands and water resources can be summarized as follows: Morris County is well endowed with both surface and groundwater resoures. However, previous and current extensive development and diversion of surface waters out of the County has reduced available supplies. By far, the bulk of water utilized within the County is derived from groundwater sources. Based on current projections of water demand, local groundwater reserves can be utilized by most municipalities to satisfy future water requirements. An exception is the SMCMUA system which serves a relatively concentrated area of demand, already relies heavily on groundwater, and will experience a large demand increase in the future. In this case, the development of a surface supply is warranted and offers significant benefits.

In the past decade, a significant change in the County-wide water supply outlook has occurred. Previously, large increases in population growth and water demand were anticipated. It was envisioned that an interconnected network of four reservoirs and a well field would be necessary to assist municipalities in providing water within their jurisdictions. The present forecast has the benefit of a documented change in the previous trends. At this time, modest increases in demand are forseen, and more economical groundwater sources should continue to serve most areas.

A troubling trend has been noted in recent years. This concerns episodes of groundwater contamination which have jeopardized or closed several municipal supplies. Corrective action, if feasible at all, is costly. These incidents reflect improper land use practices and development controls. If the County is to continue its reliance on these vulnerable groundwater resources, their protection and preservation must be a high priority.

Among the specific regional water supply strategies discussed previously, the following are recommended actions (see Plate 4):

1. With respect to the SMCMUA service area and potential areas of need in the central portion of the County (Randolph, Mine Hill, Mendham Borough, Denville, Dover), it is recommended that the Washington Valley Reservoir, filtration plant, and Sussex Turnpike interconnection be constructed. These actions will supplement the regional supplies available in the Alamatong Well Field and form the backbone of a flexible, stable, and diversified regional

system, from which interconnections could be constructed to assist any one of a number of municipaliies.

2. The MCMUA should seek to interconnect its system with as many adjoining water systems as is feasible. The more important of these include Mendham Borough, Dover and Denville. Interconnections with the Roxbury systems should also be evaluated.

3. It is recommended that the development of a well field in the lower Berkshire Valley be evaluated by the MCMUA or Rockaway Township as determined by need and the availability of alternate supply sources.

4. Based on current projections of water demand within the Musconetcong corridor, this study concludes that a regional system which would supply the area is not justifiable at this time. Jefferson Township can develop a significant supply in the Weldon Mine, and Mount Olive has local groundwater resources which can satisfy projected demands. These two municipalities are the two largest users in the Musconetcong Basin. In the future, a regional system with a supply derived from a reservoir at Weldon Brook may become feasible.

5. The MCMUA should develop a detailed County-level Emergency Response Plan so that it can assist small purveyors in the County who are unable to cope with significant system failures. An organized County approach to emergency response planning will also maximize the benefit which the County can obtain from the State's emergency planning efforts and resources.

6. SMCMUA should initiate a water system evaluation survey for the purpose of detecting and correcting water leakage, which is significant in this system.

7. To the extent that the State becomes involved in the testing and evaluation of episodes of contamination, it should communicate its findings to the municipalities which are affected as well as to adjacent towns which share the same aquifer system.

8. Finally, the County should encourage and assist municipalities in the development of ordinances, zoning regulations, and land use criteria which will help protect the quality and quantity of the groundwater resources which constitute the bulk of the County's water supply, both now and in the future. If these supplies are lost through contamination, residents will pay heavily either for expensive treatment systems or for comparatively costly surface supplies.

5.2 MUNICIPAL/LOCAL PURVEYOR ACTIONS

Based on the issues discussed in this report, the following general recommendations apply to the municipal water supply systems in the County:

1. Municipalities should actively pursue programs to preserve and protect local groundwater resources. Zoning ordinances should reflect the location of local aquifers and recharge areas, as well as incorporate controls to avoid potential groundwater contamination. A local study of groundwater hydrology is recommended as such a study could develop specific land use criteria and suggest methods of regulating and managing new development.

2. Water conservation devices should be installed in all municipal facilities. Public education programs stressing water conservation should be pursued in the municipal school systems and by local environmental commissions. Building inspectors should insure that water saving devices are installed in all new buildings in accordance with the State Building Code.

3. Municipalities with high per capita rates of water consumption or large amounts of "unaccounted for" water should initiate a leak detection and correction program.

4. The majority of Morris County municipalities do not have local-level water supply plans. This type of planning should be conducted on the municipal level so that better defined plans for new supply sources can be made. The adequacy of the existing water supply infrastructure (storage capacity, water main sizes, etc.) can also be evaluated in this type of study.

5. Improved record keeping and source monitoring will provide more useful data for evaluating supplies, demands, and resources on a local and regional level. It is recommended that water purveyors continually tally water use by user class and by municipality. In addition, water levels in production or observation wells should be periodically measured and logged.

6. In light of the recent episodes of groundwater contamination in the County, municipalities should increase their vigilance concerning the possibility of industrial and commercial contaminants potentially entering groundwater or surface-water sources. Municipal ordinances should be developed so that at the site plan application stage for any manufacturing or processing plant, a complete listing will be provided to the site plan-approving agency of any toxic, potentially toxic and other possibly contaminating materials that will be utilized at the plant. This should be accompanied by a list of

any processing products and wastes that might contaminate surface waters or groundwaters, and the methods by which these materials will be stored and removed from the site. It is also recommended that municipalities develop procedures and implementing ordinances so that changes in the input or output of such materials can be monitored on a continuing basis.

7. As a further step in the protection of groundwater and surface-water supplies, water purveyors should frequently test their supply sources with respect to volatile and toxic compounds in addition to the routine analyses now required under State law. Where local water departments are a municipal function, this testing could be conducted by the Health Department. If significant levels of toxic contaminants are detected, this information should be transmitted to both the State and to adjacent municipalities.

8. Each purveyor should prepare an emergency response plan as outlined in Appendix D. This will help to insure a quick and measured response in the event of system failure.

9. Where possible, municipalities should seek to interconnect their systems with adjoining systems. These interconnections are invaluable in the event of fire, contamination, or other emergency.

10. Municipalities with numerous, piecemeal, and inadequate supply systems should move toward the acquisition, consolidation and upgrading of these systems. This will provide a safer, more reliable supply to affected residents.

Specific coments on each municipal system, developed in the course of this study, are presented below:

Town of Boonton - Boonton's water supply includes a surface water reservoir and a well field. The town has recently constructed and is now operating a water filtration plant. With a 20 year incremental demand equal to 28% of existing consumption, Boonton should be able to handle future demand increases. Boonton should periodically monitor the quality of water it diverts from its well field with respect to volatile organic compounds.

Boonton Township - This municipality primarily relies on private well supplies. This situation is expected to continue in the future. Extension of public water supplies to additional areas of the Township should be considered in the event that any large scale developments are implemented or if service is warranted adjacent to areas currently served by the Town of Boonton system.

Borough of Butler - Butler is unique in Morris County in that it operates and is exclusively served by a surface supply system. The resources available to the Butler water department are adequate to satisfy future demands within the Borough. The Borough should consider bringing its Asphawa Reservoir in Passaic County on line in order to meet future demands.

Borough of Chatham - Chatham's water supplies appear to be adequate for the forseeable future.

Chatham Township - Chatham Township is served by the Commonwealth Water Company. This municipality should look to Commonwealth to supply the incremental demands which will occur in the future as service is extended to additional areas of the Township.

Borough of Chester - At this time, a regional water supply does not appear feasible for the Borough. However, population densities warrant the extension of a community supply in this municipality. It is recommended that the existing system be expanded to encompass a larger service area which will require the development of new groundwater supplies. A new production well in the Black River glacial drift deposits could meet the 20 year incremental demand. Alternatively, a large diameter well drilled into bedrock may be considered, but more than one may be necessary over the 20 year period.

Chester Township - Chester Township should continue to rely on private well supplies as long as the existing rural characteristics of the municipality are retained. Those portions of the Township near Chester Borough could be served by a future expanded Borough system.

Denville - Denville will require the development of additional groundwater sources in the future. It is recommended that additional wells not be placed in the existing well field, but be placed in the drift deposits in another portion of the Township (see geology map). As safeguards against volatile organic contamination, the Township should routinely monitor its supply and should interconnect with the MCMUA Transmission Main as a backup source of supply.

Dover - Dover's existing wells can provide sufficient quantities of water to satisfy future demands. However, groundwater contamination has affected and may further affect these supplies. Dover should carefully monitor its supply with respect to volatile organics and should interconnect with the MCMUA system as soon as possible. If an additional well should be

necessary in the future, it should not be installed near the existing well field.

East Hanover - Additional supply sources may be necessary in the future. The Township should continue with the development of groundwater sources as the planned extensions of the water supply system are implemented. Purchase of water from SMCMUA or Parsippany-Troy Hills is a possibility should difficulties be encountered in developing a local supply.

Florham Park - Supplies in this municipality seem adequate for the present and new sources should be available to supply future demands.

Hanover - This municipality is now supplied by SMCMUA, and will continue to be supplied by the Authority.

Harding - Most residents of Harding utilize private well supplies. A small portion of the Township's residents are served by SMCMUA and by the Lakeshore Water Company. It is anticipated that some extension of service by SMCMUA will occur in the future. Areas beyond the reach of the Authority will continue to rely on private wells.

Jefferson - The Township's recently organized water department should continue to upgrade and consolidate the numerous water systems serving the Township. New water sources are presently required. It is recommended that the Township develop new wells in the northern part of the Berkshire Valley to serve that area of the Township. In the southern portion of the Township, either Weldon Mine or new wells near Lake Shawnee should be developed as a supply to serve the residents in the Lake Hopatcong Basin.

Kinnelon - Approximately half of the water consumed in Kinnelon is obtained through public supply facilities. In the future, extensions of community facilities to unserved areas will occur. The Township should attempt to obtain additional water from the Butler Water Department in order to supply additional areas within the Township. Locally developed wells can be utilized to served areas distant from the Butler system.

Lincoln Park - This municipality relies on the Pequannock Water Department for much of its supply. As long as Pequannock has available capacity to supply Lincoln Park's needs, this arrangement can be beneficial to both towns. However, Lincoln Park has potential for local groundwater development if necessary. The municipality may also have the option of purchasing water from the Passaic Valley Water Commission.

Madison - The relatively small incremental demands projected for the Borough can be met by the existing municipal wells, or by the development of an additional well. Purchase of water from SMCMUA is also a possibility.

Mendham Borough - It is recommended that the Borough interconnect with the County system in the vicinity of the Clyde Potts Reservoir. To meet Future demands it is recommended that the existing facilities be supplemented by the MCMUA supply.

Mendham Township - Portions of the Township are served by Mendham Borough, SMCMUA, and by Randolph Township. As the Township develops, it is expected that these purveyors will increase service within the municipality.

Mine Hill - Mine Hill currently obtains water from the MCMUA and it is anticipated that additional demands in the future will be satisfied from the County's Alamatong Well Field.

Montville - Montville is anticipated to experience a significant demand increase in the future. However, groundwater resources appear to be more than adequate to satisfy this demand. In addition, Montville has rights to 1 MGD of the surface supply from the Boonton Reservoir. If feasible, the Township should consider the extension of service to areas of the municipality which have documented septic problems. In many cases, particularly near the basaltic ridges, malfunctioning septics are affecting private wells in unserved areas. The Township is also in a position to extend service to adjacent municipalities if necessary, as it has the required resources.

Morris Plains - This municipality is now supplied by SMCMUA, and will continue to be supplied by the Authority in the future.

Morristown - This municipality is now supplied by SMCMUA, and will continue to be supplied by the Authority in the future.

Morris Township - This municipality is now supplied by SMCMUA, and will continue to be supplied by the Authority in the future.

Mount Arlington - Two small water companies supply the demands of a portion of the Borough at this time. With reasonably dense unsewered development in hilly, rocky terrain, this municipality is a candidate for an expanded water supply system in the future. New water supply sources may be developed locally, but this may be limited in quantity. An interconnection with the Roxbury system in Landing may be another possibility. Ultimately, a regional system could serve the Borough.

Mountain Lakes - The Borough has sufficient local groundwater resources to provide for existing and future needs. Considering the fact that its wells tap drift deposits connected to the Rockaway Valley aquifer system, it is recommended that the Borough periodically monitor the quality of its supply. Alternate sources of supply are available by interconnection with Denville or Parsippany- Troy Hills.

Mount Olive - It is recommended that Mount Olive attempt to acquire, upgrade and interconnect the numerous and piecemeal water systems present within the Township. Service should be extended to areas as development densities and as on-site septic/well problems dictate. A water supply system for the Budd Lake area, which has documented septic problems, has been proposed by the Township. We concur with their proposal. The Township should seek to develop new groundwater supplies in the Musconetcong and the Drakes Brook/South Branch valleys where geological mapping indicates glacial drift overlying limestone.

Netcong - Increases in water demand in Netcong are expected to be small. The Borough should be able to obtain the required supply by developing an additional well. Alternatively, water may be purchased from Stanhope which is interconnected with the Borough system, or from Mount Olive or Roxbury through a future interconnection.

Parsippany-Troy Hills - This community appears to have adequate supplies and resources for present and future demands. There has been a case of well closure due to contamination, but this seems to be an isolated case. The Township has a widespread network of supply wells which provide stability within the water system.

Passaic Township - Passaic Township is served by the Commonwealth Water Company. This municipality should look to Commonwealth to supply the incremental demands which will occur in the future as service is extended to additional areas of the Township.

Pequannock - This municipality obtains water from local groundwater sources and from Newark's surface supply. Local resources should be sufficient to supply the incremental demands for Pequannock and neighboring Lincoln Park.

Randolph - Randolph Township currently obtains water from the MCMUA and it is anticipated that additional demands in the future will be satisfied from the County's Alamatong Well Field.

Riverdale - Additional demands within the Riverdale system are expected to be small. If necessary, the development of an additional well would be sufficient to satisfy this demand.

Rockaway Borough - The Borough has groundwater resources which are quantitatively adequate with respect to present and future demands. At present, the existing activated carbon filtration system is satisfactorily handling the levels of volatile organics present in the groundwater.

While the treatment system has been operating satisfactorily, an interconnection with another water system would be prudent. Should water become available in this area from the County system in the future, the Borough should consider this supply as a backup source.

Rockaway Township - The Township public supply system is also subject to the activated carbon treatment due to the presence of volatile organic contamination. As has been discussed previously, Rockaway Township will experience a significant increase in demand. This will require the development of new supply sources either within the Township or in nearby areas. The possibility of developing a well field in the lower Berkshire Valley is an alternative which can be evaluated by the Township subsequent to the completion of groundwater studies within the Township itself. If feasible, new groundwater sources within the Township would be a preferred alternative.

Roxbury - Additional supplies may be required for both water purveyors which serve the Township. Numerous possibilities exist within the Township for water supply development. New wells would best be located in areas where glacial drift overlies limestone within the Drakes Brook Basin. New wells should not be located in the Black River Watershed, as this is the source of the County's Alamatong well field supply.

It is also recommended that both local systems interconnect with the County system at Alamatong to provide back-up in the event of system failure. The Township should also consider the extension of service to Mount Arlington from its Landing system if the Borough seeks additional supply.

Victory Gardens - This Borough is now supplied by the Dover Water Department, and will continue to be supplied by Dover in the future.

Washington Township - This municipality is expected to experience significant increases in demand in the future. Much of the development which has

occurred in this Township is located on the elevated rocky ridges which traverse the municipality. Unfortunately, the opportunity to develop wells of even moderate capacity is low on these ridges. On the other hand, the valleys are commonly underlain by glacial drift and limestone, which present good water supply potential. As the need develops, it is recommended that the Municipal Utilities Authority develop wells along the South Branch of the Raritan River and pump water to areas of high demand.

Wharton - Groundwater supplies and resources appear to be adequate for this municipality. The threat of groundwater contamination is the only factor which must be addressed in this case. Supplies should be monitored and interconnections with the Dover system or a regional supply (if and when available) should be considered by the Borough.

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APPENDIX A

ABBREVIATIONS AND DEFINITIONS

ABBREVIATIONS

CFS	Cubic Feet per Second
DEP	Department of Environmental Protection, New Jersey State agency
EPA	Environmental Protection Agency, Federal agency
GPCD	Gallons Per Capita Per Day
GPM	Gallons Per Minute
MCMUA	Morris County Municipal Utilities Authority
MG	Million Gallons
MGD	Million Gallons Per Day
PPM	Parts Per Million
SMCMUA	Southeast Morris County Municipal Utilities Authority
SWSMP	Statewide Water Supply Master Plan

DEFINITIONS

Aquifer - The portion of the subsoil which is permeable, porous and water bearing.

Artesian - A condition of specific aquifers shown to exist when a well is drilled and the water is observed to rise above the level first encountered.

Average Daily Demand - Normal amount of water needed to satisfy demands for a day. Total water delivered to the system in a year divided by the number of days in a year.

Commercial Consumer - Business or industrial customers of a water system.

Community Water System - Any facility delivering water on a fulltime basis used by 25 or more persons.

Cone of Depression - The depression in a water table in the vicinity of pumping operations.

Consumer - Anyone receiving water from the distribution system.

Diversion - The act of removing water from surface or subsurface sources.

Domestic Use - Use of water in homes, for lawns, laundry, bathing, etc.

Drainage Area - The land area of a drainage basin or watershed. Usually expressed in acres or square miles.

Drainage Divide - The boundary between one drainage basin and another.

Drawdown - The lowering of a water table due to the removal of groundwater.

Elevated Tank - A water storage tank raised above the ground surface by posts or columns.

Fire Demand - Based on population and district, the amount of water and flow needed for fire fighting purposes.

Flood Plain - The low land that borders a river, usually dry but subject to flooding when the river over flows its banks.

Hydraulics - The science that deals with the laws governing water or other liquids in motion and their applications.

Hydrologic Cycle - The process whereby liquid water or ice is converted to water vapor, transported in the vapor state, condensed and returned to the earth as precipitation.

Hydrology - The science that deals with the circulation, distribution, and properties of the water of the earth.

Hydropneumatic Tank - An airtight tank that holds both air and water. May by used by one home or several homes by compressing air and creating pressure to transmit water.

Impervious - A term describing material where water is unable to pass through or passes with extreme difficulty and very slowly.

Incremental Demand - The additional volume needed to satisfy requirements of the water distribution system.

Industrial Consumption - The water used by mechanical or manufacturing processes.

Infiltration - The process whereby water sinks into the soil.

Peak Daily Demand - The maximum amount of water needed to meet consumptive needs that day.

Permeability - The ability of sediments to transmit water.

Porosity - An index of soil characteristics as related to the percolation rate of water through the soil.

Potable Water - Water which is suitable in every way for human consumption.

Public Water Supply - A water supply available to many people and the general public.

Recharge - Flow to groundwater storage through infiltration from surface supplies or precipitation.

Safe Yield - Dependable amount of water that can be withdrawn from a source during a span of years which equals the driest on record.

Specific Yield - The amount of water that can be obtained from the pores or cracks of a unit volume of soil or rock.

Standpipe - A tank used for water storage with its height greater than its diameter.

Water Table - The upper limit of useable groundwater.

Well - A hole bored, drilled or excavated into the earth to obtain water.

Well Field - Tract of land containing more than one well.

APPENDIX B

NON-COMMUNITY WATER SYSTEMS IN MORRIS COUNTY

	Facility Name	Municipality	Average 1980 Water Use (gallons/day)
1	Aircraft Radio and Control	Boonton Twp.	7,000
2.	Conklin Scout Reservation	Boonton Twp.	1,250
3.	Johanson Manufacturing	Boonton Twp.	7,400
4.	RFL Industries	Boonton Twp.	4,000
5.	Tally-Ho Manor/Sarah Francis Nursing Home	Boonton Twp.	16,250
6.	Chester Diner	Chester	750
7.	Chester Mall	Chester	10,400
8.	Chester Springs Shopping Center	Chester	16,800
9.	Larison's Turkey Farm Inn	Chester	1,500
10.	Williamson School	Chester	1,875
11.	Bell Laboratories	Chester	1,000
12.	Black River Middle School	Chester Twp.	5,250
13.	Bragg School	Chester Twp.	5,250
14.	Cooperative Industries	Chester Twp.	50,000
15.	Dickerson School	Chester Twp.	6,000
16.	Glenora Nursing Home	Chester Twp.	4,500
17.	Hillside Lounge	Chester Twp.	250
18.	N.J. Association for Retarded Citizens	Chester Twp.	9,375
19.	Westmont School	Chester Twp.	650
20.	Camp Hope for the Retarded	East Hanover	150
21.	Sandoz	East Hanover	750,000
22.	Exxon Research and Engineering	Florham Park	180,000
23.	Sun Valley Swim & Tennis Club	Florham Park	4,250
24.	Anchor Golf Land	Hanover Twp.	2,500
25.	Harding Twp. Elementary School	Harding	2,820
26.	Harding Twp. Junior School	Harding	2,565
27.	Minuteman Restaurant	Harding	2,500
28.	Mt. Kemble Inn	Harding	4,500
29.	999 Mt. Kemble Avenue	Harding	3,750
30.	N.J. Bell Telephone	Harding	900
31.	Camp Clifton	Jefferson	7,500
32.	Captains Quarters	Jefferson	2,250
33.	Consolidated School	Jefferson	2,400
34.	Countryside Restaurant	Jefferson	1,125
35.	Ellen T. Briggs School	Jefferson	6,975

	Facility Name	Municipality	Average 1980 Water Use (gallons/day)
36.	Great Cove Park	Jefferson	125
37.	Jefferson House Inc.	Jefferson	1,125
38.	Mark III Manor	Jefferson	1,875
39.	The Windless	Jefferson	300
40.	The Betty Jane	Jefferson	250
41.	Zorbas Charbroil	Jefferson	2,250
42.	American Tennis Club	Kinnelon	7,500
43.	Calamity Jane Restaurant	Kinnelon	1,875
44.	Kinnelon High School	Kinnelon	19,000
45.	Municipal Building	Kinnelon	625
46.	Stoney Brook School	Kinnelon	6,600
47.	Farleigh Dickenson University	Madison	100,000
48.	Mt. St. John Academy	Mendham Twp.	14,250
49.	Roxiticus Golf Club	Mendham Twp.	1,400
50.	Schiff Scout Reservation	Mendham Twp.	15,500
51.	Camp Dawson	Montville	2,100
52.	Central School	Montville	9,750
53.	Hilltop Nursing Home	Montville	15,625
54.	J. and J.	Montville	250
55.	Kevah Konner	Montville	750
56.	Montville Colonial Rest Home	Montville	3,875
57.	Montville Inn	Montville	375
58.	Pierson Mold & Tool Company	Montville	875
59.	Ramapo Instrument Company	Montville	725
60.	Thermal American Fused Quartz Company	Montville	1,875
61.	Vreeland's Red Barn Restaurant	Montville	900
62.	Allied Chemical Corp.	Morris Twp.	500,000
63.	Morris County Golf Club	Morris Twp.	5,250
64.	The Mennen Company	Morris Twp.	400,000
65.	Country Motor Inn	Morris Plains	3,300
66.	Warner-Lambert	Morris Plains	46,500
67.	Morristown Memorial Hospital	Morristown	36,000
68.	Sandshore School	Mt. Olive	11,625
69.	Tomahawk Day Camp	Mt. Olive	600
70.	Steven's State Park	Mt. Olive	600
71.	Delicatessen	Mt. Olive	75
72.	Mt. Olive High School	Mt. Olive	20,400
73.	YMHA Day Camp	Mt. Olive	6,250

	Facility Name	Municipality	Average 1980 Water Use (gallons/day)
74.	Arrowhead Tennis Club	Parsippany-Troy Hills	5,250
75.	Morristown Medical Group	Parsippany-Troy Hills	750
76.	Pfizer Corp.	Parsippany-Troy Hills	115,600
77.	Harbor Hills Day Camp	Randolph	1,500
78.	Stoneybrook Day Camp	Randolph	1,050
79.	Sun N' Fun Beach Club	Randolph	250
80.	Rockaway Veterans Park	Rockaway Twp.	1,000
81.	Egberts Lake Campground	Rockaway Twp.	1,500
82.	Camp Budsonia	Rockaway Twp.	375
83.	N.J. Camp for the Blind	Rockaway Twp.	1,500
84.	Winnebago Scout Reservation	Rockaway Twp.	1,250
85.	Judy's Dance Studio	Roxbury	100
86.	Hopatcong State Park	Roxbury	1,000
87.	Assembly of God Camp	Washington	1,750
88.	Hacklebarney St. Park	Washington	1,500
89.	U.S. Radium Corp.	Washington	50,000
90.	West Morris Central High School	Washington	24,000
91.	Christadelphian Bible Camp	Washington	150

APPENDIX C

INDEX TO SYMBOLS ON PLATE 1

Public Community Wells

Number	Location	Owner	Safe Yield
1	Boonton Township	Boonton Water Department	900 GPM
2	Boonton Township	Boonton Water Department	
3	Boonton Township	Boonton Water Department	
4	Boonton Township	Boonton Water Department	
5	Boonton Township	Boonton Water Department	
1	Chatham Borough	Chatham Water Department	1050 GPM
2	Chatham Borough	Chatham Water Department	560 GPM
3	Chatham Borough	Chatham Water Department	1340 GPM
1	Chester Borough	Chester Water Company	50 GPM
1	Denville	Denville Water Department	450 GPM
2	Denville	Denville Water Department	600 GPM
3	Denville	Denville Water Department	1100 GPM
4	Denville	Mt. Lakes Water Department	200 GPM
5	Denville	Mt. Lakes Water Department	380 GPM
1	Dover	Dover Water Department	1500 GPM
2	Dover	Dover Water Deparatment	1100 GPM
3	Dover	Dover Water Department	1000 GPM
4	Dover	Dover Water Department	1500 GPM
1	East Hanover	East Hanover Water Dept.	NOT IN USE
2	East Hanover	East Hanover Water Dept.	1000 GPM
3	East Hanover	East Hanover Water Dept.	NOT IN USE
4	East Hanover	East Hanover Water Dept.	800 GPM
1	Florham Park	Florham Park Water Dept.	300 GPM
2	Florham Park	Florham Park Water Dept.	1000 GPM
3	Florham Park	Florham Park Water Dept.	700 GPM
4	Florham Park	Florham Park Water Dept.	1300 GPM
5	Florham Park	East Orange Water Dept.	1080 GPM
6	Florham Park	East Orange Water Dept.	1080 GPM
7	Florham Park	East Orange Water Dept.	1080 GPM
1	Hanover Township	Southeast	347 GPM
2	Hanover Township	Southeast	695 GPM
3	Hanover Township	Southeast	695 GPM
4	Hanover Township	Southeast	1389 GPM
5	Hanover Township	Southeast	1042 GPM
6	Hanover Township	Southeast	347 GPM
7	Hanover Township	Southeast	347 GPM

Public Community Wells, Continued

Number	Location	Owner	Safe Yield
1	Harding	Southeast	597 GPM
2	Harding	Lakeshore Water Company	80 GPM
3	Harding	Lakeshore Water Company	
1	Jefferson Township	Mountain Shores	-
2	Jefferson Township	Jefferson Township MUA	125 GPM
3	Jefferson Township	Jefferson Township MUA	65 GPM
4	Jefferson Township	Jefferson Township MUA	13 GPM
5	Jefferson Township	Jefferson Township MUA	16 GPM
6	Jefferson Township	Jefferson Township MUA	150 GPM
7	Jefferson Township	Jefferson Township MUA	75 GPM
8	Jefferson Township	High Ridge Water Company	135 GPM
9	Jefferson Township	High Ridge Water Company	250 GPM
10	Jefferson Township	Jefferson Township MUA	50 GPM
11	Jefferson Township	Jefferson Township MUA	75 GPM
12	Jefferson Township	Mola Well	-
13	Jefferson Township	Peterson Well	-
14	Jefferson Township	Sisco Well	-
15	Jefferson Township	Sisco Well	-
16	Jefferson Township (Sussex Co. Line)	Lake Stockholm	30 GPM
1	Kinnelon	Fayson Lakes Water Company	500 GPM
2	Kinnelon	Fayson Lakes Water Company	
3	Kinnelon	Fayson Lakes Water Company	
1	Lincoln Park	Lincoln Park Water Department	140 GPM
1	Madison	Madison Water Department	3235 GPM
2	Madison	Madison Water Department	
3	Madison	Madison Water Department	
4	Madison	Madison Water Department	
5	Madison	Madison Water Department	
1	Mendham Borough	Mendham Water Department	400 GPM
2	Mendham Borough	Mendham Water Department	65 GPM
1	Montville Township	Montville Township MUA	-
2	Montville Township	Montville Township MUA	-
3	Montville Township	Montville Township MUA	-
4	Montville Township	Montville Township MUA	1000 GPM
5	Montville Township	Montville Township MUA	750 GPM
6	Montville Township	Montville Township MUA	-
7	Montville Township	Montville Township MUA	-
8	Montville Township	Montville Township MUA	150 GPM
1	Morristown	Southeast	250 GPM
2	Morristown	Southeast	694 GPM
3	Morristown	Southeast	451 GPM

Public Community Wells, Continued

Number	Location	Owner	Safe Yield
1	Morris Township	Southeast	347 GPM
1	Mountain Lakes	Mt. Lakes Water Dept.	1000 GPM
2	Mountain Lakes	Mt. Lakes Water Dept.	-
1	Mount Arlington	Mt. Arlington Water Co.	-
1	Mount Olive	Netcong Water Department	200 GPM
2	Mount Olive	Netcong Water Department	300 GPM
3	Mount Olive	Stanhope Water Department	200 GPM
4	Mount Olive	Stanhope Water Department	275 GPM
5	Mount Olive	Indian Springs Well	300 GPM
6	Mount Olive	Stonehedge Well	20 GPM
7	Mount Olive	Stonehedge Well	61 GPM
8	Mount Olive	Stonehedge Well	40 GPM
9	Mount Olive	Stonehedge Well	20 GPM
10	Mount Olive	Indian Springs Well	85 GPM
11	Mount Olive	West Jersey Water Company	150 GPM
12	Mount Olive	West Jersey Water Company	70 GPM
13	Mount Olive	West Jersey Water Company	70 GPM
14	Mount Olive	West Jersey Water Company	130 GPM
15	Mount Olive	Vasa Homes Well	30 GPM
16	Mount Olive	Vasa Homes Well	30 GPM
17	Mount Olive	Vasa Homes Well	30 GPM
18	Mount Olive	Vasa Homes Well	50 GPM
19	Mount Olive	Developer Well	16 GPM
20	Mount Olive	Mt. Olive Twp. Water Dept.	150 GPM
21	Mount Olive	Highridge	43 GPM
22	Mount Olive	Pinecrest	60 GPM
23	Mount Olive	Pinecrest	125 GPM
24	Mount Olive	Mt. Olive Twp. Water Dept.	20 GPM
25	Mount Olive	Mt. Olive Twp. Water Dept.	380 GPM
26	Mount Olive	Mt. Olive Twp. Water Dept.	380 GPM
27	Mount Olive	Mt. Olive Twp. Water Dept.	140 GPM
28	Mount Olive	Mt. Olive Twp. Water Dept.	100 GPM
29	Mount Olive	Mt. Olive Twp. Water Dept.	44 GPM
1	Parsippany-Troy Hills	Par-Troy Water Department	
2	Parsippany-Troy Hills	Par-Troy Water Department	
3	Parsippany-Troy Hills	Par-Troy Water Department	
4	Parsippany-Troy Hills	Par-Troy Water Department	
5	Parsippany-Troy Hills	Par-Troy Water Department	
6	Parsippany-Troy Hills	Par-Troy Water Department	
7	Parsippany-Troy Hills	Par-Troy Water Department	
8	Parsippany-Troy Hills	Par-Troy Water Department	
9	Parsippany-Troy Hills	Par-Troy Water Department	
10	Parsippany-Troy Hills	Par-Troy Water Department	9060 GPM
11	Parsippany-Troy Hills	Par-Troy Water Department	
12	Parsippany-Troy Hills	Par-Troy Water Department	
13	Parsippany-Troy Hills	Par-Troy Water Department	
14	Parsippany-Troy Hills	Par-Troy Water Department	
15	Parsippany-Troy Hills	Par-Troy Water Department	
16	Parsippany-Troy Hills	Par-Troy Water Department	
17	Parsippany-Troy Hills	Par-Troy Water Department	

Public Community Wells, Continued

Number	Location	Owner	Safe Yield
1	Pequannock	Pequannock Water Dept.	-
2	Pequannock	Pequannock Water Dept.	-
1	Randolph Township	Morris County MUA	450 GPM
2	Randolph Township	Morris County MUA	450 GPM
3	Randolph Township	Morris County MUA	450 GPM
4	Randolph Township	Chapel Hill Well	NOT IN USE
5	Randolph Township	Musiker Well	375 GPM
6	Randolph Township	Shongum Well	NOT IN USE
7	Randolph Township	Brandy Pierre Well	NOT IN USE
8	Randolph Township	Emery Well	NOT IN USE
9	Randolph Township	Denville Water Dept.	880 GPM
10	Randolph Township	Denville Water Dept.	780 GPM
1	Riverdale	Riverdale Water Dept.	250 GPM
2	Riverdale	Riverdale Water Dept.	200 GPM
1	Rockaway	Rockaway Water Dept.	
2		Rockaway Water Dept.	
3		Rockaway Water Dept.	
1	Rockaway Township	Rockaway Twp. Water Dept.	
2	Rockaway Township	Rockaway Twp. Water Dept.	
3	Rockaway Township	Rockaway Twp. Water Dept.	
4	Rockaway Township	Picatinny	903 GPM
5	Rockaway Township	Picatinny	
6	Rockaway Township	Picatinny	
7	Rockaway Township	Picatinny	
8	Rockaway Township	Picatinny	
1	Roxbury Township	Roxbury Twp. Water Dept.	40 GPM
2	Roxbury Township	Roxbury Twp. Water Dept.	240 GPM
3	Roxbury Township	Roxbury Twp. Water Dept.	160 GPM
4	Roxbury Township	Roxbury Twp. Water Dept.	360 GPM
5	Roxbury Township	Roxbury Twp. Water Dept.	50 GPM
6	Roxbury Township	Roxbury Twp. Water Dept.	50 GPM
7	Roxbury Township	Roxbury Water Company	1000 GPM
8	Roxbury Township	Roxbury Water Company	
9	Roxbury Township	Roxbury Water Company	
10	Roxbury Township	Roxbury Water Company	
11	Roxbury Township	Roxbury Water Company	
12	Roxbury Township	Hercules Powder Company	1000 GPM
13	Roxbury Township	Hercules Powder Company	
1	Washington Township	Washington Twp. MUA	31 GPM
2	Washington Township	Washington Twp. MUA	14 GPM
3	Washington Township	Washington Twp. MUA	62 GPM
4	Washington Township	Washington Twp. MUA	60 GPM
5	Washington Township	Washington Twp. MUA	41 GPM

Public Community Wells, Continued

Number	Location	Owner	Safe Yield
6	Washington Township	Washington Twp. MUA	67 GPM
7	Washington Township	Washington Twp. MUA	148 GPM
8	Washington Township	Washington Twp. MUA	117 GPM
9	Washington Township	Washington Twp. MUA	46 GPM
10	Washington Township	Washington Twp. MUA	58 GPM
11	Washington Township	Washington Twp. MUA	-
12	Washington Township	Washington Twp. MUA	-
13	Washington Township	Washington Twp. MUA	-
14	Washington Township	Washington Twp. MUA	65 GPM
15	Washington Township	Washington Twp. MUA	183 GPM
1	Wharton	Wharton Water Department	1000 GPM
2	Wharton	Wharton Water Department	
3	Wharton	Wharton Water Department	

Tank Index

Town	Size (MG)		High Water Elevation (Ft.)	Owner
Boonton A	0.5		790	Boonton Water Department
B	0.5		535	Boonton Water Department
Boonton Twp. A	0.05		805	Boonton Water Department
Butler A	0.5		640	Butler Water Department
Chatham Boro A			514	Chatham Water Department
B	1.38	COMBINED	514	Chatham Water Department
C			514	Chatham Water Department
Chatham Twp. A	1.42		584.5	Commonwealth Water Co.
Chester A	0.01			Chester Water Company
Denville A	0.01			Denville Water (summer tank)
B	0.5		790	Denville Water Dept.
C	0.25		713	Denville Water Dept.
D	0.2			Denville Water Dept.
E	1.5			Denville Water Dept.
F	0.5		790	Denville Water Dept.
G	0.5		1013	Denville Water Dept.
Dover A	(RESERVOIR)			Dover Water Department
B	2	RESERVOIR		Dover Water Department
East Hanover A	1			East Hanover Water Dept.
Florham Park A	0.25		376	Florham Park Water Dept.
Hanover A	1		523	Southeast Morris MUA
B	0.2		423	Southeast Morris MUA
C	0.3		523	Southeast Morris MUA
D	0.5			Southeast Morris MUA
Harding A	0.03	STANDPIPE	245	Lakeshore Water Co.
B	0.03	STANDPIPE	245	Lakeshore Water Co.
Jefferson A	0.03			Lake Stocholm Water Co.
Kinnelon A	1.5		876	Butler Water Department
B	0.1		835	Fayson Lakes Water Co.
C	0.15		867	Fayson Lakes Water Co.
D	0.1		867	Fayson Lakes Water Co.
E	0.1		844	Fayson Lakes Water Co.

Tank Index, Continued

Town	Size (MG)	High Water Elevation (Ft.)	Owner
Lincoln Park A	1.3	398	Lincoln Park Water Dept.
Madison A	0.5	474	Madison Water Dept.
B	0.75	476	Madison Water Dept.
Mendham A	0.25		Mendham Water Dept.
Mendham Twp. A	0.06 RESERVOIR		Mendham Water Dept.
B	0.5 RESERVOIR		Mendham Water Dept.
Montville A	1	660	Montville Twp. MUA
B	0.25	455	Montville Twp. MUA
C	1	335	Montville Twp. MUA
Morris Plains A	0.3	737	Southeast Morris MUA
B	0.12	552	Southeast Morris MUA
Morris Twp. A	0.5		Southeast Morris MUA
B			Southeast Morris MUA
C			Southeast Morris MUA
D	0.3	670	Southeast Morris MUA
E	0.5	795	Southeast Morris MUA
F	0.15		Southeast Morris MUA
G	0.3	523	Southeast Morris MUA
Mt. Arlington A	0.2		Roxbury Twp. Water Dept.
Mt. Lakes A	1	785	Mt. Lakes Water Dept.
B	0.5	785	Mt. Lakes Water Dept.
Mt. Olive A	1	1065	Village Green
B	0.5	1227	Eagle Rock
C	0.7	1196	Oakwood
D	0.7	745	Clover Hill
Par-Troy A		468	Par-Troy Water Dept.
B	0.5	486	Par-Troy Water Dept.
C	1	668	Par-Troy Water Dept.
D	0.16	737	Par-Troy Water Dept.
E	2	600	Par-Troy Water Dept.
F	1	820	Par-Troy Water Dept.
G	0.5	1125	Par-Troy Water Dept.
H	1	465	Par-Troy Water Dept.

