ML – General Jan 81

"Environmental Impact Statement on the Upper Rockaway River Basin"

Expert Report by the US Environmental Protection Agency

pgs. 273

notes: marked 'draft" but stamped received

ML 000812 E

D-Den-6

ENVIRONMENTAL IMPACT STATEMENT

ON THE UPPER ROCKAWAY RIVER BASIN

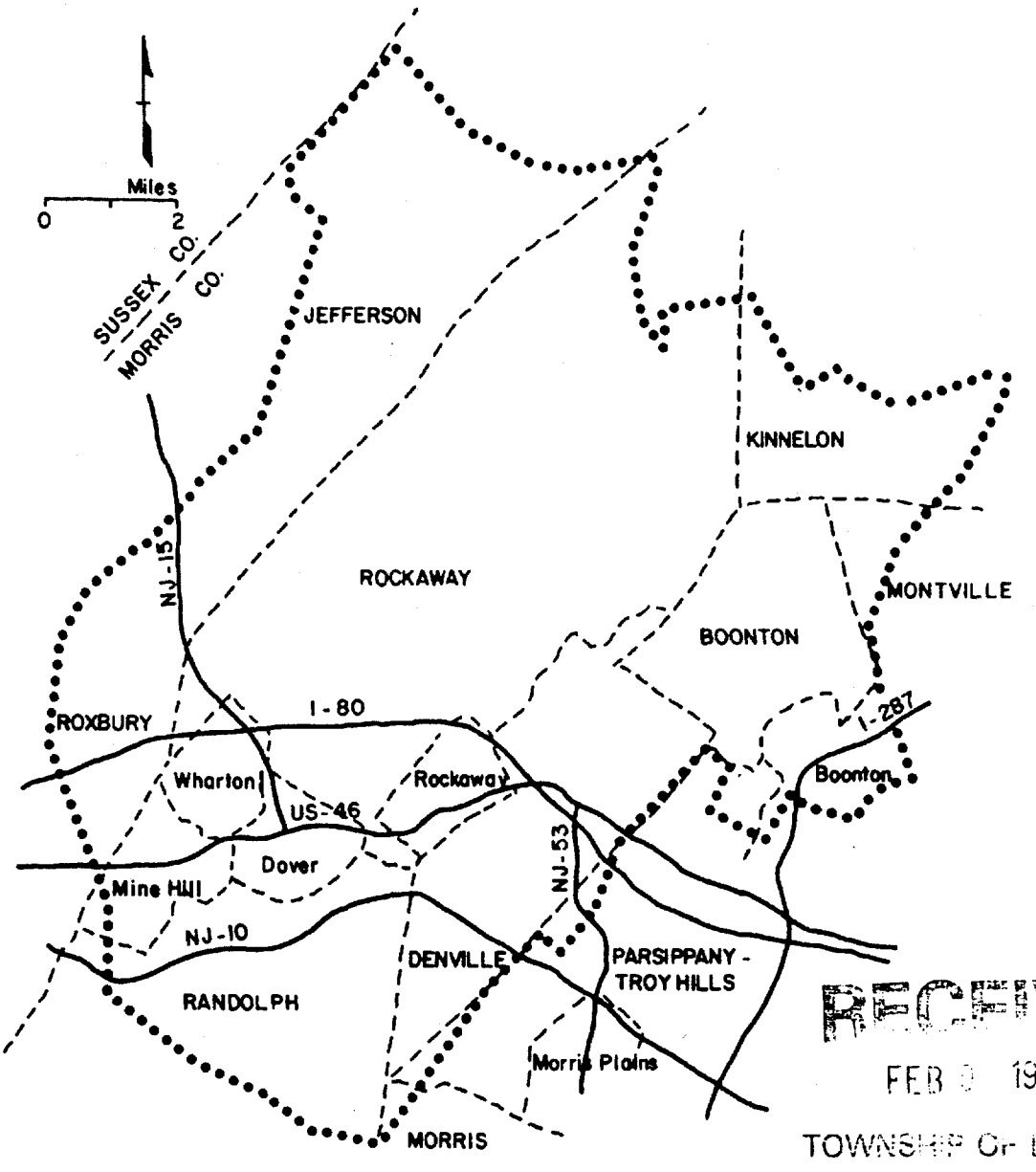
ML000812E

201 FACILITY PLAN

MORRIS COUNTY, NEW JERSEY

DRAFT

JANUARY 1981



U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10278

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
26 FEDERAL PLAZA
NEW YORK NEW YORK 10278

0 8 JAN 1981

To All Interested Government Agencies, Public Groups, and Citizens:

Enclosed is the draft Environmental Impact Statement on the Upper Rockaway River Basin, New Jersey 201 Facility Plan. This environmental impact statement (EIS) was prepared by the EPA-Region II with the assistance of Wapora, Inc. an environmental engineering consultant.

The EIS investigates alternative wastewater treatment schemes for the study area and addresses the major environmental issues associated with them. The primary concerns addressed in the EIS are: the capacity of proposed treatment facilities, the primary and secondary impacts of projected populations growth, environmental constraints to development, and the protection of sensitive areas. The impacts of each alternative including the selected plan were analysed based on their environmental effects, engineering feasibility, cost effectiveness and the ease of implementation.

The EIS is a decision making document. It is meant to bring together all pertinent information on the issues. Public participation, especially at the local level, is an essential component of the decision making process.

Public participation workshops and Citizen Advisory Committee meetings were held during the preparation of this EIS to insure input from local, county, state and federal representatives. A public hearing has also been scheduled to receive formal comments on the draft EIS. The hearing information is presented below.

March 26, 1981 at 7:30 PM
Boonton Township Municipal Building - Room 1
Powerville Road
Boonton, New Jersey 07005

Your participation at this hearing is encouraged. The public hearing record will be kept open for fifteen days following this hearing should you wish to submit a written statement. Comments should be addressed to Chief, Environmental Impacts Branch, EPA-Region II.

If you need additional information please contact Mr. Robert Raab, Environmental Engineer, New Jersey/Puerto Rico Section, Environmental Impacts Branch, EPA-Region II at (212) 264-0522.

Sincerely yours,

Charles S. Warren
Regional Administrator

Enclosure

DRAFT

ENVIRONMENTAL IMPACT STATEMENT ON THE UPPER ROCKAWAY RIVER BASIN 201 FACILITY PLAN

MORRIS COUNTY, NEW JERSEY

Prepared by:
U.S. Environmental Protection Agency
Region II
26 Federal Plaza
New York, New York 10278

Approved by:

Charles S. Warren
Regional Administrator
January, 1981

ENVIRONMENTAL IMPACT STATEMENT
ON THE UPPER ROCKAWAY RIVER BASIN
201 FACILITY PLAN
MORRIS COUNTY, NEW JERSEY

SUMMARY

DATE: September, 1980

TYPE OF STATEMENT: Draft

RESPONSIBLE FEDERAL AGENCY: U.S. Environmental Protection Agency (EPA) Region II

TYPE OF ACTION: Administrative

1. DESCRIPTION OF THE PROPOSED ACTION AND RECOMMENDED PLAN

1a. Recommended Plan

This project involves the construction of sewage treatment facilities in the Rockaway Valley Facilities Planning Area (RVFPA). The recommended plan includes:

Jefferson Township

Local collection and treatment for the Lake Swannanoa and Cozy Lake areas and creation of a septic management district (SMD) for Jefferson Township, with initial implementation in these two lake areas are alternatives that are feasible and have comparable environmental and economic impacts. A detailed analysis for selection of one of the two approaches should be done in the detailed 201 facilities planning for this part of the RVFPA.

Upper Rockaway Township

Similarly, local collection and treatment for the Green Pond and Lake Telemark areas and creation of an SMD for Rockaway Township, with initial implementation in these two lake areas, are feasible alternatives for Upper Rockaway Township. Environmental and economic impacts are comparable and selection of an alternative should be based on analysis in facilities planning for the area.

Areas Served by RVRSA Interceptor

The construction of three branch interceptors for these areas (Rockaway, Randolph, and Mine Hill townships; Dover Town; and Victory Gardens Borough), with connection to the Rockaway Valley Regional Sewerage Authority (RVRSA) plant, is recommended for implementation. The alternative routings selected to minimize environmental impacts are:

- Jackson Brook Branch Interceptor Alternative B.
- Oak Street Branch Interceptor Alternative A.
- Mill Brook Branch Interceptor Alternative A.

Other RVRSA Municipalities

No action is recommended with respect to the other municipalities in the RVFPA (Boonton Town, Rockaway, Wharton, Kinnelon, and Mountain Lakes boroughs; and Boonton, Montville, Parsippany-Troy Hills, and Roxbury township). These municipalities are either already sewerd or have adequate on-lot systems-- in which case no new facilities are required--or are only partially contained in the RVFPA and do not have population densities which would necessitate sewering. Decisions for wastewater treatment in these latter areas should be based on more detailed 201 facilities planning on a municipality basis.

DRAFT
ENVIRONMENTAL IMPACT STATEMENT (EIS)
ON THE UPPER ROCKAWAY RIVER BASIN
NEW JERSEY 201 FACILITY PLAN
MORRIS COUNTY, NEW JERSEY

January 1980

Prepared by:

U.S. Environmental Protection Agency
Region II
New York, New York 10278

Abstract: This EIS addresses major issues concerning primary and secondary impacts. Population projections were generated which reflect the preservation of environmentally sensitive areas. These projections were a result of an environmental constraints analysis which defined developable lands by deleting sensitive areas from the total land of the planning area. Potential undevelopable areas were plotted and alternative wastewater treatment schemes were introduced. The impacts of each alternative including the selected plan were then analyzed based on their environmental effects, engineering feasibility, cost effectiveness and the ease of implementation. It was determined that only three branch interceptors would be required, a major reversal from original 201 facilities planning which proposed numerous lengthy branch interceptors traversing much of the study area. These segments will hook up to the existing regional interceptor which was built in 1976 and designed to accommodate large future flows. It has been estimated that flows for the year 2000 being treated at the Rockaway Valley regional wastewater treatment plant will be 43,900 cubic meter/day [11.6 million gallons per day (mgd)]. This is consistent with an EPA Step II grant (C-34-38902) which provided funds for the design of a 45,400 cu m/d (12 mgd) advanced wastewater treatment plant expansion awarded in June of 1980. The EIS indicates that there appears to be no need for any future expansions of the plant, this is contrary to original facility planning which slated a 45,400 cu m/d (12 mgd) plant for the year 1987 with the potential for future expansions by the addition of 13,100 cu m/d (4 mgd) modules. The proposed branch interceptors will service highly developed areas adjacent to the regional interceptor. Small community wastewater systems and the creation of septic management districts have been proposed for areas of limited septic tank failure and/or lesser population density. The ultimate constrained (development not permitted in environmentally sensitive areas) population for the planning area is projected to be 157,990. The year 2000 projection is 136,590. Water supply, originally thought to be the major constraining factor to future development, has been shown to be sufficient to support the projections shown in the EIS. Areas identified as environmentally sensitive, wetlands and floodplains will be protected from future development by denial of future sewer hook ups from new development in these areas. Future 201 grants given in the planning area will be subject to the recommendations and conclusions presented in the final EIS.

Public Hearing:

March 26, 1981 at 7:30 PM
Boonton Township Municipal
Building - Room 1
Powerville Road
Boonton, New Jersey 07005

Contact for Information:

Mr. Robert Raab
EPA - Region II
26 Federal Plaza - Room 400
New York, New York 10278
(212) 264-0522

Approved by: Charles S. Warren January 8, 1980

Charles S. Warren
Regional Administrator
EPA - Region II

Date

1b. Environmental Impacts

Primary Impacts

In general, adverse environmental impacts from the implementation of the proposed alternatives will be construction related, temporary, and minimal. Removal of vegetation and disruption of soils may lead to dust and soil erosion, as well as turbidity and siltation in streams and wetlands. These adverse effects can be minimized if appropriate mitigating measures are employed. Construction in or adjacent to stream corridors or wetlands should be scheduled for the fall in order to minimize bank erosion and harm to fish populations.

There is only one long-term adverse impact which will result from implementation of the recommended plan. A portion of the non-contiguous wetland adjacent to Rockaway Road at the Rockaway River in Randolph Township will be destroyed by construction of either Mill Brook alternative.

The long-term beneficial impact to those areas in which an action will be taken is to improve surface water quality and to provide adequate wastewater treatment service to the population served by the RVRSA.

Secondary Impacts

The Jackson Brook branch interceptor is the only selected alternative that is in an area expected to have appreciable population increases to the year 2000. The principal effect of this growth will be an increase in impervious surfaces, which may result in increased flood flows and non-point source pollution. Induced population growth may cause development pressures on wetlands, floodplains, and steep slopes. Judicious land use planning and zoning ordinances can prevent adverse impacts to these sensitive areas.

2. AREAS OF CONTROVERSY

Since 1968 a series of judges of the Chancery Division of the Superior Court have administered a limited ban on sewer connections to the RVRSA system. Local authorities do not have the power to grant permits, but must make recommendations to the court. Each time a connection is permitted, a reduction is made in the amount allocated to the permittee's municipality. Although some growth has occurred in the RVFPA since the inception of the ban residential development has been substantially curtailed.

In 1979 EPA issued a notice of intent to prepare an environmental impact statement (EIS) on the RVRSA Facilities Plan. Among the issues identified at that time were the protection of environmentally sensitive areas, water supply, proper phasing and placement of branch sewers, identification of areas suitable for on-site disposal methods, evaluation of effect of increased storm water run-off and population growth, and the reduction of water quality and aquifer recharge.

3. ISSUES TO BE RESOLVED

Among the issues that were not resolved by this EIS are implementation of SMDs or local collection and treatment for the Lake Swannanoa and Cozy Lake areas of Jefferson Township and for the Green Pond and Lake Telemark areas of Rockaway Township. Both alternatives have comparable environmental and economic impacts for these areas. Alternative selection should be based on detailed facilities planning.

In addition, decisions on wastewater treatment for those municipalities described under "other RVRSA municipalities" should be based on more detailed future facilities planning.

4. ALTERNATIVES CONSIDERED

4a. Conceptual Alternatives

The conceptual alternatives considered were:

- No action. (However, the existing facility would be expanded to a 45,400 cu m/d (12 mgd) plant, and the 79,500 cu m/d (21 mgd) trunk interceptor would be constructed.).
- Construction of additional branch interceptors (beyond those proposed in the Facilities plan).
- Construction of municipally owned and operated local wastewater treatment plants with disposal by land application.
- Institution of septic management districts (SMD's).
- Use of Clivis-Multrum and other waterless toilet systems.

The alternatives eliminated at the conceptual level were: no action, construction of additional branch interceptors, and use of Clivus-Multrum and other waterless toilet systems.

4b. Feasible Alternatives

The feasible alternatives that were evaluated included construction of branch interceptors, centralized treatment at local wastewater treatment plants, and creation of SMD's.

Jefferson Township

- Construction of municipally owned and operated local wastewater treatment plant with disposal by land application for the Longwood Valley area (Lake Swannanoa and Cozy Lake). This system would include collection of septic tank effluent by pressure sewers, conventional aerobic treatment, and disposal by land application.
- Creation of an SMD for the Longwood Valley area.

Upper Rockaway Township

- Collection and local treatment for Lake Telemark area with disposal by land application.
- Creation of an SMD for Lake Telemark area.
- Treatment of Lake Telemark area by RVRSA including construction of interceptor.
- Collection and local treatment for Green Pond area, with final disposal by land application.
- Creation of an SMD for Green Pond area.

Areas Served by RVRSA Interceptors

- Connection to RVRSA Plant

  Construction of the Jackson Brook Branch Interceptor (two alternative routes).

  Construction of the Oak Street Branch Interceptor.

  Construction of Mill Brook Branch Interceptor (two alternative routes).

No feasible alternatives were evaluated for any of the other RVRSA municipalities. These municipalities are either already sewered or have adequate on lot systems, in which case no new facilities are required, or are only partly contained in the RVFPA and do not have population densities which would necessitate sewering. In this latter case, wastewater treatment facilities should be evaluated based on detailed facilities planning on a municipality basis.

5. MAJOR CONCLUSIONS

5a. Effects of Population Growth on Flows at the RVRSA Treatment Plant

The initial concept for wastewater treatment planning in the RVFPA was for the construction of a large interceptor system with a central plant. This concept has been revised significantly to incorporate small-scale systems--which is consistent with EPA policy--as well as to provide centralized treatment for only a portion of the RVFPA. Many municipalities which were originally planned to be entirely sewered will either not be sewered or only partially sewered (e.g., Jefferson Township).

Population and flow projections indicate that the capacity to which the RVRSA plant is currently being expanded, 45,400 cu m/d (12 mgd), will not be exceeded until after the year 2000. This 45,400 cu m/d (12 mgd) design capacity was originally planned for 1987.

Further expansion of the plant beyond 45,400 cu m/d (12 mgd) should not be contemplated at this time. In fact, if future development is planned in accordance with environmental constraints, and water conservation measures for new development as implemented, there may be no need for any expansion of the plant. This will have to be evaluated in future 201 facilities planning.

5b. Areas Where Intercertors Are Not Necessary

Analyses of alternatives concluded that interceptor sewers were not feasible for the Longwood Valley area (Lake Swannonoa or Cozy Lake) of Jefferson Township or for the Green Pond and Lake Telemark areas of Rockaway Township. The remaining municipalities in the RVFPA (Boonton town; Rockaway, Wharton, Kinnelon, and Mountain Lakes boroughs; and Boonton Montville, Parsippany-Troy Hills and Roxbury townships) are either already sewered--in which case no facilities are required--or are only partially contained in the RVFPA.

The recommended method of treatment for these areas is either local collection and treatment or SMDs. The final decision on method should be based on detailed facilities planning. No action is recommended for the remaining areas in the RVFPA.

5c. Controlling Development in Environmentally Sensitive Areas

Population projections were developed based on consideration of environmentally sensitive areas and existing zoning.

Zoning regulations for municipalities in the RVFPA should be modified to protect environmentally sensitive lands--delineated in the Draft Environmental Impact Statement (DEIS)--from indiscriminate development.

Specifically, the following areas should be protected:

Environmental Constraint Category	Total Open Land hectares (acres)
Steep Slopes	3,940 (9,750)
Floodplains	570 (1,400)
Wetlands	1,100 (2,720)
Historic Sites	20 (60)
Prime Aquifer Recharge Areas	320 (790)
Prime Agricultural Lands	40 (100)

In order to protect wetlands and floodplains from development, EPA Step 2 and Step 3 grants to the municipalities should contain conditions. These conditions include the following:

- The grantee shall submit to EPA and the New Jersey Department of Environmental Protection (NJDEP) an approvable facilities plan amendment, including maps that clearly delineate all specific vacant parcels of land which are partially or wholly within the 100-year floodplain as defined by the U.S. Department of Housing and Urban Development (USDHUD), or within wetlands as defined by the U.S. Fish and Wildlife Service (USFWS).

- The grantee shall agree that for a period of 50 years no sewer hookup to the facilities included in the scope of the grant will be permitted within presently undeveloped wetlands or floodplains designated in this EIS unless approved by the EPA Regional Administrator.

- This condition is intended to benefit any person, private organization, or governmental entity which may have an

interest in the avoidance of future development in the designated areas. Any such beneficiary may seek to enforce compliance in the courts of the State of New Jersey. Notice of intent to seek such enforcement must first be given to the EPA Regional Administrator, the NJDEP, the grantee and affected governmental entities.

- If the EIS delineates any vacant parcels which will be affected by this special condition, the grantee will conduct a public hearing within 60 days of submission.

The New Jersey State Public Advocate has initiated a lawsuit charging 27 Morris County municipalities with perpetuating exclusionary zoning policies. The RVFPA municipalities named in the suit are the boroughs of Kinnelon and Mountain Lakes and the townships of Boonton, Denville, Jefferson, Montville, Parsippany-Troy Hills, Randolph, Rockaway, and Roxbury.

Part of the nature and intent of this environmental impact statement (EIS) is to determine what portions of the RVFPA have environmentally sensitive areas. In so doing, it is hoped that these areas will remain undeveloped. However, this analysis is not intended to be a statement concerning development impacts on other areas. Specifically, it is not a statement that growth cannot occur in non-sensitive areas.

The analysis regarding future growth was dependent on two factors:

- Environmental constraints in various sensitive areas, and
- Existant zoning in non-sensitive areas.

5d. Water Supply

During periods of average usage the water districts in the RVFPA pump from only a few wells, reserving surplus capacity for peak and emergency needs. Estimates based on well records of the maximum yield for each purveyor's wells indicate that the RVFPA would be able to support in excess of the maximum constrained saturation population of 157,990, if:

- Existing basin surpluses could be fully utilized and evenly distributed.
- Interbasin transfers are retained at existing levels.
- No new in-basin sources are developed.
- Present usage remains the same.

However, this surplus is not evenly distributed throughout the basin. A water distribution system must be developed or the growth rate in the RVFPA will be slowed until such a system exists.