Tank Index, Continued

Town		Size (MG)	High Water Elevation (Ft.)	Owner
Randolph	A	RESERVOIR		Dover Water Dept.
	B	3	918	Morris County MUA
	C	4 RESERVOIR		Mendham Water Dept.
	D	1		Mendham Water Dept.
	E	1.4		Randolph Twp. MUA
Rockaway Boro	A	0.5		Rockaway Water Dept.
	B	1		Rockaway Water Dept.
	C	0.15		Rockaway Water Dept.
Rockaway Twp.	A			Picatinny
	B			Picatinny
	C			Picatinny
	D			Picatinny
	E			Picatinny
	F			Picatinny
	G	0.75		Rockaway Twp. Water Dept.
	H	0.4 RESERVOIR		Rockaway Twp. Water Dept.
	I	1		Rockaway Twp. Water Dept.
	J	0.5		Rockaway Twp. Water Dept.
	K	1		Rockaway Twp. Water Dept.
	L	0.1		Rockaway Twp. Water Dept.
Roxbury	A	0.15		Roxbury Twp. Water Dept.
	B	1		Netcong Water Dept.
	C	0.3		Roxbury Twp. Water Dept.
	D	1		Roxbury Twp. Water Dept.
	E	0.5		Roxbury Twp. Water Dept.
Washington Twp.	A	0.18	1188	Washington Twp. MUA
	B	0.77	1289	Washington Twp. MUA
	C	2.4	804	Washington Twp. MUA
	D	0.05	795	Washington Twp. MUA
	E	0.2	930	Washington Twp. MUA
	F	0.2	1008	Washington Twp. MUA
Wharton	A	RESERVOIR		Wharton Water Dept.

Effects of disasters should be determined upon each of the following components:

1. Sources
2. Collection Works
3. Transmission System
4. Treatment Facilities
5. Distribution System
6. Personnel
7. Power Supply
8. Materials and Supplies
9. Communications
10. Mutual Aid and/or Interconnection Agreements

This task will enable the utility to identify its critical, or weaker components. A strengthening of these components will help to prepare the entire system to be able to face a crisis and survive.

B. In addition, the availability of emergency water supply needs to be assessed and selected. The following should be included in this assessment:

1. use of tank trucks and availability of potable water to fill them
2. the use of potable water treatment facilities
3. the proximity of alternate systems

Vulnerability assessment should be included in an Appendix section of the plan, along with procedural information for coping with each of the specific emergencies previously listed.

Task III - Priorities

Specify priorities and determine the best apparent way of using resources. Priorities should be included in a set of guidelines along with preparations for water allowances, rationing, and time phasing of estimated water requirements.

A. Establish baselines on raw water quality.

B. Determine amount of water needed and the priority to be given to each of the following uses:

1. potable
2. sanitary
3. fire-fighting
4. industrial and commercial

The need should be determined in order to be able to allocate a sufficient amount of water to each of these areas. Of course, by definition of priorities, some areas will require more water than others.

C. Also to be established in this section of the plan are emergency procedures for the following:

1. treatment
2. pumping
3. distribution
4. stations for service of emergency water

Task IV - Personnel Protection

In this section of the plan, the water utility should examine available means of shelter and safety, and determine procedure for attaining shelter and safety while an emergency is in progress.

A. Plan instructions for assembly of emergency utility and auxiliary personnel in a safe location.

B. Develop plan to provide test exercises to familiarize personnel with emergency procedures.

Task V - Communications Equipment

An up to date inventory of communications equipment should be taken to determine availability for emergency usage.

Task VI - Plant Equipment Protection

Provide for the protection of plant equipment, inventories, and records. Keep records readily available at all levels of operation, and provide security for these materials.

Task VII - Mutual Aid Agreements

These agreements will pertain only to emergency situations, so it is imperative to establish an exact definition of an emergency situation in each agreement.

A. Execute written agreements with adjacent community public water suppliers providing for the derivation of water through interconnections, and specify procedures.

B. Execute written agreements with private, industrial, and commercial well owners in order to establish temporary connections for obtaining water under emergency conditions. Once again, specify procedures, and determine the quality of water from these sources.

Task VIII - Emergency Phase Action Steps

Determine the steps involved in alerting personnel, readying equipment, and providing public information during each of the following phases:

A. Increased tension period, or long period of warning

B. Warning period

C. Period during which emergency is in progress.

Task IX - Assessment of Time Needed for Plant or System Recovery

Outline planned recovery operations. This phase, in which damage is estimated, may be included with vulnerability assessment.

Task X - Miscellaneous Guidelines

The following guidelines were first presented in the Journal AWWA, August, 1972, p. 485.

1. Design the emergency system with resistance to damage in mind and with backup equipment for all essential elements.

2. Train personnel to know what they are doing and why. Drill them in emergency procedures.

3. Keep communications simple, and use written instructions where necessary to avoid confusion.

4. Arrange to have all public announcements coordinated through a public relations office or other single source in the water utility.

5. Encourage interaction among employees in different levels.

6. Try to acquire and maintain standardized parts and equipment that will be compatible with nearby water utilities or sources, where economically feasible.

7. Keep the recovery plan flexible. Few disasters will be so obliging as to follow a prepared blueprint.

Utilities that prepare plans through the use of these guidelines will be setting a precedent, since ultimately all water utilities in New Jersey will be expected to adopt a local emergency response plan.

REFERENCE NO. 19

Uncontrolled Hazardous Waste Site Ranking System

A Users Manual

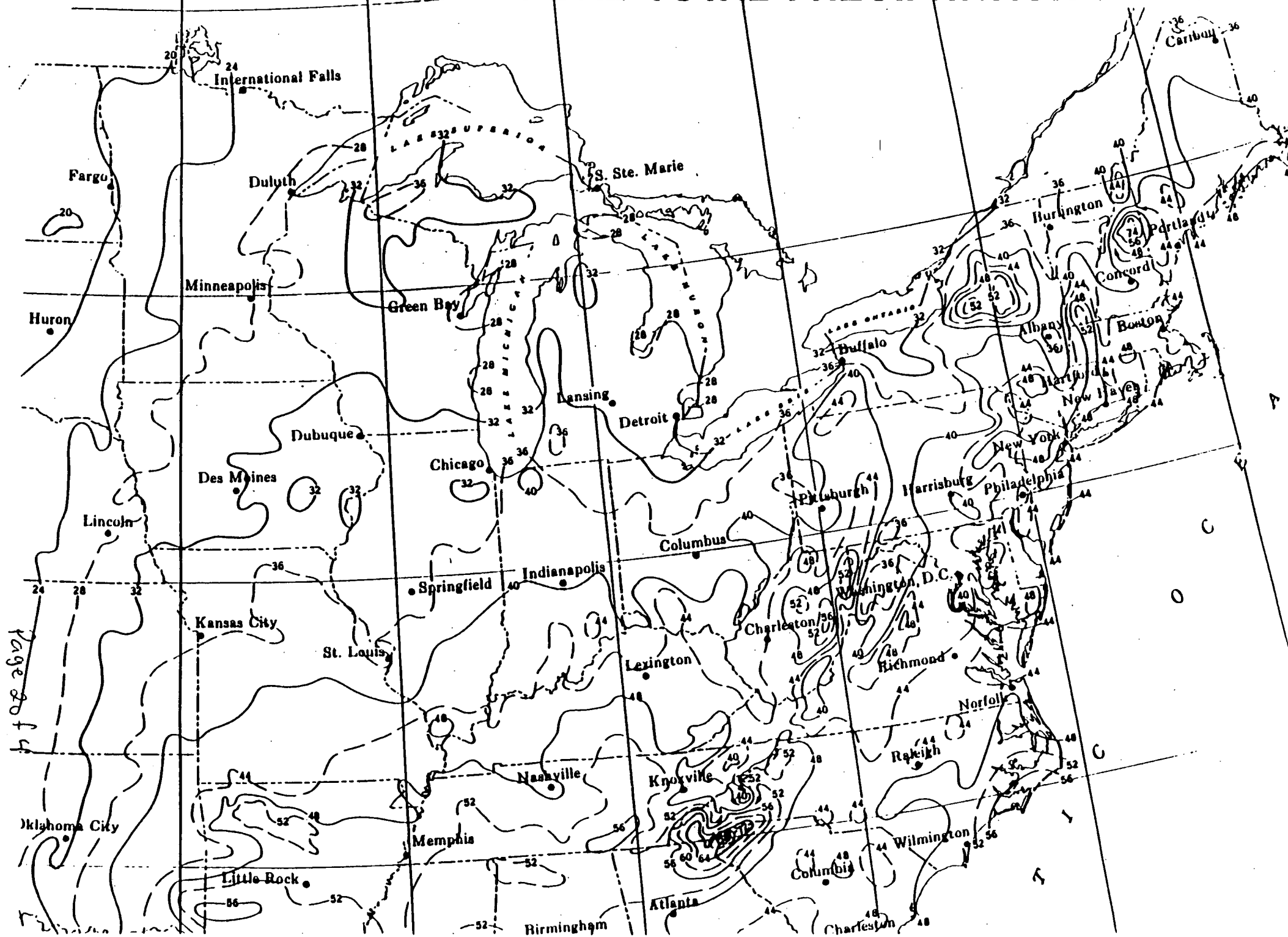
(HW-10)

Originally Published in
the July 16, 1982, *Federal Register*

United States
Environmental Protection
Agency

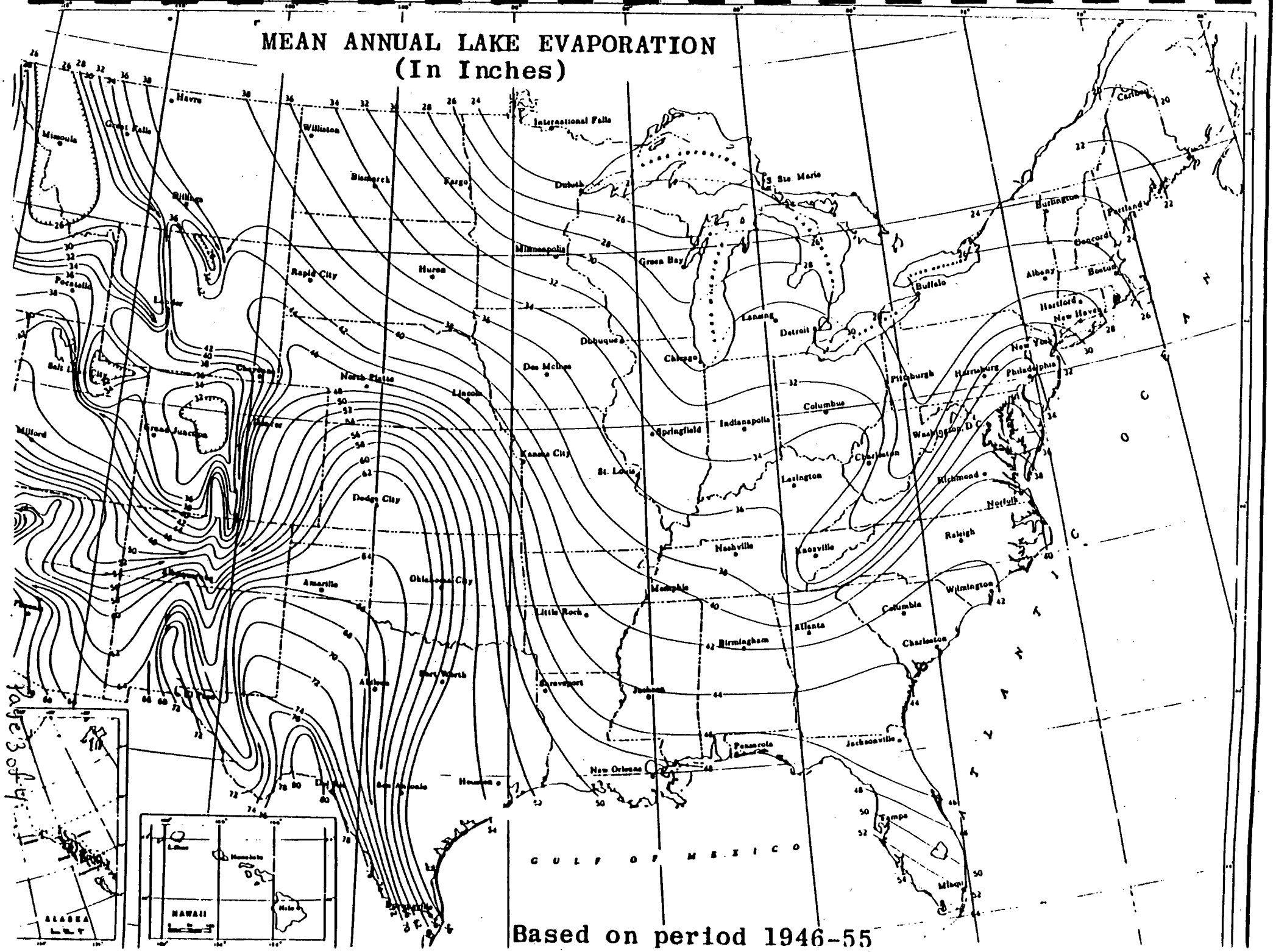
1984

NORMAL ANNUAL TOTAL PRECIPITATION (inches)



Page 8 of 4

MEAN ANNUAL LAKE EVAPORATION
(In Inches)



Based on period 1946-55

HRS MANUAL INSTRUCTIONS

Permeability of unsaturated zone (or intervening geological formations) is an indicator of the speed at which a contaminant could migrate from a facility. Assign a value from Table 2.

TABLE 2

PERMEABILITY OF GEOLOGIC MATERIALS*

Type of Material	Approximate Range of Hydraulic Conductivity	Assigned Value
Clay, compact till, shale; unfractured metamorphic and igneous rocks	$<10^{-7}$ cm/sec	0
Silt, loess, silty clays, silty loams, clay loams; less permeable limestone, dolomites, and sandstone; moderately permeable till	10^{-5} - 10^{-7} cm/sec	1
Fine sand and silty sand; sandy loams; loamy sands; moderately permeable limestone, dolomites, and sandstone (no karst); moderately fractured igneous and metamorphic rocks, some coarse till	10^{-3} - 10^{-5} cm/sec	2
Gravel, sand; highly fractured igneous and metamorphic rocks; permeable basalt and lavas; karst limestone and dolomite	$> 10^{-3}$ cm/sec	3

*Derived from:

Davis, S. N., Porosity and Permeability of Natural Materials in Flow-Through Porous Media, R.J.M. DeWest ed., Academic Press, New York, 1969.

Freeze, R. A. and J. A. Cherry, Groundwater, Prentice-Hall, Inc., New York, 1979.

REFERENCE NO. 20

Gulf South Environmental Laboratory
Contract 68-D9-0038

Case 15918
SDG No. BGQ34

Narrative

Case 15918 consisted of twelve (12) water and five (5) soil samples which were received by Gulf South Environmental Laboratory on February 22, 1991 and logged in as Episodes FUN. The samples were identified as follows:

BGQ34	BGQ35	BGQ36	BGQ37	BGQ38
BGQ39	BGQ40	BGQ41	BGQ42	BGQ43
BGQ44	BGQ45	BGQ46	BGQ47	BGQ48
BGQ49	BGQ51			

The samples were analyzed for volatile organics, semivolatile organics, and pesticide/PCBs.

Volatile Organics

Soil samples BGQ43, BGQ44, and BGQ46 required reanalysis due to low area counts for the internal standards and/or surrogate recoveries outside QC requirements. For all three samples reanalysis results were similar; therefore reruns are being submitted. No other problems were encountered.

Semivolatile

No problems were encountered with the analyses.

Pesticide/PCB

The MS/MSD for the low soil was originally prepared without DBC surrogate spike. The sample (BGQ-42) was prepared with surrogate. A reextraction was performed on the sample BGQ-42 and its MS/MSD. The reextraction was performed within the holding time. Both sets of recovery data are entirely within specification, however, only the reextraction of the MS/MSD is submitted.

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or his designee, as verified by the following signature."

Shelley R Antoine
Shelley R. Antoine
GC/MS Laboratory Manager

3/11/91
Date

~~000501~~ 3/12/91

U.S. EPA - CLP
COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

SOW No.: 3/90

EPA Sample No.	Lab Sample ID.
MBDZ33	02176-01S
MBDZ34	02176-02S
MBDZ35	02176-03S
MBDZ36	02176-04S
MBDZ37	02176-05S
MBDZ37D	02176-05S2
MBDZ37S	02176-05DS
MBDZ38	02176-06S
MBDZ39	02176-07S
MBDZ40	02176-08S
MBDZ41	02176-09S
MBDZ41D	02176-09S2
MBDZ41S	02176-09DS
MBDZ42	02176-10S
MBDZ43	02176-11S
MBDZ44	02176-12S
MBDZ45	02176-13S
MBDZ46	02176-14S
MBDZ47	02176-15S
MBDZ48	02176-16S

Were ICP interelement corrections applied? Yes/No YES
Were ICP background corrections applied? Yes/No YES
If yes-were raw data generated before application of background corrections? Yes/No NO

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: KDJohnson Name: Kirk D. Johnson

Date: 3/25/91 Title: Inorganic Data Auditor

U.S. EPA - CLP

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ33

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): WATER Lab Sample ID: 02176-01S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	32600.00			P
7440-36-0	Antimony	35.90	B		P
7440-38-2	Arsenic	7.90	B		F
7440-39-3	Barium	300.00			P
7440-41-7	Beryllium	2.40	B		P
7440-41-7	Cadmium	1.00	U		P
7440-70-2	Calcium	50300.00			P
7440-47-3	Chromium	61.40			P
7440-48-4	Cobalt	42.10	B		P
7440-50-8	Copper	73.70			P
7439-89-6	Iron	124000.00		J	P
7439-92-1	Lead	~~49.80~~		~~S~~	F
7439-95-4	Magnesium	15700.00			P
7439-96-5	Manganese	822.00			P
7439-97-6	Mercury	0.20	U	N	CV
7440-02-0	Nickel	42.20			P
7440-09-7	Potassium	9230.00			P
7782-49-2	Selenium	15.00	U	W J	F
7440-22-4	Silver	2.00	U		P
7440-23-5	Sodium	342000.00		J	P
7440-28-0	Thallium	10.00	U	NE J	F
7440-62-2	Vanadium	95.50			P
7440-66-6	Zinc	101.00			P
	Cyanide				NR

Color Before: BROWN Clarity Before: OPAQUE Texture:

Color After: BROWN Clarity After: OPAQUE Artifacts:

Comments:

Dilution: (1:1.x) Se(F) Tl(F)

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ34

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15913 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): WATER Lab Sample ID: 02176-02S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2790.00			P
7440-36-0	Antimony	17.00	U		P
7440-38-2	Arsenic	15.70			F
7440-39-3	Barium	135.00	B		P
7440-41-7	Beryllium	1.00	U		P
7440-41-7	Cadmium	1.00	U		P
7440-70-2	Calcium	38400.00			P
7440-47-3	Chromium	6.20	B		P
7440-48-4	Cobalt	128.00			P
7440-50-8	Copper	8.00	B		P
7439-89-6	Iron	80100.00		J	P
7439-92-1	Lead	~~6.40~~		~~W~~	F
7439-95-4	Magnesium	6400.00			P
7439-96-5	Manganese	9510.00			P
7439-97-6	Mercury	~~2.40~~		~~N~~	CV
7440-02-0	Nickel	32.20	B		P
7440-09-7	Potassium	6980.00			P
7782-49-2	Selenium	3.00	U	WJ	F
7440-22-4	Silver	2.00	U		P
7440-23-5	Sodium	51900.00		J	P
7440-28-0	Thallium	2.00	U	NWJ	F
7440-62-2	Vanadium	3.00	U		P
7440-66-6	Zinc	21.70			P
	Cyanide				NR

Color Before: GREY Clarity Before: CLOUDY Texture:

Color After: GREY Clarity After: CLOUDY Artifacts:

Comments:

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ35

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-00-0108

Lab Code: SKINER Case No.: 15913 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): WATER Lab Sample ID: 02176-03S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1720.00			P
7440-36-0	Antimony	21.50	B		P
7440-38-2	Arsenic	16.20			F
7440-39-3	Barium	114.00	B		P
7440-41-7	Beryllium	1.00	U		P
7440-41-7	Cadmium	1.00	U		P
7440-70-2	Calcium	38900.00			P
7440-47-3	Chromium	6.00	B		P
7440-48-4	Cobalt	106.00			P
7440-50-8	Copper	3.70	B		P
7439-89-6	Iron	70800.00		J	P
7439-92-1	Lead	~~6.20~~			F
7439-95-4	Magnesium	6310.00			P
7439-96-5	Manganese	9210.00			P
7439-97-6	Mercury	~~1.00~~		~~N~~	CV
7440-02-0	Nickel	30.40	B		P
7440-09-7	Potassium	7090.00			P
7782-49-2	Selenium	3.00	U	WJ	F
7440-22-4	Silver	2.00	U		P
7440-23-5	Sodium	49600.00		J	P
7440-28-0	Thallium	2.00	U	NWJ	F
7440-62-2	Vanadium	3.00	U		P
7440-66-6	Zinc	17.20	B		P
	Cyanide				NR

Color Before: GREY Clarity Before: CLOUDY Texture:

Color After: GREY Clarity After: CLOUDY Artifacts:

Comments:

000004

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ36

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): WATER Lab Sample ID: 02176-04S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	415.00			P
7440-36-0	Antimony	17.00	U		P
7440-38-2	Arsenic	2.50	B		F
7440-39-3	Barium	15.00	B		P
7440-41-7	Beryllium	1.00	U		P
7440-41-7	Cadmium	1.00	U		P
7440-70-2	Calcium	10000.00			P
7440-47-3	Chromium	9.90	B		P
7440-48-4	Cobalt	15.30	B		P
7440-50-8	Copper	7.00	B		P
7439-89-6	Iron	13900.00		J	P
7439-92-1	Lead	~~15.50~~		~~S~~	F
7439-95-4	Magnesium	1900.00	B		P
7439-96-5	Manganese	1090.00			P
7439-97-6	Mercury	0.20	U	N	CV
7440-02-0	Nickel	12.90	B		P
7440-09-7	Potassium	751.00	B		P
7782-49-2	Selenium	3.00	U	W J	F
7440-22-4	Silver	2.00	U		P
7440-23-5	Sodium	5980.00		J	P
7440-28-0	Thallium	2.00	U	N J	F
7440-62-2	Vanadium	3.00	U		P
7440-66-6	Zinc	25.90			P
	Cyanide				NR

Color Before: GREY Clarity Before: CLOUDY Texture:

Color After: GREY Clarity After: CLOUDY Artifacts:

Comments:

000085

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ37

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): WATER Lab Sample ID: 02176-05S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	74.20	B		P
7440-36-0	Antimony	17.00	U		P
7440-38-2	Arsenic	2.00	U		F
7440-39-3	Barium	7.70	B		P
7440-41-7	Beryllium	1.00	U		P
7440-41-7	Cadmium	1.00	U		P
7440-70-2	Calcium	6630.00			P
7440-47-3	Chromium	4.00	U		P
7440-48-4	Cobalt	2.00	U		P
7440-50-8	Copper	9.50	B		P
7439-89-6	Iron	226.00		J	P
7439-92-1	Lead	1.70	B	WJ	F
7439-95-4	Magnesium	2470.00	B		P
7439-96-5	Manganese	27.90			P
7439-97-6	Mercury	0.20	U	N	CV
7440-02-0	Nickel	4.00	U		P
7440-09-7	Potassium	530.00	B		P
7782-49-2	Selenium	3.00	U	J	F
7440-22-4	Silver	2.00	U		P
7440-23-5	Sodium	9410.00		J	P
7440-28-0	Thallium	2.00	U	NJ	F
7440-62-2	Vanadium	3.00	U		P
7440-66-6	Zinc	10.50	B		P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLOUDY Texture:

Color After: COLORLESS Clarity After: CLOUDY Artifacts:

Comments:

U.S. EPA - CLP

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ38

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): WATER Lab Sample ID: 02176-06S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	11600.00			P
7440-36-0	Antimony	17.00	U		P
7440-38-2	Arsenic	2.00	U		F
7440-39-3	Barium	97.60	B		P
7440-41-7	Beryllium	1.00	U		P
7440-41-7	Cadmium	1.00	U		P
7440-70-2	Calcium	11000.00			P
7440-47-3	Chromium	19.80			P
7440-48-4	Cobalt	5.60	B		P
7440-50-8	Copper	30.40			P
7439-89-6	Iron	8790.00		J	P
7439-92-1	Lead	81.00		S	F
7439-95-4	Magnesium	4370.00	B		P
7439-96-5	Manganese	307.00			P
7439-97-6	Mercury	~~0.41~~		~~N~~	CV
7440-02-0	Nickel	6.90	B		P
7440-09-7	Potassium	1600.00	B		P
7782-49-2	Selenium	15.00	U	W J	F
7440-22-4	Silver	2.00	U		P
7440-23-5	Sodium	20800.00		J	P
7440-28-0	Thallium	2.00	U	NW J	F
7440-62-2	Vanadium	22.40	B		P
7440-66-6	Zinc	270.00			P
	Cyanide				NR

Color Before: BROWN Clarity Before: OPAQUE Texture:

Color After: BROWN Clarity After: OPAQUE Artifacts:

Comments:

Dilution: Pb-(-x) Se(-x)

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U.S. EPA - CLP

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ39

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): WATER Lab Sample ID: 02176-07S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	12600.00			P
7440-36-0	Antimony	21.50	B		P
7440-38-2	Arsenic	2.00	U		F
7440-39-3	Barium	213.00			P
7440-41-7	Beryllium	1.00	U		P
7440-41-7	Cadmium	1.00	U		P
7440-70-2	Calcium	20900.00			P
7440-47-3	Chromium	60.10			P
7440-48-4	Cobalt	8.90	B		P
7440-50-8	Copper	77.80			P
7439-89-6	Iron	13800.00		J	P
7439-92-1	Lead	127.00			F
7439-95-4	Magnesium	7410.00			P
7439-96-5	Manganese	634.00			P
7439-97-6	Mercury	~~0.57~~		~~N~~	CV
7440-02-0	Nickel	12.40	B		P
7440-09-7	Potassium	2250.00	B		P
7782-49-2	Selenium	15.00	U	WJ	F
7440-22-4	Silver	2.00	U		P
7440-23-5	Sodium	56200.00		J	P
7440-28-0	Thallium	2.00	U	NWJ	F
7440-62-2	Vanadium	29.10	B		P
7440-66-6	Zinc	730.00			P
	Cyanide				NR

Color Before: BROWN Clarity Before: OPAQUE Texture:

Color After: BROWN Clarity After: OPAQUE Artifacts:

Comments:

Dilution (1-(2-x) 2(c.)

U.S. EPA - CLP

1

INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ40

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): WATER Lab Sample ID: 02176-08S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	150.00	B		P
7440-36-0	Antimony	17.00	U		P
7440-38-2	Arsenic	2.00	U		F
7440-39-3	Barium	7.30	B		P
7440-41-7	Beryllium	1.00	U		P
7440-41-7	Cadmium	1.10	B		P
7440-70-2	Calcium	6600.00			P
7440-47-3	Chromium	4.00	U		P
7440-48-4	Cobalt	2.00	U		P
7440-50-8	Copper	1.00	U		P
7439-89-6	Iron	248.00		J	P
7439-92-1	Lead	4.00		J	F
7439-95-4	Magnesium	2450.00	B		P
7439-96-5	Manganese	27.80			P
7439-97-6	Mercury	0.20	U	N	CV
7440-02-0	Nickel	4.00	U		P
7440-09-7	Potassium	537.00	B		P
7782-49-2	Selenium	3.00	U	J	F
7440-22-4	Silver	2.00	U		P
7440-23-5	Sodium	9340.00		J	P
7440-28-0	Thallium	2.00	U	NWJ	F
7440-62-2	Vanadium	3.00	U		P
7440-66-6	Zinc	7.80	B		P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ41

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): SOIL Lab Sample ID: 02176-09S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 66.7

Concentration Units (ug/L or mg/Kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	9540.00			P
7440-36-0	Antimony	6.50	B	N J	P
7440-38-2	Arsenic	2.80	B		F
7440-39-3	Barium	47.60	B		P
7440-41-7	Beryllium	0.61	B		P
7440-41-7	Cadmium	0.29	U		P
7440-70-2	Calcium	1510.00			P
7440-47-3	Chromium	14.80			P
7440-48-4	Cobalt	7.70	B	J	P
7440-50-8	Copper	7.30	B	J	P
7439-89-6	Iron	13900.00			P
7439-92-1	Lead	6.90			F
7439-95-4	Magnesium	1490.00			P
7439-96-5	Manganese	304.00			P
7439-97-6	Mercury	0.13	U	N	CV
7440-02-0	Nickel	6.50	B		P
7440-09-7	Potassium	273.00	B		P
7782-49-2	Selenium	0.86	U	NW J	F
7440-22-4	Silver	0.59	U		P
7440-23-5	Sodium	79.30	B	J	P
7440-28-0	Thallium	0.58	U		F
7440-62-2	Vanadium	25.40			P
7440-66-6	Zinc	25.70			P
	Cyanide				NR

Color Before: BROWN Clarity Before: Texture: FINE

Color After: BROWN Clarity After: Artifacts: YES

Comments:

ROOTS

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ42

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): SOIL Lab Sample ID: 02176-10S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 38.7

Concentration Units (ug/L or mg/Kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	22900.00			P
7440-36-0	Antimony	8.10	U	N J	P
7440-38-2	Arsenic	8.10			F
7440-39-3	Barium	101.00			P
7440-41-7	Beryllium	1.00	B		P
7440-41-7	Cadmium	0.48	U		P
7440-70-2	Calcium	2340.00	B		P
7440-47-3	Chromium	44.60			P
7440-48-4	Cobalt	10.80	B	J	P
7440-50-8	Copper	37.60		J	P
7439-89-6	Iron	21000.00			P
7439-92-1	Lead	148.00			F
7439-95-4	Magnesium	2480.00			P
7439-96-5	Manganese	351.00			P
7439-97-6	Mercury	0.25		N J	CV
7440-02-0	Nickel	14.10	B		P
7440-09-7	Potassium	707.00	B		P
7782-49-2	Selenium	1.40	U	NWJ	F
7440-22-4	Silver	0.96	U		P
7440-23-5	Sodium	157.00	B	J	P
7440-28-0	Thallium	0.91	U	W	F
7440-62-2	Vanadium	52.40			P
7440-66-6	Zinc	204.00			P
	Cyanide				NR

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: BROWN Clarity After: Artifacts: YES

Comments:

ROOTS, STONES Dilution: 1:4 (20x)

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ43

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): SOIL Lab Sample ID: 02176-11S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 44.8

Concentration Units (ug/L or mg/Kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	20800.00			P
7440-36-0	Antimony	8.30	B	N J	P
7440-38-2	Arsenic	6.10			F
7440-39-3	Barium	119.00			P
7440-41-7	Beryllium	1.00	B		P
7440-41-7	Cadmium	0.42	U		P
7440-70-2	Calcium	2140.00			P
7440-47-3	Chromium	80.00			P
7440-48-4	Cobalt	8.70	B	J	P
7440-50-8	Copper	41.60		J	P
7439-89-6	Iron	16800.00			P
7439-92-1	Lead	94.20			F
7439-95-4	Magnesium	2300.00			P
7439-96-5	Manganese	143.00			P
7439-97-6	Mercury	0.25		N J	CV
7440-02-0	Nickel	12.10	B		P
7440-09-7	Potassium	607.00	B		P
7782-49-2	Selenium	1.30	U	NW J	F
7440-22-4	Silver	0.84	U		P
7440-23-5	Sodium	135.00	B	J	P
7440-28-0	Thallium	0.88	U	W	F
7440-62-2	Vanadium	43.00			P
7440-66-6	Zinc	262.00			P
	Cyanide				NR

Color Before: BROWN Clarity Before: Texture: FINE

Color After: BROWN Clarity After: Artifacts: YES

Comments:

ROOTS Dilution Pb (ex)

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ44

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): SOIL Lab Sample ID: 02176-12S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 51.5

Concentration Units (ug/L or mg/Kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	8760.00			P
7440-36-0	Antimony	6.20	U	NJ	P
7440-38-2	Arsenic	2.30	B		F
7440-39-3	Barium	59.40	B		P
7440-41-7	Beryllium	0.76	B		P
7440-41-7	Cadmium	0.36	U		P
7440-70-2	Calcium	1800.00	B		P
7440-47-3	Chromium	14.80			P
7440-48-4	Cobalt	6.00	B		P
7440-50-8	Copper	12.30		J	P
7439-89-6	Iron	17500.00			P
7439-92-1	Lead	30.90			F
7439-95-4	Magnesium	1680.00	B		P
7439-96-5	Manganese	265.00			P
7439-97-6	Mercury	0.19	U	N	CV
7440-02-0	Nickel	9.70	B		P
7440-09-7	Potassium	321.00	B		P
7782-49-2	Selenium	1.10	U	NWJ	F
7440-22-4	Silver	0.73	U		P
7440-23-5	Sodium	92.30	B	J	P
7440-28-0	Thallium	0.72	U	W	F
7440-62-2	Vanadium	21.20			P
7440-66-6	Zinc	74.70			P
	Cyanide				NR

Color Before: BROWN Clarity Before: Texture: FINE

Color After: BROWN Clarity After: Artifacts: YES

Comments:

ROOTS [illegible]

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ45

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): SOIL Lab Sample ID: 02176-13S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 51.5

Concentration Units (ug/L or mg/Kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7400.00			P
7440-36-0	Antimony	6.60	U	NJ	P
7440-38-2	Arsenic	1.20	B	S	F
7440-39-3	Barium	48.90	B		P
7440-41-7	Beryllium	0.81	B		P
7440-41-7	Cadmium	0.39	U		P
7440-70-2	Calcium	1570.00	B		P
7440-47-3	Chromium	12.60			P
7440-48-4	Cobalt	6.10	B		P
7440-50-8	Copper	10.30		J	P
7439-89-6	Iron	16200.00			P
7439-92-1	Lead	26.10			F
7439-95-4	Magnesium	1550.00	B		P
7439-96-5	Manganese	223.00			P
7439-97-6	Mercury	0.18		NJ	CV
7440-02-0	Nickel	6.50	B		P
7440-09-7	Potassium	256.00	B		P
7782-49-2	Selenium	1.10	U	NWJ	F
7440-22-4	Silver	0.78	U		P
7440-23-5	Sodium	89.80	B	J	P
7440-28-0	Thallium	0.74	U	W	F
7440-62-2	Vanadium	18.00	B		P
7440-66-6	Zinc	53.60			P
	Cyanide				NR

Color Before: BROWN Clarity Before: Texture: FINE

Color After: BROWN Clarity After: Artifacts: YES

Comments:

ROOTS

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ46

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): WATER Lab Sample ID: 02176-14S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	20.00	U		P
7440-36-0	Antimony	17.00	U		P
7440-38-2	Arsenic	2.00	U		F
7440-39-3	Barium	1.40	B		P
7440-41-7	Beryllium	1.00	U		P
7440-41-7	Cadmium	1.00	U		P
7440-70-2	Calcium	23.20	B		P
7440-47-3	Chromium	4.00	U		P
7440-48-4	Cobalt	2.00	U		P
7440-50-8	Copper	3.30	B		P
7439-89-6	Iron	23.10	B		P
7439-92-1	Lead	1.20	B	J	F
7439-95-4	Magnesium	29.70	B		P
7439-96-5	Manganese	6.00	U		P
7439-97-6	Mercury	0.20	U	N	CV
7440-02-0	Nickel	4.00	U		P
7440-09-7	Potassium	101.00	U		P
7782-49-2	Selenium	3.00	U	WJ	F
7440-22-4	Silver	2.00	U		P
7440-23-5	Sodium	39.00	U		P
7440-28-0	Thallium	2.00	U	NJ	F
7440-62-2	Vanadium	3.00	U		P
7440-66-6	Zinc	7.80	B		P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

U.S. EPA - CLP

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ47

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): WATER Lab Sample ID: 02176-15S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	20.20	B		P
7440-36-0	Antimony	23.50	B		P
7440-38-2	Arsenic	2.00	U		F
7440-39-3	Barium	1.70	B		P
7440-41-7	Beryllium	1.00	U		P
7440-41-7	Cadmium	1.00	U		P
7440-70-2	Calcium	25.10	B		P
7440-47-3	Chromium	4.00	U		P
7440-48-4	Cobalt	2.00	U		P
7440-50-8	Copper	8.40	B		P
7439-89-6	Iron	21.20	B		P
7439-92-1	Lead	4.40		J	F
7439-95-4	Magnesium	37.20	B		P
7439-96-5	Manganese	6.00	U		P
7439-97-6	Mercury	0.20	U	N	CV
7440-02-0	Nickel	4.00	U		P
7440-09-7	Potassium	130.00	B		P
7782-49-2	Selenium	3.00	U	WJ	F
7440-22-4	Silver	2.00	U		P
7440-23-5	Sodium	56.80	B	J	P
7440-28-0	Thallium	2.00	U	NJ	F
7440-62-2	Vanadium	3.00	U		P
7440-66-6	Zinc	16.40	B		P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MBDZ48

Lab Name: SKINNER & SHERMAN LABS. Contract: 68-D0-0108

Lab Code: SKINER Case No.: 15918 SAS No.: SDG No.: MBDZ33

Matrix (soil/water): WATER Lab Sample ID: 02176-16S

Level (low/med): LOW Date Received: 02/22/91

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	49.70	B		P
7440-36-0	Antimony	17.00	U		P
7440-38-2	Arsenic	2.00	U		F
7440-39-3	Barium	1.70	B		P
7440-41-7	Beryllium	1.00	U		P
7440-41-7	Cadmium	1.00	U		P
7440-70-2	Calcium	22.20	B		P
7440-47-3	Chromium	4.00	U		P
7440-48-4	Cobalt	2.00	U		P
7440-50-8	Copper	2.80	B		P
7439-89-6	Iron	23.70	B		P
7439-92-1	Lead	10.10			F
7439-95-4	Magnesium	29.70	B		P
7439-96-5	Manganese	6.00	U		P
7439-97-6	Mercury	0.20	U	N	CV
7440-02-0	Nickel	4.00	U		P
7440-09-7	Potassium	101.00	U		P
7782-49-2	Selenium	3.00	U	WJ	F
7440-22-4	Silver	2.00	U		P
7440-23-5	Sodium	104.00	B	J	P
7440-28-0	Thallium	2.00	U	NJ	F
7440-62-2	Vanadium	3.00	U		P
7440-66-6	Zinc	7.00	B		P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

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1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ34

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN01

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN01R1

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 02/26/91

Column: (pack/cap) PACK Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U J
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	24	~~5~~ U
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	U
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	U
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	5	U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ34

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN01

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN01R1

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 02/26/91

Column (pack/cap) PACK Dilution Factor: 1.0

Number TICs found: 2 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN ALCOHOL	4.10	12	J N
2.	UNKNOWN (COLUMN BLEED)	31.61	11	~~BJ~~ R

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ35

ab Name: G S E L I Contract: 68-D9-0038

a Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

atrix: (soil/water) WATER Lab Sample ID: FUN02

ample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN02R1

evel: (low/med) LOW Date Received: 02/22/91

Moisture: not dec. ____ Date Analyzed: 02/26/91

olumn: (pack/cap) PACK Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U J
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	23	~~B~~ U
67-64-1	Acetone	42	
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	U
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	U
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	7	
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	25	

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1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ36

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN03

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN03R1

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 02/28/91

Column: (pack/cap) PACK Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	9	
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	31	
67-64-1	Acetone	48	
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	U
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	U
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	6	
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	30	

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ36

Name: G S E L C Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN03

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN03R1

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 02/28/91

Column (pack/cap) PACK Dilution Factor: 1.0

Number TICs found: 1 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 103-65-1	BENZENE,PROPYL	32.86	5.7	JN

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EPA SAMPLE NO.