5e. Cost to Users

The per household cost of implementing and maintaining the selected plan is as follows:

Jefferson Township

1.	Local Collection and Treatment	
	Lake Swannanoa	$290[1]
	Cozy Lake	305[1]
	Lake Swannanoa/Cozy Lake	250[1]
2.	SMD	100

Upper Rockaway Township

1.	Local Collection and Treatment	
	Green Pond	$280[1]
	Lake Telemark	285[1]
2.	SMD	100

Areas to be Served by RVRSA Interceptor

Jackson Brook (Alternative B)	$88 (67)[2]
Oak Street (Alternative A)	88 (67)[2]
Mill Brook (Alternative A)	88 (67)[2]

Note:
1. Annual cost per household based on 75 percent federal grants.
2. 1980 cost (year 2000 cost)

5f. Mitigating Measures

In general, unavoidable impacts from the implementation of the proposed alternatives will be construction related, temporary, and minimal. The only unavoidable, adverse impact will be the destruction of some noncontiguous wetland by the implementation of either Mill

Brook alternative. Construction activities may cause removal of vegetation, disruption of soils, erosion, increased surface runoff, and turbidity and siltation in adjacent streams, lakes, and wetlands. Other temporary effects include noise and dust generated during construction activities.

Erosion during and after construction can be minimized by immediate revegetation and mulching. Contractors should follow New Jersey Department of Environmental Protection (NJDEP) guidelines for construction of interceptor sewers (1978). Stream crossings should be scheduled for the fall to minimize harm to fish populations. Appropriate techniques should be employed to minimize stream bank erosion.

Periodic sweeping of and wetting down the construction site will minimize air pollution effects. Noise effects can be minimized by using muffled equipment and by scheduling construction only during daylight hours.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES

CHAPTER 1

PURPOSE ANC NEED

The Rockaway Valley Facility Planning Area (RVFPA) is within Morris County in northeastern New Jersey, approximately 56 kilometers (35 miles) west of northern Manhattan and 32 km (20 mi) west of downtown Newark (Figure 1-1). The RVFPA contains 16 municipalities encompassing an area of approximately 329 square kilometers (127 square miles). Approximately 95 percent of the entire planning area is within the Upper Rockaway River Watershed. The southern third of the RVFPA is suburban, in character, while the northern two-thirds are rural and virtually undeveloped. An exception is one section of Jefferson Township in the northwest corner of the study area.

On November 29, 1971 nine municipalities formed the Rockaway Valley Regional Sewerage Authority (RVRSA). Currently, the RVRSA has wastewater management planning authority over the entire RVFPA but only assumes operational responsibility for those areas of the RVFPA presently connected to its wastewater treatment system. As a result of a settlement signed earlier by the municipalities and Jersey City ending litigation initiated by the city in 1968, the RVRSA assumed all the responsibility to provide sewage treatment in accordance with New Jersey state standards. A summary of the legal history that led to the creation of the RVRSA can be found in Table A-7.

Since first assuming jurisdiction over the matter in 1968, the Chancery Division of the Superior Court has retained jurisdiction. A series of judges have personally administered a limited ban on sewer connections to the RVRSA system, with some flow allocations being made available to municipalities. Local authorities do not have the power to grant permits, but must make recommendations to the court. Each time an order is signed to permit a connection, an appropriate reduction is made in the amount allocated to the municipality in which the permitee is located. Although growth has occurred in the RVRSA member municipalities since the inception of the ban, residential development has been substantially curtailed for the past ten years.

In 1979, EPA identified major issues associated with the draft Facilities Plan and issued a notice of intent to prepare an environmental impact statement for the RVFPA Facilities Plan. Among the issues identified at that time were:

- The inability of local land use regulations to protect environmentally critical and sensitive lands from development.
- The adequacy of water supply to serve the proposed population.
- Phasing and placement of branch sewers to reflect need priorities for sewering.

- Delineation and maintenance of areas capable of being served by on-site disposal methods.
- Potential adverse impacts of additional non-point source pollution and increased flooding from increased storm water run-off.
- Potential socioeconomic impacts associated with the size and distribution of the additional population.
- The reduction of water quantity from a combination of excessive consumption and reduced recharge resulting from the development of recharge areas.

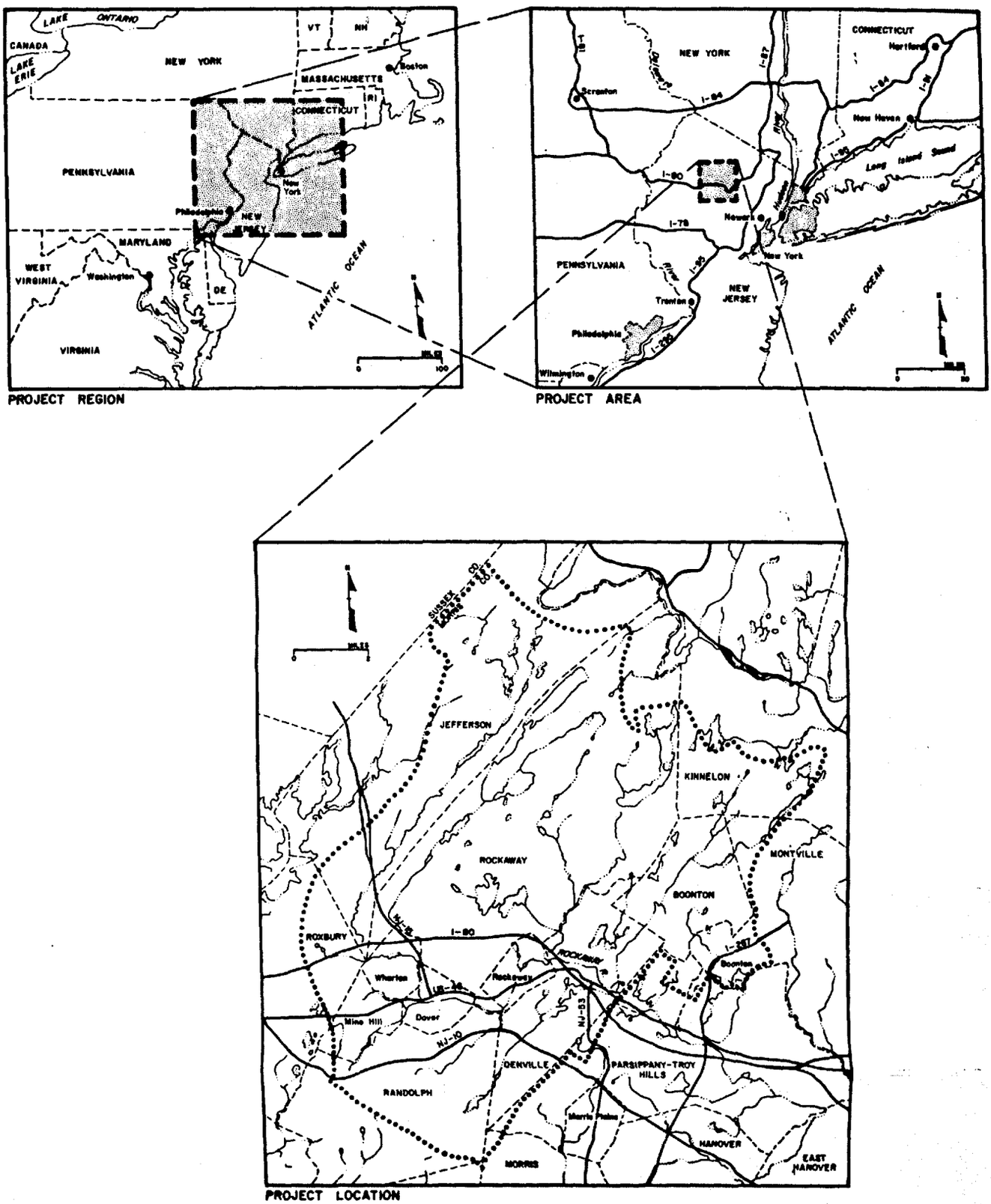


FIGURE I-1 GENERAL LOCATION

Chapter 2

ALTERNATIVES, INCLUDING PROPOSED ACTION

1. INTRODUCTION TO ALTERNATIVE CONSIDERATIONS

The development and selection of alternatives for wastewater treatment is a multi-step process consisting of the following steps:

- Development and analysis of conceptual alternatives. Conceptual alternatives represent overall approaches to wastewater treatment in the facilities planning area. These conceptual alternatives are presented in Table 2-1. The result of the analysis of conceptual alternatives is that some may drop out as not feasible, while others may be developed in more detail.

- Development and analysis of feasible alternatives. In this step detailed alternatives are developed and evaluated. The end result of this step is one or more alternatives which can be implemented without significant environmental problems.

- Selection of implementation plan. Based on further analysis, a recommended plan is selected.

At all levels of alternatives analysis, alternatives are evaluated with respect to environmental constraints, engineering criteria, and cost and resource criteria.

1a. Environmental Constraints

Environmentally sensitive areas within the RVFPA are identified and described in Chapter 3. During the evaluation of alternatives particular attention has been directed to the impacts posed to areas such as wetlands, steep slope areas, endangered and threatened species, national historic sites, and any unique natural areas. Those plans which have significant adverse overall effects can generally be eliminated from further feasibility review, unless overriding environmental benefits are thus foregone.

Table 2-1

Conceptual Alternatives

- No Action
- Alternatives for the upper portion of RVFPA (upper Rockaway and Jefferson Townships)
  - Branch Interceptor
  - Municipally Owned Wastewater Treatment Plants
  - Local Septic Management Districts
- Alternatives for the lower portion of RVFPA (Rockaway, Randolph, and Mine Hill townships, Dover Town, and Victory Gardens Borough)
  - Connection to RVRSA Plant
    - Green Pond Brook Branch Interceptor
    - Oak Street Branch Interceptor
    - Jackson Brook Branch Interceptor
- Alternatives for Remaining Municipalities
  - Municipalities with Existing or Anticipated RVRSA Service: Boonton Town, Rockaway and Wharton boroughs, and Boonton and Montville townships have existing sewer systems with RVRSA service. In addition, it is anticipated that a small portion of Montville Township will be served in the future via the Boonton Township local collection system. No branch interceptor construction is proposed for these areas.
  - Municipalities Partially Included in the RVFPA: Only portions of Kinnelon and Mountain Lakes boroughs and Parsippany-Troy Hills and Roxbury townships are included in the RVFPA. Wastewater management for these municipalities should be addressed in facilities planning for the entire municipality.
- Other Alternatives
  - Clivus-Multrum and Other Waterless Toilet Systems

1b. Engineering Criteria

Engineering criteria are used to provide adequate engineering design and construction for branch interceptors, force mains, and pumping stations at reasonable costs. Wherever possible, the criteria are used to minimize the need for costly complex construction techniques. The alternative plans which require significant and obviously costly complex design and construction methods can generally be eliminated from further consideration.

1c. Cost and Resource Criteria

Rough cost estimates are prepared for each of the alternative plans. Those plans with excessively high costs can generally be eliminated from further consideration if other alternatives exist. Costs for construction and operation of wastewater collection systems are based on several sources. Construction costs for the collection system branch interceptors, pump stations, and force mains are based on Construction Costs for Wastewater Conveyance Systems (EPA, 1978d) and on costs developed by Killam Associates (Platt, Killam Associates, May 23, 1980). Construction and operation costs for proposed local centralized wastewater treatment and disposal facilities are based on Appendix H of the Areawide Assessment Procedures Manual (EPA, 1976a). These costs have been adjusted for increases in construction costs due to inflation and for regional differences in construction costs.

2. ANALYSIS OF CONCEPTUAL WASTEWATER MANAGEMENT ALTERNATIVES

2a. No Action

The RVRSA Wastewater Treatment Plant, built in 1922, had an original design capacity of 13,250 cubic meters per day (3.5 million gallons per day). Since 1922 the plant has been modified four times to increase the capacity and to improve treatment efficiency to the present design peak flow of 34,000 cu m/d (9 mgd) with modified secondary treatment (Killam, 1977). The RVRSA has been responsible for the operation of this wastewater treatment facility since 1977. The wastewater treatment facility, in general, is currently meeting its initial National Pollutant Discharge Elimination System (NPDES) permit limitations for discharge but cannot meet its final effluent requirements and is therefore under an Enforcement Compliance Schedule Letter from EPA (Table A-8).

The RVTPA is not completely sewered (the existing sewered areas are in the southernmost third of the study area). Those general areas

within the RVFPA that are permanently sewered and in service are shown on Figure 2-1.

Under the no action alternative, no branch interceptors would be constructed. However, the existing facility will be upgraded and expanded to a 45,420 cu m/d (12 mgd) plant under a Step 3 Facilities Construction Grant (not part of this EIS), and the 79,500 cu m/d (21 mgd) trunk interceptor (not part of this EIS) already under construction will be completed. The treatment facilities will include advanced waste treatment.

The existing state bans on sewer extensions and new connections for some municipalities in the RVFPA would continue to be enforced. New development in the basin would continue using septic systems or package treatment plants to provide the necessary wastewater treatment. However, the soil limitations for septic systems preclude their use in large portions of the study area (see Figure 4-2).

The no action alternative is not viable in the RVFPA because of the current building bans and because of the economic losses that would occur if proper utilization of the new plant and trunk interceptor was not realized.

2b. Alternatives for the Upper Portion of RVFPA

Branch Interceptor

This alternative involves construction of a branch interceptor to serve the existing population centers within Jefferson Township and the upper portion of Rockaway Township. This branch will be considered in two stages (Figure 2-2).

The first phase would follow existing sewer routes in Denville from the interceptor trunk sewer to Green Pond Road, then follow the Green Pond Road right-of-way (ROW) to Lake Telemark, providing service for the Hibernia and Lake Telemark areas. This branch would be approximately 6.4 km (4 mi) long. The lower portion of this interceptor would possibly be funded by Hewlett-Packard as part of their ongoing expansion program. The corporate management had agreed to this, but the decision was deferred until completion of this EIS. The cost to the local community of providing collection from the Lake Telemark area to the Hewlett-Packard Interceptor would be roughly comparable to the costs of local waste management, so this remains a feasible alternative.

The second phase would continue along the Green Pond Road ROW from the Lake Telemark area to the Green Pond area and then cross Green Pond mountain to Border Road following the Border Road ROW to the White Rock Lake area. This second phase would provide service to the Marcella, Green Pond, and Longwood Valley areas. The second phase branch would be approximately 11.3 km (7 mi) long and require six

FIGURE 2-1
SEWERED AREAS

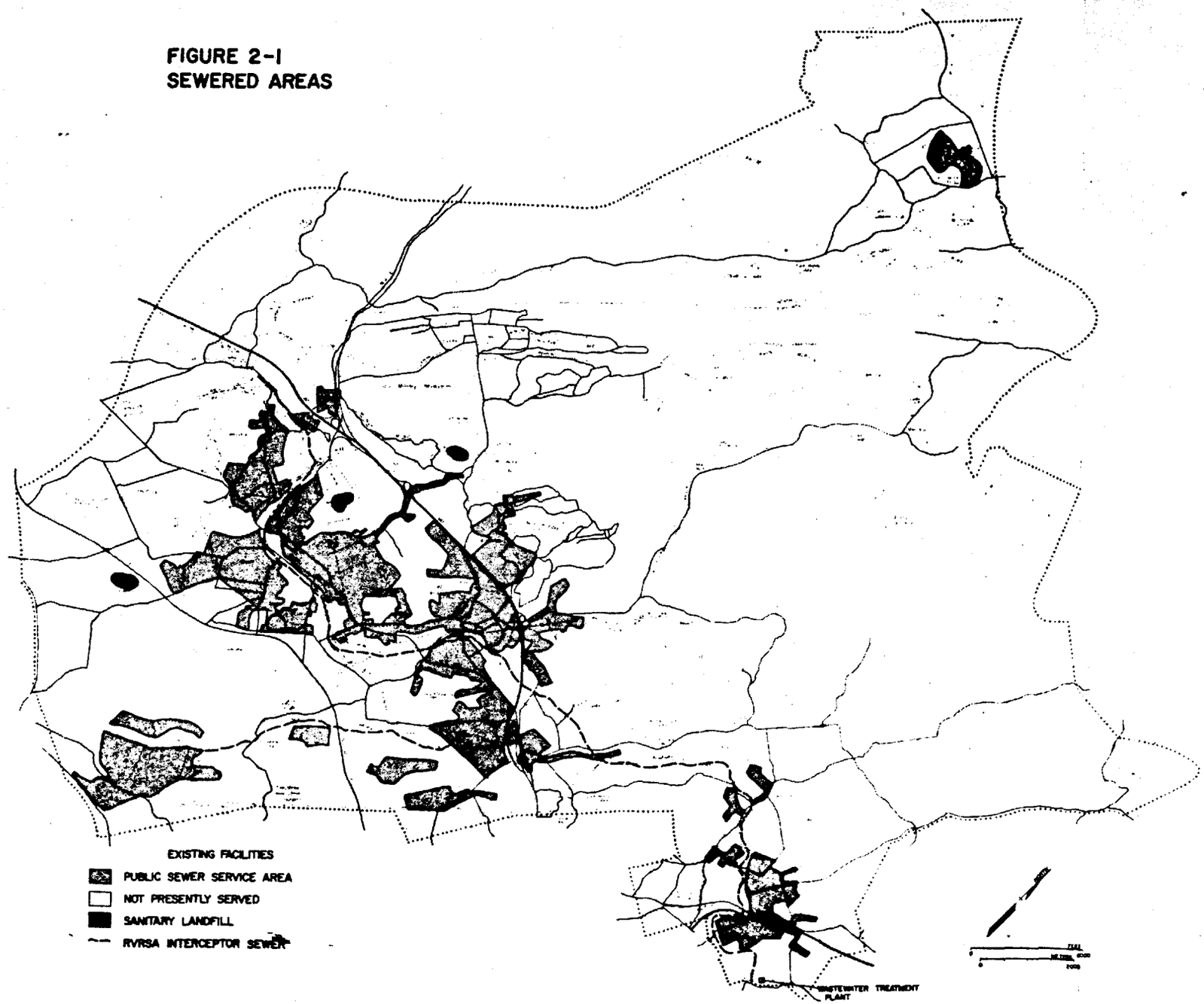
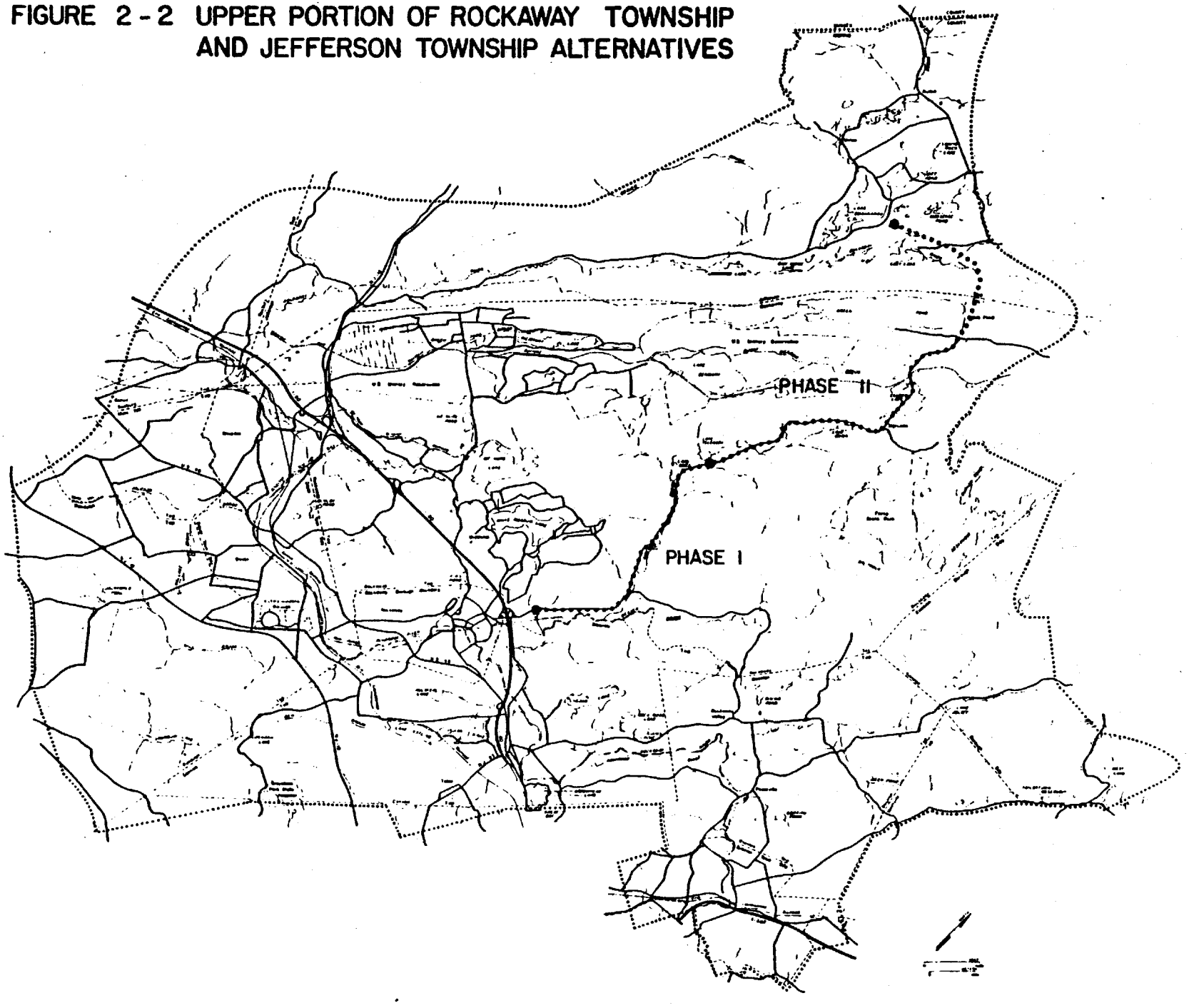


FIGURE 2 - 2 UPPER PORTION OF ROCKAWAY TOWNSHIP AND JEFFERSON TOWNSHIP ALTERNATIVES



regional level pump stations. Sizing for this interceptor alternative is based only on flows from areas now eligible for collection and treatment under PRM 78-9 (EPA, 1978c). The construction of this extension to the interceptor above Lake Telemark would require rock excavation along the majority of the route, and the construction costs, including the pump stations, would be approximately five million dollars. For the Green Pond and Jefferson Township communities, this alternative is neither cost-effective nor environmentally sound (due to construction and secondary impacts) in comparison to local treatment and thus will not be pursued.

Municipally Owned Wastewater Treatment Plants

Three areas have been identified as being eligible for provision of local centralized treatment (Figure 2-3). Figure 2-3 highlights these areas as "generalized municipally owned wastewater treatment plants service areas". This figure also depicts existing facilities and service areas, future branch interceptors, and future generalized service areas for branch interceptors. The arrows on this figure represent those areas where sewer service is expected by the year 2000. The Longwood Valley area in Jefferson Township and the Green Pond and Lake Telemark areas of Rockaway Township have reported problems with existing septic systems and exceed the population density criterion of 25 persons per hectare (10 persons per acre) used in the EPA Program Requirements Memorandum (PRM) 78-9 (EPA, 1978c) as the presumptive test for centralized treatment.

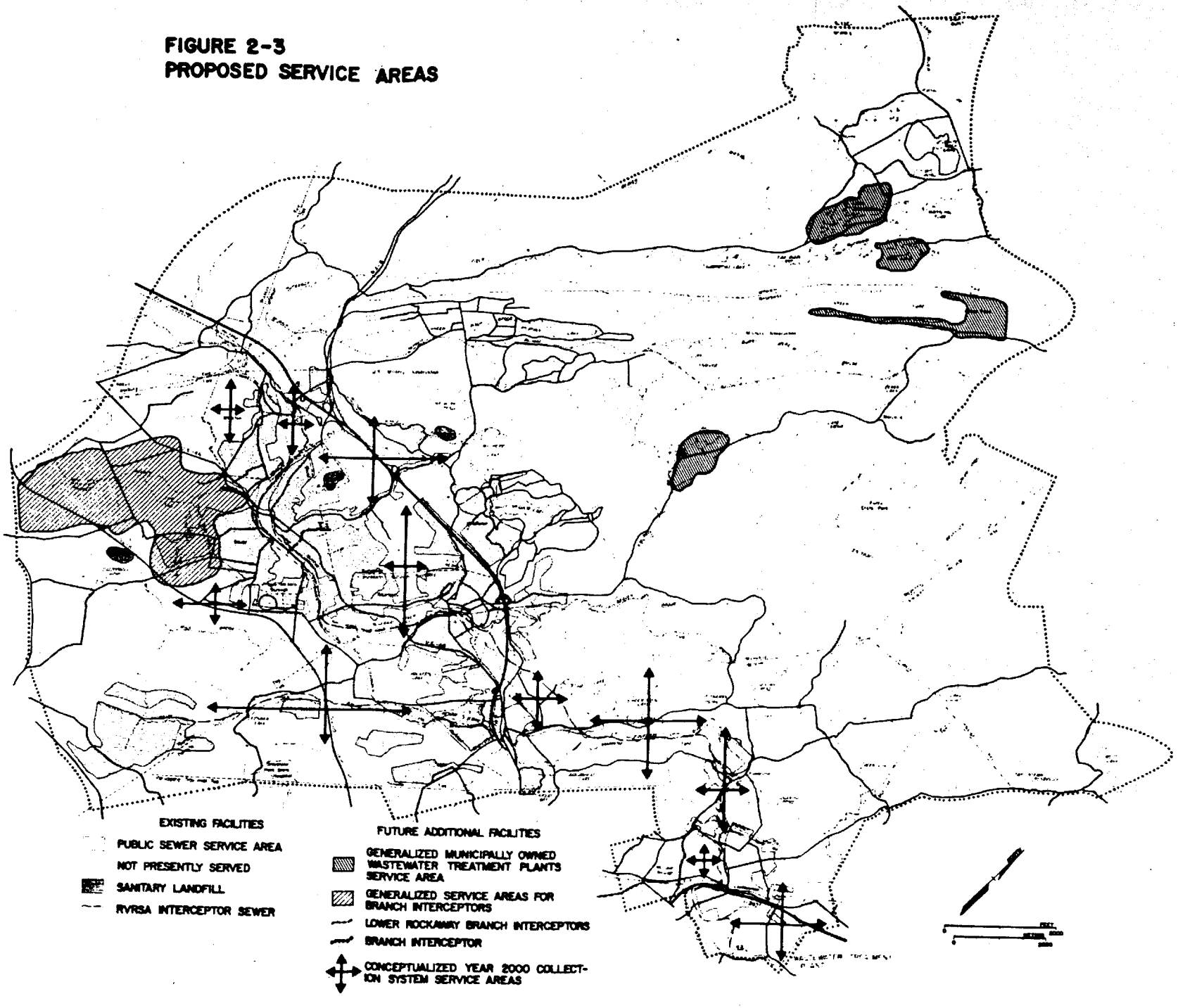
Two high-density areas in the RVRSA portion of Jefferson Township (Lake Swannanoa and Cozy Lake) were identified as possibly requiring centralized wastewater management and as definitely meeting the density criterion. House counts for these two areas showed total residences, populations, and expected flows including:

Lake Swannanoa: 400 homes with 1,280 residents, 365 cu m/d (0.1 mgd)

Cozy Lake: 220 homes with 544 residents, 115 cu m/d (0.03 mgd)

For the Green Pond and Lake Telemark areas of Rockaway Township, the expected population is also based on house counts for the high-density areas. The growth in the township should not affect these areas which are essentially completely developed. Using house counts and the 1970 population per household projections by the United States Bureau of the Census (USBC), populations and flows are:

FIGURE 2-3
PROPOSED SERVICE AREAS



Green Pond: 360 homes with 1,220 people, 350 cu m/d (0.09 mgd)

Lake Telemark: 350 homes with 1,190 people, 340 cu m/d (0.09 mgd).

This is a feasible alternative which will be analyzed further.

Local Septic Management Districts

An alternative for wastewater disposal within the RVTPA would be the development and use of septic management districts (SMDs). An SMD is a defined political area in which the use, operation, and maintenance of septic tanks or other small wastewater disposal systems (e.g., community mound systems or small treatment plants with land application) would not be the responsibility of the home owner but rather the responsibility of appointed or elected SMD personnel. The SMD would ensure that the system would operate correctly to treat the wastewater, create and supervise a sludge removal and disposal schedule, and levy and collect fees for this service.

The EPA policy to encourage and, where possible, assist in the development of innovative and alternative technologies for the construction of treatment work is stated under 40 CFR 35.909. Projects, or portions of projects which the EPA Regional Administrator determines meet the criteria for innovative and alternative technology may receive 85 percent grants. This increased funding applies only to publicly-owned facilities rather than to privately-owned systems. Through regulations promulgated pursuant to the Clean Water Act, EPA has provided guidance concerning the requirements for eligibility for construction grant funding of an SMD. Under federal regulations (40 CFR 35.918) the terms used in Section 201(h) of the Act are defined. "Individual systems" includes not only septic tank systems, but also any wastewater treatment works (such as dual waterless/gray water systems) which are neither connected into or a part of any conventional treatment works.

Any authority for the establishment of septic system management programs must be implied from the New Jersey State statutes by interpretation, because the laws do not specifically authorize this type of management program. However, some of the broadest authority in New Jersey for water pollution control is vested in sewerage authorities and municipal utility authorities (NJDEP, 1979b). These statutes essentially lay the groundwork allowing regional sewerage authorities such as the RVRSA to establish an SMD without additional legislation. The laws also provide potential for the collection of rents, rates, fees or other charges for direct or indirect connection with, or the use of services of, the sewerage system (NJDEP, 1979b). In addition, sewerage authorities have the power to approve or disapprove the construction of any facilities for the collection, treatment, or disposal of sewage arising within a district.

A second possible arrangement for septic system management would be for the RVRSA to organize an SMD to monitor operations of the local health departments. This approach would make use of periodic reports of activities such as inspections, replacement of system components, pumpouts, and other pertinent topics. The oversight role of the RVRSA in this case would include designation of testing and recordkeeping procedures. One benefit of this arrangement would be that the RVRSA could require that septage disposal be at the RVRSA plant, and from comparing pumpout records with deliveries of septage to the plant, thereby minimize illegal discharges by septic tank cleaners. Thus, the use of SMDs for the less developed portions of the RVFPA is a viable alternative that will be considered later in this chapter.

Any recommendations regarding creation of SMDs in the RVFPA would have to be consistent with the statewide scheme for SMDs being prepared by the state of New Jersey. Furthermore, details regarding the systems to be used, management, and costs would have to be developed in the 201 facilities planning activity for the municipalities.

Approximate costs to the homeowner can be summarized as follows (85 percent federal funding for innovative and alternative technologies is available where residences were in place before December 1977):

Construction of a typical septic system	$2,000
Detailed site analysis (including groundwater analysis, percolation tests)	$ 350
Annual Operation and Maintenance (O&M) (assumes pumping, inspection every three years, well sampling every six years)	$ 80
Average Annual Homeowner Cost (including annual O&M, amortization of local share of funding, and 20 percent capital reserve fund	$ 100

2c. Alternatives for the Lower Portion of RVFPA

Lower Portion of Rockaway Township

This alternative includes two branch interceptors to serve the lower section of Rockaway Township. One branch would be in the Green Pond Brook area to serve the Rockaway Mall, Picatinny Arsenal, and any housing units that now have dry sewers (Figure 2-4). The second branch would follow the Oak Street ROW to relieve wet weather overflow conditions in that area.

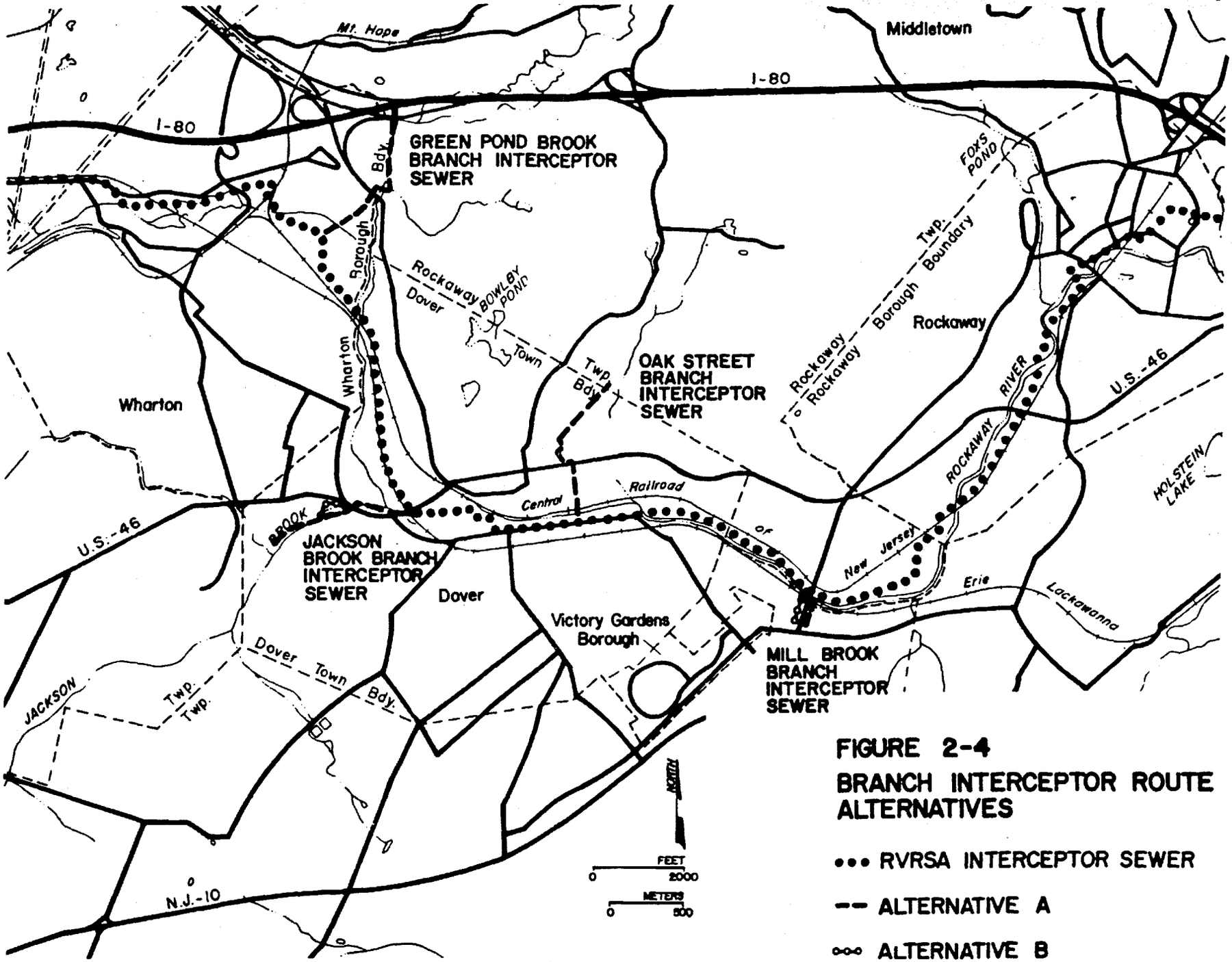


FIGURE 2-4

BRANCH INTERCEPTOR ROUTE ALTERNATIVES

••• RVRSA INTERCEPTOR SEWER

— — ALTERNATIVE A

ooo ALTERNATIVE B

Because the Oak Street Branch Interceptor uses an existing ROW, no alternative alignment is necessary. This branch interceptor is intended to relieve the overloaded local collection system in Dover (Killam, 1978). These feasible alternatives will be discussed further in this chapter.

One provision of Public Law 92-500 (the Water Pollution Control Act Amendments of 1972) requires that two-thirds of the households in a proposed service area be in place before October 18, 1972 in order to obtain federal funding (FPA, 1974). The design capacity of the proposed branch interceptor as presented in the Facilities Plan would accommodate 330 households, and the United States Geological Survey (USGS) map, photorevised in 1970, shows an approximate house count of 113. Because a substantial portion of development in the drainage area occurred after this date (following completion of I-80), the construction of the Green Pond Brook Branch Interceptor can not be done with federal funds.

As an alternative, connection to the Wharton system may be possible after legal restrictions on flow are revised. The combined present theoretical wastewater flow for the two Wharton subareas is 1,550 cu m/d (0.41 mgd) (Killam, 1978), which is below the design flow of the trunk sewer in that area. The additional flow from the projected 330 homes would not significantly increase the Wharton flows so as to exceed the design capacity of the trunk sewer. In addition, development within the eastern portion of the Jackson Brook service area may connect to a sewer line that travels north along Mt. Hope Avenue, terminating just south of the intersection with Mt. Hope Road. This sewer line connects with portions of the Rockaway Township and Dover Town systems. Minor subdivision may also use private package treatment plants or on-site systems. Package treatment plants do not require NPDES permits.

Randolph and Mine Hill Townships, Dover Town, and Victory Gardens Borough

This alternative includes two branch interceptors, one that will serve Randolph and Mine Hill townships and one to serve Randolph Township and Victory Gardens Borough (Figure 2-4). The first branch interceptor would pass through the town of Dover to the Jackson Brook area and would terminate near the border where Dover Town, Mine Hill Township, and Randolph Township meet. This branch will serve Mine Hill and Randolph townships, and collect flows from Randolph that now pass through the Dover sewer system to the RVRSA trunk line (thus benefitting the town of Dover). This is a feasible alternative with two possible routings and will be discussed further.

The second branch interceptor would be in the Mill Brook area of Randolph Township. The routing of this branch has two alternatives. The branch will serve Randolph Township and Victory Gardens Borough.

This is a feasible alternative that will be discussed later in this chapter.

Both of these proposed interceptors are relief interceptors that are required to accommodate existing flows, along with a reasonable increment for future growth. Therefore, the need for these two interceptors is because of overloading (Killam, 1978).

2d. Alternatives for Other Municipalities

The remaining municipalities in the RVRSA facilities planning area (Boonton Town; Kinnelton, Mountain Lakes, Rockaway, and Wharton boroughs; Roxbury, Boonton, Denville, Montville, and Parsippany-Troy Hills townships) either contain adequate on-line systems (e.g., Rockaway Borough) or are only partially contained in the study area and do not have population densities which would necessitate sewering (e.g., Roxbury Township) (Table 2-2). For these latter municipalities wastewater treatment needs should be established on the basis of facilities planning for each municipality in its entirety.

2e. Other Alternatives

The Clivus-Multrum system is not a feasible alternative for existing households because the costs to the individual homeowner are high, the systems are difficult to operate in order to maintain them odor free, and they have a tendency to draw insects during the warmer months. In addition, there would still be a requirement for a system to treat the gray water generated within the house. This alternative will not be considered further.

Other waterless toilet systems may be useful in allowing construction on lots which are currently unable to support septic systems and which cannot be served by a regional or local system. However, such systems may require significant changes in lifestyle and may not be permitted under existing building codes.

2f. Summary of Analysis of Conceptual Alternatives

As a result of the foregoing analysis, the no-action and Clivus-Multrum conceptual alternatives have been eliminated, as well as the construction of branch interceptors beyond those proposed in the facilities plan and the Green Pond Brook Interceptor. Those alternatives remaining include local collection and treatment, SMDs, and construction of the branch interceptors.

Table 2-2

Feasible Alternatives

- Jefferson Township
  - Local collection and treatment for Lake Swannanoa and Cozy Lake Areas
  - Creation of an SMD for Jefferson Township with initial implementation in these two lake areas
- Upper Rockaway Township
  - Local collection and treatment for the Green Pond and Lake Telemark areas
  - Creation of an SMD for Rockaway Township with initial implementation in these two lake areas
  - Construction of a branch interceptor to the Lake Telemark area to allow for waste treatment at the RVRSA Plant
- Areas Served by RVRSA Regional Interceptor
  - Flow to plant

    Jackson Brook Branch Interceptor (two routes)

    Oak Street Branch Interceptor (one route)

    Mill Brook Branch Interceptor (one route)
- Other Communities
  - To be determined on the basis of future facilities planning.

3. ANALYSIS OF FEASIBLE ALTERNATIVES

After analysis of conceptual alternatives, some options were eliminated, leaving several feasible alternatives. The feasible alternatives to be evaluated include alternatives for Jefferson, Rockaway, Randolph, and Mine Hill townships; Dover Town; and Victory Gardens Borough (Table 2-2). The feasible alternatives have been analyzed for costs, energy use and differentiating environmental impacts.

3a. Jefferson Township

The area of the RVRSA portion of Jefferson Township which could require (and be eligible for) sewering is the Longwood Valley area. The developed areas around Lake Swannanoa and Cozy Lake meet the density criteria for local collection systems of 25 per ha--(10 persons per a). At the time of this writing, no data are available on septic system failures in these areas. The alternative to local sewers and centralized treatment is to form an SMD.

Sewering and waste treatment for these areas would require collection, treatment and waste disposal systems. This area is at the headwaters of the Rockaway River, and effluent discharge to surface waters would require Advanced Wastewater Treatment (AWT) in order to comply with state and federal water quality standards. However, as flow decreases below 11,360 cu m/d (3 mgd) land application becomes more cost effective than AWT systems (Pound, and others, 1975). Because the combined project flow from the Lake Swannanoa and Cozy Lakes areas is estimated to be 490 cu m/d (0.13 mgd), the waste disposal system should be orientated towards land application rather than toward AWT. Because of difficult topography, the collection system should be based on use of small diameter pressure sewers which pump septic tank effluent from each household. Because of the complex terrain and small clearances between existing homes, these areas may require additional booster pump stations for collection at a single point.

The complete system for these communities would include collection of septic tank effluent by pressure sewers, conventional aerobic treatment, and discharge to land application. The detailed description of each system is:

- Lake Swannanoa; 400 housing units, 1,280 residents, 365 cu m/d (0.096 mgd) average daily flow based on 303 lpcd (75 gpcd).

- Collection system for 400 units, $2,000 per unit, including effluent pump and small diameter collectors. The cost range (EPA, 1978a) for such systems is $2,000 to $5,000 per household. Because of the high density, the lower cost was used. The capital cost of collection would be $800,000, with an annual operation and maintenance (O&M) cost of about $40,000 per year. The O&M cost includes periodic pumping of existing septic tanks.

- Treatment system for 365 cu m/d (0.10 mgd), with estimated costs of $132,000 for construction (adjusted for 1979 prices) and an annual O&M cost of $15,000 per year (EPA, 1976a).

- Land disposal system for 365 cu m/d (0.10 mgd), requiring about 16 ha (40 a) for storage, application and buffer. The cost would be $151,000 for construction and $200,000 for land. The annual O&M cost would be $22,000.

- Total present worth costs, including salvage value of land, are $2,040,000.

- Annual costs per household, based on 75 percent federal grants, would be $290.