BGQ37

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN04

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN04R1

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 02/28/91

Column: (pack/cap) PACK Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	16	u
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	8	u
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	U
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	U
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	5	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ37

Lab Name: G S F L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN04

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN04R1

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 02/28/91

Column (pack/cap) PACK Dilution Factor: 1.0

Number TICs found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN (COLUMN BLEED)	31.41	7.5 ~~97~~	R

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EPA SAMPLE NO.

BGQ38

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN05

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN05

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 03/01/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	17	
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	18	~~B~~ U
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	UJ
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	UJ
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	~~U~~ R
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	5	U

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EPA SAMPLE NO.

BGQ39

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN08

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN08

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 03/01/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	38	~~U~~
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	8	~~U~~
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	U J
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U J
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	~~U~~ R
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	5	U

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EPA SAMPLE NO.

BGQ40

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN09

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN09

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 03/01/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	26	UL
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	10	~~B~~ UL
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	UJ
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	UJ
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	~~U~~ R
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	5	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ41

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN10

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN10

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 03/01/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	47	UL
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	21	~~B~~ UL
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	UJ
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	UJ
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	~~U~~ R
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	5	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ42

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ04

Matrix: (soil/water) SOIL Lab Sample ID: FUN11

Sample wt/vol: 5.0 (g/mL) G Lab File ID: VOFUN11

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 37 Date Analyzed: 02/25/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	Q
74-87-3	Chloromethane	16 U
74-83-9	Bromomethane	16 U
75-01-4	Vinyl Chloride	16 U
75-00-3	Chloroethane	16 U
75-09-2	Methylene Chloride	16 U
67-64-1	Acetone	53 ~~U~~
75-15-0	Carbon Disulfide	16 ~~12~~ UJ
75-35-4	1,1-Dichloroethene	8 U
75-34-3	1,1-Dichloroethane	8 U
540-59-0	1,2-Dichloroethene (total)	8 U
67-66-3	Chloroform	8 U
107-06-2	1,2-Dichloroethane	8 U
78-93-3	2-Butanone	8 U
71-55-6	1,1,1-Trichloroethane	16 U
56-23-5	Carbon Tetrachloride	8 U
108-05-4	Vinyl Acetate	8 U
75-27-4	Bromodichloromethane	16 U
78-87-5	1,2-Dichloropropane	8 U
10061-01-5	cis-1,3-Dichloropropene	8 U
79-01-6	Trichloroethene	8 U
124-48-1	Dibromochloromethane	8 U
79-00-5	1,1,2-Trichloroethane	8 U
71-43-2	Benzene	8 U
10061-02-6	Trans-1,3-Dichloropropene	8 U
75-25-2	Bromoform	8 U
108-10-1	4-Methyl-2-Pentanone	8 U
591-78-6	2-Hexanone	16 U
127-18-4	Tetrachloroethene	16 UJ
79-34-5	1,1,2,2-Tetrachloroethane	8 U
108-88-3	Toluene	8 U
108-90-7	Chlorobenzene	8 U
100-41-4	Ethylbenzene	8 U
100-42-5	Styrene	8 U
1330-20-7	Xylene (total)	8 U

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ42

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN11

Sample wt/vol: 5.0 (g/mL) G Lab File ID: VOFUN11

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 37 Date Analyzed: 02/25/91

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN HYDROCARBON	4.63	1.8	JN

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ43

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN14

Sample wt/vol: 5.0 (g/mL) G Lab File ID: VOFUN14R1

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 62 Date Analyzed: 02/26/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	26	U
74-83-9	Bromomethane	26	U
75-01-4	Vinyl Chloride	26	U
75-00-3	Chloroethane	26	U
75-09-2	Methylene Chloride	25	~~U~~ J B
67-64-1	Acetone	26	U J
75-15-0	Carbon Disulfide	13	U
75-35-4	1,1-Dichloroethene	13	U
75-34-3	1,1-Dichloroethane	13	U
540-59-0	1,2-Dichloroethene (total)	13	U
67-66-3	Chloroform	13	U
107-06-2	1,2-Dichloroethane	13	U
78-93-3	2-Butanone	26	U
71-55-6	1,1,1-Trichloroethane	13	U
56-23-5	Carbon Tetrachloride	13	U
108-05-4	Vinyl Acetate	26	U
75-27-4	Bromodichloromethane	13	U
78-87-5	1,2-Dichloropropane	13	U
10061-01-5	cis-1,3-Dichloropropene	13	U
79-01-6	Trichloroethene	13	U
124-48-1	Dibromochloromethane	13	U
79-00-5	1,1,2-Trichloroethane	13	U
71-43-2	Benzene	13	U
10061-02-6	Trans-1,3-Dichloropropene	13	U
75-25-2	Bromoform	13	U
108-10-1	4-Methyl-2-Pentanone	26	U
591-78-6	2-Hexanone	26	U J
127-18-4	Tetrachloroethene	13	U
79-34-5	1,1,2,2-Tetrachloroethane	13	U
108-88-3	Toluene	13	U
108-90-7	Chlorobenzene	13	U
100-41-4	Ethylbenzene	13	U
100-42-5	Styrene	13	U
1330-20-7	Xylene (total)	13	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ43RE

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN14RE

Sample wt/vol: 5.0 (g/mL) G Lab File ID: VOFUN14R2

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 62 Date Analyzed: 03/27/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	26	U
74-83-9	Bromomethane	26	U
75-01-4	Vinyl Chloride	26	U
75-00-3	Chloroethane	26	U
75-09-2	Methylene Chloride	43	~~B~~
67-64-1	Acetone	26	~~BQ~~
75-15-0	Carbon Disulfide	13	U
75-35-4	1,1-Dichloroethene	13	U
75-34-3	1,1-Dichloroethane	13	U
540-59-0	1,2-Dichloroethene (total)	13	U
67-66-3	Chloroform	13	U
107-06-2	1,2-Dichloroethane	13	U
78-93-3	2-Butanone	26	U
71-55-6	1,1,1-Trichloroethane	13	U
56-23-5	Carbon Tetrachloride	13	U
108-05-4	Vinyl Acetate	26	U
75-27-4	Bromodichloromethane	13	U
78-87-5	1,2-Dichloropropane	13	U
10061-01-5	cis-1,3-Dichloropropene	13	U
79-01-6	Trichloroethene	13	U
124-48-1	Dibromochloromethane	13	U
79-00-5	1,1,2-Trichloroethane	13	U
71-43-2	Benzene	13	U
10061-02-6	Trans-1,3-Dichloropropene	13	U
75-25-2	Bromoform	13	U
108-10-1	4-Methyl-2-Pentanone	26	U
591-78-6	2-Hexanone	26	U
127-18-4	Tetrachloroethene	13	U
79-34-5	1,1,2,2-Tetrachloroethane	13	U
108-88-3	Toluene	13	U
108-90-7	Chlorobenzene	13	U
100-41-4	Ethylbenzene	13	U
100-42-5	Styrene	13	U
1330-20-7	Xylene (total)	13	U

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EPA SAMPLE NO.

BGQ44RE

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BBQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN15RE

Sample wt/vol: 5.0 (g/mL) G Lab File ID: VOFUN15R1

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 62 Date Analyzed: 02/26/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	26	U
74-83-9	Bromomethane	26	U
75-01-4	Vinyl Chloride	26	U
75-00-3	Chloroethane	26	U
75-09-2	Methylene Chloride	30	~~B~~
67-64-1	Acetone	26	U
75-15-0	Carbon Disulfide	13	U
75-35-4	1,1-Dichloroethene	13	U
75-34-3	1,1-Dichloroethane	13	U
540-59-0	1,2-Dichloroethene (total)	13	U
67-66-3	Chloroform	13	U
107-06-2	1,2-Dichloroethane	13	U
78-93-3	2-Butanone	87	
71-55-6	1,1,1-Trichloroethane	13	U
56-23-5	Carbon Tetrachloride	13	U
108-05-4	Vinyl Acetate	26	U
75-27-4	Bromodichloromethane	13	U
78-87-5	1,2-Dichloropropane	13	U
10061-01-5	cis-1,3-Dichloropropene	13	U
79-01-6	Trichloroethene	13	U
124-48-1	Dibromochloromethane	13	U
79-00-5	1,1,2-Trichloroethane	13	U
71-43-2	Benzene	13	U
10061-02-6	Trans-1,3-Dichloropropene	13	U
75-25-2	Bromoform	13	U
108-10-1	4-Methyl-2-Pentanone	26	U
591-78-6	2-Hexanone	26	U
127-18-4	Tetrachloroethene	13	U
79-34-5	1,1,2,2-Tetrachloroethane	13	U
108-88-3	Toluene	13	U
108-90-7	Chlorobenzene	13	U
100-41-4	Ethylbenzene	13	U
100-42-5	Styrene	13	U
1330-20-7	Xylene (total)	13	U

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ44

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN15

Sample wt/vol: 5.0 (g/mL) G Lab File ID: VOFUN15R

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 62 Date Analyzed: 02/26/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	26	U
74-83-9	Bromomethane	26	U
75-01-4	Vinyl Chloride	26	U
75-00-3	Chloroethane	26	U
75-09-2	Methylene Chloride	14	~~U~~
67-64-1	Acetone	26	U
75-15-0	Carbon Disulfide	13	U
75-35-4	1,1-Dichloroethene	13	U
75-34-3	1,1-Dichloroethane	13	U
540-59-0	1,2-Dichloroethene (total)	13	U
67-66-3	Chloroform	13	U
107-06-2	1,2-Dichloroethane	13	U
78-93-3	2-Butanone	26	U
71-55-6	1,1,1-Trichloroethane	13	U
56-23-5	Carbon Tetrachloride	13	U
108-05-4	Vinyl Acetate	26	U
75-27-4	Bromodichloromethane	13	U
78-87-5	1,2-Dichloropropane	13	U
10061-01-5	cis-1,3-Dichloropropene	13	U
79-01-6	Trichloroethene	13	U
124-48-1	Dibromochloromethane	13	U
79-00-5	1,1,2-Trichloroethane	13	U
71-43-2	Benzene	13	U
10061-02-6	Trans-1,3-Dichloropropene	13	U
75-25-2	Bromoform	13	U
108-10-1	4-Methyl-2-Pentanone	26	U
591-78-6	2-Hexanone	26	U
127-18-4	Tetrachloroethene	13	U
79-34-5	1,1,2,2-Tetrachloroethane	13	U
108-88-3	Toluene	13	U
108-90-7	Chlorobenzene	13	U
100-41-4	Ethylbenzene	13	U
100-42-5	Styrene	13	U
1330-20-7	Xylene (total)	13	U

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ45

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN16

Sample wt/vol: 5.0 (g/mL) G Lab File ID: VOFUN16R1

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 52 Date Analyzed: 02/26/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	21	U
74-83-9	Bromomethane	21	U
75-01-4	Vinyl Chloride	21	U
75-00-3	Chloroethane	21	U
75-09-2	Methylene Chloride	12	~~UB~~ R
67-64-1	Acetone	21	UJ
75-15-0	Carbon Disulfide	10	U
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
540-59-0	1,2-Dichloroethene (total)	10	U
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	28	
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
108-05-4	Vinyl Acetate	21	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	10	U
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	Trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	10	U
108-10-1	4-Methyl-2-Pentanone	21	U
591-78-6	2-Hexanone	21	UJ
127-18-4	Tetrachloroethene	10	U
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-88-3	Toluene	10	U
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U
1330-20-7	Xylene (total)	10	U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ45

Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN16

Sample wt/vol: 5.0 (g/mL) G Lab File ID: VOFUN16R1

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 52 Date Analyzed: 02/26/91

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 3 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	1.90	10	J N
2. 75-05-8	ACETONITRILE (DOT)	2.10	7.1	J N
3.	UNKNOWN HYDROCARBON	4.65	5.0	J N

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ46

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN17

Sample wt/vol: 5.0 (g/mL) G Lab File ID: VOFUN17R2

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 46 Date Analyzed: 02/27/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	19	U
74-83-9	Bromomethane	19	U
75-01-4	Vinyl Chloride	19	U
75-00-3	Chloroethane	19	U
75-09-2	Methylene Chloride	22	~~B~~ U
67-64-1	Acetone	19	U
75-15-0	Carbon Disulfide	9	U
75-35-4	1,1-Dichloroethene	9	U
75-34-3	1,1-Dichloroethane	9	U
540-59-0	1,2-Dichloroethene (total)	9	U
67-66-3	Chloroform	9	U
107-06-2	1,2-Dichloroethane	9	U
78-93-3	2-Butanone	19	U
71-55-6	1,1,1-Trichloroethane	9	U
56-23-5	Carbon Tetrachloride	9	U
108-05-4	Vinyl Acetate	19	U
75-27-4	Bromodichloromethane	9	U
78-87-5	1,2-Dichloropropane	9	U
10061-01-5	cis-1,3-Dichloropropene	9	U
79-01-6	Trichloroethene	9	U
124-48-1	Dibromochloromethane	9	U
79-00-5	1,1,2-Trichloroethane	9	U
71-43-2	Benzene	9	U
10061-02-6	Trans-1,3-Dichloropropene	9	U
75-25-2	Bromoform	9	U
108-10-1	4-Methyl-2-Pentanone	19	U
591-78-6	2-Hexanone	19	U
127-18-4	Tetrachloroethene	9	U
79-34-5	1,1,2,2-Tetrachloroethane	9	U
108-88-3	Toluene	9	U
108-90-7	Chlorobenzene	9	U
100-41-4	Ethylbenzene	9	U
100-42-5	Styrene	9	U
1330-20-7	Xylene (total)	9	U

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ46RE

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN17RE

Sample wt/vol: 5.0 (g/mL) G Lab File ID: VOFUN17R3

Level: (low/med) LOW Date Received: 02/22/91

Moisture: not dec. 46 Date Analyzed: 02/27/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	19	U
74-83-9	Bromomethane	19	U
75-01-4	Vinyl Chloride	19	U
75-00-3	Chloroethane	19	U
75-09-2	Methylene Chloride	19	U
67-64-1	Acetone	46	~~U~~
75-15-0	Carbon Disulfide	38	~~U~~
75-35-4	1,1-Dichloroethene	9	U
75-34-3	1,1-Dichloroethane	9	U
540-59-0	1,2-Dichloroethene (total)	9	U
67-66-3	Chloroform	9	U
107-06-2	1,2-Dichloroethane	9	U
78-93-3	2-Butanone	9	U
71-55-6	1,1,1-Trichloroethane	19	U
56-23-5	Carbon Tetrachloride	9	U
108-05-4	Vinyl Acetate	9	U
75-27-4	Bromodichloromethane	19	U
78-87-5	1,2-Dichloropropane	9	U
10061-01-5	cis-1,3-Dichloropropene	9	U
79-01-6	Trichloroethene	9	U
124-48-1	Dibromochloromethane	9	U
79-00-5	1,1,2-Trichloroethane	9	U
71-43-2	Benzene	9	U
10061-02-6	Trans-1,3-Dichloropropene	9	U
75-25-2	Bromoform	9	U
108-10-1	4-Methyl-2-Pentanone	9	U
591-78-6	2-Hexanone	19	U
127-18-4	Tetrachloroethene	19	U
79-34-5	1,1,2,2-Tetrachloroethane	9	U
108-88-3	Toluene	9	U
108-90-7	Chlorobenzene	9	U
100-41-4	Ethylbenzene	9	U
100-42-5	Styrene	9	U
1330-20-7	Xylene (total)	9	U

7A-4

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ47

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN18

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN18

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. _____ Date Analyzed: 02/28/91

Column: (pack/cap) PACK Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	13	
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	29	
67-64-1	Acetone	9	BJ
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	U
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	U
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	5	U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ47

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN18

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN18

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 02/28/91

Column (pack/cap) PACK Dilution Factor: 1.0

Number TICs found: 1 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN (COLUMN BLEED)	31.51	3.8	BJN

42-46

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ48

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN19

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN19

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 02/28/91

Column: (pack/cap) PACK Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	22	
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	18	
67-64-1	Acetone	8	BJ
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	U
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	U
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	5	U

000238

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ48

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN19

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN19

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 02/28/91

Column (pack/cap) PACK Dilution Factor: 1.0

Number TICs found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN (COLUMN ARTIFACT)	31.61	5.9	BJ

000239

31-7

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ49

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN20

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN20

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 02/28/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	25	
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	23	B
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	U J
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U J
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	~~U~~ R
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	5	U

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ51

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN21

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VOFUN21

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ Date Analyzed: 02/28/91

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	29	
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	13	B
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	5	U
75-35-4	1,1-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
67-66-3	Chloroform	5	U
107-06-2	1,2-Dichloroethane	5	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
108-05-4	Vinyl Acetate	10	U
75-27-4	Bromodichloromethane	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
79-01-6	Trichloroethene	5	U
124-48-1	Dibromochloromethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
71-43-2	Benzene	5	U
10061-02-6	Trans-1,3-Dichloropropene	5	U
75-25-2	Bromoform	5	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
108-88-3	Toluene	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
100-42-5	Styrene	5	U
1330-20-7	Xylene (total)	5	U

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ34

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN01

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN01

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.4 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
100-51-6	Benzyl Alcohol	10	U
95-50-1	1,2-Dichlorobenzene	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	bis(2-Chloroisopropyl)Ether	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-Di-n-Propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	50	U
65-85-0	Benzoic Acid	10	U
111-91-1	bis(2-Chloroethoxy)Methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	50	U
95-95-4	2,4,5-Trichlorophenol	10	U
91-58-7	2-Chloronaphthalene	50	U
88-74-4	2-Nitroaniline	10	U
131-11-3	Dimethyl Phthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ34

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN01

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN01

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.4 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
99-09-2	3-Nitroaniline	50	U
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	50	U
534-52-1	4,6-Dinitro-2-Methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)Anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)Phthalate	10	U
117-84-0	Di-n-Octyl Phthalate	10	U
205-99-2	Benzo(b)Fluoranthene	10	U
207-08-9	Benzo(k)Fluoranthene	10	U
50-32-8	Benzo(a)Pyrene	10	U
193-39-5	Indeno(1,2,3-cd)Pyrene	10	U
53-70-3	Dibenz(a,h)Anthracene	10	U
191-24-2	Benzo(g,h,i)Perylene	10	U

(1) - Cannot be separated from Diphenylamine

000019

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ35

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN02

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN02

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 03/01/91

GPC Cleanup: (Y/N) N pH: 7.1 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
108-95-2	Phenol	10	
111-44-4	bis(2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
100-51-6	Benzyl Alcohol	10	U
95-50-1	1,2-Dichlorobenzene	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	bis(2-Chloroisopropyl)Ether	10	U
106-44-5	4-Methylphenol	12	
621-64-7	N-Nitroso-Di-n-Propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
65-85-0	Benzoic Acid	50	U
111-91-1	bis(2-Chloroethoxy)Methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	45	
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	45	
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethyl Phthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ35

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN02

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN02

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 03/01/91

GPC Cleanup: (Y/N) N pH: 7.1 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
99-09-2	3-Nitroaniline	50	UJ
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	50	U
534-52-1	4,6-Dinitro-2-Methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)Anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)Phthalate	10 ~~20~~	U
117-84-0	Di-n-Octyl Phthalate	10	U
205-99-2	Benzo(b)Fluoranthene	10	U
207-08-9	Benzo(k)Fluoranthene	10	U
50-32-8	Benzo(a)Pyrene	10	U
193-39-5	Indeno(1,2,3-cd)Pyrene	10	U
53-70-3	Dibenz(a,h)Anthracene	10	U
191-24-2	Benzo(g,h,i)Perylene	10	U

(1) - Cannot be separated from Diphenylamine

000024

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ35

Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN02

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN02

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 03/01/91

GPC Cleanup: (Y/N) N pH: 7.1 Dilution Factor: 1.0

Number TICs found: 21 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN CARBOXYLIC ACID	6.35	820	J N
2.	UNKNOWN CARBOXYLIC ACID	6.48	40	J
3.	UNKNOWN CARBOXYLIC ACID	6.62	41	J
4.	UNKNOWN CARBOXYLIC ACID	6.85	31	J
5.	BENZENE,-TRIMETHYL	8.25	65	J
6.	BENZENE,-TRIMETHYL	8.72	41	J
7.	UNKNOWN	8.94	35	J
8.	UNKNOWN CARBOXYLIC ACID	9.82	78	J
9.	UNKNOWN	9.90	52	J
10.	UNKNOWN	10.69	53	J
11.	UNKNOWN	11.45	12	J
12.	ALKYLPHENOL	11.54	14	J
13.	UNKNOWN	11.70	24	J
14.	UNKNOWN	11.85	43	J
15.	BENZENEACETIC ACID,-METHYL	12.74	19	J
16.	UNKNOWN	12.87	32	J
17.	UNKNOWN	13.35	12	J
18.	NAPHTHALENE,-DIMETHYL	13.64	30	J
19.	UNKNOWN	13.94	25	J
20.	PHENOL,-(TETRAMETHYLBUTYL)	15.34	49	J
21. 934-34-9	2(3H)-BENZOTHIAZOLONE	16.02	26	J N

000025

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ36

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN03

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN03R

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 03/01/91

GPC Cleanup: (Y/N) N pH: 6.8 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
108-95-2	Phenol	10	
111-44-4	bis(2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
100-51-6	Benzyl Alcohol	10	U
95-50-1	1,2-Dichlorobenzene	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	bis(2-Chloroisopropyl)Ether	10	U
106-44-5	4-Methylphenol	11	
621-64-7	N-Nitroso-Di-n-Propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
65-85-0	Benzoic Acid	50	U
111-91-1	bis(2-Chloroethoxy)Methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	41	
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	40	
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethyl Phthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ36

Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN03

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN03R

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 03/01/91

GPC Cleanup: (Y/N) N pH: 6.8 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
99-09-2	3-Nitroaniline	50	U J
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	50	U
534-52-1	4,6-Dinitro-2-Methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)Anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)Phthalate	10 J	~~B~~
117-84-0	Di-n-Octyl Phthalate	10	U
205-99-2	Benzo(b)Fluoranthene	10	U
207-08-9	Benzo(k)Fluoranthene	10	U
50-32-8	Benzo(a)Pyrene	10	U
193-39-5	Indeno(1,2,3-cd)Pyrene	10	U
53-70-3	Dibenz(a,h)Anthracene	10	U
191-24-2	Benzo(g,h,i)Perylene	10	U

(1) - Cannot be separated from Diphenylamine

FORM I SV-2 1/87 Rev.

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ36

Name: G S K L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15919 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN03

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN03R

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 03/01/91

GPC Cleanup: (Y/N) N pH: 6.8 Dilution Factor: 1.0

Number TICs found: 21 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		UNKNOWN CARBOXYLIC ACID	6.25	340	J N
2.		UNKNOWN CARBOXYLIC ACID	6.42	32	J
3.		UNKNOWN CARBOXYLIC ACID	6.55	49	J
4.		UNKNOWN CARBOXYLIC ACID	8.23	25	J
5.		BENZENE,-TRIMETHYL	8.77	49	J
6.		UNKNOWN	9.92	130	J
7.		BENZENE,-TETRAMETHYL + UNKNO	10.15	37	J
8.		UNKNOWN	10.59	19	J
9.		UNKNOWN	10.74	53	J
10.		ALKYLPHENOL	11.60	29	J
11.		UNKNOWN	11.75	37	J
12.		UNKNOWN	11.89	26	J
13.	90-12-0	NAPHTHALENE, 1-METHYL	12.55	34	J
14.		BENZENEACETIC ACID,-METHYL	12.79	27	J
15.		UNKNOWN	12.92	25	J
16.		UNKNOWN	13.39	17	J
17.		NAPHTHALENE,-DIMETHYL	13.70	38	J
18.		UNKNOWN	14.00	34	J
19.		UNKNOWN	14.17	16	J
20.		PHENOL, 4-(3-TETRAMETHYLBUTY	15.39	57	J
21.	934-34-9	2(3H)-BENZOTHIAZOLONE	16.07	23	J N

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ37

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN04

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN04

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.5 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
100-51-6	Benzyl Alcohol	10	U
95-50-1	1,2-Dichlorobenzene	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	bis(2-Chloroisopropyl)Ether	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-Di-n-Propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
65-85-0	Benzoic Acid	50	U
111-91-1	bis(2-Chloroethoxy)Methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethyl Phthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ37

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN04

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN04

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.5 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
99-09-2	3-Nitroaniline	50	U
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	50	U
534-52-1	4,6-Dinitro-2-Methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)Anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)Phthalate	10 ~~5~~	~~BJ~~
117-84-0	Di-n-Octyl Phthalate	10	U
205-99-2	Benzo(b)Fluoranthene	10	U
207-08-9	Benzo(k)Fluoranthene	10	U
50-32-8	Benzo(a)Pyrene	10	U
193-39-5	Indeno(1,2,3-cd)Pyrene	10	U
53-70-3	Dibenz(a,h)Anthracene	10	U
191-24-2	Benzo(g,h,i)Perylene	10	U

(1) - Cannot be separated from Diphenylamine

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ38

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN05

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN05

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.6 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
100-51-6	Benzyl Alcohol	10	U
95-50-1	1,2-Dichlorobenzene	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	bis(2-Chloroisopropyl)Ether	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-Di-n-Propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
65-85-0	Benzoic Acid	50	U
111-91-1	bis(2-Chloroethoxy)Methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethyl Phthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ38

Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15919 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN05

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN05

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.6 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
99-09-2	3-Nitroaniline	50	U
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	50	U
534-52-1	4,6-Dinitro-2-Methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	2	J
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)Anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)Phthalate	10 ~~8~~	~~BJ~~
117-84-0	Di-n-Octyl Phthalate	10	U
205-99-2	Benzo(b)Fluoranthene	10	U
207-08-9	Benzo(k)Fluoranthene	10	U
50-32-8	Benzo(a)Pyrene	10	U
193-39-5	Indeno(1,2,3-cd)Pyrene	10	U
53-70-3	Dibenz(a,h)Anthracene	10	U
191-24-2	Benzo(g,h,i)Perylene	10	U

(1) - Cannot be separated from Diphenylamine

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ39

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN08

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN08

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ / dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.5 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
100-51-6	Benzyl Alcohol	10	U
95-50-1	1,2-Dichlorobenzene	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	bis(2-Chloroisopropyl)Ether	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-Di-n-Propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	50	U
65-85-0	Benzoic Acid	10	U
111-91-1	bis(2-Chloroethoxy)Methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	50	U
95-95-4	2,4,5-Trichlorophenol	10	U
91-58-7	2-Chloronaphthalene	50	U
88-74-4	2-Nitroaniline	10	U
131-11-3	Dimethyl Phthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ39

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15919 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN08

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN08

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.5 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
99-09-2	3-Nitroaniline	50	U J
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	50	U
534-52-1	4,6-Dinitro-2-Methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)Anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)Phthalate	10	U
117-84-0	Di-n-Octyl Phthalate	10	U
205-99-2	Benzo(b)Fluoranthene	10	U
207-08-9	Benzo(k)Fluoranthene	10	U
50-32-8	Benzo(a)Pyrene	10	U
193-39-5	Indeno(1,2,3-cd)Pyrene	10	U
53-70-3	Dibenz(a,h)Anthracene	10	U
191-24-2	Benzo(g,h,i)Perylene	10	U

(1) - Cannot be separated from Diphenylamine

FORM I SV-2 1/87 Rev.

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ39

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN08

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN08

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.5 Dilution Factor: 1.0

Number TICs found: 1 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN FATTY ACID	16.65	5.1	J N

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ40

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN09

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN09

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 03/01/91

GPC Cleanup: (Y/N) N pH: 8.2 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
100-51-6	Benzyl Alcohol	10	U
95-50-1	1,2-Dichlorobenzene	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	bis(2-Chloroisopropyl)Ether	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-Di-n-Propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
65-85-0	Benzoic Acid	50	U
111-91-1	bis(2-Chloroethoxy)Methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethyl Phthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BG040

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BG034

Matrix: (soil/water) WATER Lab Sample ID: FUN09

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN09

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 03/01/91

GPC Cleanup: (Y/N) N pH: 8.2 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
99-09-2	3-Nitroaniline	50	U J
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	50	U
534-52-1	4,6-Dinitro-2-Methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)Anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)Phthalate	10	U
117-84-0	Di-n-Octyl Phthalate	10	U
205-99-2	Benzo(b)Fluoranthene	10	U
207-08-9	Benzo(k)Fluoranthene	10	U
50-32-8	Benzo(a)Pyrene	10	U
193-39-5	Indeno(1,2,3-cd)Pyrene	10	U
53-70-3	Dibenz(a,h)Anthracene	10	U
191-24-2	Benzo(g,h,i)Perylene	10	U

(1) - Cannot be separated from Diphenylamine

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ41

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN10

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN10

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.4 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
100-51-6	Benzyl Alcohol	10	U
95-50-1	1,2-Dichlorobenzene	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	bis(2-Chloroisopropyl)Ether	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-Di-n-Propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
65-85-0	Benzoic Acid	50	U
111-91-1	bis(2-Chloroethoxy)Methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethyl Phthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ41

Name: G S E L I Contract: 68-D9-0038

Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN10

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN10

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.4 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
99-09-2	3-Nitroaniline	50	U J
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	50	U
534-52-1	4,6-Dinitro-2-Methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	2	J
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)Anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)Phthalate	10 ~~3~~	~~BJ~~ U
117-84-0	Di-n-Octyl Phthalate	10	U
205-99-2	Benzo(b)Fluoranthene	10	U
207-08-9	Benzo(k)Fluoranthene	10	U
50-32-8	Benzo(a)Pyrene	10	U
193-39-5	Indeno(1,2,3-cd)Pyrene	10	U
53-70-3	Dibenz(a,h)Anthracene	10	U
191-24-2	Benzo(g,h,i)Perylene	10	U

(1) - Cannot be separated from Diphenylamine

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ42

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN11

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN11

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 37 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.7 Dilution Factor: 1.00

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	520	U
111-44-4	bis(2-Chloroethyl)Ether	520	U
95-57-8	2-Chlorophenol	520	U
541-73-1	1,3-Dichlorobenzene	520	U
106-46-7	1,4-Dichlorobenzene	520	U
100-51-6	Benzyl Alcohol	520	U
95-50-1	1,2-Dichlorobenzene	520	U
95-48-7	2-Methylphenol	520	U
108-60-1	bis(2-Chloroisopropyl)Ether	520	U
106-44-5	4-Methylphenol	520	U
621-64-7	N-Nitroso-Di-n-Propylamine	520	U
67-72-1	Hexachloroethane	520	U
98-95-3	Nitrobenzene	520	U
78-59-1	Isophorone	520	U
88-75-5	2-Nitrophenol	520	U
105-67-9	2,4-Dimethylphenol	520	U
65-85-0	Benzoic Acid	520	U
111-91-1	bis(2-Chloroethoxy)Methane	2500	U
120-83-2	2,4-Dichlorophenol	520	U
120-82-1	1,2,4-Trichlorobenzene	520	U
91-20-3	Naphthalene	520	U
106-47-8	4-Chloroaniline	520	U
87-68-3	Hexachlorobutadiene	520	U
59-50-7	4-Chloro-3-Methylphenol	520	U
91-57-6	2-Methylnaphthalene	520	U
77-47-4	Hexachlorocyclopentadiene	520	U
88-06-2	2,4,6-Trichlorophenol	520	U
95-95-4	2,4,5-Trichlorophenol	520	U
91-58-7	2-Chloronaphthalene	2500	U
88-74-4	2-Nitroaniline	520	U
131-11-3	Dimethyl Phthalate	2500	U
208-96-8	Acenaphthylene	520	U
606-20-2	2,6-Dinitrotoluene	520	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BG042

Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BG034

Matrix: (soil/water) SOIL Lab Sample ID: FUN11

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN11

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 37 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.7 Dilution Factor: 1.00

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
99-09-2	3-Nitroaniline	2500	U
83-32-9	Acenaphthene	520	U
51-28-5	2,4-Dinitrophenol	2500	U
100-02-7	4-Nitrophenol	2500	U
132-64-9	Dibenzofuran	520	U
121-14-2	2,4-Dinitrotoluene	520	U
84-66-2	Diethylphthalate	520	U
7005-72-3	4-Chlorophenyl-phenylether	520	U
86-73-7	Fluorene	520	U
100-01-6	4-Nitroaniline	2500	U
534-52-1	4,6-Dinitro-2-Methylphenol	2500	U
86-30-6	N-Nitrosodiphenylamine (1)	520	U
101-55-3	4-Bromophenyl-phenylether	520	U
118-74-1	Hexachlorobenzene	520	U
87-86-5	Pentachlorophenol	2500	U
85-01-8	Phenanthrene	520	U
120-12-7	Anthracene	520	U
84-74-2	Di-n-Butylphthalate	520	U
206-44-0	Fluoranthene	520	U
129-00-0	Pyrene	520	U
85-68-7	Butylbenzylphthalate	520	U
91-94-1	3,3'-Dichlorobenzidine	1000	U
56-55-3	Benzo(a)Anthracene	520	U
218-01-9	Chrysene	520	U
117-81-7	bis(2-Ethylhexyl)Phthalate	520	U
117-84-0	Di-n-Octyl Phthalate	520	U
205-99-2	Benzo(b)Fluoranthene	520	U
207-08-9	Benzo(k)Fluoranthene	520	U
50-32-8	Benzo(a)Pyrene	520	U
193-39-5	Indeno(1,2,3-cd)Pyrene	520	U
53-70-3	Dibenz(a,h)Anthracene	520	U
191-24-2	Benzo(g,h,i)Perylene	520	U

(1) - Cannot be separated from Diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ42

Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN11

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN11

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 37 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.7 Dilution Factor: 1.00

Number TICs found: 20 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN KETONE	7.25	3400	~~EJ~~ R
2.	UNKNOWN KETONE	7.48	500	J N
3.	UNKNOWN KETONE	7.78	1300	~~EJ~~ R
4.	UNKNOWN KETONE	8.49	1400	~~EJ~~ R
5.	UNKNOWN KETONE	8.72	470	~~EJ~~ R
6.	UNKNOWN	9.20	280	J N
7.	UNKNOWN KETONE	9.34	900	J
8.	UNKNOWN HYDROCARBON	20.80	380	J
9.	UNKNOWN HYDROCARBON	22.24	1400	J
10.	UNKNOWN HYDROCARBON	23.15	330	J
11.	UNKNOWN HYDROCARBON	24.29	2400	J
12.	UNKNOWN HYDROCARBON	25.61	610	J
13.	UNKNOWN HYDROCARBON	26.31	1000	J
14.	UNKNOWN HYDROCARBON	27.29	2200	J
15.	UNKNOWN HYDROCARBON	27.39	1400	J
16.	UNKNOWN HYDROCARBON	27.74	300	J
17.	UNKNOWN HYDROCARBON	30.47	620	J
18.	UNKNOWN HYDROCARBON	31.91	1200	J
19.	UNKNOWN HYDROCARBON	32.12	810	J
20.	UNKNOWN HYDROCARBON	32.66	640	J N

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ43

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN14

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN14

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 62 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.8 Dilution Factor: 1.00

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	870	U
111-44-4	bis(2-Chloroethyl)Ether	870	U
95-57-8	2-Chlorophenol	870	U
541-73-1	1,3-Dichlorobenzene	870	U
106-46-7	1,4-Dichlorobenzene	870	U
100-51-6	Benzyl Alcohol	870	U
95-50-1	1,2-Dichlorobenzene	870	U
95-48-7	2-Methylphenol	870	U
108-60-1	bis(2-Chloroisopropyl)Ether	870	U
106-44-5	4-Methylphenol	870	U
621-64-7	N-Nitroso-Di-n-Propylamine	870	U
67-72-1	Hexachloroethane	870	U
98-95-3	Nitrobenzene	870	U
78-59-1	Isophorone	870	U
88-75-5	2-Nitrophenol	870	U
105-67-9	2,4-Dimethylphenol	870	U
65-85-0	Benzoic Acid	4200	U
111-91-1	bis(2-Chloroethoxy)Methane	870	U
120-83-2	2,4-Dichlorophenol	870	U
120-82-1	1,2,4-Trichlorobenzene	870	U
91-20-3	Naphthalene	870	U
106-47-8	4-Chloroaniline	870	U
87-68-3	Hexachlorobutadiene	870	U
59-50-7	4-Chloro-3-Methylphenol	870	U
91-57-6	2-Methylnaphthalene	870	U
77-47-4	Hexachlorocyclopentadiene	870	U
88-06-2	2,4,6-Trichlorophenol	870	U
95-95-4	2,4,5-Trichlorophenol	4200	U
91-58-7	2-Chloronaphthalene	870	U
88-74-4	2-Nitroaniline	4200	U
131-11-3	Dimethyl Phthalate	870	U
208-96-8	Acenaphthylene	870	U
606-20-2	2,6-Dinitrotoluene	870	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ43

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN14

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN14

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 62 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.8 Dilution Factor: 1.00

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
99-09-2	3-Nitroaniline	4200	U
83-32-9	Acenaphthene	870	U
51-28-5	2,4-Dinitrophenol	4200	U
100-02-7	4-Nitrophenol	4200	U
132-64-9	Dibenzofuran	870	U
121-14-2	2,4-Dinitrotoluene	870	U
84-66-2	Diethylphthalate	870	U
7005-72-3	4-Chlorophenyl-phenylether	870	U
86-73-7	Fluorene	870	U
100-01-6	4-Nitroaniline	4200	U
534-52-1	4,6-Dinitro-2-Methylphenol	4200	U
86-30-6	N-Nitrosodiphenylamine (1)	870	U
101-55-3	4-Bromophenyl-phenylether	870	U
118-74-1	Hexachlorobenzene	870	U
87-86-5	Pentachlorophenol	4200	U
85-01-8	Phenanthrene	220	J
120-12-7	Anthracene	870	U
84-74-2	Di-n-Butylphthalate	870	U
206-44-0	Fluoranthene	580	J
129-00-0	Pyrene	490	J
85-68-7	Butylbenzylphthalate	870	U
91-94-1	3,3'-Dichlorobenzidine	1700	U
56-55-3	Benzo(a)Anthracene	240	J
218-01-9	Chrysene	320	J
117-81-7	bis(2-Ethylhexyl)Phthalate	230	J
117-84-0	Di-n-Octyl Phthalate	870	U
205-99-2	Benzo(b)Fluoranthene	290	J
207-08-9	Benzo(k)Fluoranthene	260	J
50-32-8	Benzo(a)Pyrene	280	J
193-39-5	Indeno(1,2,3-cd)Pyrene	870	U
53-70-3	Dibenz(a,h)Anthracene	870	U
191-24-2	Benzo(g,h,i)Perylene	870	U

(1) - Cannot be separated from Diphenylamine

1F

EMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ43

. G S E L L Contract: 68-D9-0038

e: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

x: (soil/water) SOIL Lab Sample ID: FUN14

ple wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN14

vel: (low/med) LOW Date Received: 02/22/91

Moisture: not dec. 62 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

PC Cleanup: (Y/N) N pH: 5.8 Dilution Factor: 1.00

umber TICs found: 21 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN FATTY ACID	18.35	1200	J N
2.	UNKNOWN HYDROCARBON	20.77	900	J
3.	UNKNOWN HYDROCARBON	21.42	730	J
4.	UNKNOWN HYDROCARBON	22.19	3200	J
5.	UNKNOWN HYDROCARBON	22.89	830	J
6.	UNKNOWN HYDROCARBON	23.10	700	J
7.	UNKNOWN HYDROCARBON	23.92	750	J
8.	UNKNOWN HYDROCARBON	24.24	4900	J
9.	UNKNOWN HYDROCARBON	24.69	750	J
10.	UNKNOWN HYDROCARBON	25.19	2300	J
11.	UNKNOWN HYDROCARBON	25.56	1000	J
12.	UNKNOWN HYDROCARBON	26.24	1600	J
13.	UNKNOWN HYDROCARBON	26.72	940	J
14.	UNKNOWN HYDROCARBON	27.22	5900	J
15.	UNKNOWN HYDROCARBON	28.64	1900	J
16.	UNKNOWN HYDROCARBON	30.36	1300	J
17.	UNKNOWN HYDROCARBON	31.77	3100	J
18.	UNKNOWN HYDROCARBON	32.01	1000	J
19.	UNKNOWN	33.52	820	J
20.	UNKNOWN HYDROCARBON	33.92	880	J
21.	UNKNOWN	40.82	1500	J N

000295

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ44

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN15

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN15

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 62 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.9 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	880	U
111-44-4	bis(2-Chloroethyl)Ether	880	U
95-57-8	2-Chlorophenol	880	U
541-73-1	1,3-Dichlorobenzene	880	U
106-46-7	1,4-Dichlorobenzene	880	U
100-51-6	Benzyl Alcohol	880	U
95-50-1	1,2-Dichlorobenzene	880	U
95-48-7	2-Methylphenol	880	U
108-60-1	bis(2-Chloroisopropyl)Ether	880	U
106-44-5	4-Methylphenol	880	U
621-64-7	N-Nitroso-Di-n-Propylamine	880	U
67-72-1	Hexachloroethane	880	U
98-95-3	Nitrobenzene	880	U
78-59-1	Isophorone	880	U
88-75-5	2-Nitrophenol	880	U
105-67-9	2,4-Dimethylphenol	880	U
65-85-0	Benzoic Acid	4300	U
111-91-1	bis(2-Chloroethoxy)Methane	880	U
120-83-2	2,4-Dichlorophenol	880	U
120-82-1	1,2,4-Trichlorobenzene	880	U
91-20-3	Naphthalene	880	U
106-47-8	4-Chloroaniline	880	U
87-68-3	Hexachlorobutadiene	880	U
59-50-7	4-Chloro-3-Methylphenol	880	U
91-57-6	2-Methylnaphthalene	880	U
77-47-4	Hexachlorocyclopentadiene	880	U
88-06-2	2,4,6-Trichlorophenol	880	U
95-95-4	2,4,5-Trichlorophenol	4300	U
91-58-7	2-Chloronaphthalene	880	U
88-74-4	2-Nitroaniline	4300	U
131-11-3	Dimethyl Phthalate	880	U
208-96-8	Acenaphthylene	880	U
606-20-2	2,6-Dinitrotoluene	880	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ44

Lab Name: G S E L [Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN15

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN15

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 62 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.9 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
99-09-2	3-Nitroaniline	4300	U
83-32-9	Acenaphthene	880	U
51-28-5	2,4-Dinitrophenol	4300	U
100-02-7	4-Nitrophenol	4300	U
132-64-9	Dibenzofuran	880	U
121-14-2	2,4-Dinitrotoluene	880	U
84-66-2	Diethylphthalate	880	U
7005-72-3	4-Chlorophenyl-phenylether	880	U
86-73-7	Fluorene	880	U
100-01-6	4-Nitroaniline	4300	U
534-52-1	4,6-Dinitro-2-Methylphenol	4300	U
86-30-6	N-Nitrosodiphenylamine (1)	880	U
101-55-3	4-Bromophenyl-phenylether	880	U
118-74-1	Hexachlorobenzene	880	U
87-86-5	Pentachlorophenol	4300	U
85-01-8	Phenanthrene	190	J
120-12-7	Anthracene	880	U
84-74-2	Di-n-Butylphthalate	880	U
206-44-0	Fluoranthene	590	J
129-00-0	Pyrene	400	J
85-68-7	Butylbenzylphthalate	880	U
91-94-1	3,3'-Dichlorobenzidine	1800	U
56-55-3	Benzo(a)Anthracene	240	J
218-01-9	Chrysene	290	J
117-81-7	bis(2-Ethylhexyl)Phthalate	880	U
117-84-0	Di-n-Octyl Phthalate	880	U
205-99-2	Benzo(b)Fluoranthene	370	J
207-08-9	Benzo(k)Fluoranthene	270	J
50-32-8	Benzo(a)Pyrene	330	J
193-39-5	Indeno(1,2,3-cd)Pyrene	880	U
53-70-3	Dibenz(a,h)Anthracene	880	U
191-24-2	Benzo(g,h,i)Perylene	880	U

(1) - Cannot be separated from Diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ44

Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN15

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN15

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 62 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.9 Dilution Factor: 1.0

Number TICs found: 21 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN KETONE	7.02	5000	~~BJ~~
2.	UNKNOWN KETONE	7.28	600	J
3.	UNKNOWN KETONE	8.35	3500	~~BJ~~
4.	UNKNOWN KETONE	9.25	1200	J
5.	UNKNOWN HYDROCARBON	20.77	530	J
6.	UNKNOWN HYDROCARBON	22.19	3400	J
7.	UNKNOWN HYDROCARBON	23.12	380	J
8.	UNKNOWN HYDROCARBON	23.54	310	J
9.	UNKNOWN HYDROCARBON	24.24	4200	J
10.	UNKNOWN HYDROCARBON	24.75	760	J
11.	UNKNOWN HYDROCARBON	25.56	720	J
12.	UNKNOWN HYDROCARBON	26.24	1600	J
13.	UNKNOWN HYDROCARBON	27.22	5100	J
14.	UNKNOWN	27.67	390	J
15.	UNKNOWN HYDROCARBON	30.36	1500	J
16.	UNKNOWN HYDROCARBON	31.79	2700	J
17.	UNKNOWN HYDROCARBON	32.01	660	J
18.	UNKNOWN	32.52	520	J
19.	UNKNOWN HYDROCARBON	36.71	640	J
20.	UNKNOWN	40.11	550	J
21.	UNKNOWN	40.81	460	J

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ45

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN16

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN16

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 52 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.8 Dilution Factor: 0.99

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	680	U
111-44-4	bis(2-Chloroethyl)Ether	680	U
95-57-8	2-Chlorophenol	680	U
541-73-1	1,3-Dichlorobenzene	680	U
106-46-7	1,4-Dichlorobenzene	680	U
100-51-6	Benzyl Alcohol	680	U
95-50-1	1,2-Dichlorobenzene	680	U
95-48-7	2-Methylphenol	680	U
108-60-1	bis(2-Chloroisopropyl)Ether	680	U
106-44-5	4-Methylphenol	680	U
621-64-7	N-Nitroso-Di-n-Propylamine	680	U
67-72-1	Hexachloroethane	680	U
98-95-3	Nitrobenzene	680	U
78-59-1	Isophorone	680	U
88-75-5	2-Nitrophenol	680	U
105-67-9	2,4-Dimethylphenol	680	U
65-85-0	Benzoic Acid	680	U
111-91-1	bis(2-Chloroethoxy)Methane	3300	U
120-83-2	2,4-Dichlorophenol	680	U
120-82-1	1,2,4-Trichlorobenzene	680	U
91-20-3	Naphthalene	680	U
106-47-8	4-Chloroaniline	680	U
87-68-3	Hexachlorobutadiene	680	U
59-50-7	4-Chloro-3-Methylphenol	680	U
91-57-6	2-Methylnaphthalene	680	U
77-47-4	Hexachlorocyclopentadiene	680	U
88-06-2	2,4,6-Trichlorophenol	680	U
95-95-4	2,4,5-Trichlorophenol	680	U
91-58-7	2-Chloronaphthalene	3300	U
88-74-4	2-Nitroaniline	680	U
131-11-3	Dimethyl Phthalate	3300	U
208-96-8	Acenaphthylene	680	U
606-20-2	2,6-Dinitrotoluene	680	U

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ45

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN16

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN16

Level: (low/med) LOW Date Received: 02/22/91

Moisture: not dec. 52 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.8 Dilution Factor: 0.99

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
99-09-2	3-Nitroaniline	3300	U
83-32-9	Acenaphthene	680	U
51-28-5	2,4-Dinitrophenol	3300	U
100-02-7	4-Nitrophenol	3300	U
132-64-9	Dibenzofuran	680	U
121-14-2	2,4-Dinitrotoluene	680	U
84-66-2	Diethylphthalate	680	U
7005-72-3	4-Chlorophenyl-phenylether	680	U
86-73-7	Fluorene	680	U
100-01-6	4-Nitroaniline	3300	U
534-52-1	4,6-Dinitro-2-Methylphenol	3300	U
86-30-6	N-Nitrosodiphenylamine (1)	680	U
101-55-3	4-Bromophenyl-phenylether	680	U
118-74-1	Hexachlorobenzene	680	U
87-86-5	Pentachlorophenol	3300	U
85-01-8	Phenanthrene	190	J
120-12-7	Anthracene	680	U
84-74-2	Di-n-Butylphthalate	680	U
206-44-0	Fluoranthene	650	J
129-00-0	Pyrene	510	J
85-68-7	Butylbenzylphthalate	680	U
91-94-1	3,3'-Dichlorobenzidine	1400	U
56-55-3	Benzo(a)Anthracene	280	J
218-01-9	Chrysene	450	J
117-81-7	bis(2-Ethylhexyl)Phthalate	480	J
117-84-0	Di-n-Octyl Phthalate	680	U
205-99-2	Benzo(b)Fluoranthene	470	J
207-08-9	Benzo(k)Fluoranthene	340	J
50-32-8	Benzo(a)Pyrene	280	J
193-39-5	Indeno(1,2,3-cd)Pyrene	680	U
53-70-3	Dibenz(a,h)Anthracene	680	U
191-24-2	Benzo(g,h,i)Perylene	680	U

(1) - Cannot be separated from Diphenylamine

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ45

Name: G S E L C Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN16

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN16

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 52 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.8 Dilution Factor: 0.99

Number TICs found: 21 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN KETONE	9.32	1300	J
2.	UNKNOWN HYDROCARBON	17.44	420	J
3.	UNKNOWN HYDROCARBON	18.24	450	J
4.	UNKNOWN FATTY ACID	18.35	580	J
5.	UNKNOWN HYDROCARBON	20.77	810	J
6.	UNKNOWN HYDROCARBON	21.42	480	J
7.	UNKNOWN HYDROCARBON	22.20	3600	J
8.	UNKNOWN HYDROCARBON	23.12	520	J
9.	UNKNOWN HYDROCARBON	23.55	440	J
10.	UNKNOWN HYDROCARBON	24.24	5000	J
11.	UNKNOWN HYDROCARBON	24.75	290	J
12.	UNKNOWN HYDROCARBON	25.57	980	J
13.	UNKNOWN HYDROCARBON	26.26	2200	J
14.	UNKNOWN HYDROCARBON	27.24	8300	J
15.	UNKNOWN	27.67	740	J
16.	UNKNOWN HYDROCARBON	30.37	1400	J
17.	UNKNOWN HYDROCARBON	31.81	2100	J
18.	UNKNOWN HYDROCARBON	32.02	1200	J
19.	UNKNOWN	32.54	960	J
20.	UNKNOWN	33.54	710	J
21.	UNKNOWN STEROL	40.91	2900	J

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ46

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN17

Sample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN17

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 46 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 6.0 Dilution Factor: 1.00

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	610	U
111-44-4	bis(2-Chloroethyl)Ether	610	U
95-57-8	2-Chlorophenol	610	U
541-73-1	1,3-Dichlorobenzene	610	U
106-46-7	1,4-Dichlorobenzene	610	U
100-51-6	Benzyl Alcohol	610	U
95-50-1	1,2-Dichlorobenzene	610	U
95-48-7	2-Methylphenol	610	U
108-60-1	bis(2-Chloroisopropyl)Ether	610	U
106-44-5	4-Methylphenol	610	U
621-64-7	N-Nitroso-Di-n-Propylamine	610	U
67-72-1	Hexachloroethane	610	U
98-95-3	Nitrobenzene	610	U
78-59-1	Isophorone	610	U
88-75-5	2-Nitrophenol	610	U
105-67-9	2,4-Dimethylphenol	610	U
65-85-0	Benzoic Acid	610	U
111-91-1	bis(2-Chloroethoxy)Methane	3000	U
120-83-2	2,4-Dichlorophenol	610	U
120-82-1	1,2,4-Trichlorobenzene	610	U
91-20-3	Naphthalene	610	U
106-47-8	4-Chloroaniline	610	U
87-68-3	Hexachlorobutadiene	610	U
59-50-7	4-Chloro-3-Methylphenol	610	U
91-57-6	2-Methylnaphthalene	610	U
77-47-4	Hexachlorocyclopentadiene	610	U
88-06-2	2,4,6-Trichlorophenol	610	U
95-95-4	2,4,5-Trichlorophenol	610	U
91-58-7	2-Chloronaphthalene	3000	U
88-74-4	2-Nitroaniline	610	U
131-11-3	Dimethyl Phthalate	3000	U
208-96-8	Acenaphthylene	610	U
606-20-2	2,6-Dinitrotoluene	610	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ46

.e: G S E L [Contract: 68-D9-0038

.ode: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

.rix: (soil/water) SOIL Lab Sample ID: FUN17

ample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN17

.evel: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 46 dec. ____ Date Extracted: 02/25/91

xtraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 6.0 Dilution Factor: 1.00

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
99-09-2	3-Nitroaniline	3000	U
83-32-9	Acenaphthene	610	U
51-28-5	2,4-Dinitrophenol	3000	U
100-02-7	4-Nitrophenol	3000	U
132-64-9	Dibenzofuran	610	U
121-14-2	2,4-Dinitrotoluene	610	U
84-66-2	Diethylphthalate	610	U
7005-72-3	4-Chlorophenyl-phenylether	610	U
86-73-7	Fluorene	610	U
100-01-6	4-Nitroaniline	3000	U
534-52-1	4,6-Dinitro-2-Methylphenol	3000	U
86-30-6	N-Nitrosodiphenylamine (1)	610	U
101-55-3	4-Bromophenyl-phenylether	610	U
118-74-1	Hexachlorobenzene	610	U
87-86-5	Pentachlorophenol	3000	U
85-01-8	Phenanthrene	170	J
120-12-7	Anthracene	610	U
84-74-2	Di-n-Butylphthalate	610	U
206-44-0	Fluoranthene	520	J
129-00-0	Pyrene	410	J
85-68-7	Butylbenzylphthalate	610	U
91-94-1	3,3'-Dichlorobenzidine	1200	U
56-55-3	Benzo(a)Anthracene	210	J
218-01-9	Chrysene	330	J
117-81-7	bis(2-Ethylhexyl)Phthalate	460	J
117-84-0	Di-n-Octyl Phthalate	610	U
205-99-2	Benzo(b)Fluoranthene	360	J
207-08-9	Benzo(k)Fluoranthene	310	J
50-32-8	Benzo(a)Pyrene	230	J
193-39-5	Indeno(1,2,3-cd)Pyrene	610	U
53-70-3	Dibenz(a,h)Anthracene	610	U
191-24-2	Benzo(g,h,i)Perylene	610	U

(1) - Cannot be separated from Diphenylamine

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BGQ46

a: G S E L Contract: 68-D9-0038

ode: GLLF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

r: (soil/water) SOIL Lab Sample ID: FUN17

ample wt/vol: 30.0 (g/mL) G Lab File ID: SVFUN17

Level: (low/med) LOW Date Received: 02/22/91

Moisture: not dec. 46 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

PC Cleanup: (Y/N) N pH: 6.0 Dilution Factor: 1.00

umber TICs found: 21

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN HYDROCARBON	20.77	920	J
2.	UNKNOWN	20.87	600	J
3.	UNKNOWN HYDROCARBON	21.00	500	J
4.	UNKNOWN PNA (MW=234)	22.04	530	J
5.	UNKNOWN HYDROCARBON	22.19	3200	J
6.	UNKNOWN HYDROCARBON	23.10	470	J
7.	UNKNOWN HYDROCARBON	23.54	420	J
8.	UNKNOWN HYDROCARBON	24.22	4400	J
9.	UNKNOWN HYDROCARBON	24.75	330	J
10.	UNKNOWN	24.94	570	J
11.	UNKNOWN HYDROCARBON	25.54	750	J
12.	UNKNOWN HYDROCARBON	26.24	1600	J
13.	UNKNOWN HYDROCARBON	27.22	6400	J
14.	UNKNOWN	27.67	500	J
15.	UNKNOWN PNA (MW=252)	28.09	530	J
16.	UNKNOWN HYDROCARBON	30.36	1100	J
17.	UNKNOWN HYDROCARBON	31.77	1500	J
18.	UNKNOWN HYDROCARBON	32.01	720	J
19.	UNKNOWN	32.54	780	J
20.	UNKNOWN	33.52	440	J
21.	UNKNOWN STEROL	40.87	2100	J

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ47

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN18

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN18

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.7 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
100-51-6	Benzyl Alcohol	10	U
95-50-1	1,2-Dichlorobenzene	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	bis(2-Chloroisopropyl)Ether	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-Di-n-Propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
65-85-0	Benzoic Acid	50	U
111-91-1	bis(2-Chloroethoxy)Methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethyl Phthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ47

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN18

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN18

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.7 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
99-09-2	3-Nitroaniline	50	UJ
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	50	U
534-52-1	4,6-Dinitro-2-Methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)Anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)Phthalate	3	BJ
117-84-0	Di-n-Octyl Phthalate	10	U
205-99-2	Benzo(b)Fluoranthene	10	U
207-08-9	Benzo(k)Fluoranthene	10	U
50-32-8	Benzo(a)Pyrene	10	U
193-39-5	Indeno(1,2,3-cd)Pyrene	10	U
53-70-3	Dibenz(a,h)Anthracene	10	U
191-24-2	Benzo(g,h,i)Perylene	10	U

(1) - Cannot be separated from Diphenylamine

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ48

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN19

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN19

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 5.6 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
100-51-6	Benzyl Alcohol	10	U
95-50-1	1,2-Dichlorobenzene	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	bis(2-Chloroisopropyl)Ether	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-Di-n-Propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
65-85-0	Benzoic Acid	50	U
111-91-1	bis(2-Chloroethoxy)Methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethyl Phthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ48

Name: G S E L I Contract: 68-D9-0038

Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN19

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN19

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.6 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
99-09-2	3-Nitroaniline	50	UJ
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	50	U
534-52-1	4,6-Dinitro-2-Methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)Anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)Phthalate	3	BJ
117-84-0	Di-n-Octyl Phthalate	10	U
205-99-2	Benzo(b)Fluoranthene	10	U
207-08-9	Benzo(k)Fluoranthene	10	U
50-32-8	Benzo(a)Pyrene	10	U
193-39-5	Indeno(1,2,3-cd)Pyrene	10	U
53-70-3	Dibenz(a,h)Anthracene	10	U
191-24-2	Benzo(g,h,i)Perylene	10	U

(1) - Cannot be separated from Diphenylamine

C00655

34-37

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ49

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN20

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN20

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 9.5 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
100-51-6	Benzyl Alcohol	10	U
95-50-1	1,2-Dichlorobenzene	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	bis(2-Chloroisopropyl)Ether	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-Di-n-Propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
65-85-0	Benzoic Acid	50	U
111-91-1	bis(2-Chloroethoxy)Methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethyl Phthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ49

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN20

Sample wt/vol: 1000 (g/mL) ML Lab File ID: SVFUN20

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.5 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
99-09-2	3-Nitroaniline	50	U J
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	50	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	50	U
534-52-1	4,6-Dinitro-2-Methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	50	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
84-74-2	Di-n-Butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)Anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)Phthalate	6	BJ
117-84-0	Di-n-Octyl Phthalate	10	U
205-99-2	Benzo(b)Fluoranthene	10	U
207-08-9	Benzo(k)Fluoranthene	10	U
50-32-8	Benzo(a)Pyrene	10	U
193-39-5	Indeno(1,2,3-cd)Pyrene	10	U
53-70-3	Dibenz(a,h)Anthracene	10	U
191-24-2	Benzo(g,h,i)Perylene	10	U

(1) - Cannot be separated from Diphenylamine

C00662

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PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ34

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN01

Sample wt/vol: 1000 (g/mL) ML Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 8.4 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.050	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.050	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.10	U
53494-70-5	Endrin ketone	0.50	U
5103-71-9	alpha-Chlordane	0.10	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	0.50	U
12674-11-2	Aroclor-1016	1.0	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	0.50	U
11096-82-5	Aroclor-1260	1.0	U
		1.0	U

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1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ35

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN02

Sample wt/vol: 1000 (g/mL) ML Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 7.1 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.16	
1024-57-3	Heptachlor epoxide	0.050	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
53494-70-5	Endrin ketone	0.10	U
5103-71-9	alpha-Chlordane	0.50	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	1.0	U
12674-11-2	Aroclor-1016	0.50	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	1.0	U
11096-82-5	Aroclor-1260	1.0	U

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PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ36

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN03

Sample wt/vol: 1000 (g/mL) ML Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 6.8 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.13	
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.050	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.10	U
53494-70-5	Endrin ketone	0.50	U
5103-71-9	alpha-Chlordane	0.10	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	0.50	U
12674-11-2	Aroclor-1016	1.0	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	0.50	U
11096-82-5	Aroclor-1260	1.0	U
		1.0	U

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PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ37

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN04

Sample wt/vol: 1000 (g/mL) ML Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 8.5 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.050	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.050	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.10	U
53494-70-5	Endrin ketone	0.50	U
5103-71-9	alpha-Chlordane	0.10	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	0.50	U
12674-11-2	Aroclor-1016	1.0	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	0.50	U
11096-82-5	Aroclor-1260	1.0	U
		1.0	U

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PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ38

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN05

Sample wt/vol: 1000 (g/mL) ML Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 8.6 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.050	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
53494-70-5	Endrin ketone	0.10	U
5103-71-9	alpha-Chlordane	0.50	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	1.0	U
12674-11-2	Aroclor-1016	0.50	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	1.0	U
11096-82-5	Aroclor-1260	1.0	U

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PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ39

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN08

Sample wt/vol: 1000 (g/mL) ML Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.5 Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.050	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
53494-70-5	Endrin ketone	0.10	U
5103-71-9	alpha-Chlordane	0.50	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	1.0	U
12674-11-2	Aroclor-1016	0.50	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	1.0	U
11096-82-5	Aroclor-1260	1.0	U

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PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ40

ab Name: G S E L I Contract: 68-D9-0038

a Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

atrix: (soil/water) WATER Lab Sample ID: FUN09

ample wt/vol: 1000 (g/mL) ML Lab File ID: _____

evel: (low/med) LOW Date Received: 02/22/91

Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

xtraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

PC Cleanup: (Y/N) N pH: 8.2 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.050	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
53494-70-5	Endrin ketone	0.10	U
5103-71-9	alpha-Chlordane	0.50	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	1.0	U
12674-11-2	Aroclor-1016	0.50	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	1.0	U
11096-82-5	Aroclor-1260	1.0	U

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PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ41

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN10

Sample wt/vol: 1000 (g/mL) ML Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.4 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.050	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
53494-70-5	Endrin ketone	0.10	U
5103-71-9	alpha-Chlordane	0.50	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	1.0	U
12674-11-2	Aroclor-1016	0.50	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	1.0	U
11096-82-5	Aroclor-1260	1.0	U

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PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ42

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN11

Sample wt/vol: 30.0 (g/mL) G Lab File ID:

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 37 dec. Date Extracted: 02/28/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 03/01/91

GPC Cleanup: (Y/N) N pH: 5.7 Dilution Factor: 1.00

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
319-84-6	alpha-BHC	13	U
319-85-7	beta-BHC	13	U
319-86-8	delta-BHC	13	U
58-89-9	gamma-BHC (Lindane)	13	U
76-44-8	Heptachlor	13	U
309-00-2	Aldrin	13	U
1024-57-3	Heptachlor epoxide	13	U
959-98-8	Endosulfan I	13	U
60-57-1	Dieldrin	25	U
72-55-9	4,4'-DDE	25	U
72-20-8	Endrin	25	U
33213-65-9	Endosulfan II	25	U
72-54-8	4,4'-DDD	25	U
1031-07-8	Endosulfan sulfate	25	U
50-29-3	4,4'-DDT	25	U
72-43-5	Methoxychlor	130	U
53494-70-5	Endrin ketone	25	U
5103-71-9	alpha-Chlordane	130	U
5103-74-2	gamma-Chlordane	130	U
8001-35-2	Toxaphene	250	U
12674-11-2	Aroclor-1016	130	U
11104-28-2	Aroclor-1221	130	U
11141-16-5	Aroclor-1232	130	U
53469-21-9	Aroclor-1242	130	U
12672-29-6	Aroclor-1248	130	U
11097-69-1	Aroclor-1254	250	U
11096-82-5	Aroclor-1260	250	U

1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ43

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN14

Sample wt/vol: 30.0 (g/mL) G Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 62 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.8 Dilution Factor: 1.00

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
319-84-6	alpha-BHC	21	U
319-85-7	beta-BHC	21	U
319-86-8	delta-BHC	21	U
58-89-9	gamma-BHC (Lindane)	21	U
76-44-8	Heptachlor	21	U
309-00-2	Aldrin	21	U
1024-57-3	Heptachlor epoxide	21	U
959-98-8	Endosulfan I	21	U
60-57-1	Dieldrin	42	U
72-55-9	4,4'-DDE	42	U
72-20-8	Endrin	42	U
33213-65-9	Endosulfan II	42	U
72-54-8	4,4'-DDD	42	U
1031-07-8	Endosulfan sulfate	42	U
50-29-3	4,4'-DDT	42	U
72-43-5	Methoxychlor	210	U
53494-70-5	Endrin ketone	42	U
5103-71-9	alpha-Chlordane	210	U
5103-74-2	gamma-Chlordane	210	U
8001-35-2	Toxaphene	420	U
12674-11-2	Aroclor-1016	210	U
11104-28-2	Aroclor-1221	210	U
11141-16-5	Aroclor-1232	210	U
53469-21-9	Aroclor-1242	210	U
12672-29-6	Aroclor-1248	210	U
11097-69-1	Aroclor-1254	420	U
11096-82-5	Aroclor-1260	420	U

1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ44

Name: G S E L I Contract: 68-D9-0038

Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN15

Sample wt/vol: 30.0 (g/mL) G Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

Moisture: not dec. 62 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

Gel Cleanup: (Y/N) N pH: 5.9 Dilution Factor: 1.00

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
319-84-6	alpha-BHC	21	U
319-85-7	beta-BHC	21	U
319-86-8	delta-BHC	21	U
58-89-9	gamma-BHC (Lindane)	21	U
76-44-8	Heptachlor	21	U
309-00-2	Aldrin	21	U
1024-57-3	Heptachlor epoxide	21	U
959-98-8	Endosulfan I	21	U
60-57-1	Dieldrin	42	U
72-55-9	4,4'-DDE	42	U
72-20-8	Endrin	42	U
33213-65-9	Endosulfan II	42	U
72-54-8	4,4'-DDD	42	U
1031-07-8	Endosulfan sulfate	42	U
50-29-3	4,4'-DDT	42	U
72-43-5	Methoxychlor	210	U
53494-70-5	Endrin ketone	42	U
5103-71-9	alpha-Chlordane	210	U
5103-74-2	gamma-Chlordane	210	U
8001-35-2	Toxaphene	420	U
12674-11-2	Aroclor-1016	210	U
11104-28-2	Aroclor-1221	210	U
11141-16-5	Aroclor-1232	210	U
53469-21-9	Aroclor-1242	210	U
12672-29-6	Aroclor-1248	210	U
11097-69-1	Aroclor-1254	420	U
11096-82-5	Aroclor-1260	420	U

1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ45

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN16

Sample wt/vol: 30.0 (g/mL) G Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 52 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 5.8 Dilution Factor: 1.00

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND		Q
319-84-6	alpha-BHC	17	U
319-85-7	beta-BHC	17	U
319-86-8	delta-BHC	17	U
58-89-9	gamma-BHC (Lindane)	17	U
76-44-8	Heptachlor	17	U
309-00-2	Aldrin	17	U
1024-57-3	Heptachlor epoxide	17	U
959-98-8	Endosulfan I	17	U
60-57-1	Dieldrin	33	U
72-55-9	4,4'-DDE	33	U
72-20-8	Endrin	33	U
33213-65-9	Endosulfan II	33	U
72-54-8	4,4'-DDD	33	U
1031-07-8	Endosulfan sulfate	33	U
50-29-3	4,4'-DDT	33	U
72-43-5	Methoxychlor	170	U
53494-70-5	Endrin ketone	33	U
5103-71-9	alpha-Chlordane	170	U
5103-74-2	gamma-Chlordane	170	U
8001-35-2	Toxaphene	330	U
12674-11-2	Aroclor-1016	170	U
11104-28-2	Aroclor-1221	170	U
11141-16-5	Aroclor-1232	170	U
53469-21-9	Aroclor-1242	170	U
12672-29-6	Aroclor-1248	170	U
11097-69-1	Aroclor-1254	330	U
11096-82-5	Aroclor-1260	330	U

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PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ46

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) SOIL Lab Sample ID: FUN17

Sample wt/vol: 30.0 (g/mL) G Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. 46 dec. ____ Date Extracted: 02/25/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 02/27/91

GPC Cleanup: (Y/N) N pH: 6.0 Dilution Factor: 1.00

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND		Q
319-84-6	alpha-BHC	15	U
319-85-7	beta-BHC	15	U
319-86-8	delta-BHC	15	U
58-89-9	gamma-BHC (Lindane)	15	U
76-44-8	Heptachlor	15	U
309-00-2	Aldrin	15	U
1024-57-3	Heptachlor epoxide	15	U
959-98-8	Endosulfan I	15	U
60-57-1	Dieldrin	15	U
72-55-9	4,4'-DDE	30	U
72-20-8	Endrin	30	U
33213-65-9	Endosulfan II	30	U
72-54-8	4,4'-DDD	30	U
1031-07-8	Endosulfan sulfate	30	U
50-29-3	4,4'-DDT	30	U
72-43-5	Methoxychlor	30	U
53494-70-5	Endrin ketone	150	U
5103-71-9	alpha-Chlordane	30	U
5103-74-2	gamma-Chlordane	150	U
8001-35-2	Toxaphene	150	U
12674-11-2	Aroclor-1016	300	U
11104-28-2	Aroclor-1221	150	U
11141-16-5	Aroclor-1232	150	U
53469-21-9	Aroclor-1242	150	U
12672-29-6	Aroclor-1248	150	U
11097-69-1	Aroclor-1254	150	U
11096-82-5	Aroclor-1260	300	U
		300	U

1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ47

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN18

Sample wt/vol: 1000 (g/mL) ML Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.7 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.050	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
53494-70-5	Endrin ketone	0.10	U
5103-71-9	alpha-Chlordane	0.50	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	1.0	U
12674-11-2	Aroclor-1016	0.50	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	1.0	U
11096-82-5	Aroclor-1260	1.0	U

1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ48

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN19

Sample wt/vol: 1000 (g/mL) ML Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.6 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.050	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
53494-70-5	Endrin ketone	0.10	U
5103-71-9	alpha-Chlordane	0.50	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	1.0	U
12674-11-2	Aroclor-1016	0.50	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	1.0	U
11096-82-5	Aroclor-1260	1.0	U

1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BGQ49

Lab Name: G S E L I Contract: 68-D9-0038

Lab Code: GULF Case No.: 15918 SAS No.: _____ SDG No.: BGQ34

Matrix: (soil/water) WATER Lab Sample ID: FUN20

Sample wt/vol: 1000 (g/mL) ML Lab File ID: _____

Level: (low/med) LOW Date Received: 02/22/91

% Moisture: not dec. ____ dec. ____ Date Extracted: 02/22/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 02/28/91

GPC Cleanup: (Y/N) N pH: 8.5 Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.050	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.10	U
33213-65-9	Endosulfan II	0.10	U
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
53494-70-5	Endrin ketone	0.10	U
5103-71-9	alpha-Chlordane	0.50	U
5103-74-2	gamma-Chlordane	0.50	U
8001-35-2	Toxaphene	1.0	U
12674-11-2	Aroclor-1016	0.50	U
11104-28-2	Aroclor-1221	0.50	U
11141-16-5	Aroclor-1232	0.50	U
53469-21-9	Aroclor-1242	0.50	U
12672-29-6	Aroclor-1248	0.50	U
11097-69-1	Aroclor-1254	1.0	U
11096-82-5	Aroclor-1260	1.0	U

REFERENCE NO. 21

MALCOLM PIRNIE, INC.	PROJECT NOTES

To: File	**Date:** December 7, 1994
From: Lisa Greco	**Project #:** 8003-368
Subject: Groundwater Usage	**Site Name:** Jerry Jones Mack Truck

The following details the groundwater apportionment for the Jerry Jones Mack Truck site:

1) **Town of Boonton** - The Town of Boonton operates a blended system of four wells and one surface water intake. The four wells provide 40% of the total water for the system and the intake provides 60% of the total water for the system. Altogether, this system serves 2,635 connections. Since the average population per household for Morris County is 2.78 people, this system serves (2,635 X 2.78) = 7,325 people. Therefore, the wells serve (7,325 X 0.4) = 2,930 people. Since all four wells are located in the 2 - 3 mile distance ring, the total population served by the wells will be apportioned to this ring.

2) **Rockaway Township** - Rockaway Township operates a blended system of three wells which serve 4,200 connections. Since the average population per household for Morris County is 2.78 people, these wells serve a total population of (4,200 X 2.78) = 11,676 people. Since well No. 7 provides 49% of the total water used by Rockaway Township, the population assigned to each well was determined using the pumpage of each well. The following table details the apportionment calculations:

Well #	Distance Ring	Pumpage (gpm)	%Total Pumpage	Population Served
6	1/4 - 1/2 mile	350	21	11,676 X .21 = 2,452
7	1/4 - 1/2 mile	800	49	11,676 X .49 = 5,721
8	1/2 - 1 mile	500	30	11,676 X .30 = 3,503

3) **Rockaway Borough** - Rockaway Borough operates a blended system of three wells which serve 2,800 connections. Since the average population per household in Morris County is 2.78 people, these wells serve a total population of 7,784 people. All of the wells are located in the 1 - 2 mile distance ring. Therefore, the total population served by the wells was apportioned to this ring.

4) **Denville** - Denville operates a blended system of five wells which serve 5,00 connections. Since the average population per household in Morris County is 2.78, these wells serve a total population of (5,000 X 2.78) = 13,900 people. Well No. 5 provides 60% of the total water for the system. Therefore, the population served by each well was apportioned to the well based on pumpage. The following table details the apportionment calculations:

Well #	Distance Ring	Pumpage (gpm)	%Total Pumpage	Population Served
1	1 - 2 mile	450	5	13,900 X 0.05 = 695
3	3 - 4 mile	500	15	13,900 X .15 = 2,085
4	1 - 2 mile	550	5	13,900 X 0.05 = 695
5	1 - 2 mile	1,000	60	13,900 X .60 = 8,340
6	3 - 4 mile	500	15	13,900 X .15 = 2,085

MALCOLM PIRNIE, INC.	PROJECT NOTES

To: File	**Date:** December 7, 1994
From: Lisa Greco	**Project #:** 8003-368
Subject: Groundwater Usage	**Site Name:** Jerry Jones Mack Truck

5) **Parsippany-Troy Hills** - Parsippany obtains their drinking water from 19 wells; however, none of the wells are located within a 4-mile radius of the site.

6) **Mountain Lakes** - Mountain Lakes operates a blended system of four wells which serve 1,400 connections. Since the average population per household for Morris County is 2.78 people, these wells serve a total population of (1,400 X 2.78) = 3,892 people. Well No. 5 provides 85% of the total water for the system. Therefore, the population served by each well was apportioned to the well based on pumpage. The following table details the apportionment calculations:

Well #	Distance Ring	Pumpage (gpm)	%Total Pumpage	Population Served
4	2 - 3 mile	400	15	3,892 X .15 = 584
5	3 - 4 mile	650	85	3,892 X ..85 = 3,308

7) **Wharton** - Wharton obtains their drinking water from wells which are located outside the 4-mile radius for the site.

8) **Dover** - Dover obtains their drinking water from wells which are located outside the 4-mile radius for the site.

9) **Randolph** - Randolph obtains their drinking water from the Morris County Municipal Utilities Authority and the Southeast Morris County Municipal Utilities Authority, Dover Water Company, and Denville.