- Cozy Lake: 220 housing units, 544 residents, 115 cu m/d (0.03 mgd) based on 303 lpcd (75 gpcd). Using the same sources and assumptions as for Lake Swannanoa, the expected sizes and costs for local treatment are:

  - The collection system capital cost would be $440,000, with an annual O&M cost of $22,000.

  - The treatment system would have a capital cost of $81,900, with an annual O&M cost of $9,000.

  - The land disposal system capital costs of construction would be $99,000, with $110,000 for land-9.1 ha (22 a)- and an annual O&M cost of $20,000.

  - Total present worth costs are $1,235,000.

  - Annual cost per household based on 75 percent federal grants, would be $305.

If waste flows from the two areas were to be treated at a central facility, the collection, treatment and disposal costs would be:

- The collection system capital costs would be $1,210,000, with an annual O&M cost of $60,500.
- The treatment system would have a capital cost of $189,000 and an annual O&M cost of $17,000.
- The land disposal system capital costs of construction would be $252,000, with $226,000 for land--18.8 ha (45 a)-- and an annual O&M cost of $18,000.
- Total present worth costs are $2,822,000.
- Annual cost per household, based on 75 percent federal grants, would be $250.

A rough total present worth cost for implementation of an SMD for the Longwood Valley (assuming 620 households) area would be approximately $2,100,000. (This assumes all households will require new septic tanks). Costs per household per year would include septic tank pumping and district administrative costs. For the individual resident, leaching field replacement may be necessary at 15-year intervals (provided sufficient land area exists for a separate field) and each replacement may cost $2,000 to $3,000.

For the choice between separate treatment and joint treatment for Lake Swannanoa and Cozy Lake, the total present worth costs are $3,275,400. For joint treatment, the cost would be $2,822,000. An SMD system cost would be about $2,100,000. The differential environmental impact between separate and joint treatment appears to be negligible. However, more detailed study would be required in local 201 Facilities Plan. Therefore, the feasible alternatives for this area include local centralized treatment for Lake Swannanoa and Cozy Lake and incorporation into an SMD.

3b. Upper Rockaway Township

In Upper Rockaway Township, the areas which can be sewered are the Green Pond and Lake Telemark areas. The options for these areas are to provide collectors and local treatment, or to provide an SMD for management of on-site systems. For Lake Telemark, the choice of treatment at the RVRSA plant is also available. Because of the distance between these two areas, joint treatment is not contemplated. Costs for each of the two areas have been developed using the methods and sources described above. These costs are as follows.

- Green Pond:
  - Collection (360 households):
    Capital costs = $720,000
    Annual O&M Costs = $36,000
  - Treatment 350 cu m/d (0.09 mgd):
    Capital costs = $132,000
    Annual O&M Costs = $15,000
  - Land Application, 16 ha (40 a):
    Construction costs = $151,000
    Cost of land = $200,000
    Annual O&M Cost = $22,000
  - Total present worth cost = $1,904,000
  - Annual cost per household = $280

- Lake Telemark:
  - Collection (350 households):
    Capital costs = $700,000
    Annual O&M costs = $35,000
  - Treatment 350 cu m/d (0.09 mgd):
    Capital costs = $132,000
    Annual O&M costs = $15,000
  - Land Application, 16 ha (40 a):
    Construction costs = $151,000
    Land costs = $200,000
    Annual O&M costs = $22,000
  - Total present worth cost = $1,938,000
  - Annual cost per household = $285

For treatment of sewage from Lake Telemark at the RVRSA plant, the cost of collection would be the same, but the interceptor cost (adjusted for salvage) and unit costs of treatment at the RVRSA plant must be substituted for on-site treatment and disposal costs. These costs are:

- Interceptor to Hewlett-Packard = $1,100,000 based on 3,300 m (10,000 ft) at $360 m ($110/ft)
- Treatment at RVRSA plant = $3,285 per year based on $0.0264 per cu m ($100 per million gallons)
- Total present worth cost = $1,834,500
- Annual Cost per Household = $130

The principal reason for lower costs with RVRSA treatment is the saving in O&M costs. Costs for the implementation and management of an SMD are better defined for the eligible areas in Rockaway Township than for the similar areas in Jefferson Township. Given the malfunction rate for septic systems in these areas (RTDOH, 1980) of about 11 percent, the costs of leaching field replacement are an order of magnitude less than the cost of local centralized treatment, but

more frequent replacement or repair may be necessary. Given the rate of failure for on-site systems in these areas, additional replacement may be necessary. For such small lake communities, malfunctioning on site systems may create health-related problems in the lakes which are the basis for community recreation.

Both the Jefferson Township and Upper Rockaway Township segments of the RVFPA will be studied in more detail in the local 201 Facilities Planning process. Grants for these studies have been applied for by Jefferson and Rockaway townships. Given the foregoing analysis, the small-scale local systems are feasible, but more detailed data on on-site system failures and water quality must be obtained and analyzed.

3c. Areas Served by the RVRSA Interceptor

The areas served by the RVRSA Interceptor include the lower portion of Rockaway Township and Randolph and Mine Hill townships. Branch interceptors linking existing sewered areas to the RVRSA Interceptor at four locations were proposed by Killam Associates (1977). Of the four proposed branch interceptors, three are eligible for funding. Of these three, two required analysis of alternatives to minimize environmental impacts (Jackson Brook and Mine Hill branch interceptors). The originally proposed routes and alternatives are shown in Figure 2-4.

The Jackson Brook branch interceptor alignment proposed by Killam Associates (1977) (Alternative A) was reviewed for potentially detrimental impacts and to determine alternate routes which would avoid such impacts. One cultural resource, a silk mill with local historical significance, would be adversely affected by the proposed alignment. The combination of physical configuration and cultural sensitivity precludes construction of Alternative A. The alternative route (Alternative B) avoids the silk mill, but two stream crossings are required as shown in Figure 2-5. The low flow in the stream and preexisting provisions for bypassing to a pond will minimize any damage due to these two crossings. Both alternative routes will disrupt a small emergent, open water wetland east of the silk mill, along the north bank of Jackson Brook and a small forested wetland south of the junction of the branch and the RVRSA Interceptor.

The proposed Oak Street branch interceptor alignment;requires no alternatives, because the total route is in existing streets which do not present problems with any sensitive areas. At the termination of this branch interceptor is a small forested wetland which should be unaffected.

The Mill Brook branch interceptor (Alternative A) routed east of the existing bridge could be placed on the west side of the bridge using the present Victory Gardens branch interceptor right of way (Alternative B) but the environmental effects of either route would be

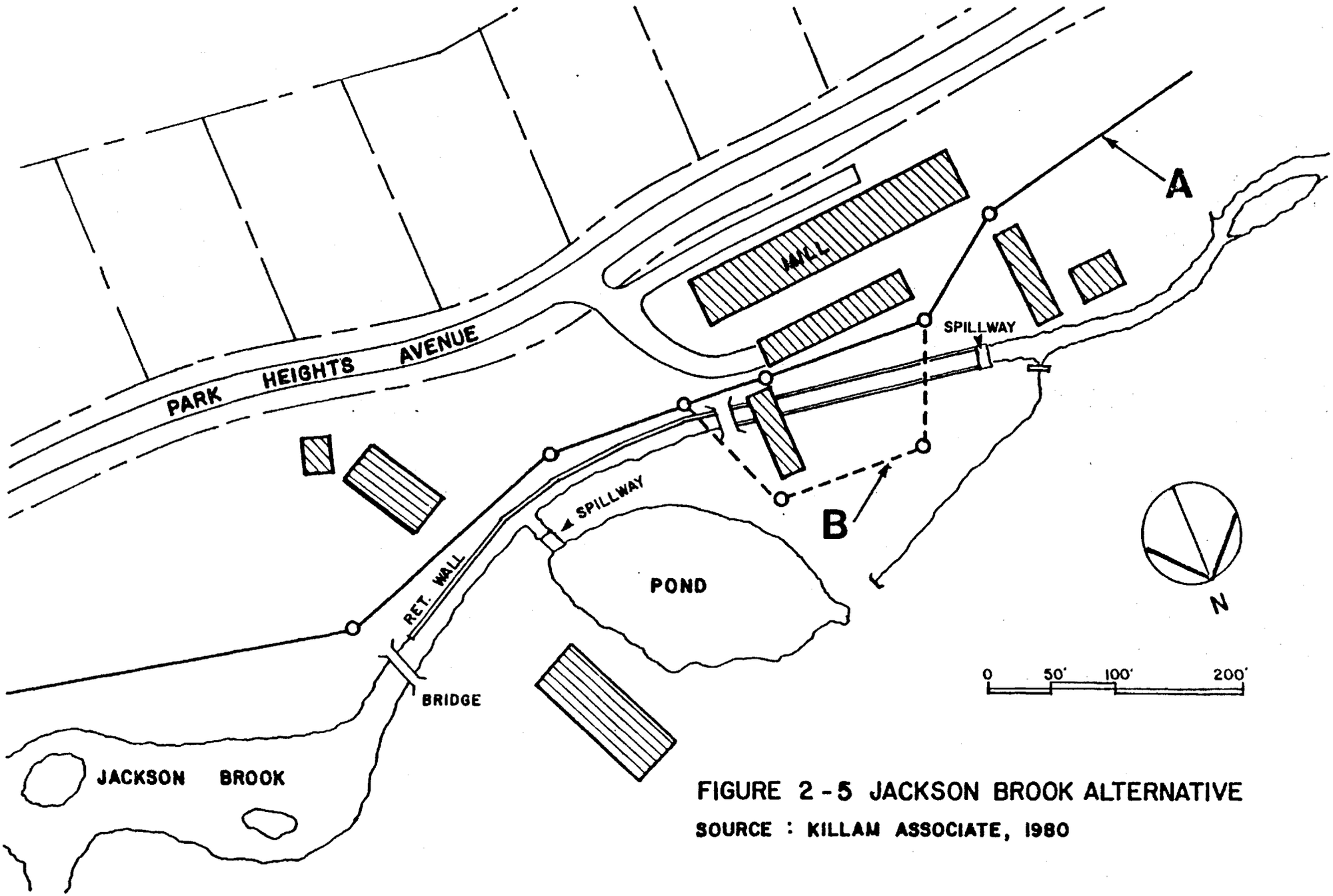


FIGURE 2-5 JACKSON BROOK ALTERNATIVE

SOURCE : KILLAM ASSOCIATE, 1980

similar, and thus the proposed route (Alternative A) should be used. Each route will affect a noncontiguous forested wetland, each being less than 1.0 ha (2.4 a). Crossing of one of the two wetlands is unavoidable.

Construction costs for the Jackson Brook, Oak Street, and Mill Brook branch interceptors are estimated to be $740,000, $429,000, and $234,000, respectively (1979 dollars). The federal government will assume 75 percent of the construction costs. Municipalities served by the RVRSA must bear the balance of the construction costs, as New Jersey is not presently allocating matching funds for new wastewater facilities (Kurisko, NJDEP, January 16, 1980). Local funds will be financed through bonding.

Projected annual user costs for new RVRSA facilities will average approximately $88 per household in 1980 and $67 in the year 2000. These costs reflect debt service and annual O & M costs associated with the branch interceptors, as well as major improvements to the RVRSA treatment plant and main interceptor (Platt, Killam Associates, May 23, 1980). They represent an approximate increment to be added to existing sewer service charges (Table A-5). Specific user charges will reflect relative wastewater flows from RVRSA municipalities.

4. SELECTION OF IMPLEMENTATION PLAN

Based on the analysis of feasible alternatives, the following plan is recommended for implementation.

4a. Jefferson Township

Local collection and treatment for the Lake Swannonoa and Cozy Lake areas and creation of an SMD for Jefferson Township, with initial implementation in these two lake areas, are alternatives that are feasible and have comparable environmental and economic impacts. A detailed analysis for selection of one of the two approaches should be done in the detailed facilities planning for this part of the RVFPA.

4b. Upper Rockaway Township

Similarly, local collection and treatment of the Green Pond and Lake Telemark areas and creation of an SMD for Rockaway Township, with initial implementation in these two lake areas, are feasible alternatives for Upper Rockaway Township. Environmental and economic impacts are comparable and selection of an alternative should be done based on analysis in facilities planning for the area.

4c. Areas Served by the RVRSA Interceptor

The construction of three branch interceptors for the areas served by the RVRSA Interceptor, with connection to the RVRSA Plant is recommended for implementation. The alternative routings selected to minimize environmental impacts are:

- Jackson Brook Branch Interceptor Alternative B.
- Oak Street Branch Interceptor Alternative A.
- Mill Brook Branch Interceptor Alternative A.

4d. Other RVRSA Municipalities

No action is recommended with respect to the other municipalities in the RVRSA (Boonton Town; Rockaway, Wharton, Kinnelon, and Mountain Lakes boroughs; and Boonton, Montville, Parsippany-Troy Hills, and Roxbury townships). These municipalities are either already sewered or have adequate on-lot systems (in which case no new facilities are required) or are only partially contained in the RVFPA and do not have population densities which would necessitate sewering. Decisions for wastewater treatment in these latter areas should be based on detailed 201 facilities planning on a municipality basis.

5. EFFECTS OF POPULATION GROWTH ON FLOWS AT THE RVRSA TREATMENT PLANT

In addition to assessing the impact of the four proposed branch interceptors, a second issue in the Notice of Intent was the determination of the effect of growth in the RVRSA Service Area on treatment plant capacity. The plant capacity is now being expanded to 45,400 cu m/d (12 mgd), and the treatment process is being upgraded to provide Level 5 treatment. The future flows are based on population growth data shown in Chapter 4. Incremental populations to be served by the RVRSA plant are shown in Table 2-3. Current flows to the plant and future (year 2000) flows to the plant are detailed in Table 2-4. These increases in population have been reviewed at the municipality level to determine the expected portion of new population to be served by the RVRSA.

Future flows to the RVRSA plant are based on flows from presently sewered populations, from existing households in areas to be sewered, and flows from additional population growth. A 64 percent increase in the population served by the RVRSA is expected by the year 2000. Per capita flows reported by Killam Associates (1977) were 340 lpcd (90 gpcd). The average water supplied (462 lpcd (122 gpcd)) should result in domestic and commercial wastewater flows of 333 lpcd (88 gpcd) after subtracting 15 percent each for distribution and consumptive

Table 2-3

Present and Future Populations To Be Served at RVRSA

Municipality[1]	Present[2] Population Served	Predicted[4] Growth 1980-2000	Percent of[5] Incremental Population Served By RVRSA	Present Unserved Population to be Served by Planned System Expansion	Total 2000 Population to be Served By RVRSA
Boonton Town	7,000	520	100	0	7,520
Dover Town	14,450[3]	160	100	0	14,610
Rockaway Borough	6,340[3]	510	100	0	6,850
Victory Gardens Borough	1,210[3]	120	100	0	1,330
Wharton Borough	5,200	570	100	0	5,770
Boonton Township	620	1,540	67	0	1,650
Denville Township	8,000	4,270	100	3,770	16,040
Mine Hill Township	0	1,370	100	1,360	2,730
Randolph Township	5,510	3,930	90	1,210	10,260
Rockaway Township	9,000	11,390	80	7,210	25,320
Montville Township	0	730	67	230	720
Total[6]	57,330	25,110	NA[7]	13,780	92,800

Notes:
1. Only municipalities to be served by RVRSA are shown.
2. Killam, 1977.
3. Entire estimated population served.
4. See Chapter 4.
5. Based on estimates of development.
6. Sums may not be precise due to rounding.
7. NA = Not applicable.

Table 2-4

Present and Future Flows to the RVRSA Plant

Domestic and Commercial Flows by Municipality	Present Flow Including Immediate System Expansion		Expected Year 2000 Flow cu m/d (mgd)	
Boonton Town	2,390	(0.63)	2,530	(0.67)
Dover Town	4,920	(1.30)	4,920	(1.30)
Rockaway Borough	2,160	(0.57)	2,310	(0.61)
Victory Gardens Borough	420	(0.11)	450	(0.12)
Wharton Borough	1,780	(0.47)	1,930	(0.51)
Boonton Township	230	(0.06)	490	(0.13)
Denville Township	4,010	(1.06)	5,150	(1.36)
Mine Hill Township	450	(0.12)	830	(0.22)
Randolph Township	2,270	(0.60)	3,220	(0.85)
Rockaway Township	5,530	(1.46)	8,020	(2.12)
Montville Township	0	(0)	230	(0.06)
Subtotal	24,150	(6.38)	30,090	(7.95)
Industrial Process[1] Wastewater	NA[2]		2,270	(0.6)
Industrial Sanitary Wastewater	1,890	(0.5)	1,890	(0.5)
Piccatiny Arsenal	1,140	(0.3)	1,140	(0.3)
Hospitals & Colleges	1,140	(0.3)	1,140	(0.3)
Infiltration/Inflow	3,790	(1.0)[3]	3,790	(1.0)[4]
Industrial Reserve Capacity	NA		3,410	(0.9)
Total[5]	32,170	(8.5)	43,900	(11.6)

Notes:
1. See Table III-D-2 of Killam, 1977 for breakdown of industries contributing to this flow.
2. NA = Not applicable.
3. After implementation of I/I controls.
4. Based on total I/I of 2.5 mgd of which 0.5 is non excessive. It is also assumed that approximately 80% of the excessive I/I can be controlled.
5. Sums may not be precise due to rounding and metric conversions.

losses. The 340 lpcd (90 gpcd) flow rate was used for estimates of wastewater quantity from existing populations, and 80 percent of this value was used for estimates on flows from the incremental population. The reduced flow for new users was based on the New Jersey Plumbing Code (NAPHCC, 1978) which requires installation of water saving devices in new homes. Based on this analysis, the plant capacity of 45,400 cu m/d (12 mgd) will not be exceeded until after the year 2000.

The cost and implementability of retrofitting existing housing with water saving devices was evaluated in light of the potential cost savings. For purposes of this EIS, flow reduction was not considered for existing homes as it makes little difference in the size of the branch interceptors which must be designed for peak demands.

Currently all domestic flows in the RVFPA are accepted by the RVRSA plant. This service will continue in the future. At this time the RVRSA does not accept any industrial process waste. However, in the future, the RVFSA will accept industrial process waste providing that pretreatment has been sufficient. Killam Associates is currently conducting a survey of industrial dischargers to determine the level of treatment, toxicity, and pollutant load of the industrial process waste. The decision to accept pretreated industrial waste at the RVRSA plant will be based on the results of this survey (Fransisco, RVRSA, September 2, 1980).

CHAPTER 3

AFFECTED ENVIRONMENT

This chapter presents descriptions of the study area and the natural and man-made environment which may be affected or created by the alternatives under consideration. Council on Environmental Quality (CEQ) regulations (43 FR 55978-56007, November 29, 1978) require that data and analyses presented in an EIS be commensurate with the importance of the issues being addressed. Those resources which were examined and found not be be affected by any of the alternative actions are briefly discussed. Next to the chapter subheadings, the reader will find the terms "Affected" and "Not Affected," indicating whether or not that environmental parameter will be significantly affected by the project or whether that parameter had a role in determining the selected plan. (The term "Not Affected" represents either no impact or minor impacts.) More details on these aspects can be found in the appropriate appendices to this document.

1. PHYSIOGRAPHY AND TOPOGRAPHY

1a. Steep Slopes (Affected)

Steep slopes, 15 percent and greater, are significant because construction in these areas may increase slope instability and significantly accelerate erosion of surface soils. Steep slope areas are depicted in Figure 3-1.

1b. Floodplains (Affected)

Floodplains (Figure 3-2) represent locations where the probability of a 100-year flood occurring during any particular year is approximately one percent (a 100-year floodplain according to the U.S. Department of Housing and Urban Development (Mayard, FEMA, June 3, 1980)).

The National Flood Insurance Act of 1968 (as amended by The Flood Disaster Protection Act of 1973) provides government sponsored flood insurance for structures in designated floodplains. As stipulated by the Act, insurance is limited to communities which initiate measures to limit floodplain development. New buildings in flood prone areas are unlikely to receive federal flood insurance. Therefore, lending institutions are reluctant to finance construction in such cases.

Moreover, a 1977 Federal Executive Order (#11988) directs the avoidance of floodplain development whenever possible.

2. GEOLOGY

2a. Bedrock Geology (Not Affected)

Bedrock in the RVFPA consists of crystalline rock and sedimentary rocks. The sedimentary deposits are found along Green Pond Mountain and near the Boonton Reservoir. The crystalline rocks are largely gneisses and form rounded hills with plateau-like summits and steep slopes.

2b. Surficial Geology (Not Affected)

The last glaciation left a linear deposit of clay, silt, and sand (terminal moraine) that extends irregularly east to west across the RVFPA. South of this deposit are patches of material from earlier glacial activity. North of the terminal moraine are extensive deposits of a mixture of bolders, silts, and clays. Loose, river-washed sand and gravel, as well as intermittent layers of clay, occupy the Rockaway River Valley and the valleys of major tributaries to the river above Boonton Reservoir.

2c. Soils (Affected)

Soils in the RVFPA are both transported and residual. The transported soils, products of erosion, are found in the tills that drape the Highlands and the floodplains adjacent to streams. The residual soils are formed in place from material weathered from bedrock.

The soils of the region may be grouped into three general categories based on geologic parent material, drainage, and topography. These categories are: young glacial till soils (limited to the Highlands); organic deposits, glacial lake sediments, or glacial outwash soils (lowlands and drainage channels); and old glacial deposits, or material weathered from bedrock soils (Randolph Township and the southern portion of Denville Township) (Table B-2).