10) **Private Wells** - Based upon the distribution areas for the Townships, some areas which are served by private wells were identified. The number of houses served by private wells in each distance ring was counted, and this number was multiplied by the average population per household for Morris County. The following table summarizes the number of people served by private wells:

0 - 1/4 mile ring	0 houses
1/4 - 1/2 mile ring	0 houses
1/2 - 1 mile ring	3 houses X 2.78 = 8 people
1 - 2 mile ring	117 houses X 2.78 = 325 people
2 - 3 mile ring	344 houses X 2.78 = 956 people
3 - 4 mile ring	52 houses X 2.78 = 145 people

Summary

0 - 1/4 mile ring	0 people
1/4 - 1/2 mile ring	8,173 people
1/2 - 1 mile ring	3,511 people
1 - 2 mile ring	17,839 people
2 - 3 mile ring	4,470 people
3 - 4 mile ring	7,623 people
Total	41,616 people

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Southeast Morris County Municipal Utilities Authority
Peter Ubertaccio/Superintendent of Treatment and Pumping

PHONE NO.: 326-6880

DATE: 10/26/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 13:55PM

SUBJECT: SMCMUA Drinking Water Supplies

PROJECT NO.: NAE62030.07.01

None of SMCMUA wells are within the sites 4-mile distance ring.

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Dover Water Company/Mary Ann Coari **PHONE NO.:** (201) 366-1221

DATE: 10/26/94

CALL FROM: Rob MacEwen/CH2M HILL **TIME:** 10:30 AM

SUBJECT: Dover Water Company Drinking Water Supply **PROJECT NO.:** NAE62030.07.01

None of Dover's three operating wells are within the sites 4-mile distance ring.

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Wharton Borough Water Supply/Clyde Canfield

PHONE NO.: (201) 366-3593

DATE: 10/25/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 10:30 AM

SUBJECT:

PROJECT NO.: NAE62030.07.01

Left message with Water Company message machine. 10:45 AM. Left message with Water Clerk.

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CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Clyde Canfield/Wharton Borough Water Supervisor

PHONE NO.: (201) 366-3595

DATE: 10/28/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 10:30 AM

SUBJECT: Location of Wharton Borough Wells

PROJECT NO.: NAE62030.07.01

None of Wharton's wells are within the sites 4-mile distance ring.

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CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Carl Danser/Retired Director of Public Works—Mountain Lakes

PHONE NO.: (201) 344-3131

DATE: 10/25/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 13:25 PM

SUBJECT: Mountain Lakes Water Company's Wells

PROJECT NO.: NAE62030.07.01

Mr. Carl Danser recently retired from the Public Works Department of Mountain Lakes. He informed me that Mountain Lakes owns four wells. Their names and locations are as follows. Well No. 5 is located next to B&V Dry Cleaners on Route 46. Wells Nos. 3 and 4 are located on the Rockaway River Golf Course in Denville, and Tower Hill located on Laurel Hill Road in Mountain Lakes. Well No. 5 is the primary provider at approximately 85% of the water used by Mountain Lakes. It pumps at approximately 650 gpm. The total depth is 370 feet and taps the Buried Valley Aquifer. Traces of PCE and TCE were observed in this well, but were detected at levels below any action level.

Well No. 3 has not been used in 20 years. It was shut down due to a manganese problem. Recent testing indicated manganese has dissipated.

Well No. 4 accounts for approximately 15% of the water used by Mountain Lakes. It pumps at 400 gpm both wells 3 and 4 tap the sand and gravel aquifer at a depth of 60 feet.

Tower Hill accounts for less than 1% of the water used by the Borough. It is 400 feet deep and taps the Buried Valley Aquifer. It pumps at 300 gpm.

Mountain Lakes Water services 1,400 residences.

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Denville Water Department-
Joe Lowell/Director of Public Works

PHONE NO.: (201) 625-8334

DATE: 10/26/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 10:55 AM

SUBJECT: Denville Water Supply Wells

PROJECT NO.: NAE62070.07.01

Joe Lowell, Denville Director of Public Works informed me that Denville operates five wells. The location and name of wells are as follows. Wells No. 1 and 4 are located at 140 Morris Avenue. They are 150 feet deep and pump at 450 gpm and 500 gpm, respectively. Wells Nos. 3 and 6 are located on Palmer Road in Randolph Township. They are 150 feet deep and pump at 700 gpm and 500 gpm, respectively. Well No. 5 is located on Savage Road in Denville and is 200 feet deep. It pumps at 1,000 gpm.

Well No. 5 produces 60% of the Township water.
Wells No. 3 and 6 produce (30% total) lead or lag of the Township water.
Wells No. 1 and 4 produce (10% total) lead or lag of the Township water.

Denville services approximately 5,000 customers. Most of the connections are in Denville with a few connections in Randolph, Mountain Lakes, Parsippany, and Boonton Township.

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Rockaway Borough Water Company
Joe Rossi/Operations Foreman

PHONE NO.: (201) 627-0344

DATE: 10/25/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 14:00 PM

SUBJECT: Rockaway Borough Drinking Water Supply

PROJECT NO.: NAE62070.07.01

Mr. Rossi informed me that Rockaway Borough owned and operated three wells to supply drinking water to 2,800 connections in Rockaway Borough. A few of the 2,800 connections are in Denville and Rockaway Township. The three wells are located at Union and Maple Street in Rockaway Borough. The wells are identified as Well No. 1, which is approximately 50 feet deep and pumps at 500 gpm, Well No. 5, which is 65 feet deep and pumps at 500 gpm, and Well No. 6 which is 80 feet deep and pumps at 800 gpm. This is a blended system. Water is treated with a graduated carbon filter and an air stripper for TCE and PCE contamination.

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Steve Koval/Director of Public Works—Boonton

PHONE NO.: (201) 229-7740

DATE: 10/26/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 09:50 AM

SUBJECT: Boonton Drinking Water Supply

PROJECT NO.: NAE62070.07.01

Mr. Koval informed me that the Town of Boonton Public Works supplies water to 2,635 connections. The sources of water are an intake on the Boonton (Taylortown) Reservoir and four wells located on Old Denville Road. The percentage of usage for the blended system is 60% surface water and 40% groundwater.

The intake for the surface water is on the southern end of the reservoir. The water is treated with granulated activated carbon filter for treatment of taste, odor, and turbidity.

The groundwater is obtained through four wells. Wells No. 1 and 2 are 30 to 50 feet deep, and run at a combined rate of 250 gpm. Well No. 4 is 130 feet deep and runs at 300 gpm. Well No. 5 is 130 feet deep and also runs at 300 gpm.

The well field starts 15 feet north of the Denville/Boonton town boundary.

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Rockaway Township Water Department—Bobby Sheard/Assistant Superintendent

PHONE NO.: (201) 627-7200

DATE: 10/26/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 09:30 AM

SUBJECT: Rockaway Township Drinking Water Supply

PROJECT NO.: NAE62070.07.01

Mr. Sheard informed me that water for Rockaway Township is obtained from three wells. They are Well Nos. 6, 7, and 9. Well Nos. 6 and 7 are located next to Dean Carpet and Action Technology on Green Pond Road. These wells run at 350 gpm and 400 gpm and are 170 feet and 180 feet, respectively. Well No. 8 is on the Hewlett Packard property on the corner of Green Pond Road and Meriden Road and runs at 500 gpm at 105 feet.

These three wells serve 4,200 connections most of which are in Rockaway Township. There are a couple of connections in Denville and Rockaway Borough.

Homes that are North of the intersection of Meridan Road and Green Pond Road are on private water.

TABLE 3–12.—DISTANCE-WEIGHTED POPULATION VALUES FOR POTENTIAL CONTAMINATION FACTOR FOR GROUND WATER MIGRATION PATHWAY [a]

Distance category (miles)	Number of people within the distance category												
	0	1 to 10	11 to 30	31 to 100	101 to 300	301 to 1,000	1,001 to 3,000	3,001 to 10,000	10,001 to 30,000	30,001 to 100,000	100,001 to 300,000	300,001 to 1,000,000	1,000,001 to 3,000,000
Other Than Karst [b]:													
0 to ¼	0	4	17	53	164	522	1,633	5,214	16,325	52,137	163,246	521,360	1,632,455
Greater than ¼ to ½	0	2	11	33	102	324	1,013	3,233	10,122	32,325	101,213	323,243	1,012,122
Greater than ½ to 1	0	1	5	17	52	167	523	1,669	5,224	16,684	52,239	166,835	522,385
Greater than 1 to 2	0	0.7	3	10	30	94	294	939	2,938	9,385	29,364	93,845	293,842
Greater than 2 to 3	0	0.5	2	7	21	68	212	678	2,122	6,778	21,222	67,777	212,219
Greater than 3 to 4	0	0.3	1	4	13	42	131	417	1,306	4,171	13,060	41,709	130,596
Karst [c]:													
0 to ¼	0	4	17	53	164	522	1,633	5,214	16,325	52,137	163,246	521,360	1,632,455
Greater than ¼ to ½	0	2	11	33	102	324	1,013	3,233	10,122	32,325	101,213	323,243	1,012,122
Greater than ½ to 1	0	2	9	26	82	261	817	2,607	8,163	26,068	81,623	260,680	816,227
Greater than 1 to 2	0	2	9	26	82	261	817	2,607	8,163	26,068	81,623	260,680	816,227
Greater than 2 to 3	0	2	9	26	82	261	817	2,607	8,163	26,068	81,623	260,680	816,227
Greater than 3 to 4	0	2	9	26	82	261	817	2,607	8,163	26,068	81,623	260,680	816,227

[a] Round the number of people present within a distance category to nearest integer. Do not round the assigned distance-weighted population value to nearest integer.
[b] Use for all aquifers, except karst aquifers underlying any portion of the sources at the site.
[c] Use only for karst aquifers underlying any portion of the sources at the site.

–Assign a distance-weighted population value for each distance category based on the number of people included within the distance category.

• Use the "Other Than Karst" portion of Table 3–12 for the remainder of the population served by points of withdrawal subject to potential contamination.

–For this portion of the population, determine the number of people included within each "Other Than Karst" distance category in Table 3–12.

–Assign a distance-weighted population value for each distance category based on the number of people included within the distance category.

Calculate the value for the potential contamination factor (PC) as follows:

$$PC = \frac{1}{10} \sum_{i=1}^{n} (W_i + K_i)$$

where:

W_i = Distance-weighted population from "Other Than Karst" portion of Table 3–12 for distance category i.

K_i = Distance-weighted population from "Karst" portion of Table 3–12 for distance category i.

n = Number of distance categories.

If PC is less than 1, do not round it to the nearest integer; if PC is 1 or more, round to the nearest integer. Enter this value in Table 3–1.

3.3.2.5 *Calculation of population factor value.* Sum the factor values for Level I concentrations, Level II concentrations, and potential contamination. Do not round this sum to the nearest integer. Assign this sum as the population factor value for the aquifer. Enter this value in Table 3–1.

3.3.3 *Resources.* To evaluate the resources factor, select the highest value specified below that applies for the aquifer being evaluated. Assign this value as the resources factor value for the aquifer. Enter this value in Table 3–1.

Assign a resources value of 5 if water drawn from any target well for the aquifer being evaluated or overlying aquifers (as specified in section 3.0) is used for one or more of the following purposes:

• Irrigation (5-acre minimum) of commercial food crops or commercial forage crops.

• Watering of commercial livestock.

• Ingredient in commercial food preparation.

• Supply for commercial aquaculture.

• Supply for a major or designated water recreation area, excluding drinking water use.

Assign a resources value of 5 if no drinking water wells are within the target distance limit, but the water in the aquifer being evaluated or any overlying aquifers (as specified in section 3.0) is usable for drinking water purposes.

Assign a resources value of 0 if none of the above applies.

3.3.4 *Wellhead Protection Area.* Evaluate the Wellhead Protection Area factor based on Wellhead Protection Areas designated according to section 1428 of the Safe Drinking Water Act, as amended. Consider only those Wellhead Protection Areas applicable to the aquifer being evaluated or overlying aquifers (as specified in section 3.0). Select the highest value below that applies. Assign it as the value for the Wellhead Protection Area factor for the aquifer being evaluated. Enter this value in Table 3–1.

Assign a value of 20 if either of the following criteria applies for the aquifer being evaluated or overlying aquifers:

• A source with a ground water containment factor value greater than 0 lies, either partially or fully, within or above the designated Wellhead Protection Area.

• Observed ground water contamination attributable to the sources at the site lies, either partially or fully, within the designated Wellhead Protection Area.

If neither criterion applies, assign a value of 3, if, within the target distance limit, there is a designated Wellhead Protection Area applicable to the aquifer being evaluated or overlying aquifers.

Assign a value of 0 if none of the above applies.

3.3.5 *Calculation of targets factor category value.* Sum the factor values for nearest well, population, resources, and Wellhead Protection Area. Do not round this sum to the nearest integer. Use this sum as the targets factor category value for the aquifer. Enter this value in Table 3–1.

3.4 *Ground water migration score for an aquifer.* For the aquifer being evaluated, multiply the factor category values for likelihood of release, waste characteristics, and targets, and round the product to the nearest integer. Then divide by 82,500. Assign the resulting value, subject to a maximum value of 100, as the ground water migration pathway score for the aquifer. Enter this score in Table 3–1.

3.5 *Calculation of ground water migration pathway score.* Calculate a ground water migration score for each aquifer underlying the sources at the site, as appropriate. Assign the highest ground water migration score for an aquifer as the ground water migration pathway score (S_{gw}) for the site. Enter this score in Table 3–1.

4.0 *Surface Water Migration Pathway.*

4.0.1 *Migration components.* Evaluate the surface water migration pathway based on two migration components:

• Overland/flood migration to surface water (see section 4.1).

• Ground water to surface water migration (see section 4.2).

Evaluate each component based on the same three threats: drinking water threat, human food chain threat, and environmental threat.

Score one or both components, considering their relative importance. If only one component is scored, assign its score as the surface water migration pathway score. If

12 of 13

2 of 2

Table 6. Household, Family, and Group Quarters Characteristics: 1990

For explanation of terms and meanings of symbols, see text

State / County / Place and (In Selected States) County Subdivision	Persons in households	All households	Family households: Total	Married-couple family	Female householder, no husband present	Nonfamily households: Total	Householder living alone: Total	65 years and over: Total	65 years and over: Female	Persons per— Household	Family	Persons in group quarters: Total	Institutionalized persons	Other in group quarters
The State	7 558 828	2 794 711	2 021 346	1 578 782	338 485	773 365	646 171	273 736	213 511	2.70	3.21	171 368	92 630	78 4
COUNTY														
Atlantic County	218 321	85 123	56 576	41 202	11 647	28 547	22 646	9 598	7 302	2.56	3.13	6 006	3 014	2
Bergen County	816 230	308 880	225 188	186 258	29 139	83 692	71 606	30 959	24 491	2.64	3.14	9 150	5 485	3
Burlington County	380 910	136 554	104 190	85 741	14 015	32 364	26 746	9 309	7 303	2.79	3.23	14 156	7 068	7
Camden County	493 933	178 758	129 568	96 405	26 205	49 190	41 328	16 352	12 633	2.76	3.28	8 891	6 812	2
Cape May County	92 414	37 856	25 667	20 592	3 882	12 189	10 406	5 510	4 206	2.44	2.98	2 675	1 839	
Cumberland County	131 455	47 118	34 946	25 318	7 429	12 152	10 191	5 060	3 961	2.79	3.24	6 598	6 047	
Essex County	759 590	278 752	191 363	124 659	53 401	87 389	75 440	30 077	23 011	2.72	3.22	18 616	8 353	10
Gloucester County	225 971	78 845	60 808	49 629	8 453	18 037	14 875	5 940	4 586	2.87	3.30	4 111	1 712	2
Hudson County	546 160	208 739	136 143	90 508	34 343	72 596	59 931	22 921	17 406	2.62	3.26	6 939	3 561	3
Hunterdon County	104 438	37 906	29 295	25 953	2 371	8 611	6 770	2 349	1 842	2.76	3.16	3 338	3 260	
Mercer County	309 804	116 941	82 447	62 715	15 448	34 494	28 277	11 589	8 976	2.65	3.16	16 020	5 802	10
Middlesex County	848 111	238 833	175 451	143 344	23 886	63 382	50 903	19 029	14 955	2.71	3.18	23 669	7 926	15
Monmouth County	541 950	197 570	145 892	120 609	19 442	51 678	43 434	19 373	15 332	2.74	3.24	11 174	5 904	5
Morris County	413 680	148 751	113 074	96 850	11 923	35 677	28 312	9 742	7 749	2.78	3.21	7 673	4 164	3
Ocean County	426 852	168 147	120 783	102 028	14 443	47 364	41 879	27 121	21 674	2.54	3.04	6 351	4 529	1
Passaic County	442 797	155 269	115 135	84 917	22 753	40 134	33 677	15 585	12 133	2.85	3.33	10 263	5 321	4
Salem County	63 765	23 794	17 645	13 780	3 017	6 149	5 329	2 579	1 924	2.68	3.15	1 529	1 337	
Somerset County	235 585	88 346	65 368	55 575	7 231	22 978	18 182	5 351	4 165	2.67	3.11	4 694	4 204	
Sussex County	129 218	44 456	35 516	30 810	3 379	8 940	7 193	2 768	2 167	2.91	3.28	1 225	1 223	
Union County	497 238	188 072	131 265	101 002	22 956	48 816	41 475	19 046	14 963	2.71	3.19	6 581	3 884	2
Warren County	90 398	33 997	25 011	20 807	3 090	8 986	7 551	3 478	2 732	2.66	3.14	1 209	784	
PLACE AND COUNTY SUBDIVISION														
Aberdeen township, Monmouth County	6 896	5 905	4 617	3 873	555	1 288	1 038	250	185	2.36	3.27	142	129	
Absecon city, Atlantic County	7 144	2 579	2 009	659	262	570	454	209	67	2.77	3.14	154	140	
Alexandria township, Hunterdon County	3 531	1 203	916	722	65	287	246	55	35	2.94	3.21	63	63	
Allamuchy township, Warren County	3 448	1 471	1 033	904	29	438	371	97	77	2.34	2.81	36	-	
Allamuchy-Panther Valley CDP, Warren County	2 728	1 232	843	750	72	389	332	82	65	2.21	2.69	36	-	
Allendale borough, Bergen County	5 709	1 859	1 603	1 439	128	256	197	69	59	3.07	3.31	191	191	
Allenhurst borough, Monmouth County	759	298	208	174	27	90	79	38	28	2.55	3.11	-	-	
Allentown borough, Monmouth County	1 828	655	519	427	73	136	107	26	21	2.79	3.13	-	-	
Alloway CDP, Salem County	1 335	473	382	329	27	91	86	46	33	2.82	3.18	36	36	
Alloway township, Salem County	2 759	956	774	664	80	182	162	81	51	2.89	3.24	36	36	
Alpha borough, Warren County	2 530	967	729	590	110	238	199	104	87	2.62	3.03	-	-	
Alpine borough, Bergen County	1 716	534	482	442	27	52	39	17	15	3.21	3.33	-	-	
Andover borough, Sussex County	700	261	181	149	24	80	61	15	15	2.68	3.23	-	-	
Andover township, Sussex County	4 747	1 695	1 337	1 162	126	358	280	81	64	2.80	3.16	691	679	
Annandale CDP, Hunterdon County	1 074	390	300	262	27	90	74	36	28	2.75	3.16	-	-	
Asbury Park city, Monmouth County	16 277	6 871	3 584	1 662	1 611	3 287	2 836	1 357	1 075	2.37	3.28	522	28	
Atlantic City city, Atlantic County	36 225	15 731	8 183	3 713	3 584	7 548	6 391	3 022	2 201	2.30	3.13	1 761	934	
Atlantic Highlands borough, Monmouth County	4 629	1 774	1 267	1 021	181	507	415	186	142	2.61	3.11	-	-	
Audubon borough, Camden County	9 205	3 622	2 433	1 952	373	1 189	1 031	521	421	2.54	3.17	-	-	
Audubon Park borough, Camden County	1 150	498	346	237	92	152	143	97	81	2.31	2.83	-	-	
Avalon borough, Cape May County	1 809	838	545	468	61	293	253	135	111	2.16	2.68	-	-	
Avenel CDP, Middlesex County	12 212	4 854	3 420	2 719	524	1 434	1 200	400	280	2.52	3.02	3 292	3 261	
Avon-by-the-Sea borough, Monmouth County	2 141	989	555	447	90	434	384	200	159	2.16	2.94	24	-	
Barnegat CDP, Ocean County	1 160	424	311	248	47	113	90	48	34	2.74	3.22	-	-	
Barnegat township, Ocean County	12 120	4 163	3 343	2 838	289	820	695	372	277	2.91	3.29	115	115	
Barnegat Light borough, Ocean County	657	330	198	173	19	132	121	56	37	1.99	2.55	18	-	
Barrington borough, Camden County	6 774	2 688	1 863	1 499	295	825	709	235	172	2.52	3.08	-	-	
Bass River township, Burlington County	1 580	554	435	361	56	119	98	44	38	2.85	3.25	-	-	
Bay Head borough, Ocean County	1 226	530	364	293	59	166	147	73	51	2.31	2.81	-	-	
Bayonne city, Hudson County	61 191	25 309	16 528	11 956	3 475	8 781	7 955	3 958	3 084	2.42	3.06	253	-	
Beach Haven borough, Ocean County	1 440	629	421	344	61	238	206	112	90	2.22	2.78	15	-	
Beach Haven West CDP, Ocean County	4 237	1 832	1 286	1 090	154	546	475	193	129	2.31	2.76	-	-	
Beachwood borough, Ocean County	9 324	3 047	2 476	2 035	339	571	461	207	162	3.06	3.42	-	-	
Beattystown CDP, Warren County	3 966	1 679	1 077	880	148	602	467	81	61	2.36	2.94	-	-	
Beckett CDP, Gloucester County	3 815	1 188	1 046	950	65	142	107	7	5	3.21	3.46	-	-	
Bedminster township, Somerset County	7 086	3 447	1 991	1 654	272	1 456	1 225	118	94	2.06	2.66	-	-	
Belleville CDP, Essex County	34 123	13 374	9 193	6 964	1 637	4 181	3 575	1 245	951	2.55	3.13	90	13	
Belleville township, Essex County	34 123	13 374	9 193	6 964	1 637	4 181	3 575	1 245	951	2.55	3.13	90	13	
Bellmawr borough, Camden County	12 623	4 679	3 531	2 732	610	1 148	968	404	307	2.69	3.13	-	-	
Belmar borough, Monmouth County	5 851	2 718	1 381	1 009	265	1 337	1 084	404	314	2.15	2.94	26	-	
Belvidere town, Warren County	2 663	1 027	728	596	100	299	247	113	96	2.59	3.09	6	-	
Bergenfield borough, Bergen County	24 417	8 799	6 733	5 462	932	2 066	1 741	919	729	2.77	3.21	41	-	
Berkeley township, Ocean County	36 794	17 614	12 394	11 076	997	5 220	4 928	4 023	3 227	2.09	2.50	525	518	
Berkeley Heights township, Union County	11 540	3 860	3 325	3 017	220	535	414	181	129	2.99	3.22	440	402	
Berkeley Heights CDP, Union County	11 540	3 860	3 325	3 017	220	535	414	181	129	2.99	3.22	440	402	
Berlin borough, Camden County	5 672	1 950	1 502	1 265	179	448	373	167	130	2.91	3.35	-	-	
Berlin township, Camden County	5 453	1 777	1 432	1 151	202	345	275	97	72	3.07	3.42	13	-	
Bernards township, Somerset County	16 146	6 345	4 608	4 160	327	1 737	1 432	425	356	2.54	3.02	1 053	1 007	
Bernardsville borough, Somerset County	6 546	2 469	1 843	1 617	164	606	496	202	163	2.67	3.07	51	51	
Bethlehem township, Hunterdon County	3 104	1 033	882	803	51	151	115	34	29	3.00	3.26	-	-	
Beverly city, Burlington County	2 973	1 011	753	510	197	258	207	89	68	2.94	3.42	-	-	
Blackwood CDP, Camden County	5 101	1 835	1 380	1 098	211	455	374	157	104	2.78	3.22	19	-	
Blairstown township, Warren County	5 331	1 773	1 474	1 328	112	299	251	128	90	3.01	3.33	-	-	
Bloomfield CDP, Essex County	44 633	18 455	11 857	9 258	1 970	6 598	5 675	2 490	1 993	2.42	3.07	428	164	
Bloomfield township, Essex County	44 633	18 455	11 857	9 258	1 970	6 598	5 675	2 490	1 993	2.42	3.07	428	164	
Bloomingdale borough, Passaic County	7 530	2 747	2 094	1 763	248	653	507	169	128	2.74	3.15	-	-	
Bloomsbury borough, Hunterdon County	890	330	255	227	18	75	62	23	18	2.70	3.11	-	-	
Bogota borough, Bergen County	7 811	2 777	2 079	1 674	312	698	582	213	169	2.81	3.31	13	11	
Boonton town, Morris County	8 198	3 121	2 127	1 665	356	994	737	315	250	2.63	3.15	145	97	
Boonton township, Morris County	3 440	1 241	1 006	893	32	235	185	82	57	2.77	3.10	126	126	
Bordentown city, Burlington County	4 297	1 784	1 148	809	258	636	543	205	149	2.41	3.02	44	-	
Bordentown township, Burlington County	7 334	2 857	2 024	1 683	256	833	678	207	154	2.57	3.08	349	115	
Bound Brook borough, Somerset County	9 475	3 675	2 490	1 913	422	1 185	945	369	293	2.58	3.10	12	-	
Bradley Beach borough, Monmouth County	4 465	2 009	1 086	778	230	923	731	248	198	2.22	2.96	10	-	
Branchburg township, Somerset County	10 885	3 744	3 080	2 799	193	664	522	151	115	2.91	3.23	3	-	
Branchville borough, Sussex County	851	354	241	193	34	113	97	52	40	2.40	2.90	-	-	
Brass Castle CDP, Warren County	1 419	477	403	374	17	74	67	44	31	2.77	3.28	-	-	
Brick township, Ocean County	66 170	24 965	18 729	15 810	2 259	6 236	5 338	2 855	2 274	2.65	3.10	303	286	
Brick township CDP, Ocean County	66 170	24 965	18 729	15 810	2 259	6 236	5 338	2 855	2 274	2.65	3.10	303	286	
Bridgeton city, Cumberland County	18 288	6 725	4 640	2 674	1 621	2 085	1 802	937	738	2.72	3.30	654	625	

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REFERENCE NO. 22

MALCOLM PIRNIE, INC.	PROJECT NOTES

To: File	**Date:** December 7, 1994
From: Lisa Greco	**Project #:** 8003-368
Subject: Surface Water	**Site Name:** Jerry Jones Mack Truck

The following documents consist of project notes and telecon notes for the surface water pathway.

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Bob Riser/USGS

PHONE NO.: (609) 771-3900
DATE: 10/28/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 14:40 PM

SUBJECT: Flow Rate of the Beaver Brook

PROJECT NO.: NAE62070.07.01

Talk with Bob River of the USGS. There is a flow meter at the beginning of the Beaver Brook near the Splitrock Reservoir. He will do an estimate of the flow of the Beaver Brook at approximately 3/4 of a mile north of Route 80. The USGS will get back to me during the week of the 31st of October.

Bob Riser called back at 10:00 on 10-31-94. The estimated flow rate for the Beaver Brook is 19 CFS.

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Malcolm Pirnie, Inc../Lisa Zigetti

PHONE NO.: (609) 860-0100
DATE: 10/27/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 09:45 AM

SUBJECT: Surface Water Flows

PROJECT NO.: NAE62070.07.01

Lisa gave me the surface water flows for surface water affected by the New Jersey Jones Mack Truck Site:

1. Beaver Brook-not listed; call Bob Riser or estimate
2. Rockaway River-above Reservoir at Boonton - 231 CFS

   below Reservoir at Boonton - 135 CFS
3. Jersey City Reservoir-use flow of streams going into reservoir.

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Glen Walling/Asst. Super./J.C.W.W.

PHONE NO.: (201) 263-1633
DATE: 10/25/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 11:40 AM

SUBJECT: Jersey City Water Works

PROJECT NO.: NAE62070.07.01

Mr. Walling informed me that the Jersey City Water Works operates a single surface water intake at Greenback Road dam on the ~~Boonton~~ Reservoir. The intake supplies an estimated 200,000 people with drinking water. The towns that are served are Jersey City, Hoboken, West Caldwell, Lyndhurst, North Arlington, and Clifton. The water works withdraws approximately 50 million gallons per day from the reservoir.

Jersey City

~~Rob 11-29-94~~

CH2M HILL TELEPHONE CONVERSATION RECORD

CALL TO: Rockaway Township Recreation Department

PHONE NO.: (201) 983-2841

DATE: 11/14/94

CALL FROM: Rob MacEwen/CH2M HILL

TIME: 13:20 PM

SUBJECT: Fishing in the Beaver Brook

PROJECT NO.: NAE62070.07.01

The Beaver Brook is stocked with trout and is a legal fishery.

ARCS II CONTRACT 68-W9-0051
MALCOLM PIRNIE, INC.
RECORD OF TELEPHONE CONVERSATION/AGREEMENT

File No. 8003-184

Date: March 19, 1993 Time: 1:46 AM [ ] PM [X]

Call

To: Bob Soldwedel, Bureau Chief (609) 292-8642 Telephone No.

Affiliation: NJDEPE Fisheries

Malcolm Pirnie Staff: David Kahlenberg DK (609) 860-0100 Telephone No.

Summary of Conversation:

I spoke with the fisheries department to determine where the nearest fishing location would be to the site. I was told that the Rockaway River is stocked with trout at several locations and also contains many other types of fish. One of the stocking locations is located below the Jackson Avenue Park Bridge by a small dam there. There is also quite a bit of sport fishing at this area of the river. In addition, the consumption of fish from the fishing activities does occur.

PROJECT NOTES

CH2M HILL

TO: File

FROM: Rob MacEwen/CH2M HILL

DATE: November 2, 1994

SUBJECT: Wetland Frontage Calculations

PROJECT: NAE62030.07.01

SITE NAME: Jerry Jones Mack Truck

Beaver Brook - 0-2.0 miles	1.6 miles of wetlands
Rockaway River (before reservoir) 2.1-11.5 miles	5.9 miles of wetlands
J.C. Reservoir 11.6-12.5 miles	0.5 miles of wetlands
Rockaway River (after reservoir) 12.6-15 miles	2.5 miles of wetlands

REFERENCE NO. 23

0038C
02-9101-03

NUS CORPORATION AND SUBSIDIARIES — **TELECON NOTE**

CONTROL NO.:	DATE: 5/8/91	TIME: 1054

DISTRIBUTION:

BETWEEN:	OF:	PHONE:
Gerald F. Jones, Jr.	Jerry Jones Made Trad	(201) 625-3330

AND: JESS TECSON (NUS)

DISCUSSION:

Mr. Jones returned my call.

—

I requested additional information about the tanks.

- the 275 gallon tank is located beneath the service area building. (no longer used)
- the 1000 gallon tank reported in the NJDEP memo (JAN. 8, 1985) is the dry-well. It is also the same ~~tank~~ tank where steam-waste was deposited. As currently reported it is no longer ~~in~~ used.
- the 275 gallon tank was tested & in good condition
- there are currently 40 full time employees ~~at~~ the facility.

ACTION ITEMS:

5/8/91

NUS 067 REVISED 0685

REFERENCE NO. 24

date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program at (800) 638-6620, or (800) 424-8872.

APPROXIMATE SCALE

1000 0 1000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

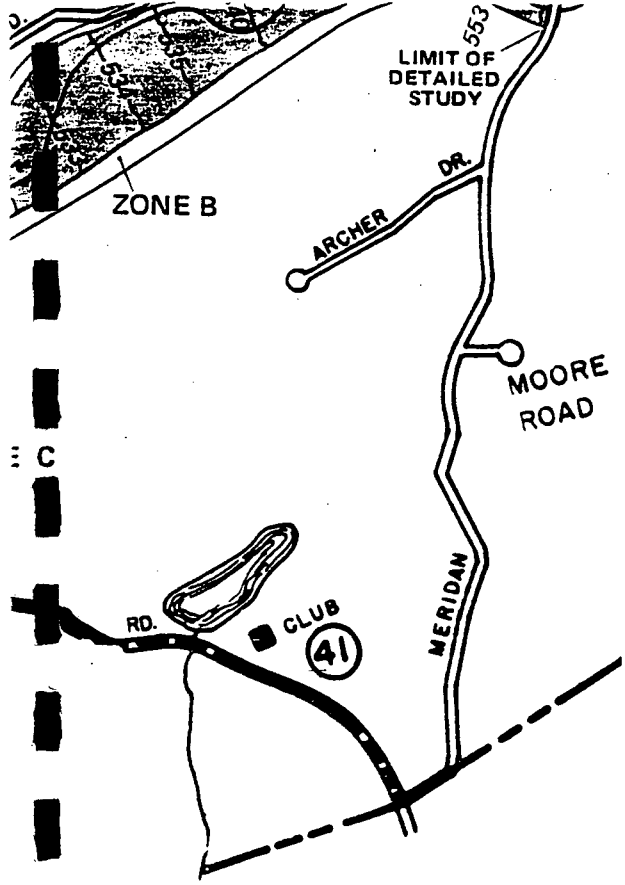
TOWNSHIP OF
ROCKAWAY,
NEW JERSEY
MORRIS COUNTY

PANEL 20 OF 25
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
340360 0020 A

EFFECTIVE DATE:
NOVEMBER 15, 1979

U.S. DEPARTMENT OF HOUSING
AND URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION



For adjoining map panels, see separately printed Index to Map Panels.

INITIAL IDENTIFICATION:

JANUARY 4, 1974

FLOOD HAZARD BOUNDARY MAP REVISIONS:

FLOOD INSURANCE RATE MAP EFFECTIVE:

NOVEMBER 15, 1979

FLOOD INSURANCE RATE MAP REVISIONS:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program at (800) 638-6620, or (800) 424-8872.

APPROXIMATE SCALE

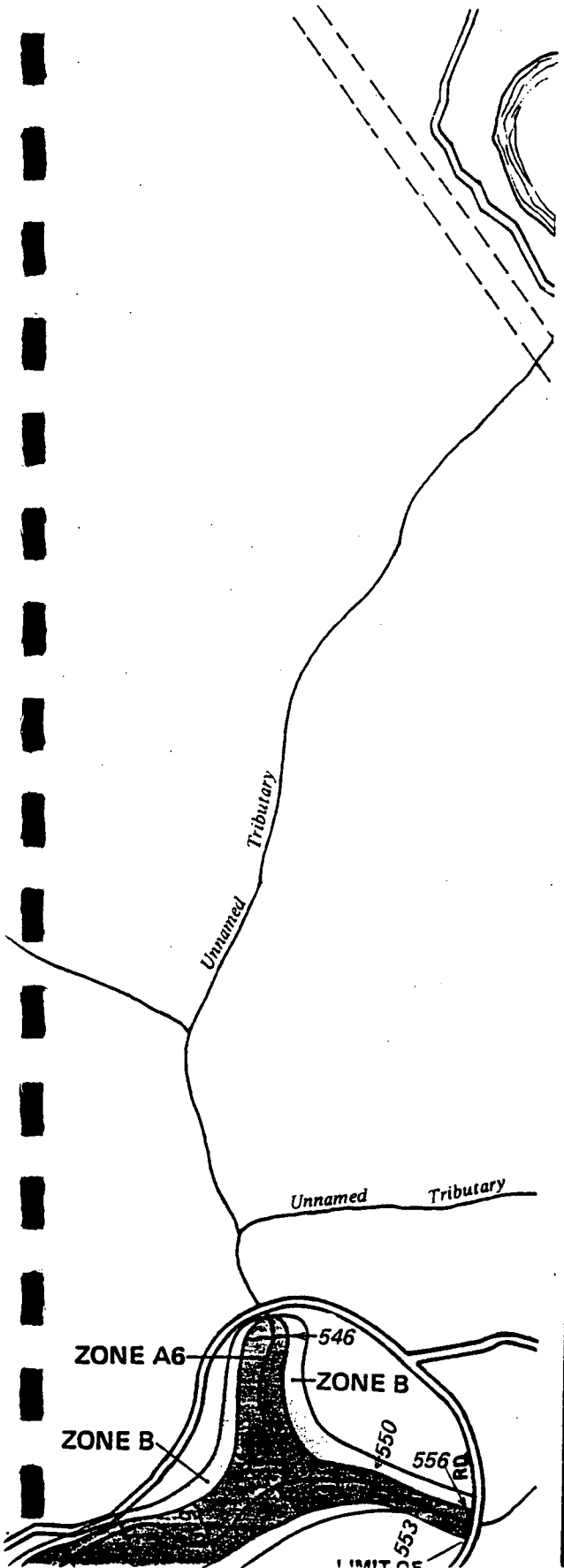
1000 0 1000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

TOWNSHIP OF ROCKAWAY.



KEY TO MAP

500-Year Flood Boundary	
100-Year Flood Boundary	ZONE B
Zone Designations* With Date of Identification e.g., 12/2/74	ZONE A6 DATE / ZONE A6 DATE
100-Year Flood Boundary	
500-Year Flood Boundary	ZONE B
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7 ×
River Mile	• M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

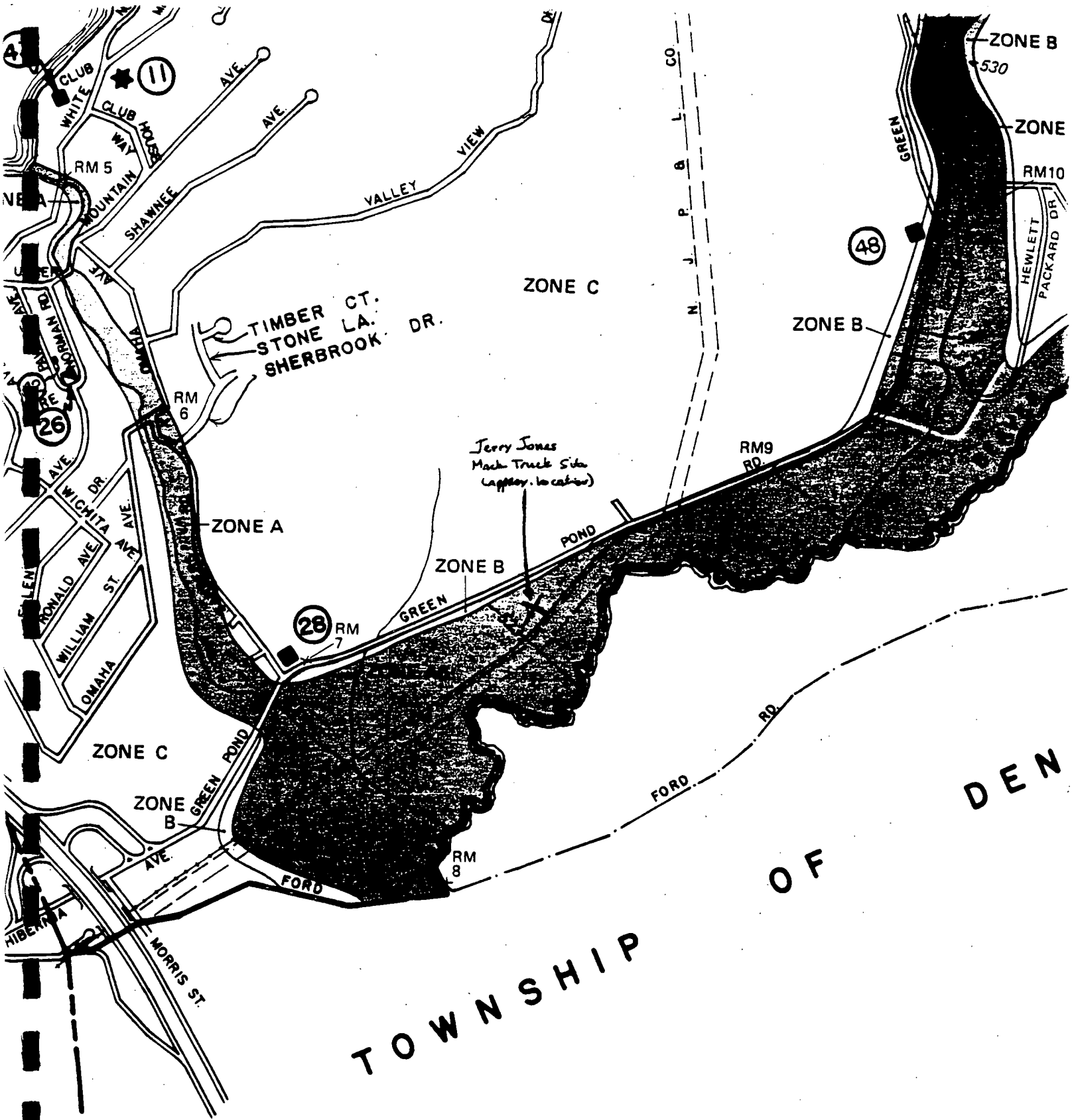
ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
AO	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To Map Panels.