Till soils from young glacial material are deep, well-drained to somewhat poorly drained; gently sloping to steep; gravelly, sandy, and stony loams. These soils all have pan layers in the lower part of their profile which restrict drainage.

FIGURE 3-1
STEEP SLOPES

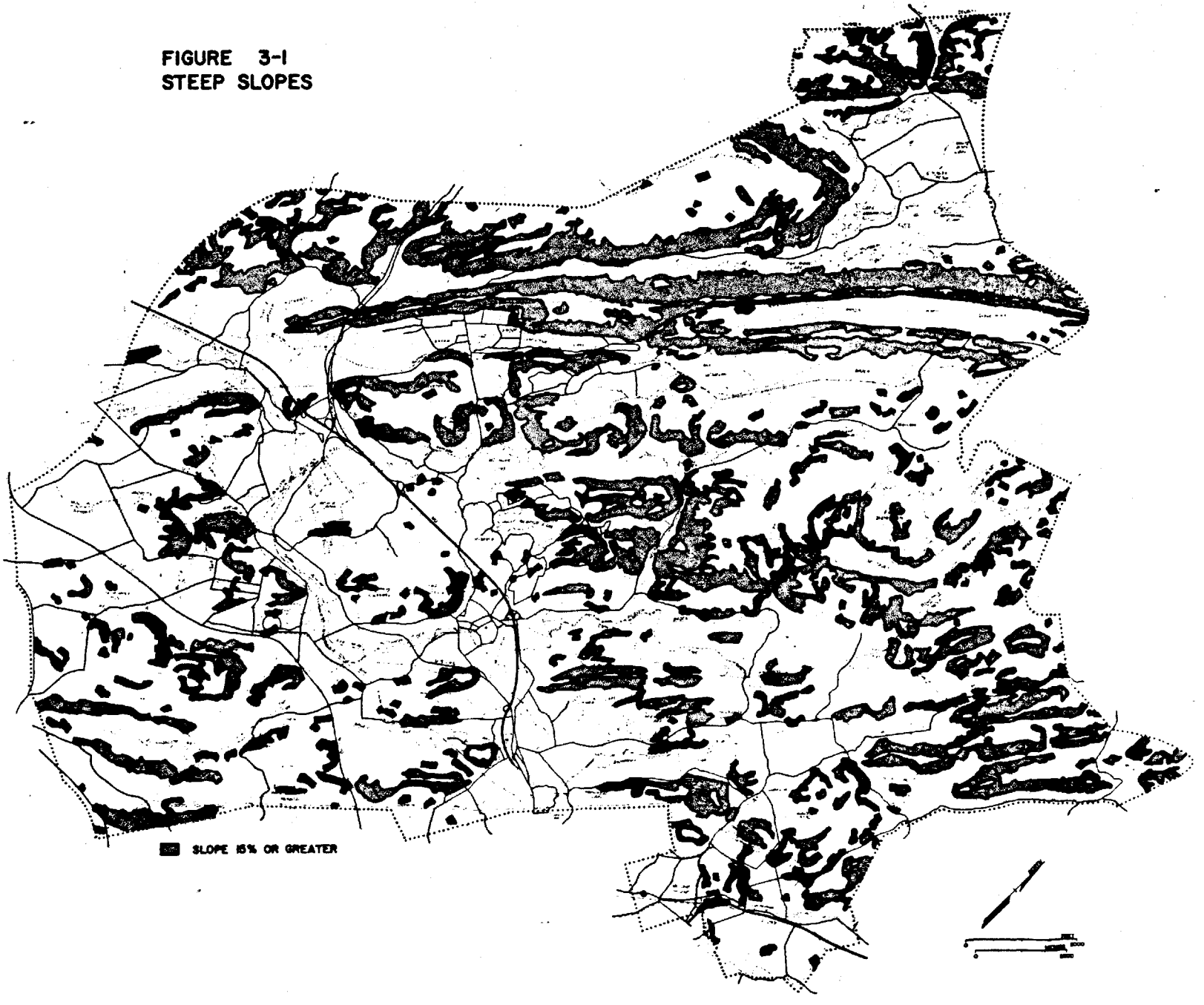
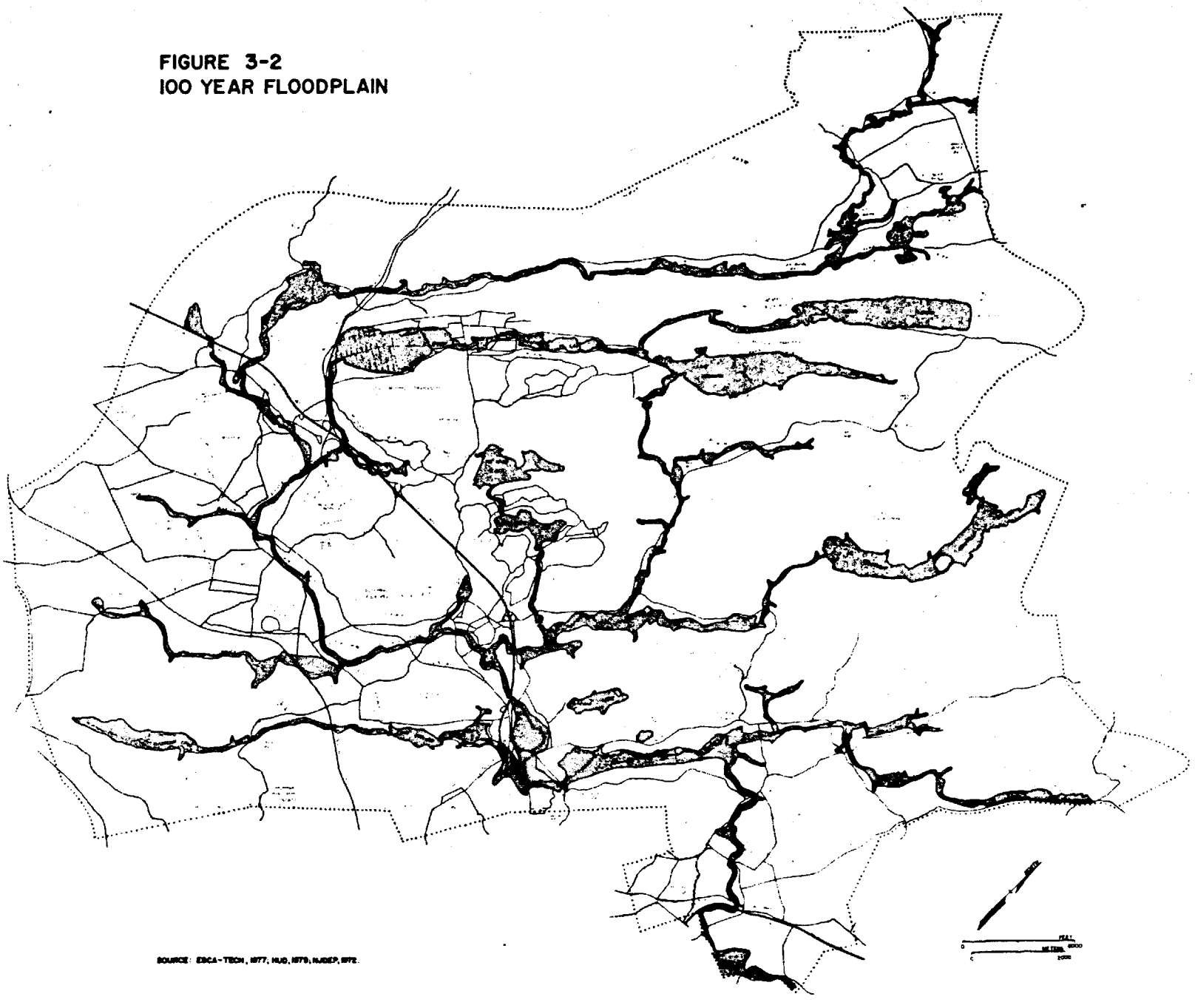


FIGURE 3-2
100 YEAR FLOODPLAIN



SOURCE: EDCA-TECH, 1977; HUD, 1979; NJDEP, 1972.

Soils formed in organic deposits, glacial lake sediments, or outwash vary greatly from deep, well-drained, sandy loams that overlie stratified outwash to poorly drained, nearly level mucks-silt loams or sandy loams--that overlie stratified lacustrine sand, silt, or clay.

Soils formed from old glacial deposits or from material weathered from bedrock are dominantly loamy and deeply weathered, and have more clay in the subsoil than in the surface layer or in the substratum. They are deep, excessively drained to poorly drained, gravelly to very gravelly sandy loams, that overlie granite gneiss.

2d. Prime Agricultural Lands (Affected)

The U.S. Department of Agriculture-Soil Conservation Service (USDA-SCS) has determined that, based on general characteristics, some soils in Morris County are prime agricultural land. These soils are described as falling within Agricultural Capability Classes I and II:

Class I — Soils having few limitations that restrict management on the growth of adapted plants. These soils are nearly level, deep, well drained, and of moderately coarse texture.

Class II — Soils having some limitations that reduce the choice of plants or require moderate conservation practices. These limitations include a moderate risk of erosion unless protected by adequate plant cover and localized areas of poor drainage (USDA-SCS, 1976).

Areas within the RVFPA that have few to moderate limitations for crop development as established by the USDA-SCS are shown on Figure 3-3.

3. WATER RESOURCES

3a. Water Quality (Not Affected)

All surface waters in the RVFPA (Figure C-1) are classified by NJDEP as FW-2 waters, with the exception of Stephans Brook, north of the Berkshire Valley Tract, which is FW-1 (Table C-1). Average, high, and low flows for the Rockaway River, and the ten-year, seven consecutive-day low flow (MA7CD10) are listed on Table C-2.

Water quality data for the upper Rockaway River is limited. Annual water quality data for the upper Rockaway River is collected at a USGS gauging station just upstream from the Boonton Reservoir. In general, the available data indicates that the quality of the Rockaway River is good. All parameters except Dissolved Oxygen (DO), fecal coliform, and total phosphorus comply with NJDEP Surface Water Quality Standards (Tables C-3, C-4, C-5, C-6). However, a comprehensive

inventory of the Rockaway River and its tributaries would be required before a thorough evaluation of its quality could be made.

3b. Point and Non-Point Source Pollution (Affected)

Point source discharges--those that enter the water body directly--are listed on Tables C-7 and C-8.

Non-point source pollution (NPS)--pollutants which do not enter a water body by direct discharge--can have a significant impact on both surface and groundwater quality. Potential sources of NPS are stormwater runoff, leachate from landfills, and wastewater from failing septic systems.

Stormwater runoff varies with land use, season, and the frequency, duration, and intensity of precipitation. Each type of land use has characteristic pollutants entrained by its storm runoff. Urban/suburban runoff is characterized by sediments which accumulate on impervious surfaces, i.e., salts; oil and grease; animal, household, and commercial wastes; and fertilizers and pesticides used in home gardens (NJDEP, 1979b). Construction activities contribute to erosion resulting in increased stream sediment. Farming operations increase quantities of sediments, fertilizers, pesticides, and organic wastes in runoff. Forestry and mining activities also increase sediments loads.

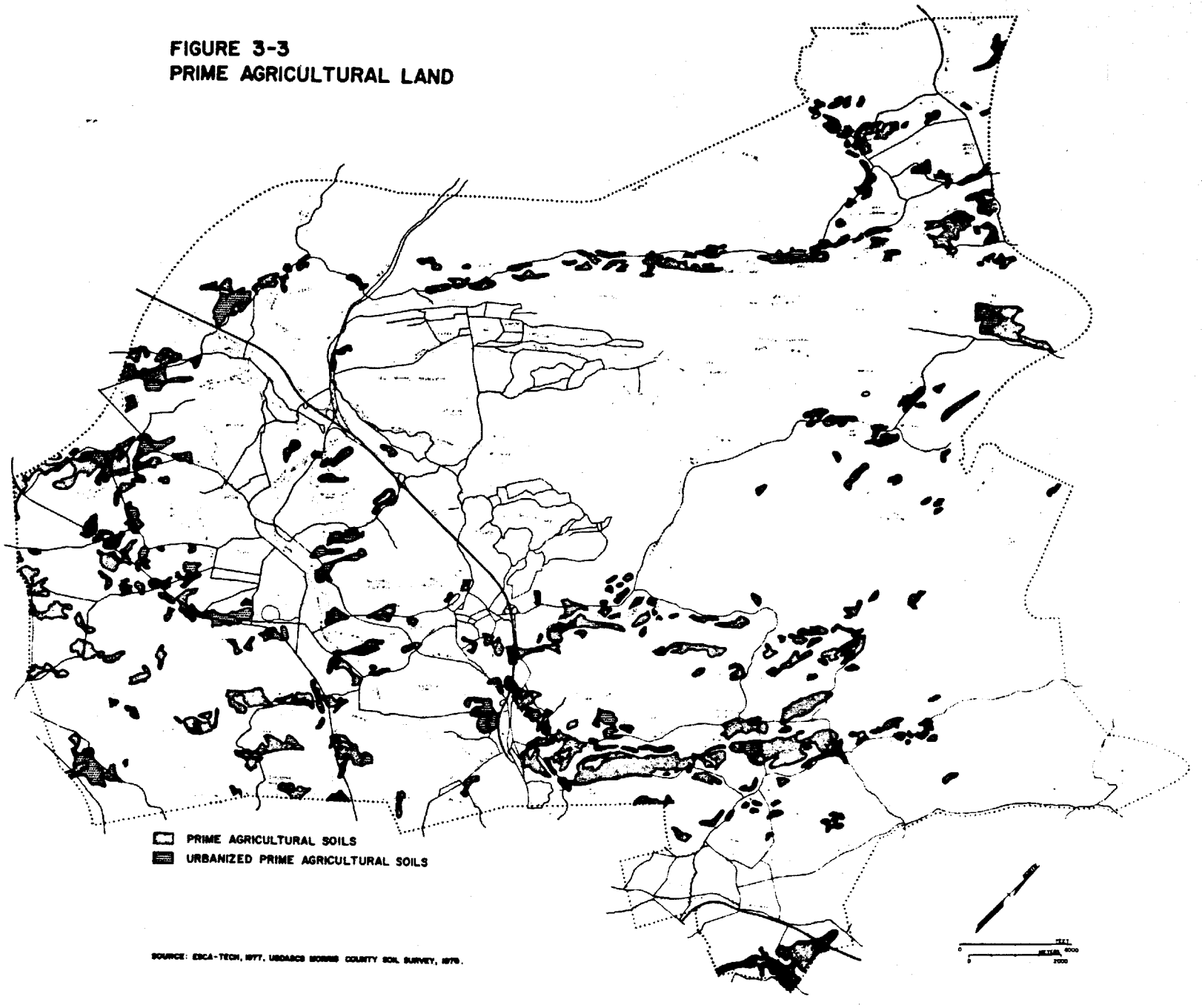
A potentially significant form of NPS in the RVFPA is the result of leachate from landfills and chemical dumps, ranging from domestic and food processing wastes to toxic chemicals and carcinogens. Recent evidence shows that several dumps in this area are leaching (Christie, Rockaway Township, July 10, 1979).

Another area of potentially significant NPS is failing septic systems. Fecal coliform levels in the study area averaged above the state standard for FW-2, non-trout waters, from 1967 to 1977. These elevated fecal coliform values are indicative of failing septic systems and of interceptor overflow that would occur during wet weather conditions.

3c. Groundwater Resources (Not Affected)

Groundwater in the RVFPA occurs in most rocks but in varying degrees of usefulness and availability. Over 95 percent of the groundwater used for public and private consumption is withdrawn from the crystalline rocks or sand and gravel deposits of the major stream valleys. The remaining rocks supply the additional demand, largely for small on-site uses.

FIGURE 3-3
PRIME AGRICULTURAL LAND



Sole Source Aquifer (Not Affected)

The Buried Valley Aquifer System of southeastern Morris and western Essex counties, New Jersey, has recently been designated as a sole source aquifer under the provisions of the Safe Drinking Water Act (Federal Register, 1980). By designating this area as a sole source aquifer, any federal financially assisted projects must be reviewed to determine if construction and/or operation may contaminate the aquifer, thereby creating a significant hazard to public health. The EPA will evaluate such projects and, where necessary, will conduct an in-depth review, including soliciting public comments, where appropriate.

The area designated consists of two distinct regions, a recharge zone (area through which water enters the aquifer) and a stream flow zone (upstream headwaters area which drains into the recharge zone). The recharge zone is south and east of the RVFPA, consisting largely of the communities in the Upper Passaic River Basin. This area directly overlies the Buried Valley Aquifer System. The streamflow source zone lies within the boundaries of the Upper Rockaway River Basin and encompasses all of the RVFPA.

The review of projects planned for the recharge zone is more intensive than those designed for the streamflow source zone. In the recharge zone, infiltrating waters are carefully considered for their potential of actual contamination of the aquifer; while for the streamflow source zone, projects are evaluated to determine if they will contaminate the stream, which eventually recharges the aquifer. Because contamination of aquifers by recharging waters is not a prime consideration in the streamflow source zone, a petition has been filed with EPA requesting that the Administrator consider the Wisconsin stratified drift aquifer system of the Upper Rockaway River Watershed a sole or principal source aquifer. The aquifer is the principle water source for the major water purveyors in the RVFPA, supplying drinking water for 50 percent or more of the residents of a large territory (310 sq km (120 sq mi)). These facts make the Wisconsin stratified drift aquifer system of the Upper Passaic River Basin eligible for designation as a sole or principle source aquifer system under EPA guidelines. Designation as such would help to control deterioration of groundwater quality in the RVFPA.

Recharge (Not Affected)

Precipitation, the most important source of water entering the RVFPA, infiltrates the surficial deposits, is released to the atmosphere through evapotranspiration, or flows overland to streams as stormwater runoff. The various types of soils and surficial deposits in the RVFPA have differing infiltration rates (Table C-10), causing non-uniform recharge of the aquifers.

For the purpose of this study, Prime Aquifer Recharge Areas are defined as highly permeable soils overlying deposits of Wisconsin stratified drift, earlier glacial drift and, in some cases, Wisconsin terminal moraine (these formations comprise the main constituents of the public water supply) (Figure 3-4). Areas considered to overlie confined aquifers were excluded from consideration as Prime Aquifer Recharge Areas. Soil descriptions from the Soil Survey of Morris County (1976) were used to determine soil permeability.

Another important source of recharge to the stratified drift deposits is induced stream bed infiltration. Under static or nonpumping conditions the movement of groundwater is toward the Rockaway River. Under pumping conditions, the gradient is reversed and river water moves towards the pumping well. In addition, the stratified drift deposits, particularly the confined areas, are recharged in part from the underlying and adjacent bedrock.

3d. Water Supply (Not Affected)

Surface Water Utilization

Most municipal drinking water supplies within the basin are obtained from groundwater sources (Figure 3-5). There are presently three reservoirs in operation:

- Boonton Reservoir - built 1904, capacity of 29 million cu m (7,700 mg) owned and operated by the Jersey City Water Department. At all times, Jersey City is required to release a minimum of 26,495 cu m/d (7 mgd) from the Boonton Reservoir to augment flow in the lower Rockaway River. In 1976 the average diversion at the reservoir was 263,000 cu m/d (69.4 mgd).

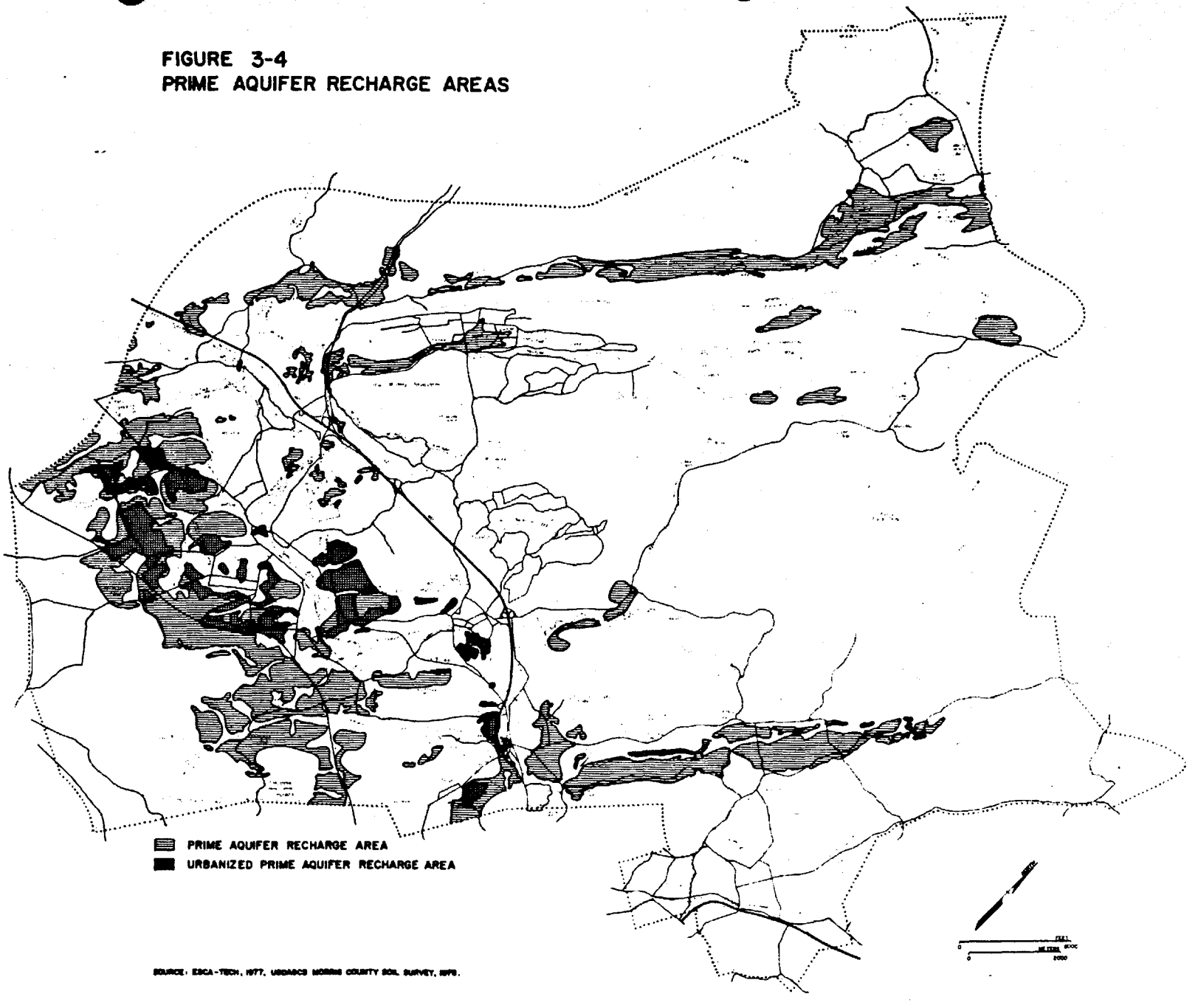
- Splitrock Reservoir - completed 1948, capacity of 12 million cu m (3,300 mg), owned and operated by the Jersey City Water Department.

- Boonton-Taylortown Reservoir - capacity 0.47 million cu m (125 mg) supplies only a portion of Boonton's water, with an average of 851 cu m/d (0.22 mgd) diverted to Boonton in 1976.

Groundwater Utilization

The communities within the RVFPA are served by several different water purveyors (Table 3-1). Four purveyors--Denville Township Water Department, the Boonton Town Water Department, the Dover Water Company

FIGURE 3-4
PRIME AQUIFER RECHARGE AREAS



SOURCE: ESCA-TECH, 1977, USDA SCS MORRIS COUNTY SOIL SURVEY, 1975.

FIGURE 3-5
PUBLIC WATER SUPPLY

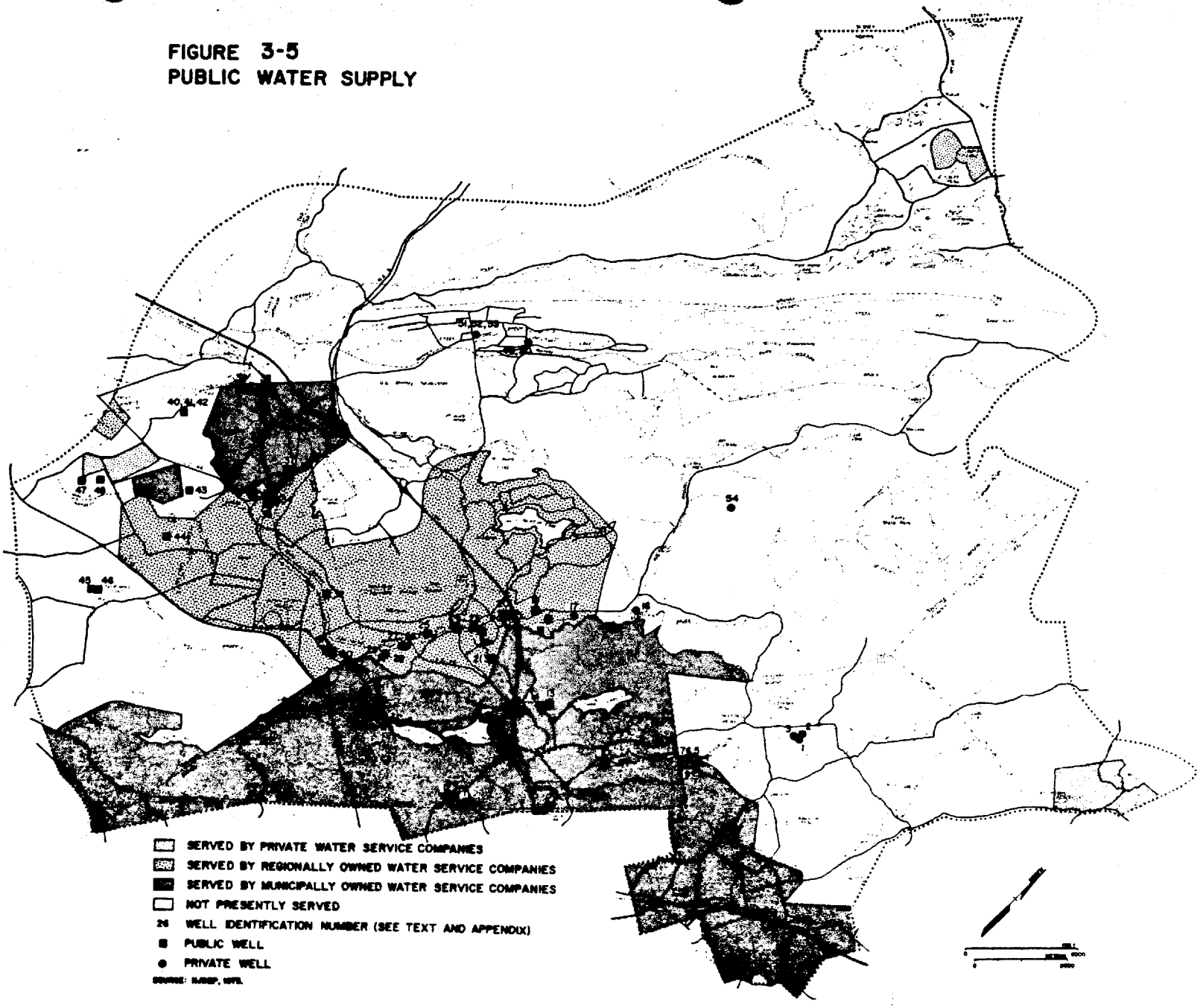


Table 3-1

Water Consumption for the Rockaway Valley Facility Planning Area

Community	Purveyor(s)	Population within watershed (percentage of total pop.) [a]	Percentage of area within watershed served by purveyor(s) [b]	Percentage of population within watershed that is served by purveyor(s) [c]	Average daily consumption cu m/d (mgd) [d]	Percentage change from 1970 [e]	Peak daily consumption cu m/d (mgd) [f]	Average annual consumption cu m (mg)	Per capita consumption lpcd (gpcd)
Boonton Town	Town of Boonton Water Dept.	8760 (100)	100	100	4542 (1.2)	-18	8175 (2.16)	1.6×10^6 (438)	490 (130)
Dover Town	Dover Water Dept.	14447 (100)	100	100	7570 (2.0)	+6	13626 (3.60)	2.7×10^6 (730)	510 (135)
Kinnelon Borough	Fayson Lakes Water Co.	2188 (33)	33	50	378 (0.10)	+6	681 (0.18)	0.14×10^6 (37)	378 (100)
Mt. Lakes Borough	Mt. Lakes Borough Water Dept.	NA*	100	100	454 (0.12)	+33	794 (0.21)	0.16×10^6 (44)	469 (124)
Rockaway Borough	Rockaway Borough Water Dept.	6341 (100)	100	100	3936 (1.04)	+12	7085 (1.8)	1.6×10^6 (445)	605 (160)
Victory Gardens Borough	Dover Water Dept.	1213 (100)	100	100	757 (0.20)	+25	1514 (0.40)	0.2×10^6 (73)	605 (160)
Wharton Borough	Wharton Borough Water Dept.	5387 (100)	100	100	2536 (0.67)	+9	4547 (1.2)	0.9×10^6 (244)	469 (124)
Boonton Township	Town of Boonton Water Dept.	2981 (97)	15	10	189 (0.05)	+80	340 (0.09)	0.06×10^6 (18)	624 (165)
Denville Township	Denville Township Water Dept.	13674 (100)	100	100	6056 (1.6)	-17	10900 (2.88)	2.2×10^6 (584)	442 (117)
Jefferson Township	High Ridge Water Co.	9788 (46)	2	4	569 (0.03)	+1	189 (0.05)	0.04×10^6 (11)	454 (120)
Mine Hill Township	Morris County MUA Roxbury Water Dept.	3105 (90)	15	45	567 (0.15)	+33	1021 (0.27)	0.2×10^6 (55)	446 (118)
Montville Township	Unserved by public water	349	NA	NA	NA	NA	NA	NA	NA
Parsip-Troy Hills Township	Parsip-Troy Hills Water Dept.	1123 (2)	100	100	416 (0.11)	NA	757 (0.20)	0.1×10^6 (40)	416 (110)
Randolph Township	Dover Township Water Dept. / Randolph Township MUA	11416 (66)	38	55	2536 (0.67)	+46	4579 (1.21)	0.9×10^6 (245)	401 (106)
Rockaway Township	Rockaway Borough Water Dept. / Dover Water Dept.	19369 (99)	15	72	6813 (1.80)	+43	9121 (2.41)	2.4×10^6 (655)	454 (120)
Roxbury Township	Roxbury Water Dept.	1159 (10)	5	20	378 (0.10)	0	681 (0.18)	0.1×10^6 (37)	276 (73)
				TOTALS[1]	37821 (9.9)		63588 (16.8)	13.8×10^6 (3656)	

Notes: *NA - Not Applicable.
1. Sums may not be precise due to rounding and/or metric conversions.

Sources: a) NJUDEA, 1975
b) NJDEP, 1976
c) Tetra Tech, 1978
d) NJDEP, 1976.
e) Killam, 1977.
f) Clark and Viessman, 1965

and the Rockaway Borough Water Department--supply over 75 percent of the public water consumed in the RVFPA. The central part of Mine Hill Township and the southeastern portion of Randolph Township are supplied by the Morris County Municipal Utilities Authority from wells outside the basin, but maintenance and operation of the water districts is controlled by the respective municipalities (Figure 3-5).

The combined consumption for the various water purveyors in the RVFPA in 1977 was 37,472 cu m/d (9.9 mgd) and the annual average was 13.8 million cu m (3,656 mg). Approximately 10 percent of this was supplied from well fields outside the basin, particularly from the Almatong well field located in the southwestern corner of Randolph Township. It is also estimated that an additional 17,000 cu m/d (4.5 mgd) is consumed by self-supplied industrial, commercial, and institutional users and 19,700 cu m/d (5.2 mgd) is derived from self-supplied domestic well pumpage (Tetra-Tech, 1978).

Estimates of per capita consumption were developed from 1976 daily flow rates reported by purveyors and estimates of population served. It is indicated in the Draft New Jersey Statewide Water Supply Master Plan (NJDEP, 1977) that approximately 242 liters per capita daily (64 gallons per capita daily) are consumed in typical indoor household usages, while an additional 38 to 76 lpcd (10 to 20 gpcd) are used for outsoor purposes. Estimated water consumption for the communities within the RVFPA ranged from 276 to 625 lpcd (73 to 165 gpcd) and averaged approximately 473 lpcd (125 gpcd) (Table 3-1).

4. ECOLOGICALLY SENSITIVE AREAS

4a. Terrestrial (Affected)

The major types of vegetation in the RVFPA are shown in Figure A-1. Wetlands are discussed in more detail here due to their sensitive nature. Wetlands serve as a necessary habitat for a number of plant and animal species and are likely to suffer lasting damage from disruptive activities. Wetlands are protected by the Federal Water Pollution Control Act and a 1977 Federal Executive Order (#11990) directing the avoidance of construction in wetlands, unless there were no practical alternative.

Three types of wetland habitats occur in the RVFPA (Figure 3-6), the most unique being the Mt. Hope Tamarack-Black Spruce Swamp. The second type is represented by two unassociated freshwater swamps that occur on the grounds of Picatinny Arsenal. The third type of habitat consists of freshwater marshes and swamps along the periphery of streams and in the littoral zones of lakes.

The Mt. Hope Tamarack-Black Spruce Swamp is approximately 13 ha (33 a) in size and is located near the town of Mt. Hope. The swamp suffers from the effects of pollution, mosquito ditching, suburban

FIGURE 3-6
WETLANDS

development, and filling. It serves as an important breeding and migratory habitat for birds and supports populations of game species. The most important characteristics of the swamp are its historical value and the unusual vegetative community, a relict of the last glacial period (U.S. Fish and Wildlife Service (USFWS), 1978).

One of the two large freshwater swamps--153 ha (377 a)--on the Picatinny Arsenal is located above Lake Denmark and is a wildlife preserve. The other swamp--146 ha (360 a)--lies at the southern end of the Picatinny Arsenal along Green Pond Brook.

The marshy expansions of streams and littoral zones in lakes and ponds are freshwater wetlands of ecological importance. They serve as breeding, feeding, and nursery areas for amphibians, reptiles, fishes, small mammals, and a number of shorebirds, marshbirds, waterfowl, and songbirds. They are found throughout the study area. The marsh habitat is dominated by red maple, black gum, black spruce, and larch trees. Shrubs, are typically heath shrubs such as leatherleaf, laurel, and labrador tea. The herbs are dominated by sphagnum moss, sedges, and ferns.

The swamp and floodplain habitats are dominated by red maple, with associates of yellow birch, oak, and black gum. Shrubs include alder, willow, buttonbush, and spicebush. Skunk cabbage is the most conspicuous herb, accompanied by ferns, sedges, and mosses (Robichaud and Buell, 1973).

The vegetation (Figure A-1) and wetlands (Figure 3-6) have been presented separately for clarity. When these two figures are compared, the areas where wetlands and woodlands coincide are known as deciduous swamps, and the areas where the wetlands and the fields coincide are either wet meadows or emergent marshes.

4b. Aquatic (Not Affected)

Most organisms found in the surface waters of the study area are typical pond, lake, and river species. Visible plant species include pondweed, pickerel weed, water lily, and duckweed. Various animals populate the surface waters of the RVFPA. The most abundant invertebrates are crustaceans, such as crabs, snails, and freshwater clams. Approximately 50 species of reptiles and amphibians spend all or part of their lives in the aquatic environment of the study area. Fish species that inhabit these waters include minnows, killifish, trout, sunfish, bass, catfish, and perch.

4c. Threatened and Endangered Species (Not Affected)

The EPA has coordinated with the USFWS (Section 7 Consultation, see Appendix A, page A-11) regarding the presence of endangered species in the RVFPA. The small whorled pogonia is being proposed as

an endangered species but its known distribution does not include Morris County. Neither the endangered bald eagle, peregrine falcon, nor Indiana bat is known to occur in the project area. Except for occasional transient species, no federally listed or proposed species under USFWS jurisdiction are known to exist in the project impact area.

The Endangered and Nongame Species Project of the State of New Jersey (NJDEP, 1978) has compiled a list of imperiled species of wildlife in the state. The list includes all the species federally designated as endangered or threatened plus additional species considered imperiled by the NJDEP. Four species appearing only on the state list are known or expected to occur in the RVFPA (ESCA-Tech, 1977): the wood turtle (status threatened); and the bog turtle, the blue-spotted salamander, and Trambley's salamander, (status endangered).

The State of New Jersey currently has no officially promulated or proposed list of imperiled plant species to be protected under the Endangered and Nongame Species Conservation Act (NJDEP, 1978). However, an unofficial "suggested" list of imperiled flora in New Jersey has been compiled by Fairbrothers and Hough (1973).

5. AIR QUALITY (Not Affected)

The RVFPA is highly rural or suburban, with relatively few major point sources of air contaminants which would significantly affect the air quality of the area (e.g., Whippany Paper and Thatcher Glass Manufacturing).

6. CULTURAL RESOURCES (Not Affected)

Few intensive archaeological surveys have been conducted in the area; therefore, the number of known sites of prehistoric occupation is minimal. The highest density of known sites occur in the vicinity of water courses, lakes, and small brooks (Figure E-1).

Historic occupation of the entire Passaic River Basin began with Dutch agricultural settlements. Several blast furnaces, farms, homes, and public structures, as well as sections of the Morris Canal, still exist in the area. Many of these sites are on the National Register of Historic Places (Table E-1, Figure E-1). In addition to National Register properties, there are a significant number of sites of state and local interest, among them a silk mill adjacent to Jackson Brook.

7. ENERGY (Not Affected)

The RVFPA is supplied with electricity from the Jersey Central Power and Light Company. Natural gas is supplied by the New Jersey Public Service Electric and Gas Company and the New Jersey Natural Gas Company.

The homes in the RVFPA rely mostly on oil or natural gas for space heating. Very few are all-electric. The choice between oil or natural gas is based on local availability. Some buildings use liquid propane, purchased from various local distributors.

There are presently no shortages of energy supply in the area. New gas connections for residential customers have recently been allowed. However, the situation may change with shifts in the national energy situation.

8. ECONOMICS (Not Affected)

Between 1966 and 1976 total employment in Morris County increased by 66 percent from approximately 70,000 to 116,000 (Table A-1). During this ten-year period, manufacturing and wholesale/retail trade were the most important sources of employment, accounting for 60 percent of all jobs in the county. The rapid industrial development of the east central portion of Morris, situated to the east and south of the RVFPA was the major factor contributing to the area's economic growth in the 1960's and 1970's (Garofalo, New Jersey Department of Industrial and Economic Development (NJDIED), July 26, 1979).

Total employment within RVFPA municipalities increased by 30 percent (from about 42,670 to over 55,410 jobs) between 1973 and 1978 (Table A-2). The greatest gains occurred in Rockaway Township (247 percent) and Randolph Township (197 percent). However, the gains in these townships were partially offset by declines--largely due to urban renewal activities--in the older, central business districts of Dover and Rockaway. Important factors contributing to the recent overall employment growth in the RVFPA have been the relocation of new industrial facilities into the Route 10 Industrial Park in Randolph Township, the expansion of the Hewlett Packard Corporation in Rockaway Township, and the development of the Denville Technical Park which accommodates computer-office facilities (Garofalo, NJDIED, July 26, 1979).

In 1978, the greatest number of covered jobs (a count of full-time and part-time employees covered by unemployment insurance) was in Parsippany-Troy Hills Township, where about 15,200 persons were employed (27 percent of total employment for municipalities included in the RVFPA). However, only a minor portion of Parsippany-Troy Hills is included in the RVFPA. Dover with 7,600 employees (14 percent) and Rockaway Township with 5,000 employees (13 percent) were also major sources of employment (Table A-2).

Average family income in the RVFPA is typical of Morris County as a whole. Median family incomes in 1970 ranged from $10,505 in Rockaway Borough, to $22,423 in Mountain Lakes Borough as compared to the Morris County figure of $13,421 (Table A-3).

9. PUBLIC SERVICES (Not Affected)

Public service per capita expenditure ratios indicate the 16 RVFPA communities spent between $114 and $177 per capita in 1976, excluding school expenditures. The two largest budget items for most communities were public safety and public works (Table A-4).

Sewer operations are funded through general revenues in only two communities, Rockaway Borough and Dover. Seven additional communities (Jefferson, Mine Hill, Montville, Roxbury, and Parsippany-Troy Hills townships, and Mountain Lakes and Kinnelon boroughs) either have no sewers or are served by non-RVRSA facilities. The remaining municipalities in the RVFPA generate revenue for sewer costs through user charges (Table A-5).

The majority of school funds are generated locally, with property taxes supplying up to 85 percent of the revenues of RVFPA school districts. State aid comprises between 10 and 20 percent of school revenues. School districts also obtain revenues from federal aid, miscellaneous funds, and tuition.

The local 1978 tax rates ranged from a high of $7.52 in Mountain Lakes Borough to a low of $2.71 in Mine Hill Township per $100 of assessed value. The highest effective tax rate was in Victory Gardens Borough, where a rate of $3.83 was charged per $100 of actual market value (Table A-6).

CHAPTER 4

POPULATION AND ENVIRONMENTAL CONSTRAINTS

The RVFPA includes 16 municipalities encompassing an area of approximately 32,960 ha (81,520 a) (Boonton Town Planning Board (BTPB), 1974; Dover Town Planning Board (DTPB), 1976; Kinnelon Borough Planning Board (KBPB), 1978; Mountain Lakes Borough Planning Board (MLBPB), 1978; Rockaway Borough Planning Board (RBPB), 1978; Victory Gardens Borough Planning Board (VGBPB), 1976; Wharton Borough Planning Board (WBPB), 1978; Boonton Township Planning Board (BTpPB), 1979; Denville Township Planning Board (DeTPB), 1975; Jefferson Township Planning Board (JTPB), 1978; Mine Hill Township Planning Board (MHTPB), 1977; Montville Township Planning Board (MTPB), 1976; Parsippany-Troy Hills Township Planning Board (PTHTPB), 1976; Randolph Township Planning Board (RaTPB), 1979; Rockaway Township Planning Board (RTPB), 1976; Roxbury Township Planning Board (RxTPB), 1977). In 1975, 19,730 ha (48,760 a)--or 60 percent of the land area-- was undeveloped. However, excellent highway and rail access to the Newark and New York City areas contribute to current development pressures.