REFER
MAF
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4 of 4

REFERENCE NO. 25

FROST ASSOCIATES

P.O. Box 495, Essex, Connecticut 06426
(203) 767-7644 Fax (203) 767-1971

Sep 28, 1994

o: Lilli Gonzalez
Malcolm Pirnie Inc
104 Interchange Plaza
Cranbury, New Jersey 08512-8543

r: Bob Frost
Frost Associates
P.O. Box 495
Essex, Conn 06426

Tel: (203) 767-1254
ax: (203) 767-7069

Sub: Jerry Jones Mack Truck
Rockaway, NJ

ERCLIS:

Job: 8003-386-701

ite Longitude: 74-29-40 74.494453
Site Latitude : 40-55-01 40.916939

he CENTRACTS report below identifies the population, households, and private water wells of each Block Group that lies within, or partially within, the 4, 3, 2, 1, .5, and .25, mile "rings" of the latitude and longitude coordinates above. CENTRACTS may ave up to ten radii of any length. 1000 block groups, and 15000 block group sides.

CENTRACTS uses the 1990 Block Group population and Block Group house count data found in the Census Bureau's 1990 STF-1A files. The sources of water supply data are from he Bureau's 1990 STF-3A files. The boundary line coordinates of the Block Groups ere extracted from the Census Bureau's 1990 TIGER/Line Files.

CENTRACTS reports are created with programs written by Frost Associates, P.O. Box 495, Essex, Conn. The code was written using Microsoft's Quick-Basic Ver. 4.5.

Latitude and Longitude coordinates identifying a site are entered in degrees and decimal degrees. One or more county files holding Block Group boundary lines are selected for use by CENTRACTS by determining whether the site coordinates fall within the minimum and maximum Lat\Lon coordinates of each county in the state.

Each Block Group line segment has Lat\Lon coordinates representing the "From" and "To" ends of that line. All coordinates from the selected county files are read and converted from degrees, decimal degrees to X\Y miles from the site location. Each line segment is then examined whether it lies within or partially within the maximum ring from the site.

The unique Block Group ID numbers of each line segment that lie within the maximum ring are retained. All Block Group boundary lines matching the Block Group numbers are then extracted from the respective county files to obtain all sides of the included Block Groups. Boundary records are then sorted in adjacent side order to determine the shape and area of each Block Group polygon.

A method to solve for the area of a polygon is to take one-half the sum of the products obtained by multiplying each X-coordinate by the difference between the adja-

cent Y-coordinates. For a polygon with coordinates at adjacent angles A, B, C, D, and E. The formula can be expressed:

$$\text{Area} = 1/2\{Xa(Ye-Yb)+ Xb(Ya-Yb)+ Xc(Yb-Yd)+ Xd(Yc-Ye)+ Xe(Yd-Ya)\}$$

For each ring, the selected Block Groups will be inside, outside, or intersected by the ring. When a polygon is intersected, the partial Block Group area within that ring is calculated using the method described below.

When a ring intersects a Block Group, the intersect points are solved and plotted at the points where the ring enters and exits the shape. The chord line, a line within the circle connecting the intersect points is determined. This chord line is used to calculate the segment area, the half moon shape between the chord line and the ring, and the sub-polygon created by the chord line and the Block Group boundaries that lie outside the ring.

The segment area is subtracted from the sub-polygon area to determine the area of the sub-polygon outside the ring. The area outside the ring is then subtracted from the area of the entire polygon to arrive at the inside area. This inside area is then divided by the tract's total area to determine the percentage of area within the ring. This process is repeated for each block group that is intersected by one of the rings. The total area, partial area, and percentage of partial area of those block groups within, or partially within a ring, are held in memory for the report.

On occasion, the algorithm described above is unable to determine the area of the partial area. Within the report program is a "Paint" routine which allows an enclosed shape to be highlighted. Another routine calculates the percentage of highlighted screen pixels to the pixels within the polygon. A manual entry is allowed. Both the "paint" method and manual entry method over ride the calculated method.

CENTRACTS lists, starting on page 4, all Block Groups in State, County, Census Tract, and Block Group ID order that lie within, or partially within, the maximum ring. Each Block Group is identified by a City or Town name and by the Block Group's State, County, Tract and Block Group ID number. Following is the Block Group's 1990 populu tion and house count extracted from the Census Bureau's 1990 STF-1A files.

The next four columns display water source data from the 1990 STF-3A files. The first column is "Units with Public system or private company source of water", followed by "Units with individual well, Drilled, source of water"; "Units with individual well, Dug, source of water" and "Units with Other source of water".

For each ring, CENTRACTS then shows the Block Groups that are within that ring, the Block Group's total area in square miles, the partial area of the Block Group within that ring, and the partial percentage within the ring. The areas of the included Block Group and the partial areas are then totaled.

The last section tallies the demographic data within each ring. The percentage of area for each Block Group is multiplied times the census data for that Block Group and totaled for all Block Group's within the ring. Ring totals are then determined by subtracting the three mile data from the four mile, the two mile from the three mile, one from the two, etc... Population on private wells is calculated using the formula: ((Drilled + Dug Wells) / Households) * Population

Jerry Jones Mack Truck
Rockaway, NJ

No.	City	Block Group ID	Blk Grp People	House Holds	Public Water	Drilled Wells	Dug Wells	Other
1	Boonton	34027 0409 1	1725	630	254	324	35	0
2	Boonton	34027 0409 9	1834	667	139	488	53	0
3	Boonton	34027 0411 2	1155	440	456	0	0	0
4	Boonton	34027 0411 3	1242	487	498	0	0	5
5	Mountain Lakes	34027 0412 1	936	302	300	5	0	0
6	Mountain Lakes	34027 0412 2	1275	429	430	0	0	0
7	Mountain Lakes	34027 0412 3	1189	383	367	0	0	0
8	Mountain Lakes	34027 0412 4	447	154	166	0	0	0
9	Denville	34027 0413 1	575	212	202	7	0	5
10	Denville	34027 0413 2	764	302	279	15	0	6
11	Denville	34027 0413 3	515	248	270	0	0	0
12	Denville	34027 0413 7	638	203	205	0	4	0
13	Denville	34027 0413 9	1754	619	477	108	0	6
14	Denville	34027 0414 1	392	180	169	0	0	0
15	Denville	34027 0414 2	1711	649	651	0	0	0
16	Denville	34027 0414 3	644	261	298	0	0	0
17	Denville	34027 0414 4	730	283	277	0	0	0
18	Denville	34027 0414 5	2035	731	700	9	0	0
19	Denville	34027 0415 1	1069	409	439	0	0	0
20	Denville	34027 0415 2	1435	472	448	12	0	6
21	Denville	34027 0415 9	1550	490	361	105	0	0
22	Rockaway	34027 0443 1	843	295	276	14	0	0
23	Rockaway	34027 0443 2	1220	475	476	0	0	0
24	Rockaway	34027 0443 3	1515	659	668	0	0	0
25	Rockaway	34027 0443 4	1868	638	651	0	0	0
26	Rockaway	34027 0443 5	797	288	270	0	0	0
27	Dover	34027 0448 1	850	277	252	0	0	0
28	Dover	34027 0448 2	2251	788	804	0	0	0
29	Dover	34027 0448 3	995	316	334	0	0	0
30	Dover	34027 0448 4	1179	390	402	0	0	0
31	Dover	34027 0448 5	646	220	199	0	0	0
32	Dover	34027 0449 1	1359	473	454	0	0	0
33	Dover	34027 0450 1	542	187	181	0	0	0
34	Dover	34027 0450 2	1800	714	741	13	0	0
35	Dover	34027 0450 3	1116	354	343	0	0	6
36	Dover	34027 0450 4	907	421	385	7	0	0
37	Wharton	34027 0451 1	1215	582	634	10	0	0
38	Wharton	34027 0451 2	1043	407	370	45	0	0
39	Parsippany-Troy	34027 0416017	1415	528	488	0	0	5
40	Parsippany-Troy	34027 0416018	2290	1256	1224	18	6	0
41	Parsippany-Troy	34027 0416019	1398	336	308	64	7	0
42	Parsippany-Troy	34027 0416021	1304	517	517	0	0	0
43	Parsippany-Troy	34027 0416022	127	49	48	0	0	0
44	Parsippany-Troy	34027 0416023	348	130	134	0	0	0
45	Parsippany-Troy	34027 0416024	472	171	160	0	0	0
46	Parsippany-Troy	34027 0416029	669	221	224	5	0	0
47	Parsippany-Troy	34027 0416031	1764	607	556	0	0	0
48	Parsippany-Troy	34027 0416049	2629	842	837	0	0	0
49	Rockaway	34027 0444011	1121	429	19	378	29	0
50	Rockaway	34027 0444019	3072	1363	73	1160	122	11
51	Rockaway	34027 0444021	550	187	166	20	0	0
52	Rockaway	34027 0444022	1185	400	401	0	0	0
53	Rockaway	34027 0444023	2082	764	789	7	0	0
54	Rockaway	34027 0444024	977	337	339	0	0	0

Jerry Jones Mack Truck
Rockaway, NJ

55	Rockaway	34027	0444025	1851	612	589	0	0	0
56	Rockaway	34027	0444026	1357	469	448	10	0	0
57	Rockaway	34027	0445011	1714	663	557	83	21	0
58	Rockaway	34027	0445012	132	44	38	0	0	0
59	Rockaway	34027	0445017	839	441	402	5	0	0
60	Rockaway	34027	0445019	955	434	392	77	0	7
61	Rockaway	34027	0445021	305	123	141	8	0	0
62	Rockaway	34027	0445022	1168	442	436	11	0	0
63	Rockaway	34027	0445023	1338	446	434	0	0	0
64	Rockaway	34027	0445026	926	323	273	31	0	0
65	Victory Gardens	34027	0456011	1322	547	538	5	0	0
66	Randolph	34027	0456021	107	40	38	7	0	0
67	Randolph	34027	0456029	1768	567	310	260	18	0
====	==========	==========		======	======	======	======	======	
	Totals:			78946	29323	25705	3311	295	57

Jerry Jones Mack Truck
Rockaway, NJ

City	Census Tract ID		Tract People	House Count	Public Water	Drilled Wells	Dug Wells	Other Wells
Boonton	34027 0409	1	1725	630	254	324	35	0
Boonton	34027 0409	9	1834	667	139	488	53	0
Boonton	34027 0411	2	1155	440	456	0	0	0
Boonton	34027 0411	3	1242	487	498	0	0	5
	Sub Totals:		5956	2224	1347	812	88	5
Denville	34027 0415	9	1550	490	361	105	0	0
Denville	34027 0414	1	392	180	169	0	0	0
Denville	34027 0414	2	1711	649	651	0	0	0
Denville	34027 0414	3	644	261	298	0	0	0
Denville	34027 0413	1	575	212	202	7	0	5
Denville	34027 0413	2	764	302	279	15	0	6
Denville	34027 0413	3	515	248	270	0	0	0
Denville	34027 0413	7	638	203	205	0	4	0
Denville	34027 0413	9	1754	619	477	108	0	6
Denville	34027 0414	5	2035	731	700	9	0	0
Denville	34027 0415	1	1069	409	439	0	0	0
Denville	34027 0415	2	1435	472	448	12	0	6
Denville	34027 0414	4	730	283	277	0	0	0
	Sub Totals:		13812	5059	4776	256	4	23
Dover	34027 0448	4	1179	390	402	0	0	0
Dover	34027 0448	5	646	220	199	0	0	0
Dover	34027 0449	1	1359	473	454	0	0	0
Dover	34027 0448	3	995	316	334	0	0	0
Dover	34027 0450	2	1800	714	741	13	0	0
Dover	34027 0448	1	850	277	252	0	0	0
Dover	34027 0448	2	2251	788	804	0	0	0
Dover	34027 0450	1	542	187	181	0	0	0
Dover	34027 0450	4	907	421	385	7	0	0
Dover	34027 0450	3	1116	354	343	0	0	6
	Sub Totals:		11645	4140	4095	20	0	6
Mountain Lakes	34027 0412	2	1275	429	430	0	0	0
Mountain Lakes	34027 0412	1	936	302	300	5	0	0
Mountain Lakes	34027 0412	4	447	154	166	0	0	0
Mountain Lakes	34027 0412	3	1189	383	367	0	0	0
	Sub Totals:		3847	1268	1263	5	0	0
Parsippany-Troy	34027 0416029		669	221	224	5	0	0
Parsippany-Troy	34027 0416019		1398	336	308	64	7	0
Parsippany-Troy	34027 0416021		1304	517	517	0	0	0
Parsippany-Troy	34027 0416017		1415	528	488	0	0	5
Parsippany-Troy	34027 0416018		2290	1256	1224	18	6	0
Parsippany-Troy	34027 0416024		472	171	160	0	0	0
Parsippany-Troy	34027 0416049		2629	842	837	0	0	0
Parsippany-Troy	34027 0416031		1764	607	556	0	0	0
Parsippany-Troy	34027 0416023		348	130	134	0	0	0
Parsippany-Troy	34027 0416022		127	49	48	0	0	0
	Sub Totals:		12416	4657	4496	87	13	5

Jerry Jones Mack Truck
Rockaway, NJ

Randolph	34027 0456021	107	40	38	7	0	0
Randolph	34027 0456029	1768	567	310	260	18	0
	Sub Totals:	1875	607	348	267	18	0
Rockaway	34027 0443 1	843	295	276	14	0	0
Rockaway	34027 0443 4	1868	638	651	0	0	0
Rockaway	34027 0444024	977	337	339	0	0	0
Rockaway	34027 0444023	2082	764	789	7	0	0
Rockaway	34027 0443 3	1515	659	668	0	0	0
Rockaway	34027 0444011	1121	429	19	378	29	0
Rockaway	34027 0443 5	797	288	270	0	0	0
Rockaway	34027 0443 2	1220	475	476	0	0	0
Rockaway	34027 0444022	1185	400	401	0	0	0
Rockaway	34027 0445021	305	123	141	8	0	0
Rockaway	34027 0445022	1168	442	436	11	0	0
Rockaway	34027 0444025	1851	612	589	0	0	0
Rockaway	34027 0444026	1357	469	448	10	0	0
Rockaway	34027 0445011	1714	663	557	83	21	0
Rockaway	34027 0445012	132	44	38	0	0	0
Rockaway	34027 0445017	839	441	402	5	0	0
Rockaway	34027 0445019	955	434	392	77	0	7
Rockaway	34027 0445023	1338	446	434	0	0	0
Rockaway	34027 0444019	3072	1363	73	1160	122	11
Rockaway	34027 0444021	550	187	166	20	0	0
Rockaway	34027 0445026	926	323	273	31	0	0
	Sub Totals:	25815	9832	7838	1804	172	18
Victory Gardens	34027 0456011	1322	547	538	5	0	0
	Sub Totals:	1322	547	538	5	0	0
Wharton	34027 0451 2	1043	407	370	45	0	0
Wharton	34027 0451 1	1215	582	634	10	0	0
	Sub Totals:	2258	989	1004	55	0	0

Jerry Jones Mack Truck
Rockaway, NJ

For Radius of 4 Mi., Circle Area = 50.265482

No.	City	Block Group ID	Total Area	Partial Area	% Within Radius
1	Boonton	34027 4091	2.317382	2.317382	100.00
2	Boonton	34027 4099	6.070855	2.539349	41.83
3	Boonton	34027 4112	0.120661	0.041323	34.25
4	Boonton	34027 4113	0.478025	0.245707	51.40
5	Mountain Lakes	34027 4121	0.931032	0.931032	100.00
6	Mountain Lakes	34027 4122	0.931944	0.814238	87.37
7	Mountain Lakes	34027 4123	0.561355	0.561355	100.00
8	Mountain Lakes	34027 4124	0.386488	0.386488	100.00
9	Denville	34027 4131	0.171778	0.171778	100.00
10	Denville	34027 4132	0.672637	0.672637	100.00
11	Denville	34027 4133	0.347374	0.347374	100.00
12	Denville	34027 4137	1.409133	1.409133	100.00
13	Denville	34027 4139	2.367122	2.367122	100.00
14	Denville	34027 4141	0.344843	0.344843	100.00
15	Denville	34027 4142	0.550871	0.550871	100.00
16	Denville	34027 4143	0.177766	0.177766	100.00
17	Denville	34027 4144	0.257755	0.257755	100.00
18	Denville	34027 4145	1.193883	1.193883	100.00
19	Denville	34027 4151	0.519099	0.519099	100.00
20	Denville	34027 4152	2.130468	2.130468	100.00
21	Denville	34027 4159	2.152186	0.639822	29.73
22	Rockaway	34027 4431	0.154470	0.154470	100.00
23	Rockaway	34027 4432	0.421283	0.421283	100.00
24	Rockaway	34027 4433	0.294449	0.294449	100.00
25	Rockaway	34027 4434	0.977307	0.977307	100.00
26	Rockaway	34027 4435	0.181515	0.181515	100.00
27	Dover	34027 4481	0.140785	0.140785	100.00
28	Dover	34027 4482	0.418275	0.353400	84.49
29	Dover	34027 4483	0.100680	0.100680	100.00
30	Dover	34027 4484	0.092493	0.092493	100.00
31	Dover	34027 4485	0.049060	0.049060	100.00
32	Dover	34027 4491	0.184304	0.000256	0.14
33	Dover	34027 4501	0.087423	0.060138	68.79
34	Dover	34027 4502	0.531438	0.453844	85.40
35	Dover	34027 4503	0.092587	0.078636	84.93
36	Dover	34027 4504	0.248581	0.000767	0.31
37	Wharton	34027 4511	0.442987	0.005776	1.30
38	Wharton	34027 4512	0.633249	0.076026	12.01
39	Parsippany-Troy	34027 416017	0.773402	0.589162	76.18
40	Parsippany-Troy	34027 416018	0.770758	0.078346	10.16
41	Parsippany-Troy	34027 416019	2.256038	0.006209	0.28
42	Parsippany-Troy	34027 416021	1.071680	0.897281	83.73
43	Parsippany-Troy	34027 416022	0.016291	0.016291	100.00
44	Parsippany-Troy	34027 416023	0.028973	0.028973	100.00
45	Parsippany-Troy	34027 416024	0.103333	0.103333	100.00
46	Parsippany-Troy	34027 416029	0.421864	0.421864	100.00
47	Parsippany-Troy	34027 416031	1.805789	0.004310	0.24
48	Parsippany-Troy	34027 416049	1.484941	0.516196	34.76
49	Rockaway	34027 444011	2.100340	2.079281	99.00
50	Rockaway	34027 444019	34.089436	15.188067	44.55
51	Randolph	34027 456029	4.702667	0.594798	12.65
52	Rockaway	34027 444022	0.320962	0.320962	100.00

Jerry Jones Mack Truck
Rockaway, NJ

53	Rockaway	34027 444023	0.737056	0.737056	100.00
54	Rockaway	34027 444024	0.166547	0.166547	100.00
55	Rockaway	34027 444025	0.493199	0.493199	100.00
56	Rockaway	34027 444026	1.385092	1.385092	100.00
57	Rockaway	34027 445011	0.819490	0.819490	100.00
58	Rockaway	34027 445012	0.047419	0.047419	100.00
59	Rockaway	34027 445017	0.736624	0.736624	100.00
60	Rockaway	34027 445019	2.302951	2.172026	94.31
61	Rockaway	34027 445021	0.287828	0.287828	100.00
62	Rockaway	34027 445022	0.303628	0.303628	100.00
63	Rockaway	34027 445023	0.256222	0.256222	100.00
64	Rockaway	34027 445026	0.283790	0.283790	100.00
65	Victory Gardens	34027 456011	0.151836	0.127149	83.74
66	Randolph	34027 456021	0.165909	0.165909	100.00
67	Rockaway	34027 444021	1.480103	1.480103	100.00
	Totals:		88.707710	52.367462	

For Radius of 3 Mi., Circle Area = 28.274334

No.	City	Block Group ID	Total Area	Partial Area	% Within Radius
1	Boonton	34027 4091	2.317382	1.549814	66.88
2	Boonton	34027 4099	6.070855	0.322667	5.32
5	Mountain Lakes	34027 4121	0.931032	0.575899	61.86
8	Mountain Lakes	34027 4124	0.386488	0.210510	54.47
9	Denville	34027 4131	0.171778	0.171778	100.00
10	Denville	34027 4132	0.672637	0.672637	100.00
11	Denville	34027 4133	0.347374	0.347374	100.00
12	Denville	34027 4137	1.409133	1.409133	100.00
13	Denville	34027 4139	2.367122	2.367122	100.00
14	Denville	34027 4141	0.344843	0.344843	100.00
15	Denville	34027 4142	0.550871	0.550871	100.00
16	Denville	34027 4143	0.177766	0.177766	100.00
17	Denville	34027 4144	0.257755	0.257755	100.00
18	Denville	34027 4145	1.193883	1.193687	99.98
19	Denville	34027 4151	0.519099	0.329339	63.44
20	Denville	34027 4152	2.130468	1.031118	48.40
22	Rockaway	34027 4431	0.154470	0.154470	100.00
23	Rockaway	34027 4432	0.421283	0.421283	100.00
24	Rockaway	34027 4433	0.294449	0.294449	100.00
25	Rockaway	34027 4434	0.977307	0.977307	100.00
26	Rockaway	34027 4435	0.181515	0.181515	100.00
42	Parsippany-Troy	34027 416021	1.071680	0.151816	14.17
43	Parsippany-Troy	34027 416022	0.016291	0.001793	11.01
46	Parsippany-Troy	34027 416029	0.421864	0.101419	24.04
49	Rockaway	34027 444011	2.100340	1.183189	56.33
50	Rockaway	34027 444019	34.089436	7.171739	21.04
52	Rockaway	34027 444022	0.320962	0.320962	100.00
53	Rockaway	34027 444023	0.737056	0.737056	100.00
54	Rockaway	34027 444024	0.166547	0.166547	100.00
55	Rockaway	34027 444025	0.493199	0.493199	100.00
56	Rockaway	34027 444026	1.385092	1.385092	100.00
57	Rockaway	34027 445011	0.819490	0.819490	100.00
59	Rockaway	34027 445017	0.736624	0.136223	18.49
60	Rockaway	34027 445019	2.302951	0.987247	42.87
61	Rockaway	34027 445021	0.287828	0.131337	45.63

Jerry Jones Mack Truck
Rockaway, NJ

62	Rockaway	34027 445022	0.303628	0.295702	97.39
63	Rockaway	34027 445023	0.256222	0.192214	75.02
64	Rockaway	34027 445026	0.283790	0.160061	56.40
66	Randolph	34027 456021	0.165909	0.000994	0.60
67	Rockaway	34027 444021	1.480103	1.480103	100.00
Totals:			69.316513	29.457520	

For Radius of 2 Mi., Circle Area = 12.566371

No.	City	Block Group ID	Total Area	Partial Area	% Within Radius
1	Boonton	34027 4091	2.317382	0.225337	9.72
9	Denville	34027 4131	0.171778	0.160844	93.63
10	Denville	34027 4132	0.672637	0.672637	100.00
11	Denville	34027 4133	0.347374	0.347374	100.00
12	Denville	34027 4137	1.409133	0.398472	28.28
13	Denville	34027 4139	2.367122	2.265946	95.73
14	Denville	34027 4141	0.344843	0.068096	19.75
15	Denville	34027 4142	0.550871	0.105263	19.11
16	Denville	34027 4143	0.177766	0.173920	97.84
17	Denville	34027 4144	0.257755	0.257755	100.00
18	Denville	34027 4145	1.193883	0.441257	36.96
22	Rockaway	34027 4431	0.154470	0.154470	100.00
23	Rockaway	34027 4432	0.421283	0.421283	100.00
24	Rockaway	34027 4433	0.294449	0.280206	95.16
25	Rockaway	34027 4434	0.977307	0.261264	26.73
26	Rockaway	34027 4435	0.181515	0.181515	100.00
49	Rockaway	34027 444011	2.100340	0.016184	0.77
50	Rockaway	34027 444019	34.089436	1.830150	5.37
52	Rockaway	34027 444022	0.320962	0.320962	100.00
53	Rockaway	34027 444023	0.737056	0.737056	100.00
54	Rockaway	34027 444024	0.166547	0.166547	100.00
55	Rockaway	34027 444025	0.493199	0.486943	98.73
56	Rockaway	34027 444026	1.385092	0.764672	55.21
57	Rockaway	34027 445011	0.819490	0.298211	36.39
60	Rockaway	34027 445019	2.302951	0.063312	2.75
62	Rockaway	34027 445022	0.303628	0.002777	0.91
67	Rockaway	34027 444021	1.480103	1.480103	100.00
Totals:			56.038368	12.582556	

For Radius of 1 Mi., Circle Area = 3.141593

No.	City	Block Group ID	Total Area	Partial Area	% Within Radius
10	Denville	34027 4132	0.672637	0.004247	0.63
11	Denville	34027 4133	0.347374	0.127855	36.81
13	Denville	34027 4139	2.367122	1.215409	51.35
22	Rockaway	34027 4431	0.154470	0.075451	48.85
23	Rockaway	34027 4432	0.421283	0.034206	8.12
50	Rockaway	34027 444019	34.089436	0.001078	0.00
52	Rockaway	34027 444022	0.320962	0.320962	100.00
53	Rockaway	34027 444023	0.737056	0.091910	12.47

Jerry Jones Mack Truck
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54	Rockaway	34027 444024	0.166547	0.016950	10.18
55	Rockaway	34027 444025	0.493199	0.015198	3.08
67	Rockaway	34027 444021	1.480103	1.238325	83.66
Totals:			41.250187	3.141593	

For Radius of .5 Mi., Circle Area = 0.785398

No.	City	Block Group ID	Total Area	Partial Area	% Within Radius
13	Denville	34027 4139	2.367122	0.345432	14.59
52	Rockaway	34027 444022	0.320962	0.017862	5.57
67	Rockaway	34027 444021	1.480103	0.422104	28.52
Totals:			4.168188	0.785398	

For Radius of .25 Mi., Circle Area = 0.196350

No.	City	Block Group ID	Total Area	Partial Area	% Within Radius
67	Rockaway	34027 444021	1.480103	0.196350	13.27
Totals:			1.480103	0.196350	

Jerry Jones Mack Truck
Rockaway, NJ

========== Site Data ==========

Population:	58934.59
Households:	21650.62
Drilled Wells:	1935.73
Dug Wells:	168.14
Other Water Sources:	45.98

========== Partial (RING) data ==========

---- Within Ring: 4 Mile(s) and 3 Mile(s) ----

Population:	24766.40
Households:	9028.97
Drilled Wells:	887.20
Dug Wells:	74.91
Other Wells:	20.76

** Population On Private Wells: 2639.07

---- Within Ring: 3 Mile(s) and 2 Mile(s) ----

Population:	14801.07
Households:	5453.29
Drilled Wells:	744.63
Dug Wells:	74.28
Other Wells:	8.01

** Population On Private Wells: 2222.63

---- Within Ring: 2 Mile(s) and 1 Mile(s) ----

Population:	15699.97
Households:	5869.76
Drilled Wells:	223.87
Dug Wells:	18.95
Other Wells:	14.09

** Population On Private Wells: 649.47

---- Within Ring: 1 Mile(s) and .5 Mile(s) ----

Population:	3188.39
Households:	1132.68
Drilled Wells:	58.56
Dug Wells:	0.00
Other Wells:	2.24

** Population On Private Wells: 164.87

Jerry Jones Mack Truck
Rockaway, NJ

---- Within Ring: .5 Mile(s) and .25 Mile(s) ----

Population:	405.80
Households:	141.11
Drilled Wells:	18.81
Dug Wells:	0.00
Other Wells:	0.88

** Population On Private Wells: 54.09

---- Within Ring: .25 Mile(s) and 0 Mile(s) ----

Population:	72.96
Households:	24.81
Drilled Wells:	2.65
Dug Wells:	0.00
Other Wells:	0.00

** Population On Private Wells: 7.80

REFERENCE NO. 26

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL
PROTECTION AND ENERGY

CHRISTINE TODD WHITMAN
Governor

Division of Parks and Forestry
Office of Natural Lands Management
CN 404
Trenton, NJ 08625-0404
Tel. #609-984-1339
Fax. #609-984-1427

ROBERT C. SHINN, JR.
Commissioner

October 6, 1994

Robert MacEwen
CH2M Hill
99 Cherry Hill Road, Suite 304
Parsippany, NJ 07054-1102

Re: Jerry Jones Mack Truck and Associated Waterways

Dear Mr. MacEwen:

Thank you for your data request regarding rare species information for the above referenced project site in Morris County.

The Natural Heritage Data Base has records for occurrences of red-shouldered hawk, wood turtle and bog turtle which may be on, or in the immediate vicinity of the Jerry Jones Mack Truck site. There are also records for a number of occurrences for rare species which may be on, or in the immediate vicinity of the waterways that you have associated with this site. The attached lists provide additional information about all these occurrences. Also attached is a list of rare species from records in the general vicinity of the project site (within approximately 4 miles). **Because some of these species are sought by collectors, this information is provided to you on the condition that no locational data are released to the public.**

Also attached is a list of rare species and natural communities which have been documented from Morris County. If suitable habitat is present at the project site, these species have potential to be present. If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend you contact the Division of Fish, Game and Wildlife, Endangered and Nongame Species Program.

In order to red flag the general locations of documented occurrences of rare and endangered species and natural communities, we have prepared computer

generated Natural Heritage Index Maps. Enclosed please find these maps for the Boonton, Dover and Morristown USGS quadrangles.

PLEASE SEE THE ATTACHED 'CAUTIONS AND RESTRICTIONS ON NHP DATA'.

Thank you for consulting the Natural Heritage Program. The attached invoice details the payment due for processing this data request. Feel free to contact us again regarding any future data requests.

Sincerely,

Thomas F. Breden
Coordinator/Ecologist
Natural Heritage Program

cc: Lawrence Niles
Thomas Hampton
NHP File No. 94-4007484

NATURAL LANDS MANAGEMENT

CAUTIONS AND RESTRICTIONS ON NATURAL HERITAGE DATA

The quantity and quality of data collected by the Natural Heritage Program is dependent on the research and observations of many individuals and organizations. Not all of this information is the result of comprehensive or site-specific field surveys. Some natural areas in New Jersey have never been thoroughly surveyed. As a result, new locations for plant and animal species are continuously added to the data base. Since data acquisition is a dynamic, ongoing process, the Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of New Jersey. Information supplied by the Natural Heritage Program summarizes existing data known to the program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The attached data is provided as one source of information to assist others in the preservation of natural diversity.

This office cannot provide a letter of interpretation or a statement addressing the classification of wetlands as defined by the Freshwater Wetlands Act. Requests for such determination should be sent to the DEPE Land Use Regulation Program, CN 401, Trenton, NJ 08625-0401.

This cautions and restrictions notice must be included whenever information provided by the Natural Heritage Database is published.

06 OCT 1994

ON OR IN THE IMMEDIATE VICINITY OF PROJECT SITE
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vertebrates									
BUTEO LINEATUS	RED-SHOULDERED HAWK		E/T		G5	S2	1991-06-05	Y	A/FARBER HILL ROAD TO MERIDEN ROAD TO VISTA DRIVE. TURN LEFT AT 90 DEGREE INTERSECTION, 200 FEET IN WOODS/SWAMP ON LEFT SIDE OF ROAD. B/ SWAMP, OLD BEACH GLEN ROAD, 0.5 MILE FROM FARBER HILL ROAD. C/NORTH OF INTERSECTION OF MERIDEN AND GREEN POND ROADS. D/ RT. 513 TO MERIDEN ROAD, APPROX. 3/4 - 1 MILE, ON SOUTH SIDE OF ROAD ALONG BEAVER BROOK.
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1989-05-25	Y	MORRIS AVE. - (DENVILLE) TO FORD ROAD - APPROXIMATELY HALF WAY BETWEEN KITCHELL ROAD AND OLD BEACH GLEN RD.
CLEMMYS MUHLENBERGII	BOG TURTLE	C2	E		G3	S2	????-??-??	Y	A/ BEAVER BROOK, ROCKAWAY TWP. S. OF BEACH GLEN. B/ ROCKAWAY TWP., VICINITY OF HIBERNIA.

3 Records Processed

06 OCT 1994

ON OR IN THE IMMEDIATE VICINITY OF ASSOCIATED WATERWAYS
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.
*** Vertebrates								
BUTEO LINEATUS	RED-SHOULDERED HAWK		E/T		G5	S2	1986-05-??	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1990-06-17	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1988-06-??	Y
STRIX VARIA	BARRED OWL		T/T		G5	S3	1990-08-25	Y
STRIX VARIA	BARRED OWL		T/T		G5	S3	1988-03-22	Y
STRIX VARIA	BARRED OWL		T/T		G5	S3	1991-06-??	