1. GROWTH TRENDS

1a. Countywide

Prior to 1950, development in Morris County was largely concentrated in older town centers such as Morristown, Chatham, Rockaway, Madison, Dover, and Boonton. These towns were located adjacent to major transportation routes such as the Erie Lackawana Railroad, Route 46, and the colonial highway, Route 24. By 1950 the developed towns comprised one third of the county's population though only about three percent of the land area. At that time the population of Morris County was 164,341 (USBC, 1950).

Between 1960 and 1970, growth primarily occurred within a corridor 10 km (6 mi) wide, extending through the central portion of the county, adjacent to Route 46 and the new Interstate 80. A second major area of population growth occurred along Lake Hopatcong, in Jefferson Township, where large numbers of summer homes were converted to year-round use during the 1960's. By 1970, the population of Morris County was 383,454 (USBC, 1970). Since 1970, the western half of the development corridor has been the only major growth area in the county (Zabihach, Morris County Planning Board (MCPB), Oct. 25, 1978).

Although Morris County's population accounts for a relatively small proportion of the New York-New Jersey metropolitan region, it has recently grown far more quickly than the region as a whole. Between 1950 and 1975 the metropolitan area's population increased by

approximately 30 percent, while the population of Morris County grew by about 140 percent (Table 4-1). The population of the RVFPA increased by 120 percent during the same 25-year period.

1b. Upper Rockaway River Basin

During the last 25 years, the distribution of population in the RVFPA has changed considerably. Until 1950 development was largely concentrated along major transportation routes in the southern third of the RVFPA. As vacant land became increasingly scarce, development focused on other areas adjacent to transportation routes and which similarly benefit from convenient access.

Thus, during the 1950's a narrow corridor surrounding the major routes was subject to intense development. This corridor included portions of the previously rural townships of Denville and Rockaway. During the 1960's the development corridor widened to include portions of Randolph and Boonton townships and areas in Rockaway Township.

The suburbanization of the RVFPA was encouraged in the 1960's and 1970's by the opening of Interstate 80. As the entire area became more accessible to New York City and Newark, additional development at greater distances from the highway became increasingly feasible.

However, since 1968 a limited ban on sewer connections has acted as a strong deterrent to the development of the RVFPA. The court-imposed ban was issued in response to severe infiltration and discharge problems resulting from the operation of the RVRSA sewerage system above its capacity. Under the terms of the limited ban, permits for new connections may only be issued by the State Supreme Court. Each community within the RVRSA jurisdiction is allocated a maximum volume of effluent to be transported and treated, thus limiting the number of potential sewer connections which may be permitted. These limitations, in turn, have substantially curtailed development of residential subdivisions for which on-site sewage disposal could not be feasible.

During the 1960's, Rockaway Township incurred the greatest residential growth in the RVFPA. The township increased in population by nearly 90 percent, approximately 8,000 persons. A major factor in this increase was the development of White Meadow Lake, a large single-family subdivision (Zabihach, MCPB, June 6, 1979). As this subdivision is located just north of Interstate 80, it represented a significant expansion of the Route 46 and I-80 development corridor.

At present, the greatest volume of residential development is taking place in Denville, where six major subdivisions are planned for the southern and western portions of the township (McDonald, DeTPB, July 6, 1979). The subdivisions range in size from 20 to 150 homes. A total of about 360 new single-family homes is anticipated, with average densities of 2.5 housing units/hectare (1.0 housing units/acre). Another large single-family development of 49 units at

Table 4-1

Population Growth Trends

Area	Year				Percent Change			
	1950	1960	1970	1975	1950-1960	1960-70	1970-75	1950-75
Boonton Town	7,163	7,981	9,261	8,760[3]	11.4	16.0	-5.4	22.3
Dover Town	11,174	13,034	15,039	14,447[3]	16.6	15.4	-3.9	29.3
Kinnelon Borough[1]	370	1,220[4]	2,080[4]	2,190[4]	229.7	70.5	5.3	491.9
Mt. Lakes Borough[1]	750[4]	1,080[4]	1,270[4]	1,180[4]	44.0	17.6	-7.1	57.3
Rockaway Borough	3,812	5,413	6,303	6,341[3]	42.0	16.4	0.6	66.3
Victory Gardens Borough	-	1,085	1,027	1,213[3]	-	-5.3	18.1	11.8[2]
Wharton Borough	3,853	5,006	5,535	5,387[3]	29.9	10.6	-2.7	39.8
Towns and Boroughs Subtotal	27,122	34,819	40,515	39,518	28.4	16.4	-2.5	45.7
Boonton Township	1,155	1,998	3,070	2,981[3]	73.0	53.7	-2.9	158.1
Denville Township	6,055	10,632	14,045	13,674[3]	75.6	32.1	-2.6	125.8
Jefferson Township[1]	1,690[4]	4,230[4]	8,690[4]	9,280[4]	150.3	105.4	6.8	449.1
Mine Hill Township[1]	1,951[4]	2,970[4]	3,170[4]	3,110[4]	52.2	6.7	-1.9	59.4
Montville Township[1]	210[4]	230[4]	370[4]	350[4]	9.5	60.9	-5.4	66.7
Parsippany-Troy Hills Twp.[1]	1,020[4]	1,090[4]	1,070[4]	1,120[4]	6.9	-1.8	4.7	9.8
Randolph Township[1]	2,910[4]	4,940[4]	10,030[4]	12,950[4]	69.8	103.0	29.1	345.0
Rockaway Township[1]	4,370[4]	10,310[4]	18,910[4]	19,370[4]	135.9	83.4	2.4	343.2
Roxbury Township[1]	550[4]	980[4]	1,130[4]	1,160[4]	78.2	15.3	2.7	110.9
Townships Subtotal	19,911	37,380	60,485	63,995	87.7	61.8	5.8	221.4
RVFPA Total[5]	47,033	72,199	101,000	103,513	53.5	39.9	2.5	120.1
Morris County	164,341	261,620	383,454	394,984	59.2	46.6	3.0	140.3
N.Y. - N.J. SMSA[6]	13,951,000	16,141,000	17,930,000	18,341,000	15.7	11.1	2.3	31.5

Notes:
1. RVFPA portion
2. Percent change 1960-1975. (Borough incorporated subsequent to the 1950 census))
3. New Jersey Office of Demographic and Economic Analysis (NJODEA) estimate
4. WAPORA estimate
5. Sums may not be precise due to rounding and/or metric conversions.
6. Standard Metropolitan Statistical Area.

Sources: USBC; 1950, 1960, 1970.

4.2 hu/ha (1.7 hu/a) is planned for the eastern portion of Randolph Township (Bishop, RaTPB, July 6, 1979). In addition, a 200-unit garden apartment development, at 26.9 hu/ha (10.9 hu/a), has been approved for the densely settled southern portion of Rockaway Township. All of these developments are to be built at the maximum densities for which the properties are zoned.

Two large shopping malls in Randolph and Rockaway townships and a Holiday Inn in Denville Township are also planned. An industrial park is under construction in Denville.

2. LAND USE

2a. Residential

Of the total 16,780 net ha (41,500 net a) zoned for residential purposes--excluding public and semi-public land--in the RVFPA, approximately 33 percent have been developed (Table F-2). (A net hectare is a gross hectare less the area required for streets (Table F-4)). Approximately 90 percent of the RVFPA's housing units in 1975 were one-family and two-family homes. The majority of the remaining units were garden apartments. The largest residential concentrations were found in the RVFPA's southern sector.

The character and density of housing has hardly changed during the last ten years. Between 1968 and 1978 approximately 86 percent of all housing units constructed in the RVFPA were single family homes (NJDLI, 1967-1977). Due to large minimum-size building lot requirements, development densities have historically equalled maximum densities permitted under each municipality's zoning regulations. The highest average densities--approximately 10.4 to 16.3 hu/ha (4.2 to 6.6 hu/a)--are located in the southern portion of the RVFPA (Table F-5). Average densities in the remaining sections of the area are significantly less.

Housing costs in the area have changed considerably in the past decade. In 1973 the prices for one-family to four-family units in Morris County were among the highest in the New York-New Jersey metropolitan region. A median sales price of $42,000 for homes in the county was comparable to the median price in Bergen County, New Jersey, and Rockland and Westchester counties in New York. Between 1968 and 1973, housing prices in Morris County increased by approximately 15 percent. This was one of the fastest growth rates in the region, exceeded only by Monmouth and Passaic counties in New Jersey and Putnam County in New York (New Jersey Local Property Tax Bureau, 1968, 1971, 1973). Minimum sales prices for existing homes within the RVFPA currently range between $60,000 and $70,000. The price for new single family homes is significantly higher. Costs range between $100,000 and $150,000 in communities such as Boonton, Denville, Randolph, and Rockaway townships (Chuaravallati, Real Estate Agent, July 26, 1979). Housing costs are increasing steadily in the

area. Available data indicate sales prices have increased as much as 25 percent in the past five years (MCPB, 1978).

2b. Commercial

Approximately 37 percent of the total 840 net ha (2,110 net a) of commercially zoned land in the RVFPA was developed in 1975. The RVFPA's most diversified local shopping areas continue to be located in central business districts of the older communities of Boonton, Dover, Rockaway, and Wharton boroughs and along Route 46. The Rockaway Town Square Mall in Rockaway Township provides regional shopping facilities for area residents (Zabihach, MCPB, Oct. 25, 1978). Other commercial uses consist of office developments and neighborhood shops scattered throughout the RVFPA.

2c. Industrial

In 1975 industrial development in the RVFPA consisted predominantly of manufacturing plants and corporate offices. These facilities occupied approximately 640 net ha (1,590 net a), or about 23 percent of the area's total net industrial zoned land (including land zoned for mining). These industries were concentrated in Dover, Randolph, Denville, and Rockaway townships.

2d. Transportation and Utilities

The entire street network of the RVFPA accounts for about four percent, or 1,380 ha (3,410 a) of its total land area. Major regional highways serving the area are Interstate 80 and New Jersey Routes 46, 10, and 15. Land within railroad and utility line rights-of-way amount to an additional 390 ha (970 a). There are two railroad lines, the Erie Lackawanna's Gladstone and Morristown branches, serving the RVFPA. Major gas pipelines also pass through the area.

2e. Parks and Open Space

Parklands and open space including watershed lands amount to approximately 3,330 ha (8,160 a) or 10 percent of the RVFPA's total land. The largest public open space is Farney Park--(378 ha (994 a)--which is partially situated in Rockaway Township. Other large county-owned park and open space areas include Hidden Parks (in Dover Town and Mine Hill and Randolph townships), Tourne Park (in Denville and Boonton townships), and a State Fish and Game Preserve (in Roxbury and Jefferson townships).

2f. Public and Semi-Public Land

Public and semi-public land accounts for 11 percent, or 3,760 ha (9,290 a) of the RVFPA's total area. The major public institutions include the U.S. Military Reservation (Picatinny Arsenal) in Jefferson and Rockaway townships, and Greystone Park State Hospital in Denville and Parsippany-Troy Hills townships, a portion of which is located in the RVFPA.

2g. Vacant Land

In 1975, approximately 13,940 net ha (34,500 net a) or 42 percent of the RVFPA was vacant land zoned for residential, commercial, and industrial uses (Table F-2). These areas were predominantly located in Jefferson and Rockaway Townships and, to a lesser extent, in Randolph Township. While residentally zoned land accounts for about three quarters of the vacant land in the RVFPA, the 2,700 net ha (6,690 net a) of vacant industrial and commercial land in the RVFPA represents an opportunity for the continued development of corporate offices and research laboratories in the area.

2h. Zoning

Exclusive of public and semi-public land, about 80 percent of the total acreage in the RVFPA is designated for residential housing units. These areas are predominantly zoned for low-density use. More than 65 percent of the residential land is restricted to densities of 2.5 hu/ha (1 hu/a) or less. Residential land zoned for low densities is concentrated largely in the relatively undeveloped townships of Jefferson, Rockaway, Boonton, Denville, and Randolph.

High-density development, defined as 15 hu/ha (6 hu/a) or more, is permitted on only about five percent of the residential acreage. High-density zoning is concentrated within Route 46-Interstate 80 development corridor, with nearly 40 percent in the town of Dover.

Approximately five percent of the RVFPA, exclusive of public and semi-public land, is zoned for commercial use. While the area's commercial activity is largely composed of neighborhood and highway-oriented retail facilities, approximately 15 percent of the commercially zoned land is designated for office space. Industrial zones, which permit primarily light industry and research laboratories, represent about eight percent of the RVFPA.

A relatively unusual feature in this part of the country is the designation of particular lands to be utilized for mining purposes. Mining zones, which occur in the townships of Rockaway and Mine Hill, account for about seven percent of the RVFPA total area, exclusive of public and semi-public land (Table 4-4). While Rockaway Township

permits low-density residential use in its mining zone (1.2 hu/ha (0.5 hu/a)), Mine Hill prohibits any new housing due to several man-made hazards, such as potential cave-ins and drinking-well pollution resulting from the mining of iron. Though neither township reports any current mining activity, its resumption is reportedly imminent in Rockaway (MHTPB, 1977, RTPB, 1976).

2i. Summary of Master Plans and Other Land-Use Regulations

Section 208 of the Federal Water Pollution Control Act provides for regional water quality management planning, in regard to both treatment and prevention of water pollution. Section 208 plans must provide a program for meeting established water quality goals. The plans must also show that management institutions exist with sufficient financial and legal authorities to implement the plan. An additional important function of the 208 agency is to develop areawide population projections. Such projections are the base on which funds are allocated to sub-areas for facilities planning and construction.

The RVFPA is within the Northeast New Jersey 208 Planning Area, which includes 175 communities within the counties of Morris, Bergen, Essex, Hudson, Passaic, Union, and Somerset. The plan was prepared by NJDEP.

This document considers improvements proposed under Section 201 of the Federal Water Pollution Control Act. Section 201 requires facilities planning in connection with specific federally funded sewer projects.

The New Jersey Municipal Land-Use Law (Chapter 291, Laws of New Jersey, 1975) requires each community in the state to prepare a comprehensive master plan to serve as an overall development strategy for guiding future growth. Each plan is to provide for land use, housing, circulation, utility service, community facilities, recreation, and conservation. Goals and objectives of the master plans adopted by communities in the RVFPA are briefly summarized as they relate to recommended future development patterns.

It is recommended in several plans that undeveloped land be developed at low densities, due to environmental constraints such as steep slopes and flood prone areas. This concern is reflected in existing provisions of several municipal zoning ordinances. For example, Jefferson Township's R-E residential zone--(0.7 hu/ha (0.3 hu/a)--is located in an area "characterized by steep slopes and varying topography along with other environmental constraints" (JTPB, 1978). Mine Hill Township requires low residential densities "where there is poor drainage, high water table, steep or wet lands, poor soil, severe limitations for septic disposal systems, (or) lack of public utilities" (MHTPB, 1977). Denville Township's R-C--(2.7 hu/ha (1.1 hu/a)--and C (1.2 hu/ha (0.5 hu/a)) residential zones are designed to protect aquifer recharge areas, steeply sloped lands, and floodplains (DeTPB, 1977).

In addition, Wharton, Randolph, and Denville emphasize the concept of cluster zoning. This is an option whereby residential builders may decrease individual lot sizes, while providing public open space to achieve the same overall density. The three communities propose the application of this option to low density zones--generally 2.5 hu/ha (1.0 hu/a)--in order to conserve environmentally sensitive land and maximize recreational opportunities.

A number of communities propose to increase the range of available housing types by providing limited high-density zones. Garden apartments and townhouses are permitted in portions of nearly all communities in the RVFPA. Rockaway Township proposes to provide a density bonus in certain zones to developers who build housing specifically for the elderly. Several areas currently zoned for single-family homes are identified in the Mine Hill Master Plan as potential future sites for garden apartments and high-density senior citizen developments. In general, however, recommendations for high-density zoning are limited to small areas not significant enough to affect the overall community density.

In a few cases large-scale non-residential developments are envisioned. For example, Randolph's Master Plan calls for a town center in the Mt. Freedom area, which would include pedestrian-oriented shopping, office space, and townhouses; Dover proposes to revitalize its downtown through the development of urban renewal property; and, the Mine Hill Land Use Plan contains a provision for a large-scale industrial park.

There are presently no subsidized low- or moderate-income housing projects in the RVFPA. A 144-unit subsidized housing development for the elderly is under construction in the town of Dover. Several other communities have plans for low- and moderate-income housing.

2j. Current Litigation

The New Jersey State Public Advocate has initiated a lawsuit against 27 Morris County municipalities, alleging the communities engage in exclusionary zoning practices. The RVFPA municipalities named in the suit are Kinnelton and Mountain Lakes boroughs and Boonton, Denville, Jefferson, Montville, Parsippany-Troy Hills, Randolph, Rockaway, and Roxbury townships. The suit represents an effort to ensure compliance with the 1975 New Jersey Supreme Court ruling that developing municipalities must provide a "fair share" of the region's low-cost housing needs.

It is recognized that each community is responsible for guiding its growth and development by means of a local zoning ordinance and master plan. The EPA policy to protect environmentally sensitive areas will not interfere with any locality's goals and objectives for regulating community growth or with compliance with potential court orders which may result from the current litigation.

3. ENVIRONMENTAL CONSTRAINTS

The EPA considers steep slopes, floodplains, wetlands, archaeological and historic sites, and prime agricultural lands to be environmentally sensitive areas. When the population projections were forecast, only those lands deemed developable (not environmentally constrained) by EPA were considered for future development, in accordance with the present local zoning ordinances. It is assumed for purposes of this EIS that no future development will occur on the environmentally constrained lands.

In order to protect previously undeveloped wetlands and floodplains from development, EPA Step 2 and Step 3 grants to the municipalities will contain certain conditions which prohibit sewer hookups from new buildings, facilities, or other construction. These conditions are presented in Section 5C of the EIS Summary. Furthermore, federal funds cannot be expended for promoting development in environmentally sensitive areas.

3a. Land Capacity

Based on a detailed inspection of municipal land use and zoning maps, approximately 13,960 ha (34,510 a) of privately-owned land within the RVFPA are underdeveloped. Of this amount approximately 80 percent is zoned for residential use. The extent to which this land may be developed is limited, however, both by natural constraints and by government regulations.

Approximately 6,000 ha (14,830 a) of the 13,960 ha (34,510 a) of vacant land are likely to remain underdeveloped due to a combination of the following environmental and legal factors.

Constrained Lands	Percentage of Vacant Lands
• Steep slopes	28.2
• Floodplains	4.1
• Wetlands	7.9
• Archaeological and historic sites	0.2
• Prime aquifer recharge areas	2.3
• Prime agricultural lands under cultivation	0.3

To avoid double counting, the lands characterized by more than one constraint have been assigned to the factor that appears first in the list above. This scheme is reflected in the percentages shown above.

Steep Slopes

Steeply sloped areas comprise approximately 3,940 ha (9,750 a) of the RVFPA (Table 4-2). At times it may be feasible to develop such land, given sufficiently high development pressures. However,

developers are generally not likely to build on steeply sloped sites because of technical problems and high costs.

Floodplains

Approximately 570 ha (1,400 a) are located in floodplains (Table 4-2). Flood prone areas are protected by the National Flood Insurance Act of 1968 (as amended by the Flood Disaster Protection Act of 1973), which provides government-sponsored flood insurance for structures in designated floodplains. Insurance is limited to communities which initiate measures to limit floodplain development. New buildings in floodprone areas are unlikely to receive federal flood insurance and, therefore, lending institutions are reluctant to finance the construction. Moreover, Federal Executive Order #11488 (Federal Register, 1977) as amended by Executive Order #12148 (Federal Register, 1979) directs the avoidance of floodplain development whenever possible.

Wetlands

Wetlands comprise approximately 1,100 ha (2,720 a), exclusive of acreage coinciding with flood plains (Table 4-2). Wetlands serve as a necessary habitat for a number of plant and animal species and are more likely to suffer lasting damage from disruptive activities. Wetlands are protected by the Federal Water Pollution Control Act and by Federal Executive Order #11990 (Federal Register, 1977) which direct the avoidance of construction in wetlands, unless there is no practical alternative.

Archaeological and Historic Sites

There are approximately 25 ha (60 a) of National Register-designated land in the RVFPA, exclusive of land coinciding with steep slopes, floodplains, and wetlands (Table 4-2). Certain eligible sites of historic value are recorded in the National Register and are protected from modification by the National Historic Preservation Act of 1966.

Prime Aquifer Recharge Areas

The development of aquifer recharge areas is likely to result in increased surface runoff and decreased infiltration. Certain prime aquifer recharge areas within the RVFPA are essential for the maintenance of public water supply wells. Such areas account for about 320 ha (790 a), exclusive of acreage coinciding with floodplains and historic sites (Table 4-2).