6 Records Processed

GENERAL VICINITY OF PROJECT SITE
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.
*** Vertebrates								
ACCIPITER COOPERII	COOPER'S HAWK		E		G4	S2	1989-05-??	Y
ACCIPITER GENTILIS	NORTHERN GOSHAWK	C2	T/T		G4	S1	1989-06-??	Y
ACCIPITER GENTILIS	NORTHERN GOSHAWK	C2	T/T		G4	S1	1991-04-29	Y
AMMODRAMUS SAVANNARUM	GRASSHOPPER SPARROW		T/T		G4	S2	1989-07-05	Y
BUTEO LINEATUS	RED-SHOULDERED HAWK		E/T		G5	S2	1990-06-05	Y
BUTEO LINEATUS	RED-SHOULDERED HAWK		E/T		G5	S2	1990-06-08	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1981-08-??	
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1990-06-17	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1987-08-20	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1988-10-17	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1989-10-12	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1990-05-25	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1985-04-??	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1990-04-24	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1988-06-??	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1990-06-12	Y
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3	1991-07-19	Y
CLEMMYS MUHLENBERGII	BOG TURTLE	C2	E		G3	S2	1988-10-17	Y
CROTALUS HORRIDUS	TIMBER RATTLESNAKE		E		G5	S2	1986-SUMMR	Y
DOLICHONYX ORYZIVORUS	BOBOLINK		T/T		G5	S2	1989-06-26	Y
DOLICHONYX ORYZIVORUS	BOBOLINK		T/T		G5	S2	1989-05-??	Y
LANIUS LUDOVICIANUS MIGRANS	LOGGERHEAD SHRIKE	C2	E		G4G5T3T4	S1	1991-07-??	Y
MELANERPES ERYTHROCEPHALUS	RED-HEADED WOODPECKER		T/T		G5	S3	1989-05-03	
MYOTIS LEIBII	SMALL-FOOTED MYOTIS	C2	U		G3	S1	1990-03-22	Y
MYOTIS SODALIS	INDIANA BAT	LE	E		G2	S1	1993-02-19	Y
NEOTOMA FLORIDANA MAGISTER	EASTERN WOODRAT	C2	E		G5T4Q	S1	1984-??-??	Y
STRIX VARIA	BARRED OWL		T/T		G5	S3	1989-05-??	Y
STRIX VARIA	BARRED OWL		T/T		G5	S3	1993-03-26	Y
STRIX VARIA	BARRED OWL		T/T		G5	S3	1989-SPRNG	Y

GENERAL VICINITY OF PROJECT SITE
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.
STRIX VARIA	BARRED OWL		T/T		G5	S3	1991-07-??	Y
STRIX VARIA	BARRED OWL		T/T		G5	S3	1985-04-03	Y
STRIX VARIA	BARRED OWL		T/T		G5	S3	1988-??-??	Y
STRIX VARIA	BARRED OWL		T/T		G5	S3	1990-08-25	Y
STRIX VARIA	BARRED OWL		T/T		G5	S3	1991-06-??	
STRIX VARIA	BARRED OWL		T/T		G5	S3	1991-03-??	Y
*** Ecosystems								
GLACIAL BOG	GLACIAL BOG				G4?	S1	198?-??-??	Y
*** Invertebrates								
AESHNA CLEPSYDRA	MOTTLED DARNER				G3G4	S?	1984-09-20	Y
AESHNA MUTATA	SPATTERDOCK DARNER				G3G4	S1?	1986-06-22	Y
AESHNA TUBERCULIFERA	BLACK-TIPPED DARNER				G4	S1?	1984-09-20	Y
ARIGOMPHUS FURCIFER	LILYPAD CLUBTAIL				G5	S1?	1985-06-04	Y
CORDULEGASTER OBLIQUA	ARROWHEAD SPIKETAIL				G4	S1?	1989-06-26	Y
ENALLAGMA LATERALE	NEW ENGLAND BLUET				G3	S1	1992-06-20	
*** Other types								
BAT HIBERNACULUM	BAT HIBERNACULUM				G?	S?	1993-02-19	Y
BAT HIBERNACULUM	BAT HIBERNACULUM				G?	S?	1994-02-21	Y
*** Vascular plants								
ERIOPHORUM VAGINATUM VAR SPISSUM	SHEATHED COTTONGRASS		E		G5T5	SH.1	1941-05-20	Y
HOTTONIA INFLATA	FEATHERFOIL		E		G3G4	S1	1994-06-11	Y
KALMIA POLIFOLIA	PALE LAUREL		E		G5	S1	1941-05-20	Y
NYMPHOIDES CORDATA	FLOATING HEART			LP	G5	S3	1994-06-11	Y
POTAMOGETON ROBBINSII	ROBBIN'S PONDWEED		E		G5	S1	1994-06-07	Y
PYCNANTHEMUM TORREI	TORREY'S MOUNTAIN MINT		E		G2	S1	1919-08-24	Y

06 OCT 1994

GENERAL VICINITY OF PROJECT SITE
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.
SPARGANIUM MINIMUM	SMALL BUR-REED		E		G5	S1	1993-09-30	Y
SPARGANIUM MINIMUM	SMALL BUR-REED		E		G5	S1	1993-09-30	Y
TRIPHORA TRIANTHOPHORA	THREE BIRDS ORCHID		E		G4	S1	1905-08-13	Y
UTRICULARIA PURPUREA	PURPLE BLADDERWORT			LP	G5	S3	1993-07-23	Y

54 Records Processed

NATURAL HERITAGE INDEX MAPS

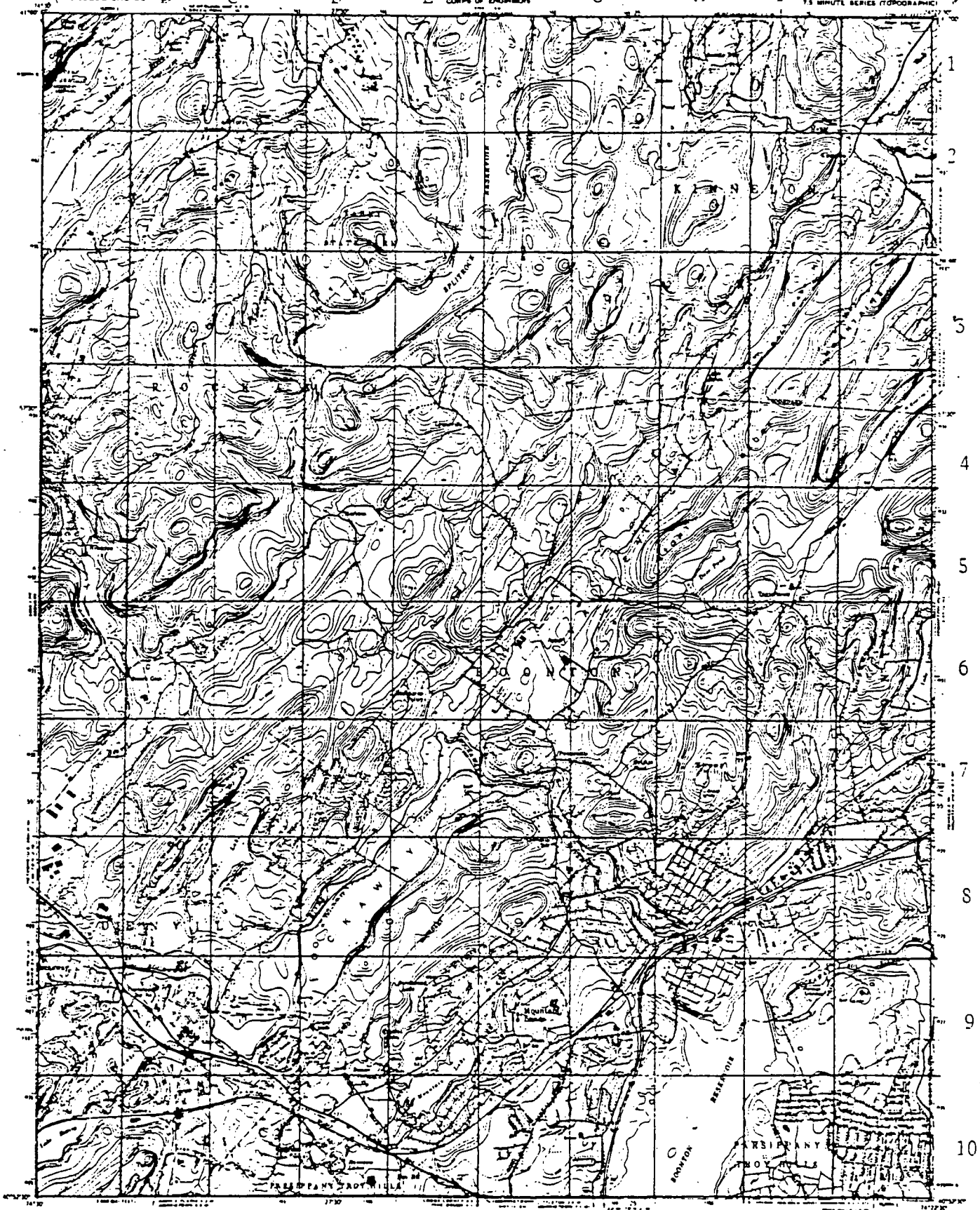
The Natural Heritage Database contains several thousand records of individual occurrences of endangered and threatened species and ecosystems. Many of these occurrences either have not been documented in recent years or have not had habitat boundaries delineated. Because much work remains to be done to delineate habitat boundaries and determine current status for these occurrences, Natural Heritage Index Maps were devised to red flag general areas in which the occurrences are located. The index maps are meant to be used as a tool to point to areas which may be of significance for endangered biological diversity. These maps do not depict all endangered species habitat in the state, but merely general areas which contain documented occurrences. Many additional areas may contain unidentified or poorly documented occurrences.

The maps have been produced using a computer generated grid which shades a grid cell approximately 330 acres in size if an endangered or threatened species or ecosystem has been documented anywhere within the cell. To use these maps, we suggest that you first find the location to be checked on the quad maps and then refer to the same grid location of the Natural Heritage Index Maps. The Natural Heritage Program can be contacted for additional information as specific projects are planned.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

BOONTON QUADRANGLE
NEW JERSEY-MORRIS CO
7.5 MINUTE SERIES (TOPOGRAPHIC)



SCALE 1:24000

CONTOUR INTERVAL 20 FEET

BOONTON N J

10 of 27

28

Generalized Natural Heritage Index Map

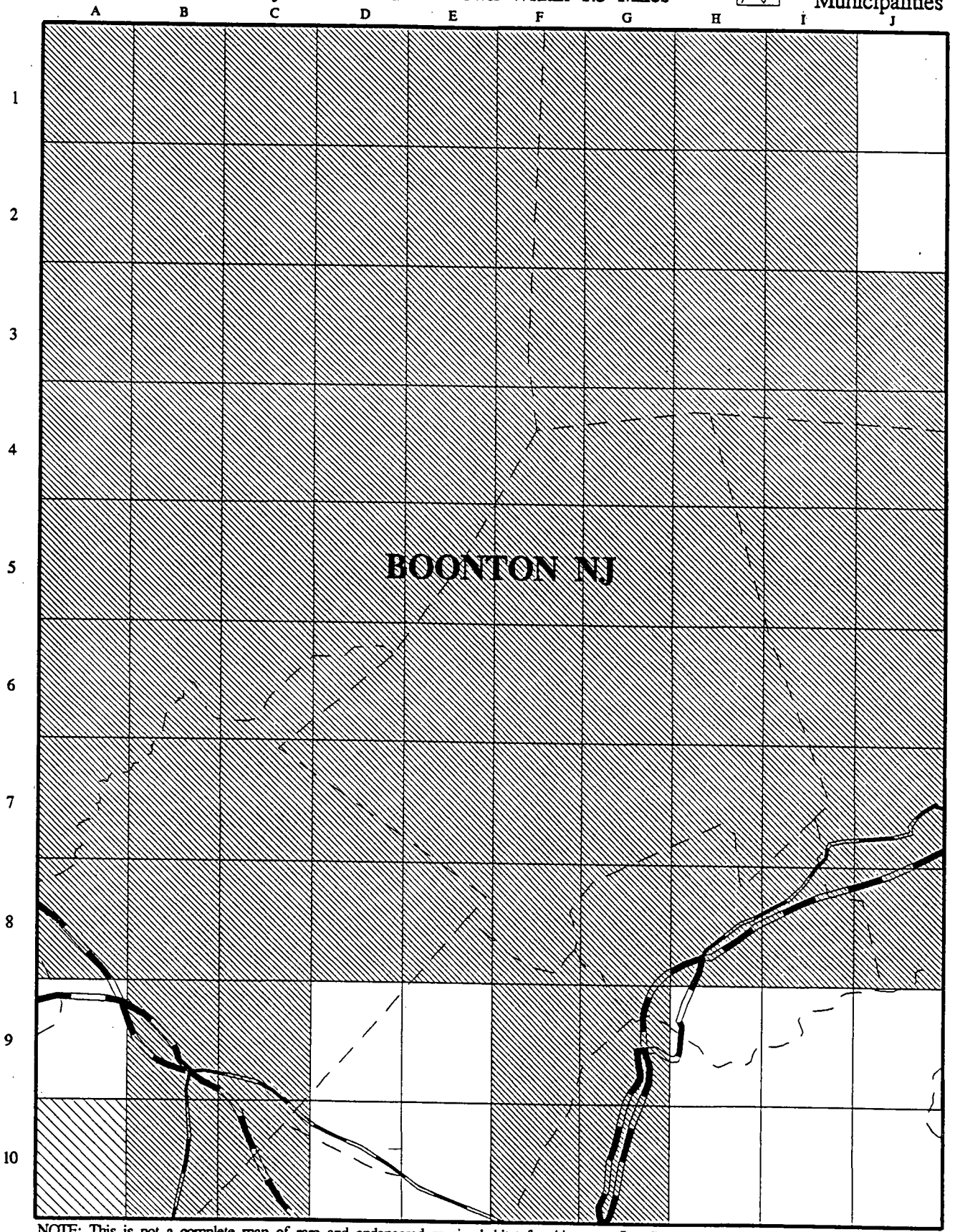
Generalized Locations for Rare and Endangered Elements of Natural Diversity

Documented Location Known Precisely

Documented Location Known Within 1.5 Miles

Major Roads

Municipalities



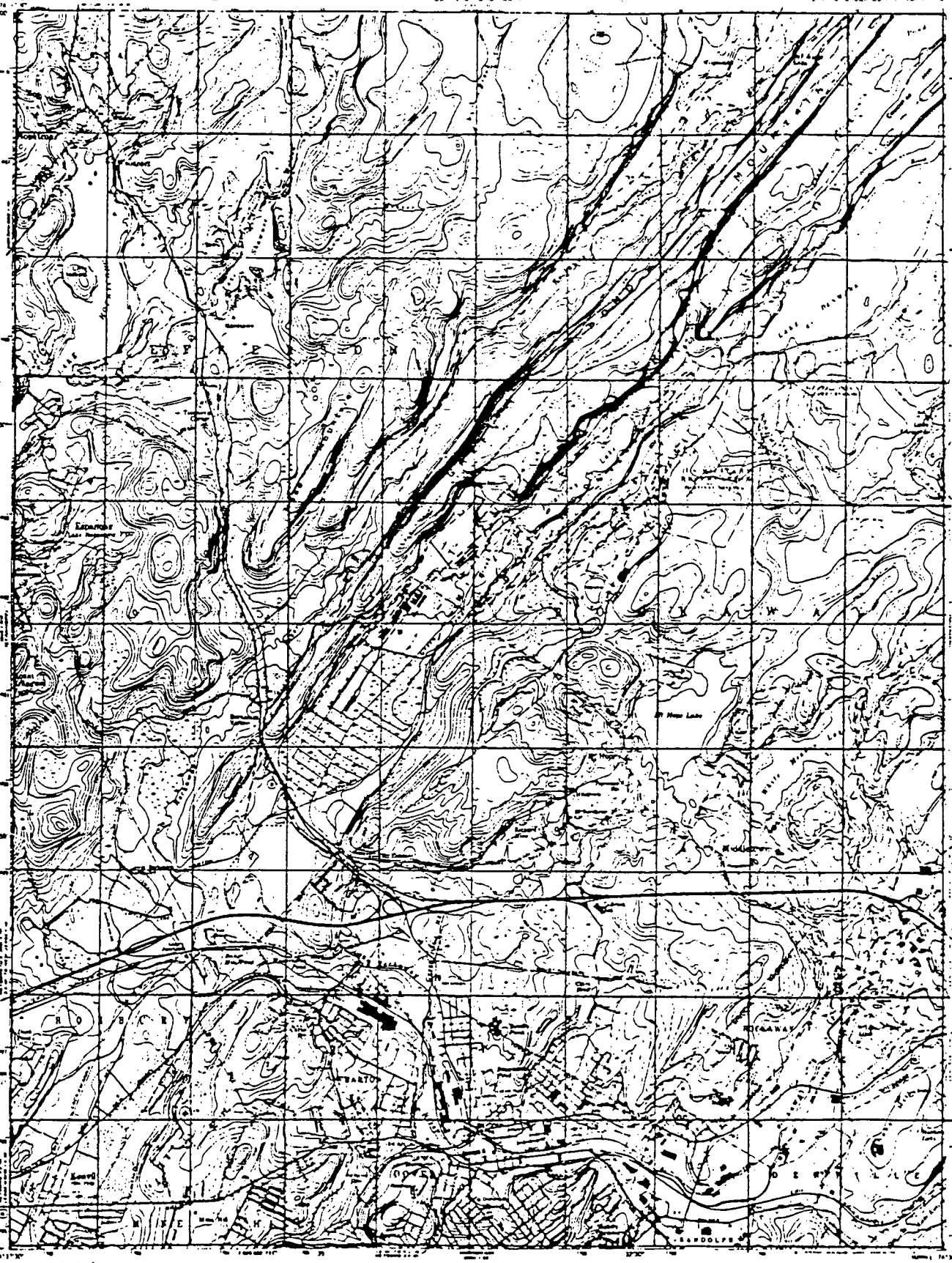
NOTE: This is not a complete map of rare and endangered species habitat for this area. It reflects data on known occurrences compiled as of the above date. It includes both historically and recently documented habitat. Additional occurrences may be found on unsurveyed habitat. For more information, contact the Office of Natural Lands Management, CN404, Trenton, NJ 08625.

APRIL 1994
Updated semiannually

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

DOVER QUADRANGLE
NEW JERSEY
7.5 MINUTE SERIES (TOPOGRAPHIC)



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DOVER N. J.

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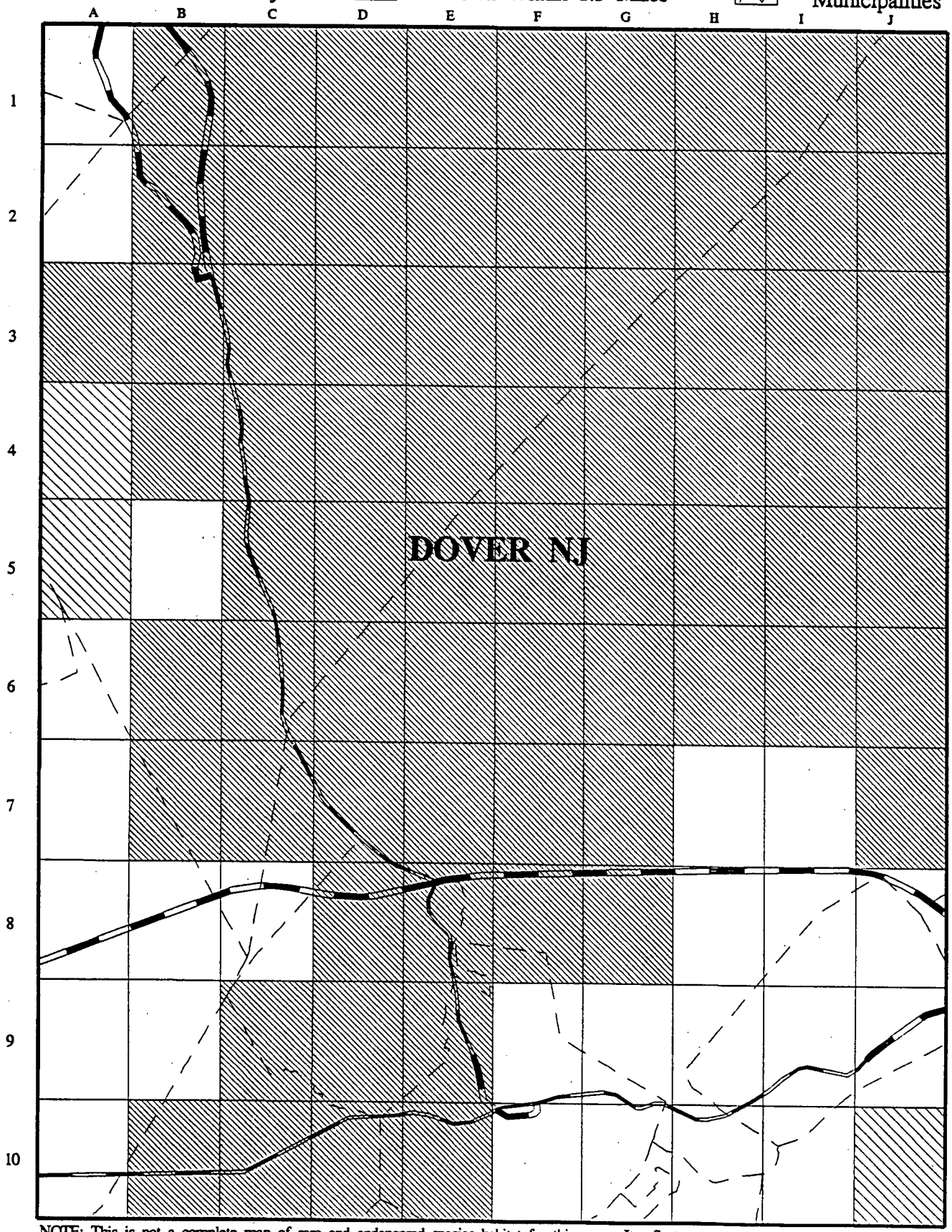

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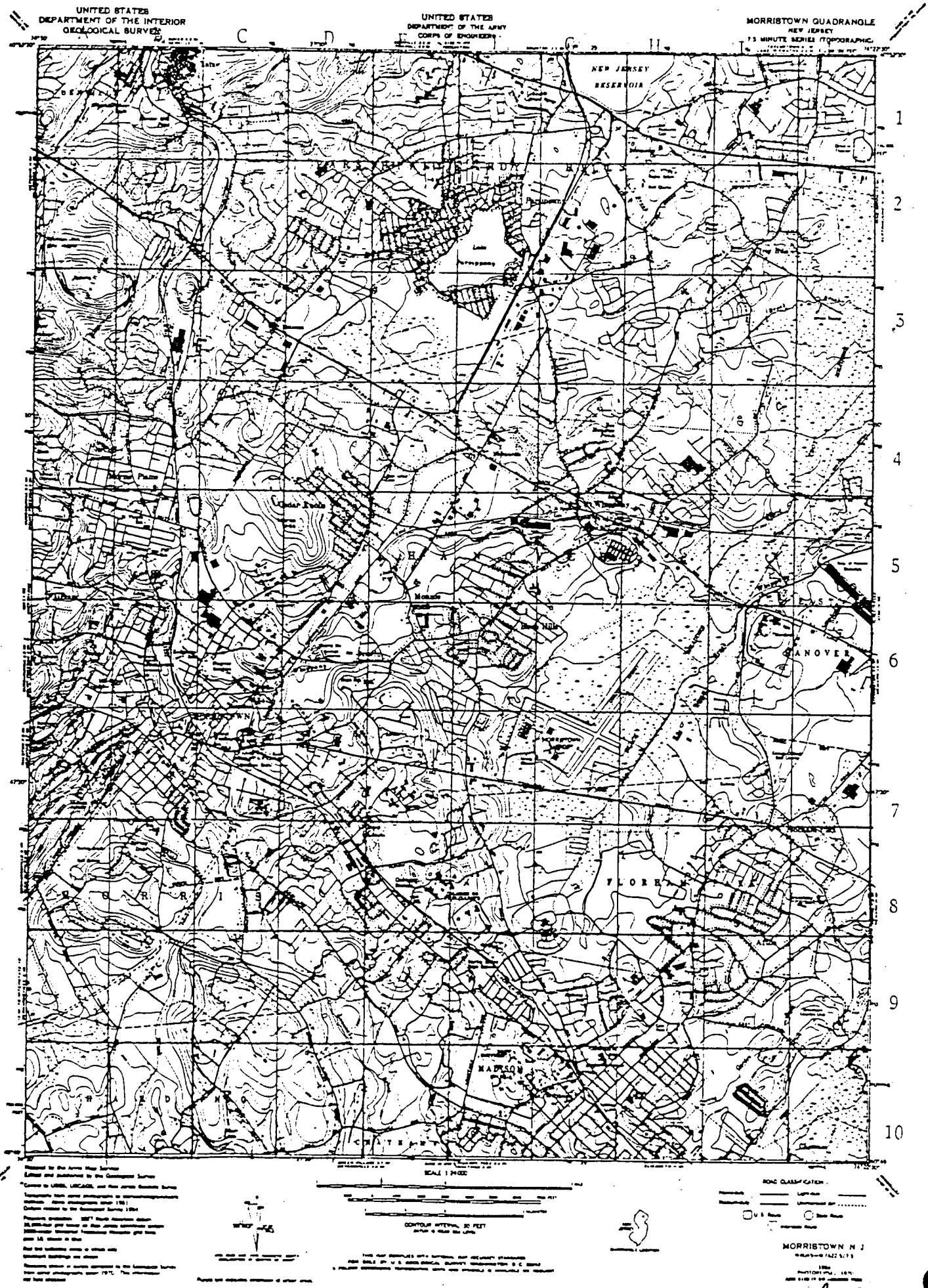
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
MORRISTOWN QUADRANGLE
NEW JERSEY
7.5 MINUTE SERIES (TOPOGRAPHIC)
NEW JERSEY
RESERVOIR
HANOVER
FLORHAM
MADISON
MORRISTOWN N J

Generalized Natural Heritage Index Map

Generalized Locations for Rare and Endangered Elements of Natural Diversity

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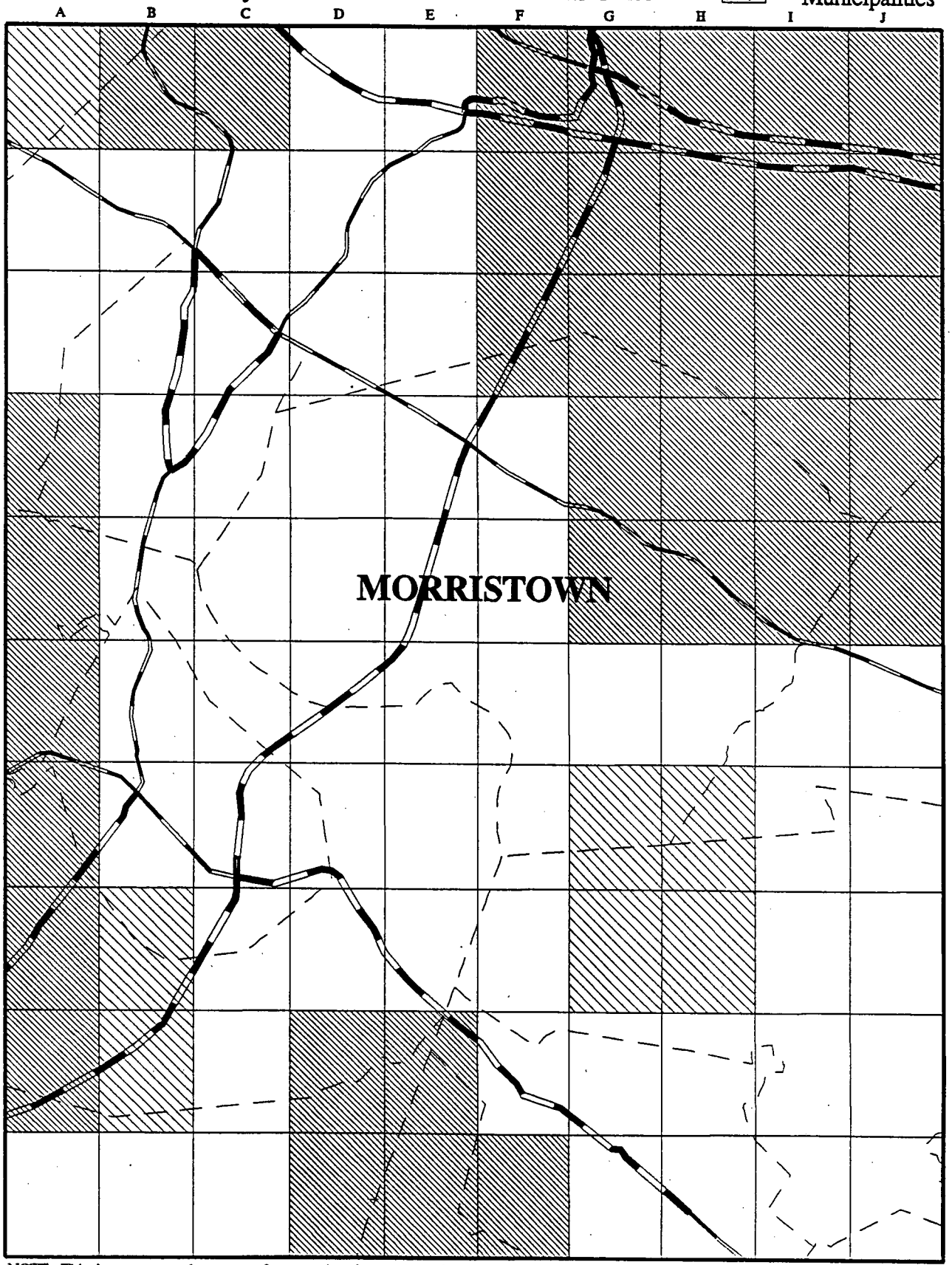

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EXPLANATIONS OF CODES USED IN NATURAL HERITAGE REPORTS

FEDERAL STATUS CODES

The following U.S. Fish and Wildlife Service categories and their definitions of endangered and threatened plants and animals have been modified from the U.S. Fish and Wildlife Service (F.R. Vol. 50 No. 188; Vol. 55, No. 35; F.R. 50 CFR 17.11 and 17.12). Federal Status codes reported for species follow the most recent listing.

LE Taxa formally listed as endangered.

LT Taxa formally listed as threatened.

PE Taxa already proposed to be formally listed as endangered.

PT Taxa already proposed to be formally listed as threatened.

C1 Taxa for which the Service currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list them as endangered or threatened species.

C1* Taxa which may be possibly extinct (although persuasive documentation of extinction has not been made--compare to 3A status).

C2 Taxa for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threat(s) are not currently known or on file to support the immediate preparation of rules.

C3 Taxa that are no longer being considered for listing as threatened or endangered species. Such taxa are further coded to indicate three subcategories, depending on the reason(s) for removal from consideration.

3A Taxa for which the Service has persuasive evidence of extinction.

3B Names that, on the basis of current taxonomic understanding, do not represent taxa meeting the Act's definition of "species".

3C Taxa that have proven to be more abundant or widespread than was previously believed

and/or those that are not subject to any identifiable threat.

S/A Similarity of appearance species.

STATE STATUS CODES

Two animal lists provide state status codes after the Endangered and Nongame Species Conservation Act of 1973 (NSSA 23:2A-13 et. seq.): the list of endangered species (N.J.A.C. 7:25-4.13) and the list defining status of indigenous, nongame wildlife species of New Jersey (N.J.A.C. 7:25-4.17(a)). The status of animal species is determined by the Nongame and Endangered Species Program (ENSP). The state status codes and definitions provided reflect the most recent lists that were revised in the New Jersey Register, Monday, June 3, 1991.

D Declining species-a species which has exhibited a continued decline in population numbers over the years.

E Endangered species-an endangered species is one whose prospects for survival within the state are in immediate danger due to one or many factors - a loss of habitat, over exploitation, predation, competition, disease. An endangered species requires immediate assistance or extinction will probably follow.

EX Extirpated species-a species that formerly occurred in New Jersey, but is not now known to exist within the state.

I Introduced species-a species not native to New Jersey that could not have established itself here without the assistance of man.

INC Increasing species-a species whose population has exhibited a significant increase, beyond the normal range of its life cycle, over a long term period.

T Threatened species-a species that may become endangered if conditions surrounding the species begin to or continue to deteriorate.

P Peripheral species-a species whose occurrence in New Jersey is at the extreme edge of its present natural range.

S Stable species-a species whose population is not undergoing any long-term increase/decrease within its natural cycle.

U Undetermined species-a species about which there is not enough information available to determine the status.

Status for animals separated by a slash(/) indicate a duel status. First status refers to the state breeding population, and the second status refers to the migratory or winter population.

Plant taxa listed as endangered are from New Jersey's official Endangered Plant Species List N.J.S.A. 131B-15.151 et seq.

E Native New Jersey plant species whose survival in the State or nation is in jeopardy.

REGIONAL STATUS CODES FOR PLANTS

LP Indicates taxa listed by the Pinelands Commission as endangered or threatened within their legal jurisdiction. Not all species currently tracked by the Pinelands Commission are tracked by the Natural Heritage Program. A complete list of endangered and threatened Pineland species is included in the New Jersey Pinelands Comprehensive Management Plan.

EXPLANATION OF GLOBAL AND STATE ELEMENT RANKS

The Nature Conservancy has developed a ranking system for use in identifying elements (rare species and natural communities) of natural diversity most endangered with extinction. Each element is ranked according to its global, national, and state (or subnational in other countries) rarity. These ranks are used to prioritize conservation work so that the most endangered elements receive attention first. Definitions for element ranks are after The Nature Conservancy (1982: Chapter 4, 4.1-1 through 4.4.1.3-3).

GLOBAL ELEMENT RANKS

G1 Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state; a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout it's range; with the number of occurrences in the range of 21 to 100.

G4 Apparently secure globally; although it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally; although it may be quite rare in parts of its range, especially at the periphery.

GH Of historical occurrence throughout its range i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

GU Possibly in peril range-wide but status uncertain; more information needed.

GX Believed to be extinct throughout range (e.g., passenger pigeon) with virtually no likelihood that it will be rediscovered.

G? Species has not yet been ranked.

STATE ELEMENT RANKS

S1 Critically imperiled in New Jersey because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres). Elements so ranked are often restricted to very specialized conditions or habitats and/or restricted to an extremely small geographical

area of the state. Also included are elements which were formerly more abundant, but because of habitat destruction or some other critical factor of its biology, they have been demonstrably reduced in abundance. In essence, these are elements for which, even with intensive searching, sizable additional occurrences are unlikely to be discovered.

S2 Imperiled in New Jersey because of rarity (6 to 20 occurrences). Historically many of these elements may have been more frequent but are now known from very few extant occurrences, primarily because of habitat destruction. Diligent searching may yield additional occurrences.

S3 Rare in state with 21 to 100 occurrences (plant species in this category have only 21 to 50 occurrences). Includes elements which are widely distributed in the state but with small populations/acreage or elements with restricted distribution, but locally abundant. Not yet imperiled in state but may soon be if current trends continue. Searching often yields additional occurrences.

S4 Apparently secure in state, with many occurrences.

S5 Demonstrably secure in state and essentially ineradicable under present conditions.

SA Accidental in state, including species (usually birds or butterflies) recorded once or twice or only at very great intervals, hundreds or even thousands of miles outside their usual range; a few of these species may even have bred on the one or two occasions they were recorded; examples include european strays or western birds on the East Coast and visa-versa.

SE Elements that are clearly exotic in New Jersey including those taxa not native to North America (introduced taxa) or taxa deliberately or accidentally introduced into the State from other parts of North America (adventive taxa). Taxa ranked SE are not a conservation priority (viable introduced occurrences of G1 or G2 elements may be exceptions).

SH Elements of historical occurrence in New Jersey. Despite some searching of historical occurrences and/or potential habitat, no extant occurrences are known. Since not all of the historical occurrences have been field surveyed, and unsearched potential habitat remains, historically ranked taxa are considered possibly extant, and remain a conservation priority for continued field work.

SN Regularly occurring, usually migratory and typically nonbreeding species for which no significant or effective habitat conservation measures can be taken in the state; this category includes migratory birds, bats, sea turtles, and cetaceans which do not breed in the state but pass through twice a year or may remain in the winter (or, in a few cases, the summer); included also are certain lepidoptera which regularly migrate to a state where they reproduce, but then completely die out every year with no return migration. Species in this category are so widely and unreliably distributed during migration or in winter that no small set of sites could be set aside with the hope of significantly furthering their conservation. Other nonbreeding, high globally-ranked species (such as the bald eagle, whooping crane or some seal species) which regularly spend some portion of the year at definite localities (and therefore have a valid conservation need in the state) are not ranked SN but rather S1, S2, etc.

SR Elements reported from New Jersey, but without persuasive documentation which would provide a basis for either accepting or rejecting the report. In some instances documentation may exist, but as of yet, its source or location has not been determined.

SRF Elements erroneously reported from New Jersey, but this error persists in the literature.

SU Elements believed to be in peril but the degree of rarity uncertain. Also included are rare taxa of uncertain taxonomical standing. More information is needed to resolve rank.

SX Elements that have been determined or are presumed to be extirpated from New Jersey. All historical occurrences have been searched and a reasonable search of potential habitat has been completed. Extirpated taxa are not a current conservation priority.

SXC Elements presumed extirpated from New Jersey, but native populations collected from the wild exist in cultivation.

T Element ranks containing a "T" indicate that the infraspecific taxon is being ranked differently than the full species. For example *Stachys palustris* var. *homotricha* is ranked "G5T? SH" meaning the full species is globally secure but the global rarity of the var. *homotricha* has not been determined; in New Jersey the variety is ranked historic.

Q Elements containing a "Q" in the global portion of its rank indicates that the taxon is of questionable, or uncertain taxonomical standing, e.g., some authors regard it as a full species, while others treat it at the subspecific level.

.1 Elements documented from a single location.

Note: To express uncertainty, the most likely rank is assigned and a question mark added (e.g., G2?). A range is indicated by combining two ranks (e.g., G1G2, S1S3).

IDENTIFICATION CODES

These codes refer to whether the identification of the species or community has been checked by a reliable individual and is indicative of significant habitat.

Y Identification has been verified and is indicative of significant habitat.

BLANK Identification has not been verified but there is no reason to believe it is not indicative of significant habitat.

? Either it has not been determined if the record is indicative of significant habitat or the identification of the species or community may be confusing or disputed.

Revised September 1991

MORRIS COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
*** Vertebrates						
ACCIPITER COOPERII	COOPER'S HAWK		E		G4	S2
ACCIPITER GENTILIS	NORTHERN GOSHAWK	C2	T/T		G4	S1
AMBYSTOMA LATERALE	BLUE-SPOTTED SALAMANDER		E		G5	S1
AMMODRAMUS SAVANNARUM	GRASSHOPPER SPARROW		T/T		G4	S2
ARDEA HERODIAS	GREAT BLUE HERON		T/S		G5	S2
ASIO OTUS	LONG-EARED OWL		T/T		G5	S3
BARTRAMIA LONGICAUDA	UPLAND SANDPIPER		E		G5	S1
BOTAURUS LENTIGINOSUS	AMERICAN BITTERN		T/S		G4	S3
BUTEO LINEATUS	RED-SHOULDERED HAWK		E/T		G5	S2
CIRCUS CYANEUS	NORTHERN HARRIER		E/U		G5	S2
CISTOTHORUS PLATENSIS	SEDGE WREN		E		G5	S1
CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3
CLEMMYS MUHLENBERGII	BOG TURTLE	C2	E		G3	S2
CROTALUS HORRIDUS	TIMBER RATTLESNAKE		E		G5	S2
DOLICHONYX ORYZIVORUS	BOBOLINK		T/T		G5	S2
EURYCEA LONGICAUDA LONGICAUDA	LONGTAIL SALAMANDER		T		G5T5	S2
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	LELT	E		G4	S1
LANIUS LUDOVICIANUS MIGRANS	LOGGERHEAD SHRIKE	C2	E		G4G5T3T4	SN
MELANERPES ERYTHROCEPHALUS	RED-HEADED WOODPECKER		T/T		G5	S3
MYOTIS SODALIS	INDIANA BAT	LE	E		G2	S1
NEOTOMA FLORIDANA MAGISTER	EASTERN WOODRAT	C2	E		G5T4Q	S1
PANDION HALIAETUS	OSPREY		T/T		G5	S3
STRIX VARIA	BARRED OWL		T/T		G5	S3
*** Ecosystems						
BLACK SPRUCE SWAMP	BLACK SPRUCE SWAMP				G4	S1
GLACIAL BOG	GLACIAL BOG				G4?	S1

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MORRIS COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
HARDWOOD-CONIFER SWAMP	HARDWOOD-CONIFER SWAMP				G4?	S2S3
*** Invertebrates						
AESHNA CLEPSYDRA	MOTTLED DARNER				G3G4	S?
AESHNA MUTATA	SPATTERDOCK DARNER				G3G4	S1?
AESHNA TUBERCULIFERA	BLACK-TIPPED DARNER				G4	S1?
ALASMIDONTA HETERODON	DWARF WEDGE MUSSEL	LE	E		G1	SH
ALASMIDONTA VARICOSA	BROOK FLOATER	C2			G3	S1
ARIGOMPHUS FURCIFER	LILYPAD CLUBTAIL				G5	S1?
CORDULEGASTER OBLIQUA	ARROWHEAD SPIKETAIL				G4	S1?
ENALLAGMA BASIDENS	DOUBLE-STRIPED BLUET				G5	S2?
ENALLAGMA LATERALE	NEW ENGLAND BLUET				G3	S1
GOMPHUS ROGERSI	SABLE CLUBTAIL				G4	S1?
LAMPSILIS CARIOSA	YELLOW LAMPMUSSEL	C2			G4	S1
LANTHUS VERNALIS	SINGLE-STRIPED CLUBTAIL				G4	S1?
OPHIOGOMPHUS ASPERSUS	BROOK SNAKETAIL				G3G4	S1?
OPHIOGOMPHUS MAINENSIS	TWIN-HORNED SNAKETAIL				G3G4	S1?
SOMATOCHLORA WALSHII	WALSH'S EMERALD				G5	S1?
SOMATOCHLORA WILLIAMSONI	WILLIAMSON'S EMERALD				G5	S1?
*** Other types						
BAT HIBERNACULUM	BAT HIBERNACULUM				G?	S?
*** Vascular plants						
ANDROMEDA GLAUCOPHYLLA	BOG ROSEMARY		E		G5	S1
ANGELICA VENENOSA	HAIRY ANGELICA				G5	S2
ASPLENIUM BRADLEYI	BRADLEY'S SPLEENWORT		E		G3	S1
ASTER RADULA	LOW ROUGH ASTER		E		G5	S1

MORRIS COUNTY
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NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
BOTRYCHIUM MULTIFIDUM	LEATHERY GRAPE-FERN		E		G5	S1
BOTRYCHIUM ONEIDENSE	BLUNT-LOBED GRAPE-FERN				G3?	S2
CALYSTEGIA SPITHAMAEA	ERECT BINDWEED		E		G4G5	S1
CARDAMINE PRATENSIS VAR PALUSTRIS	CUCKOO FLOWER				G5T4T5	S2
CAREX BRUNNESCENS	BROWNISH SEDGE		E		G5	S1
CAREX FOENEA	DRY-SPIKED SEDGE		E		G5	S1
CAREX HAYDENII	CLOUD SEDGE		E		G5	S1
CAREX LIMOSA	MUD SEDGE		E		G5	S1
CAREX LOUISIANICA	LOUISIANA SEDGE		E		G5	S1.1
CAREX PAUPERCULA	BOG SEDGE				G5	SU
CAREX POLYMORPHA	VARIABLE SEDGE	C2	E		G2	S1
CAREX ROSTRATA	BEAKED SEDGE				G5	S2
CAREX TYPHINA	CAT-TAIL SEDGE				G5	S2
CERCIS CANADENSIS	REDBUD		E		G5	S1
CUSCUTA CEPHALANTHI	BUTTON-BUSH DODDER		E		G5	S1
DIRCA PALUSTRIS	LEATHERWOOD				G4	S2
EQUISETUM PRATENSE	MEADOW HORSETAIL		E		G5	S1
EQUISETUM VARIEGATUM	VARIEGATED HORSETAIL		E		G5	S1
ERIOPHORUM GRACILE	SLENDER COTTONGRASS		E		G5	SH
ERIOPHORUM TENELLUM	ROUGH COTTONGRASS		E		G5	S1
ERIOPHORUM VAGINATUM VAR SPISSUM	SHEATHED COTTONGRASS		E		G5T5	SH.1
GLYCERIA GRANDIS	AMERICAN MANNAGRASS		E		G5	S1
GNAPHALIUM MACOUNII	CLAMMY EVERLASTING		E		G5?Q	SH
GYMNOCARPIUM DRYOPTERIS	OAK FERN				G5	S2
HELONIAS BULLATA	SWAMP-PINK	LT	E	LP	G3	S3
HEMICARPHA MICRANTHA	HEMICARPHA		E		G4	S1

MORRIS COUNTY
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NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
HIERACIUM KALMII	CANADA HAWKWEED		E		G5	SH
HOTTONIA INFLATA	FEATHERFOIL		E		G3G4	S1
ILEX MONTANA	MOUNTAIN HOLLY		E		G5	S1
KALMIA POLIFOLIA	PALE LAUREL		E		G5	S1
LEMNA TRISULCA	STAR DUCKWEED				G5	S2
LOBELIA DORTMANNA	WATER LOBELIA		E		G4	SH
LYCOPODIUM ANNOTINUM	STIFF CLUBMOSS		E		G5	S1
MELANTHIUM VIRGINICUM	VIRGINIA BUNCHFLOWER		E		G5	S1
MILIUM EFFUSUM	TALL MILLET GRASS		E		G5	SH
MYRIOPHYLLUM VERTICILLATUM	WHORLED WATER-MILFOIL		E		G5	SH
NUPHAR MICROPHYLLUM	SMALL YELLOW POND LILY		E		G5	SH
OBOLARIA VIRGINICA	VIRGINIA PENNYWORT				G5	S2
PANICUM BOREALE	NORTHERN PANIC GRASS		E		G5	S1
PHLOX PILOSA	DOWNY PHLOX		E		G5	SH
PLATANTHERA HOOKERI	HOOKER'S ORCHID		E		G5	S1
POTAMOGETON ALPINUS	NORTHERN PONDWEED		E		G5	S1
POTAMOGETON ILLINOENSIS	ILLINOIS PONDWEED		E		G5	S1
POTAMOGETON OBTUSIFOLIUS	OBTUSE-LEAVED PONDWEED		E		G5	SH.1
POTAMOGETON RICHARDSONII	RICHARD'S PONDWEED		E		G5	SRF
POTAMOGETON ROBBINSII	ROBBIN'S PONDWEED		E		G5	S1
POTAMOGETON ZOSTERIFORMIS	FLAT-STEMMED PONDWEED		E		G5	S1
POTENTILLA PALUSTRIS	MARSH CINQUEFOIL		E		G5	S1
PRENANTHES RACEMOSA	SMOOTH RATTLESNAKE ROOT		E		G5	SH
PRUNUS ALLEGHANIENSIS	ALLEGHANY PLUM	3C	E		G3	S1
PRUNUS PUMILA VAR DEPRESSA	LOW SAND CHERRY				G5T5	S2
PYCNANTHEMUM TORREI	TORREY'S MOUNTAIN MINT		E		G2	S1
RANUNCULUS FASCICULARIS	EARLY BUTTERCUP		E		G5	S1
RHODODENDRON CANADENSE	RHODORA		E		G5	S1

MORRIS COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
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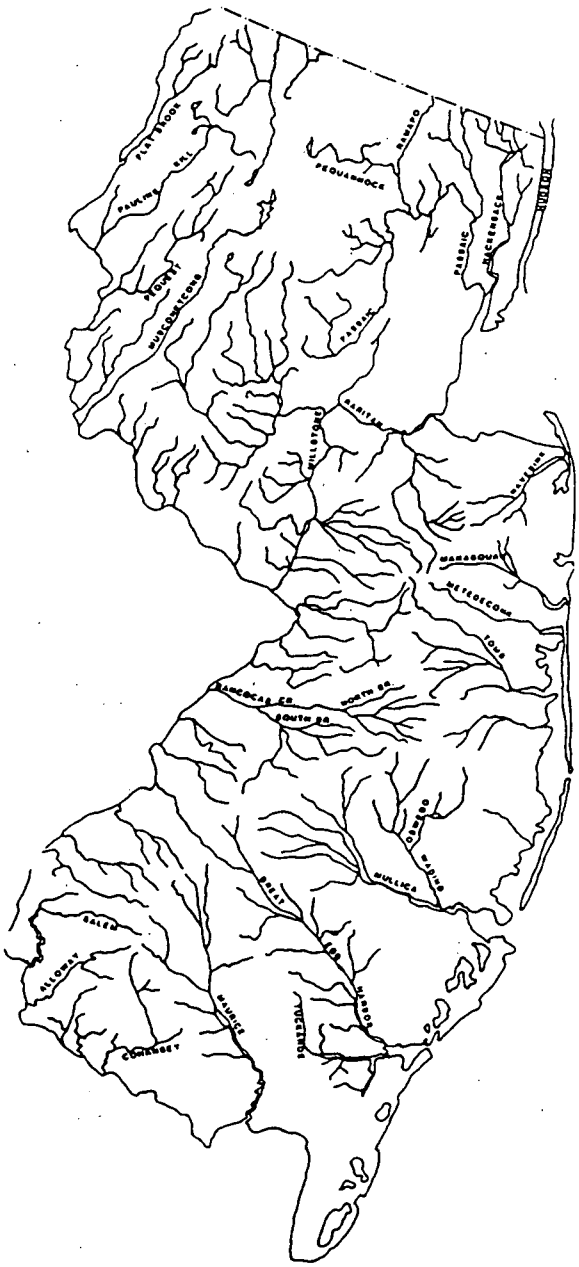
NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
RUBUS SEMISETOSUS	NEW ENGLAND BLACKBERRY				G5	S3
SALIX LUCIDA	SHINING WILLOW				G5	S2
SALIX PEDICELLARIS	BOG WILLOW		E		G5	S1
SCHEUCHZERIA PALUSTRIS	ARROW-GRASS		E		G5	SH
SMILACINA TRIFOLIA	THREE-LEAVED SOLOMON'S-SEAL				G5	S1
SOLIDAGO RIGIDA	STIFF GOLDENROD		E		G5	S1
SPARGANIUM ANGUSTIFOLIUM	NARROW-LEAVED BUR-REED		E		G5	SH
SPOROBOLUS NEGLECTUS	PUFF-SHEATHED DROPSEED		E		G5	S1
TIARELLA CORDIFOLIA	FOAMFLOWER		E		G5	S1
TRIADENUM FRASERI	FRASER'S ST. JOHN'S-WORT		E		G4G5	S2
TRIPHORA TRIANTHOPHORA	THREE BIRDS ORCHID		E		G4	S1
TROLLIUS LAXUS SSP LAXUS	SPREADING GLOBE FLOWER	3C	E		G4T3Q	S1
VERBENA SIMPLEX	NARROW-LEAVED VERVAIN		E		G5	SH
VIOLA CANADENSIS	CANADA VIOLET		E		G5	S1
VIOLA INCOGNITA	LARGE-LEAVED WHITE VIOLET				G5	S3

116 Records Processed

REFERENCE NO. 27

Surface Water Quality Standards

N.J.A.C. 7:9-4.1 et seq.



AUGUST 1989

New Jersey Department of Environmental Protection

Division of Water Resources

1. It is demonstrated to the satisfaction of the Department that the waters should be set aside to represent the natural aquatic environment and its associated biota; or

2. It is demonstrated to the satisfaction of the Department that a more restrictive use is necessary to protect a unique ecological system or threatened/endangered species.

(g) In those cases in which a thermal discharge is involved, the procedures for reclassifying segments for more restrictive uses shall be consistent with section 316 of the Federal Clean Water Act.

7:9-4.12 Designated uses of FW1, PL, FW2, SE1, SE2, SE3, and SC Waters

(a) In all FW1 waters the designated uses are:

1. Set aside for posterity to represent the natural aquatic environment and its associated biota;

2. Primary and secondary contact recreation;

3. Maintenance, migration and propagation of the natural and established aquatic biota; and

4. Any other reasonable uses.

(b) In all PL waters the designated uses are:

1. Cranberry bog water supply and other agricultural uses;

2. Maintenance, migration and propagation of the natural and established biota indigenous to this unique ecological system;

3. Public potable water supply after such treatment as required by law or regulations;

4. Primary and secondary contact recreation; and

5. Any other reasonable uses.

(c) In all FW2 waters the designated uses are:

1. Maintenance, migration and propagation of the natural and established biota;

2. Primary and secondary contact recreation;

3. Industrial and agricultural water supply;

4. Public potable water supply after such treatment as required by law or regulation; and

5. Any other reasonable uses.

(d) In all SE1 waters the designated uses are:

1. Shellfish harvesting in accordance with N.J.A.C. 7:12;

2. Maintenance, migration and propagation of the natural and established biota;

3. Primary and secondary contact recreation; and

4. Any other reasonable uses.

(e) In all SE2 waters the designated uses are:

1. Maintenance, migration and propagation of the natural and established biota;

2. Migration of diadromous fish;

3. Maintenance of wildlife;

4. Secondary contact recreation; and

5. Any other reasonable uses.

(f) In all SE3 waters the designated uses are:

1. Secondary contact recreation;

2. Maintenance and migration of fish populations;

3. Migration of diadromous fish;

4. Maintenance of wildlife; and

5. Any other reasonable uses.

(g) In all SC waters the designated uses are:

1. Shellfish harvesting in accordance with N.J.A.C. 7:12;

2. Primary and secondary contact recreation;

3. Maintenance, migration and propagation of the natural and established biota; and

4. Any other reasonable uses.

(e) The surface water classifications in Table 3 are for waters of the Passaic, Hackensack and New York Harbor Complex Basin:

TABLE 3

WATER BODY	CLASSIFICATION
ARTHUR KILL	
(Perth Amboy) - The Kill and its saline New Jersey tributaries between the Outerbridge Crossing and a line connecting Ferry Pt., Perth Amboy to Wards Pt., Staten Island, New York	SE2
(Elizabeth) - From an east-west line connecting Elizabethport with Bergen Pt., Bayonne to the Outerbridge Crossing	SE3
(Woodbridge) - All freshwater tributaries	FW2-NT
BEAR SWAMP BROOK (Mahwah) - Entire length	FW2-TP(C1)
BEAR SWAMP LAKE (Ringwood)	FW2-NT(C1)
BEAVER BROOK	
(Meriden) - From Splitrock Reservoir Dam downstream to Meriden Road Bridge	FW2-TM
(Denville) - Meriden Road Bridge to Rockaway River	FW2-NT
BEECH BROOK	
(West Milford) - From State line downstream to Wanaque River	FW2-TM
BELCHER CREEK (W. Milford) - Entire length	FW2-NT
BERRYS CREEK (Secaucus) - Entire length	FW2-NT/SE2
BLACK BROOK	
(Meyersville) - Entire length, except segment described below	FW2-NT
(Great Swamp) - Segment and tributaries within the Great Swamp National Wildlife Refuge	FW2-NT(C1)
BLUE MINE BROOK	
(Wanaque) - Entire length, except segment described below	FW2-TM
(Norvin Green State Forest) - That portion of the stream and any tributaries within the Norvin Green State Forest	FW2-TM(C1)
BRUSHWOOD POND (Ringwood)	FW2-TM(C1)
BUCKABEAR POND (Newfoundland) - Pond, its tributaries and connecting stream to Clinton Reservoir	FW2-NT(C1)
BURNT MEADOW BROOK (Stonetown) - Entire length	FW2-TP(C1)
CANISTEAR RESERVOIR (Vernon)	FW2-TM
CANISTEAR RESERVOIR TRIBUTARY (Vernon) - The southern branch of the eastern tributary to the Reservoir	FW1
CANOE BROOK (Chatham) - Entire length	FW2-NT

REFERENCE NO. 28

TO: File

FROM: Rob MacEwen/CH2M HILL

DATE: November 2, 1994

SUBJECT: Wetland Acreage

PROJECT: NAE62030.07.01

SITE NAME: Jerry Jones Mack Truck

0 - 1/4 mile	=	38 acres
1/4 - 1/2 mile	=	103 acres
1/2 - 1 mile	=	151 acres
1 - 2 miles	=	315 acres
2 - 3 miles	=	461 acres
3 - 4 miles	=	+500 acres (<600 acres)

REFERENCE NO. 29

APPENDIX A: SCOPE OF THE CERCLA PETROLEUM EXCLUSION UNDER SECTIONS 101(14) and 104(a)(2)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460

JUL 31 1987

OFFICE OF GENERAL COUNSEL

MEMORANDUM

SUBJECT: Scope of the CERCLA Petroleum Exclusion Under Sections 101(14) and 104(a)(2)

FROM: Francis S. Blake
General Counsel (LE-130)

TO: J. Winston Porter
Assistant Administrator
for Solid Waste and Emergency Response (WH-562A)

One critical and recurring issue arising in the context of Superfund response activities has been the scope of the petroleum exclusion under CERCLA. Specifically, you have asked whether used oil which is contaminated by hazardous substances is considered "petroleum" under CERCLA and thus excluded from CERCLA response authority and liability unless specifically listed under RCRA or some other statute. For the reasons discussed below, we believe that the contaminants present in used oil or any other petroleum substance are not within the petroleum exclusion. "Contaminants", as discussed below, are substances not normally found in refined petroleum fractions or present at levels which exceed those normally found in such fractions. If these contaminants are CERCLA hazardous substances, they are subject to CERCLA response authority and liability.

Background

Under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 as amended (CERCLA), governmental response authority, release notification requirements, and liability are largely tied to a release of a "hazardous substance." Section 104 authorizes government response to releases or threatened releases of hazardous substances, or "pollutants or contaminants." Similarly, liability for response costs and damages under Section 107 attaches to persons who generate, transport or

dispose of hazardous substances at a site from which there is a release or threatened release of such substances. Under Section 103, a release of a reportable quantity of a hazardous substance triggers notification to the National Response Center.

The term "hazardous substance" is defined under CERCLA Section 101(14) to include approximately 714 toxic substances listed under four other environmental statutes, including RCRA. Both the definition of hazardous substance and the definition of "pollutant or contaminant" under Section 104(a)(2) exclude "petroleum, including crude oil or any fraction thereof", unless specifically listed under those statutes. 1/ Accordingly, no petroleum substance, including used oil, can be a "hazardous substance" except to the extent it is listed as a hazardous waste under RCRA or under one of the other statutes. Thus two critical issues in assessing whether a substance is subject to CERCLA is whether or not, and to what extent, a substance is "petroleum." This memorandum discusses the second type of petroleum exclusion issue. The question, therefore, is not whether used oil is "petroleum" and thus exempted from CERCLA jurisdiction, but to what extent substances found in used oil which are not found in crude oil or refined petroleum fractions are also "petroleum". If such substances are not "petroleum" then a release of used oil containing such substances may trigger CERCLA response actions, not to the release of used oil, but to the contaminants present in the oil.

1/ The full texts of these provisions are as follows:

Section 101(14)

. . . .

The term [hazardous substance] does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

Section 104 (a)(2)

. . . .

The term [pollutant or contaminant] does not include petroleum, including crude oil and any fraction thereof which is not otherwise specifically listed or designated as hazardous substances under section 101(14)(A) through (F) of this title, nor does it include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas).

Although the term "hazardous substance" is defined by statute, there is no CERCLA definition of "petroleum" and very little direct legislative history explaining the purpose or intended scope of this exclusion. None of the four early Superfund bills originally excluded responses to oil, although the apparent precursor to Section 101(14), found in S. 1480, excluded "petroleum" without explanation in all versions except that introduced. The legislative debates on the final compromise indicate only that Congress intended to enact later, separate superfund-type legislation to cover "oil spills." See generally 126 Cong. Rec. H11793-11802 (December 3, 1980).

Since the enactment of CERCLA, the Agency has provided some interpretations of the nature and scope of the petroleum exclusion. In providing guidance in 1981 on the notification required under Section 103 for non-RCRA hazardous waste sites the Agency stated that petroleum wastes, including waste oil, which are not specifically listed under RCRA are excluded from the definition of "hazardous substance" under 101(14). 46 Fed. Reg. 22145 (April 15, 1981). 2/

In 1982 and in 1983, the General Counsel issued two opinions on the CERCLA petroleum exclusion. In the first opinion, the General Counsel distinguished under the petroleum exclusion between hazardous substances which are inherent in petroleum, such as benzene, and hazardous substances which are added to or mixed with petroleum products. The General Counsel concluded that the petroleum exclusion includes those hazardous substances which are inherent in petroleum but not those added to or mixed with petroleum products. Thus, the exclusion of diesel oil as "petroleum" includes its hazardous substance constituents, such as benzene and toulene, but PCB's mixed with oil would not be excluded. Moreover, if the petroleum product and an added hazardous substance are so commingled that, as a practical matter, they cannot be separated, then the entire oil spill is subject to CERCLA response authority.

In the second opinion, the General Counsel concluded that the petroleum exclusion as applied to crude oil "fractions" includes blended gasoline as well as raw gasoline, even though refined or blended gasoline contains higher levels of hazardous

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2/ In the notice the Agency used the term "waste oil" without stating whether it was intended to include all waste oil or only unadulterated waste oil. The Agency has subsequently interpreted the reference to "waste oil" in this notice to include only unadulterated waste oil. 50 Fed. Reg. 13460 (April 4, 1985).

substances. The increased level of hazardous substances results from the blending of raw gasoline with other petroleum fractions to increase its octane levels. Because virtually all gasoline which leaves the refinery is blended gasoline, the petroleum exclusion would include virtually none of this fraction if the increased concentration of hazardous substances due only to its processing made it subject to CERCLA.

Finally, the Agency has interpreted the petroleum exclusion in two recent Federal Register notices. In the April 4, 1985 final rule adjusting reportable quantities under Section 102, the Agency provided its general interpretation of the exclusion:

> EPA interprets the petroleum exclusion to apply to materials such as crude oil, petroleum feedstocks, and refined petroleum products, even if a specifically listed or designated hazardous substance is present in such products. However, EPA does not consider materials such as waste oil to which listed CERCLA substances have been added to be within the petroleum exclusion. Similarly, pesticides are not within the petroleum exclusion, even though the active ingredients of the pesticide may be contained in a petroleum distillate: when an RQ of a listed pesticide is released, the release must be reported.

50 Fed. Reg. 13460 (April 4, 1985).

In March 10, 1986, the Agency published a notice of data availability and request for comments on the proposed used oil listing under RCRA. 51 Fed. Reg. 8206. In that notice, the Agency responded to commenters who had argued that the RCRA listing would discourage used oil recycling because it would subject generators, transporters, processors, and users to Superfund liability. The Agency stated that used oil which contains hazardous substances at levels which exceed those normally found in petroleum are currently subject to CERCLA. 51 Fed. Reg. 8206 (March 10, 1986). Although the fact that the used oil is contaminated does not remove it from the protection of the petroleum exclusion, the contaminants in the used oil are subject to CERCLA response authority if they are hazardous substances. Accordingly, most used oil, even without a specific listing, would not be fully within the petroleum exclusion, irrespective of the listing.

Discussion

Because there is no definition of "petroleum" in CERCLA or any legislative history which clearly expresses the intended scope of this exclusion, there are several possible interpretations which could be given to this provision. However, we believe that our current interpretation, under which "petroleum" includes hazardous substances normally found in refined petroleum fractions but does not include either hazardous substances found at levels which exceed those normally found in such fractions or substances not normally found in such fractions, is most consistent with the statute and the relevant legislative history. Under this interpretation, the source of the contamination, whether intentional addition of hazardous substances to the petroleum or addition of hazardous substances by use of the petroleum, is not relevant to the applicability of the petroleum exclusion. The remainder of this memorandum explains in greater detail this interpretation and its legal basis, and responds to arguments raised in opposition to this interpretation.

The following is our interpretation of "petroleum" under CERCLA 101(14) and 104(a)(2), which we believe to be consistent with Congressional intent and the position which the Agency has taken on the scope of the petroleum exclusion thus far. First, we interpret this provision to exclude from CERCLA response and liability crude oil and fractions of crude oil, including the hazardous substances, such as benzene, which are indigenous in those petroleum substances. Because these hazardous substances are found naturally in all crude oil and its fractions, they must be included in the term "petroleum," for that provision to have any meaning.

Secondly, "petroleum" under CERCLA also includes hazardous substances which are normally mixed with or added to crude oil or crude oil fractions during the refining process. This includes hazardous substances the levels of which are increased during refining. These substances are also part of "petroleum" since their addition is part of the normal oil separation and processing operations at a refinery in order to produce the product commonly understood to be "petroleum."

Finally, hazardous substances which are added to petroleum or which increase in concentration solely as a result of contamination of the petroleum during use are <u>not</u> part of the "petroleum" and thus are not excluded from CERCLA under the

exclusion. 3/ In such cases, EPA may respond to releases of the added hazardous substance, but not the oil itself.

We believe that an interpretation of "petroleum" to include only indigenous, refinery-added hazardous substances is the interpretation of this provision which is most consistent with Congressional intent. The language of the provision, its explanation in the legislative history, and the Congressional debates on the final Superfund bill clearly indicate that Congress had no intention of shielding from Superfund response and liability hazardous substances merely because they are added, intentionally or by use, to petroleum products.

The language of the petroleum exclusion describes "petroleum" principally in terms of crude oil and crude oil fractions. This language is virtually identical to the language used in an earlier Superfund bill to define "oil." 4/ There is no indication in the statute or legislative history that the term "petroleum" was to be given any meaning other than its ordinary, everyday meaning. See Malat v. Riddell, 383 U.S. 569, 571 (1966) (words of a statute should be interpreted where possible in their ordinary, everyday sense). Petroleum is defined in a standard dictionary as

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3/ The mixing of two or more excluded petroleum substances, such as blending of fuels, would not be considered contamination by use, and the mixture would thus also be an excluded substance.

4/ See H.R. 85, 96th Cong., 2d Sess. §101(s) (as passed by the House, September 1980) (""Oil" means petroleum, including crude oil or any fraction or residue therefrom"). H.R. 85 was designed principally to provide compensation and assess liability for oil tanker spills in navigable waters. As discussed below, the omission of this "oil spill" coverage under the petroleum exclusion was believed to be the most significant omission in terms of response to environmental releases under the final Superfund bill.

Although the bill containing the precursor to Section 101(14), S. 1480, does not have a definition of "petroleum", its accompanying report did explain the term "petroleum oil" in the context of the taxing provisions:

> The term "petroleum oil" as used in subsection 5 means petroleum, including crude petroleum and any of its fractions or residues other than carbon black.

S. Rep. No. 96-848, 96th Cong., 2d Sess. 70 (1980).

> an oily flammable bituminous liquid that may vary from almost colorless to black, occurs in many places in the upper strata of the earth, is a complex mixture of hydrocarbons with small amounts of other substances, and is prepared for use as gasoline, naphtha, or other products by various refining processes.

Webster's Ninth New Collegiate Dictionary 880 (1985). Thus, an interpretation of the phrase "petroleum, including crude oil or any fraction thereof" to include only crude oil, crude oil fractions, and refined petroleum fractions is consistent with the plain language of the statute. 5/

The only legislative history which specifically discusses this provision states that

> petroleum, including crude oil and including fractions of crude oil which are not otherwise specifically listed or designated as hazardous substances under subparagraphs (A) through (F) of the definition, is excluded from the definition of a hazardous substance. The reported bill does not cover spills or other releases strictly of oil.

S. Rep. No. 96-848, 96th Cong., 2d Sess. 29-30 (1980) (emphasis added). Thus, the petroleum exclusion is explained as an exclusion from CERCLA for spills or releases only of oil. The legislative history clearly contemplates that the petroleum

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5/ This distinction under the exclusion in Title I of CERCLA between petroleum as the substance that leaves the refinery and the hazardous substances which are added to it prior to, during or after use was also made by Congress in Title II, the revenue provisions or CERCLA. In Title II, Congress made a distinction between "chemicals", petrochemical feedstocks and inorganic substances, taxed in Subchapter B of Chapter 38 of Internal Revenue Code, and "petroleum", crude oil and petroleum products, taxed in Subchapter A. Section 211 of CERCLA. The list of taxed chemicals includes many of the contaminant hazardous substances typically found in used oil: arsenic, cadmium, chromium, lead oxide, and mercury. The term "petroleum products" was explained in the legislative history as including essentially crude oil and its refined fractions. H. Rep. No. 96-172, Part III, 96th Cong., 2d Sess. 5 (1980) (to accompany H.R. 85).

In addition, several speakers specifically identified such mixtures as releases not only covered by the legislation but releases to which the bill was addressed.

> Mr. Edgar ...
>
> In my State, hazardous substances problems have been discovered at an alarming rate in recent years. In the summer of 1979, an oil slick appeared on the Susquehanna River near Pittston, Pa. When EPA officials responded under section 311 of the Clean Water Act, they learned that the slick contained a variety of highly poisonous chemicals in addition to the oil.
>
> Officials estimate that more than 300,000 gallons of acids, cyanide compounds, industrial solvents, waste oil and other chemicals remain at this site where they could be washed to the surface anywhere in a 10-square-mile surface.

Id. at H11798. See also 126 Cong. Rec. S14963 (daily ed. November 24, 1980) (Sen. Randolph) (contaminated oil slick). Other petroleum products containing hazardous substance additives intended to be addressed by the legislation include PCB's in transformer fluid, id. at S14963 (Sen. Randolph) and S14967 (Sen. Stafford), dioxin in motor fuel used as a dust suppressant, id. at S14974 (Sen. Mitchell), PCB's in waste oil, id. (Sen. Mitchell) 6/ and contaminated waste oil, id. at S14980 (Sen. Cohen). Accordingly, Congress understood the petroleum exclusion to remove from CERCLA jurisdiction spills only of oil, not releases of hazardous substances mixed with the oil.

There are two principal arguments which have been raised in opposition to this interpretation. First, the argument has been made that this interpretation narrows the petroleum exclusion to the extent that it has became virtually meaningless. As we have noted in previous opinions on this issue, an interpretation which emasculates a provision of a statute is strongly disfavored. Marsano v. Laird, 412 F.2d 65, 70 (2d Cir. 1969). However, this interpretation leaves a significant number of petroleum spills outside the reach of CERCLA. Spills or releases of gasoline remain excluded from CERCLA under the petroleum exclusion. As indicated by the legislative history for the 1984 underground storage tank

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6/ The illegal disposal of PCB's in North Carolina described by Senator Mitchell was a result of the spraying of 131,000 gallons of PCB-contaminated waste oil along a roadway. See 126 Cong. Rec. H9448 (daily ed. September 23, 1980).

exclusion will not apply to mixtures of petroleum and other toxic materials since these would not be releases "strictly of oil".

The Congressional debates on the final compromise Superfund legislation provides further clarification of Congressional intent concerning the scope of the petroleum exclusion, both in terms of what this provision deleted from the bill and what it did not. First, the major concern expressed with respect to the final compromise bill was the omission of its oil spill jurisdiction due to the petroleum exclusion. See e.g. 126 Cong. Rec. H11797 (Rep. Florio) (daily ed. December 3, 1980); id. at H11790 (Rep. Broyhill); id. at H11792 (Rep. Madigan); id. at H11793 (Rep. Studds); id. at H11795 (Rep. Biaggi); id. at H11796 (Rep. Snyder). This omission was of concern because it was believed to leave coastal areas and fisheries vunerable to tanker spills of crude and refined oil, such as the wreck of the Argo Merchant, and offshore oil well accidents. 126 Cong. Rec. H11793 (Rep. Studds) (daily ed. December 3, 1980). See also 126 Cong. Rec. S10578 (proposed amendment to S1480 by Sen. Magnuson) (daily ed. August 1, 1980); id. at S10845 (proposed amendment to S1480 by Sen. Gravel) (daily ed. August 5, 1980). The omitted coverage of oil spills was believed to include approximately 500 spills per year, 126 Cong. Rec. H11796 (Rep. Snyder) (daily ed. December 3, 1980), far less than the number of contaminated oil releases each year.

However, it was clear that the omission of oil coverage was intended to include spills of oil only, and there was no intent to exclude from the bill mixtures of oil and hazardous substances. The remarks of Rep. Mikulski are typical of the general understanding of the effect of the petroleum exclusion in the final bill:

> The Senate bill is substantially similar to the House measure, with the exception that there is no oil title.
>
> I realize that it is disappointing to see no oil-related provision in the bill, but we must also realize that this is our only chance to get hazardous waste dump site cleanup legislation enacted. . . .
>
> Moreover, there is already a mechanism in place that is designed to deal with spills in navigable waterways. There is not, however, any provision currently in our law that addresses the potentially ruinous situation of abandoned toxic dump sites.
>
> I, therefore, believe that it is imperative that we pass the Senate bill as a very important beginning in our attempt to defuse the ticking environmental time bomb of abandoned toxic waste sites.

Id. at H11796.

Finally, although the Superfund Amendments and Reauthorization Act of 1986 (SARA) contains several provisions related to oil and oil releases, it did not amend the petroleum exclusion under CERCLA. Moreover, the new provisions concerning oil and oil releases and their legislative history do not indicate a Congressional intent inconsistent with this opinion.

The only discussion of "petroleum" in the Conference Report for SARA is in the context of defining the scope of the new petroleum response fund for leaking underground storage tanks under Subtitle I of the Resource Conservation and Recovery Act (RCRA). Subtitle I defines "petroleum" in a manner nearly identical to CERCLA. The Conference Report specifies that used oil would be subject to the response fund notwithstanding its contamination with hazardous substances. H. Rep. No. 99-962, 99th Cong., 2d Sess. 228 (1986). The Conference Report is not inconsistent with the Agency's position on "petroleum" under CERCLA since it merely specifies that the leaking underground storage tank (UST) response fund is applicable to tanks containing certain mixtures of oil and hazardous substances, as well as to tanks containing uncontaminated petroleum. In fact, the Report further states that the UST response fund must cover releases of used oil from tanks since "releases from tanks containing used oil would not <u>rise to the priority necessary</u>...for CERCLA response", <u>id.</u> (emphasis added), not because such releases would be entirely excluded from CERCLA jurisdiction. <u>See also</u> 132 Cong. Rec. S14928 (daily ed. October 3, 1986) (Senator Chaffee) (Nothing in Section 114, pertaining to liability for releases of recycled oil, "shall affect or impair the authority of the President to take a response action pursuant to Section 104 or 106 of CERCLA with respect to any release...of used oil or recycled oil"); 132 Cong. Rec. H9611 (daily ed. October 8, 1986) (Rep. Schneider) ("...the oil companies are rightfully assessed a significant share of the Superfund tax...Waste oils laced with contaminants have been identified at at least 153 Superfund sites in 32 States.").

legislation, leakage of gasoline from underground tanks appears to be the greatest source of groundwater contamination in the United States. 130 Cong. Rec. S20[illegible] 2028 (daily ed. February 29, 1984) (Sen. Durenberger). In addition, spills of crude or refined petroleum are not subject to Superfund, as was frequently noted prior to its passage. See generally 126 Cong. Rec. H11786-H11802 (daily ed. December 5, 1980). Moreover, under this interpretation not all releases of used oil will be subject to CERCLA since used oil does not necessarily contain non-indigenous hazardous substances or hazardous substances in elevated levels. 7/ Although used oil is generally "contaminated" by definition, see e.g., RCRA Section 1005 (36), the impurities added by use may not be CERCLA hazardous substances.

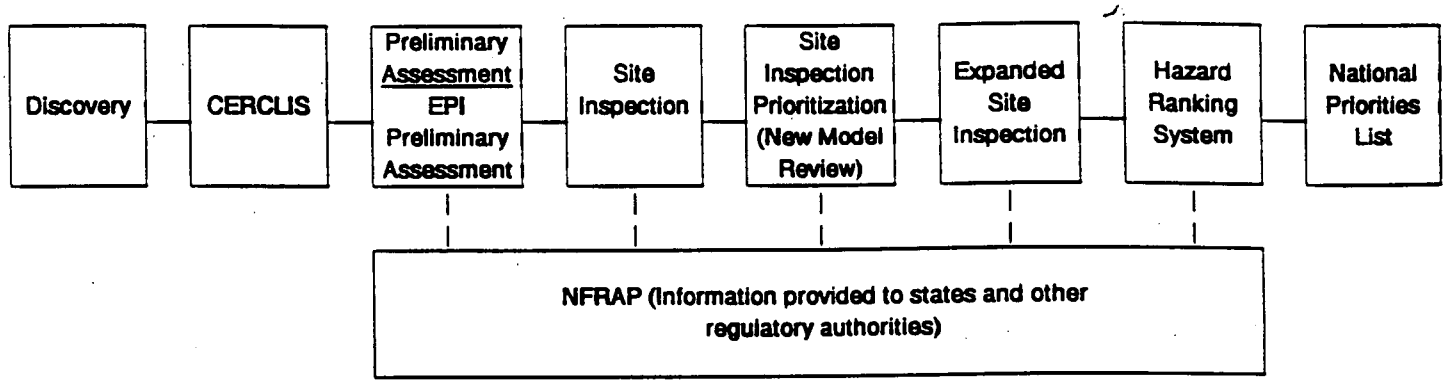
A second argument which has been made opposing this interpretation is that Congress intended to include in the term "petroleum" all hazardous substances added through normal use of the petroleum substance. However, even if it were possible to determine in a response situation whether a hazardous substance was added intentionally or only through normal use or to determine what additions are "intentional", the legislative history is contrary to such a distinction. As noted above, the Senate Report explaining this provision states that it excludes releases or spills strictly of oil. This explanation expresses Congressional intent that releases of mixtures of oil and toxic chemicals, i.e. releases which are not strictly of oil, would be subject to CERCLA response authority. Releases of contaminated oil even if contaminated due to "normal use" are not releases strictly of oil.

Furthermore, the Congressional debates prior to passage clearly indicate an intent that contaminated oil would be subject to Superfund as several such releases were discussed as the focus of the legislation. Congress was concerned with the environmental and health effect of abandoned toxic waste sites, not whether the presence of such hazards was intentional or due to normal practices. In fact, one of the petroleum-hazardous substance mixtures most often mentioned during the debates was that of PCB contaminated oil, which is a type of contamination arguably resulting from the "normal use" of the oil in transformers. Accordingly, an interpretation of the petroleum exclusion which includes as "petroleum" hazardous substances added during use of the petroleum would not be consistent with Congressional intent.

7/ Data submitted to EPA by the Utility Solid Waste Activities Group et al. in Appendix C of their comments on the RCRA Used Oil listing, February 11, 1986.

ATTACHMENT 2

SUPERFUND SITE ASSESSMENT PROGRAM



SITE ASSESSMENT REPORTS

1. PRELIMINARY ASSESSMENT
   - Quick Review of Readily Accessible Records and Reports
   - Undertaken to Determine the Existence of a Problem and the Need for Further Action at a Site by Characterizing:
     - Magnitude of the Hazard
     - Source and Nature of the Release or Potential Release
     - Identification of Targets
   - Does Not Include Sample Collection
2. SITE INSPECTION
   - The Purpose of the Site Inspection is to:
     - Further Define and Characterize the Problem
     - Provide Data for the Hazard Ranking System (HRS) Scoring and Compute Initial Score
     - Identification of Targets
     - Determine the Necessity of Further Action
   - The Site Inspection Involves an On-Site Visit and Sampling (10+/- Samples)
   - A Site Inspection is not an Extent of Contamination Study
3. SITE INSPECTION PRIORITIZATION
   - Quick Review of Readily Accessible Records and Reports
   - Undertaken to Determine the Validity and Update Background Conditions Under the New HRS Model, and the Need for Further Action at a Site by Characterizing:
     - Magnitude of the Hazard
     - Source and Nature of the Release or Potential Release
   - Included On-Site Visits or Sample Collection as needed
     - Analyze Samples/Limited Analytical Resources
     - Account for Significant Safety Hazards On-Site
4. EXPANDED SITE INSPECTION

   A Follow-Up Inspection May Be Recommended After the SI To:
   - Gather Additional Data Necessary to Strengthen or Substantiate the Initial HRS Score
     - Geophysical Surveys
     - Installation of Groundwater Monitoring Wells
     - Additional Sampling

Review of Analytical Data

If previous analytical data are available, they should be reviewed for information which supports the design of the sampling and analysis program, tests site hypotheses, and documents the site score. The Site Investigation (SI) investigator should review all previous analytical data. While analytical data collected for other purposes may not meet SI objectives, site-specific analytical data are generally helpful in better understanding the nature of the problem at the site, regardless of data sources or data quality. The depth of the review depends on the overall quality and quantity of data, the intended use of the data, and whether they are representative of current site conditions and comparable to SI data. Determining whether available data can be applied as SI-generated data requires the professional judgement of an experienced reviewer. Both validated and non-validated analytical data may be available. Previous SI data will be validated and of CLP-quality. Non-validated data may contain false positive and false negatives, as well as quantitation, transcription, and calculation errors. If data of unknown or questionable quality are used for decision-making, the investigator should review all available information to assess the level of certainty associated with the data. If these data are used for HRS documentation, data validation will be necessary. The investigator should be able to determine the general quality of the data set by reviewing QC data for evaluation under the Superfund Program.