Table 4-2

Developable Vacant Land in the Rockaway Valley Facility Planning Area

Municipality	Zoning Type	Total Vacant Land (Net ha (a))	Vacant Land Unsuitable for Development							Total Developable Land
			Steep Slopes	Floodplains	Wetlands[2]	Historic[3] Sites	Aquifer[4] Recharge Areas	Agricultural[5]	Total	
Boonton Town	Residential	54 (134)	6 (16)		1 (2)				7 (18)	47 (116)
	Commercial	7 (16)	0 (0)		0 (0)				0 (0)	7 (16)
	Industrial	24 (60)	6 (15)		0 (0)				6 (15)	18 (45)
	Subtotal	85 (210)	12 (31)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	13 (33)	72 (177)
Dover Town	Residential	21 (53)	9 (23)			0 (0)			9 (23)	12 (30)
	Commercial	1 (3)	0 (0)			0 (0)			0 (0)	1 (3)
	Industrial	23 (58)	0 (0)			11 (26)			11 (26)	12 (32)
	Subtotal	45 (114)	9 (23)	0 (0)	0 (0)	11 (26)	0 (0)	0 (0)	20 (49)	25 (65)
Kinnelon[1] Borough	Residential	921 (2275)	178 (439)		101 (250)				279 (689)	642 (1586)
	Industrial	53 (130)	11 (28)		8 (21)				19 (49)	34 (81)
	Subtotal	974 (2405)	189 (467)	0 (0)	109 (271)	0 (0)	0 (0)	0 (0)	298 (738)	676 (1667)
Mountain Lakes[1] Borough	Residential	1 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3)
Rockaway Borough	Residential	35 (86)	4 (11)	0 (0)	0 (0)	0 (0)			4 (11)	31 (75)
	Commercial	21 (52)	0 (0)	0 (0)	1 (2)	0 (0)			1 (2)	20 (50)
	Industrial	71 (175)	1 (2)	15 (37)	8 (21)	2 (4)			26 (64)	45 (111)
	Subtotal	127 (313)	5 (13)	15 (37)	9 (23)	2 (4)	0 (0)	0 (0)	31 (77)	96 (236)
Victory Gardens Borough	Residential	3 (7)	2 (4)						2 (4)	1 (3)
	Industrial	1 (2)	0 (0)						0 (0)	1 (2)
	Subtotal	4 (9)	2 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (4)	2 (5)
Wharton Borough	Residential	62 (154)	.2 (6)	2 (4)	16 (40)				20 (50)	42 (104)
	Commercial	0 (1)	0 (0)	0 (0)	0 (0)				0 (0)	0 (1)
	Industrial	136 (336)	33 (82)	19 (47)	1 (2)				53 (131)	83 (205)
	Subtotal	198 (491)	35 (98)	21 (51)	17 (42)	0 (0)	0 (0)	0 (0)	73 (181)	125 (310)
Boonton Township	Residential	1059 (2617)	339 (833)	88 (217)	94 (232)		55 (135)		576 (1417)	685 (1200)
	Commercial	0 (0)	0 (0)	0 (0)	0 (0)		0 (0)		0 (0)	0 (0)
	Industrial	4 (11)	0 (0)	0 (0)	0 (0)		4 (11)		4 (11)	0 (0)
	Subtotal	1063 (2628)	339 (833)	88 (217)	94 (232)	0 (0)	59 (146)	0 (0)	578 (1428)	485 (1200)
Denville Township	Residential	1105 (2732)	219 (542)	56 (139)	76 (189)	3 (9)	139 (343)	17 (43)	511 (1265)	594 (1467)
	Commercial	101 (250)	4 (15)	17 (43)	4 (3)	0 (0)	0 (0)	0 (0)	25 (61)	77 (189)
	Industrial	165 (408)	8 (20)	24 (59)	29 (72)	2 (5)	18 (41)	0 (0)	79 (195)	86 (213)
	Subtotal	1371 (3390)	233 (577)	97 (241)	109 (264)	5 (12)	156 (384)	17 (43)	614 (1521)	757 (1869)
Jefferson[1] Township	Residential	3198 (7905)	1438(3553)	75 (186)	107 (265)		15 (38)		1635 (4042)	1563 (3863)
	Commercial	248 (614)	9 (23)	2 (6)	7 (17)		18 (42)		36 (88)	212 (526)
	Industrial	216 (533)	22 (55)	9 (22)	39 (96)		0 (0)		70 (173)	146 (360)
	Subtotal	3662 (9052)	1469(3631)	86 (214)	153 (378)	0 (0)	33 (80)	0 (0)	1741 (4303)	1921 (4749)
Mine Hill[1] Township	Residential	146 (361)	22 (54)		10 (24)				32 (78)	114 (283)
	Industrial	85 (209)	11 (27)		2 (5)				13 (32)	72 (177)
	Mining	136 (335)	20 (49)		11 (27)				31 (76)	105 (259)
	Subtotal	367 (905)	53 (130)	0 (0)	23 (56)	0 (0)	0 (0)	0 (0)	76 (186)	291 (719)
Montville[1] Township	Residential	315 (777)	114 (283)	23 (57)	15 (36)				152 (376)	163 (401)
	Commercial	0 (1)	0 (0)	0 (0)	0 (0)				0 (0)	0 (1)
	Industrial	29 (71)	0 (0)	0 (0)	0 (0)				0 (0)	29 (71)
	Subtotal	344 (849)	114 (283)	23 (57)	15 (36)	0 (0)	0 (0)	0 (0)	152 (376)	192 (473)
Parsippany-Troy Hills Township[1]	Residential	32 (81)	6 (15)	0 (0)	2 (4)	0 (0)	4 (11)	0 (0)	12 (30)	20 (51)
Randolph[1] Township	Residential	1090 (2694)	253 (625)	19 (48)	44 (109)		58 (143)	19 (46)	393 (971)	697 (1723)
	Commercial	36 (90)	7 (17)	0 (0)	0 (0)		0 (0)	0 (0)	7 (17)	29 (73)
	Industrial	198 (490)	0 (0)	27 (67)	23 (57)		1 (2)	0 (0)	51 (126)	147 (364)
	Subtotal	1324 (3274)	260 (642)	46 (115)	67 (166)	0 (0)	59 (145)	19 (46)	451 (1114)	873 (2160)
Rockaway[1] Township	Residential	2993 (7396)	889 (2197)	90 (222)	297 (735)	0 (0)	0 (0)	5 (12)	1281 (3166)	1712 (4230)
	Commercial	120 (297)	0 (0)	10 (24)	35 (88)	0 (0)	0 (0)	0 (0)	45 (112)	75 (185)
	Industrial	180 (444)	23 (57)	66 (163)	73 (180)	4 (9)	11 (27)	0 (0)	177 (436)	3 (8)
	Mining	486 (1201)	268 (662)	15 (37)	54 (134)	0 (0)	0 (0)	0 (0)	337 (833)	149 (368)
	Subtotal	3779 (9338)	1180 (2916)	181 (446)	459(1137)	4 (9)	11 (27)	5 (12)	1840 (4547)	1939 (4791)
Roxbury[1] Township	OSGU[6]	138 (341)	26 (65)	1 (2)	10 (24)	0 (0)			37 (91)	101 (250)
	Residential	74 (184)	4 (9)	0 (0)	6 (14)	0 (0)			10 (23)	64 (159)
	Industrial	374 (925)	9 (22)	7 (19)	30 (73)	4 (9)			50 (123)	324 (802)
	Subtotal	586 (1450)	39 (96)	8 (21)	46 (113)	4 (9)	0 (0)	0 (0)	97 (239)	489 (1211)
RVFPA TOTAL[7]	All areas	13962 (34512)	3963 (9749)	563 (1399)	1101(2724)	26 (60)	322 (795)	41(101)	5990(14826)	7966(19686)

Notes:
1. RVFPA portion.
2. Inclusive of acreage coinciding with floodplains.
3. Inclusive of acreage coinciding with steep slopes, floodplains, and wetlands.
4. Inclusive of acreage coinciding with floodplains and historic sites.
5. Inclusive of acreage coinciding with floodplains, historic sites, and aquifer recharge areas.
6. Open Space for Government Use.
7. Sums may not be precise due to rounding and/or metric conversions.

Prime Agricultural Lands

The continuing decrease in farmland has adverse social, economic, and environmental impacts. Prime agricultural land, or farmland cannot be restored once developed. Approximately 40 ha (100 a) of prime agricultural land are presently under cultivation in the RVFPA, exclusive of land coinciding with floodplains, historic sites, and aquifer recharge areas (Table 4-2).

Parks and Open Spaces

In addition to the privately owned vacant land discussed above, the RVFPA contains 3,330 ha (8,160 a) of public and semi-public parks and open space (Table 4-2). Several municipalities have designated open areas as proposed parkland. Such areas are included in the "parks and open space" category and thus have been removed from the supply of vacant developable land. Also included are some 1,250 ha (3,100 a) of reservoir lands held by the cities of Jersey City and Newark to protect municipal water supplies.

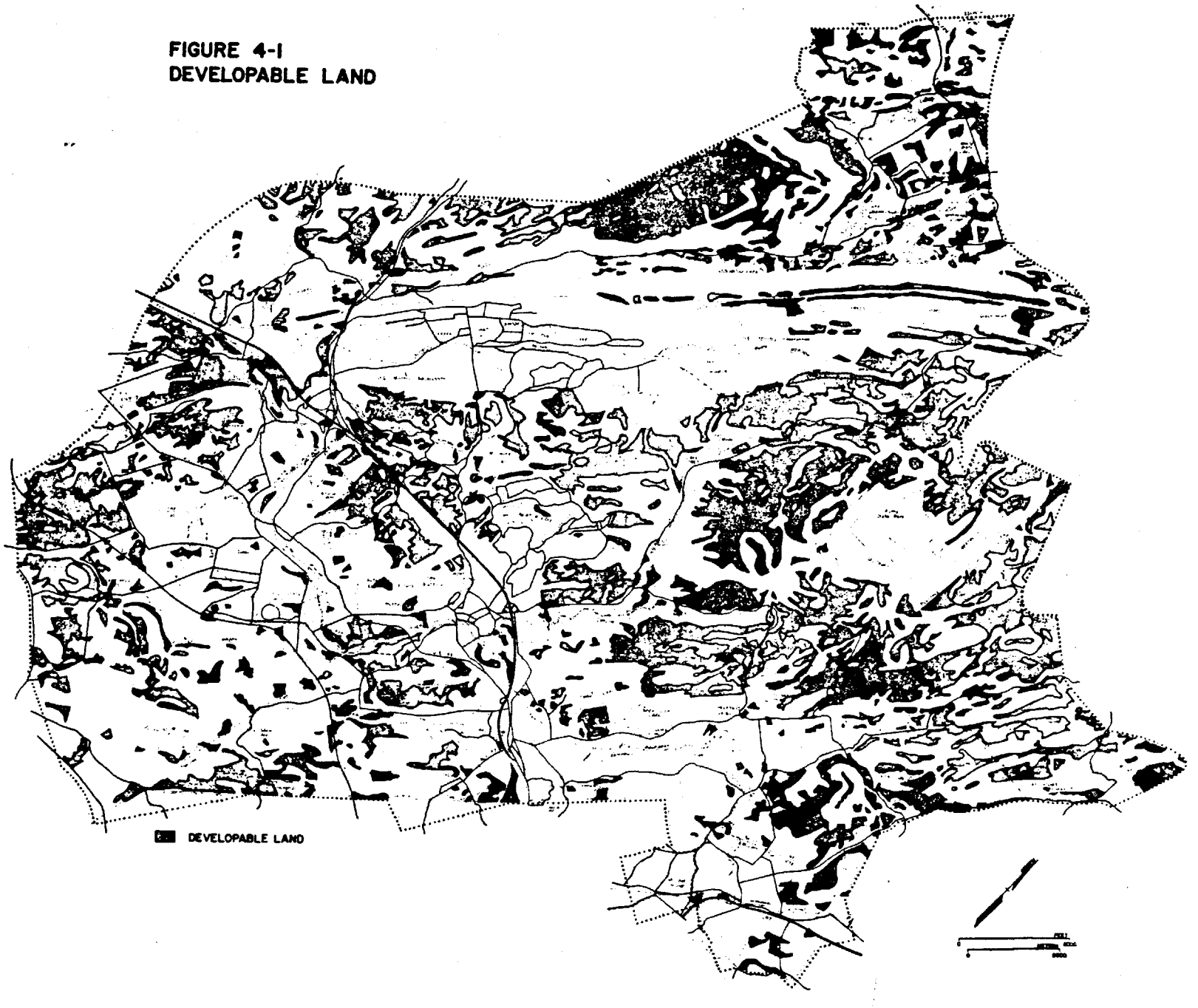
Common to all master plans in the RVFPA is the objective of preserving parkland. Therefore, those areas devoted to parks and open space are likely to remain undeveloped in the foreseeable future.

3b. Effects on the Growth Patterns of New Development

Environmental constraints have been a major factor influencing the pattern of development in the RVFPA. As discussed in this chapter, development has historically been concentrated within a corridor surrounding a group of major transportation routes. This area benefits not only from accessibility but also from large tracts of land free of environmental constraints. Development in areas such as the northern sections of Rockaway and Jefferson townships, however, has been greatly limited due to a preponderance of steep slopes, wetlands, and floodplains.

As vacant developable land continues to be readily available throughout much of the RVFPA, development trends for the near future are not likely to substantially differ from past growth patterns. As the quantity of unconstrained vacant land diminishes, the pressure to develop environmentally sensitive lands is expected to intensify. Therefore, current growth trends may alter over the long term. The lands considered developable based on the constraints discussed in this EIS are shown in Figure 4-1.

FIGURE 4-1
DEVELOPABLE LAND



3c. Water Supply

Total water usage for 1977 in the RVFPA was 71,900 cu m/d (19.0 mgd), of which 37,472 cu m/d (9.9 mgd) was used by public supply customers. Because the stratified drift deposits are the most productive, all wells of the four main purveyors tap these deposits. During periods of average usage the water districts pump from only a few wells in order to satisfy their customers demands, reserving surplus capacity for times of peak and emergency needs. Estimates based on well records of the maximum yield for each purveyor's wells indicate that the RVFPA has a surplus capacity of approximately 49,962 cu m/d (13.2 mgd). If existing basin surplus could be fully utilized and evenly distributed throughout the RVFPA, interbasin transfers retained at existing levels, and no new in-basin sources developed, and if the present usage (462 lpcd (122 gpcd)) remains the same, the capacity of the present well systems would be able to support a maximum constrained population of 164,960 that would require 76,174 million cu m/d (20.1 mgd) of groundwater (Table 3-1, Table 4-3). While this amount of water may be obtained if all wells are operating at maximum efficiency, withdrawals will slightly exceed estimated safe yield based on recharge rates for the stratified drift deposits, causing a long-term reduction in storage. In addition, it is unlikely that all water purveyors would be able to operate at maximum efficiency.

However, this surplus is not evenly distributed throughout the basin. Most public supply wells are spaced in groups or fields along the Rockaway River. Some fields have larger capacities than others either because they tap highly productive aquifers or because they are in hydraulic conductivity with the Rockaway River. In Dover, three wells tapping the same aquifer produce an average of 5,300 lpm (1,400 gpm), with no evidence of induced recharge, while in Boonton, six wells completed in two different aquifers yield an average of 1500 lpm (400 gpm), with indications of induced recharge. If a water distribution system is not developed, the growth rate in the RVFPA will be slowed until such a system exists.

The water surplus is largely restricted to areas adjacent to the Rockaway River and around White Meadow Lake. The northern portion of the RVFPA lacks areas of extensive stratified drift, forcing the use of the Precambrian rocks for water supply. While productive enough for single-family self-suppliers, cost considerations preclude development of public water supply from this aquifer. Additional development in low-density areas will likely use private wells, and water supply mains may only be extended in a limited number of locations.

In Wharton, recent tests of public supply well No. 3 have disclosed possible contamination by xylene, a vinyl solvent (Danco, 1979). This well is located about one kilometer (0.62 mi) down the Rockaway River from a chemical dump, on private property owned by L.E. Carpenter, a manufacturer of vinyl wall coverings. In April 1979, concentrations of 100 parts per billion were detected by a private

Table 4-3

Surpluses of Major Water Purveyors in the Rockaway Valley Facility Planning Area

Major Water Purveyors	Communities Served	Estimated Total Effective Capacity of Purveyor cu m/d (mgd)[1]	1977 Average Daily Flows cu m/d (mgd)	Surplus(+) or Deficit(-) cu m/d (mgd)
Rockaway Borough Water Co.	Rockaway Borough Rockaway Township	9462 (2.50)	8327 (2.20)	+1135 (+0.30)
Dover Water Co.	Dover Town Victory Gardens Randolph Twp. Rockaway Twp.	29901 (7.90)	11355 (3.09)	+18205 (+4.81)
Wharton Borough Water Dept.	Wharton Borough	14913 (3.94)	2536 (0.67)	+12377 (+3.27)
Denville Township Water Dept.	Denville Township	18471 (4.88)	6056 (1.60)	+12415 (+3.28)
Boonton Town Water Dept.	Boonton Town Boonton Township	10219 (2.70)	4542 (1.21)	+5639 (+1.49)
RVFPA Totals[2]		83080 (21.92)	33194 (8.77)	+49772 (13.15)

Notes:

1. With present equipment this is the maximum combined withdrawals from all wells that can be sustained for a 24 hour period.
2. Sums may not be precise due to rounding and/or metric conversions.

Source: Well records
NJDEP, 1977

laboratory, but subsequent tests by Wharton Borough and the NJDEP indicate only trace amounts/ At the present time the well is designated for emergency use only. An additional concern is that Dover Town has a group of wells approximately a mile further downstream which use the same aquifer. At the present time there are no indications of xylene in water from the Dover wells (Danco, 1979).

Safe Yield/Groundwater Recharge

Safe yield of a groundwater basin is the amount of water which can be withdrawn from it annually without the depletion of the groundwater reserves, the intrusion of water of undesired quality, the contravention of existing water rights, the deterioration of the economic advantages of pumping, or the excessive depletion of streamflow by induced recharge and land subsistence (Todd, 1959; Freeze and Cherry, 1979). Methods of establishing safe yield vary based on the availability of data and depth of analysis. One of the most direct methods is to compare average annual groundwater recharge to consumptive use. This method is used in the RVFPA to establish safe yields of the aquifers under long-term and drought year conditions (Appendix B).

Surface water rights in the RVFPA are held by Jersey City and groundwater withdrawal limits are set by NJDEP. In most valley fill aquifer systems containing a stream, the aquifer and stream are interconnected, so that pumping of a well near the stream causes a certain amount of river water to be drawn down through its bed, entering the underlying aquifer, and subsequently being intercepted by the well. In the RVFPA, this interconnection is important because river flow replenishes the Boonton Reservoir.

The 1977 yield of the Boonton Reservoir was 287,660 cu m/d (76 mgd), of which 261,165 cu m/d (69 mgd) was for Jersey City water supply and 26,490 cu m/d (7 mgd) for augmentation of the lower Rockaway River flow. This means that the river must supply a minimum of 287,660 cu m/d (76 mgd) to the Boonton Reservoir in order to maintain adequate supply for Jersey City and flow in the lower Rockaway River. Average annual river flow is 495,830 cu m/d (131 mgd), but for the drought years (1961-1966) the average annual flow was 352,000 cu m/d (93 mgd). This indicates that even during an extended low-flow period the river still supplied an excess of 18 percent (64,345 cu m/d (17 mgd)) of Jersey City needs. In addition, stream gauging measurements made by TetraTech in 1977 indicate that for the reach of heaviest pumpage, between Denville and Rockaway boroughs, the Rockaway River only loses approximately 4,920 cu m/d (1.3 mgd). This implies that pumpage along the river does not significantly alter flow and that only during periods of extreme low flow does well pumpage effect the amount of water needed for Jersey City water supply. However, the Boonton Reservoir has nine percent surplus storage (Jersey City Department of of Public Works, 1977).

The average annual recharge to the stratified drift based on precipitation and infiltration rates is 75,700 cu m/d (20 mgd) (Appendix B). During the drought years precipitation averaged 11 percent less, decreasing the average annual recharge to approximately 68,130 cu m/d (18 mgd). A substantial portion of the sewer district coincides with the water districts, indicating that most public supply water is discharged outside the basin (consumptive use) at the wastewater treatment plant. This amounts to approximately 30,280 cu m/d (8.0 mgd) of which 3,785 cu m/d (1.0 mgd) is inflow or infiltration (Tetra-Tech, 1978). Assuming that the majority of this consumptive use comes from the stratified drift, the present public supply pumping levels (44 percent of drought recharge and 40 percent of normal stratified drift recharge) are diverted from the RVFPA (Table B-4). This indicates that less than half of the total stratified drift recharge is used for public supply. However, distribution is throughout the valley-fill aquifer system and may not be immediately accessible to all well fields, causing a certain degree of lowering of the local water table. In addition, some well fields are hydraulically connected to the Rockaway River, drawing their pumpage from the river and the valley-fill aquifer system.

Groundwater usage also occurs from self-supplied industrial, institutional, commercial, and domestic sources. However, wastewater from such users is discharged on site, with little consumptive use.

3d. Air Quality

The NJDEP has participated with the EPA in an air quality modeling program (EPA, 1979a) which predicts satisfactory Total Suspended Particulates (TSP) and Sulfur Dioxide (SO_2) concentrations in this area with regard to the "cost-effective guideline" population projections. These projections are greater than the 208 population projections for this area, and as the population projections used in this analysis are either equal to or less than the projected 208 figures, there should be no problem with these contaminants.

As far as the remaining regulated contaminants are concerned, the Northeast Corridor Regional Modeling Program (NECRMP) will evaluate ozone concentrations as part of a larger regional problem, and NECRMP also utilizes 208 population projection. This study is being undertaken in order to develop strategies to bring the area into attainment with regard to the ozone standard. In addition, the 1982 New Jersey State Implementation Plan (SIP) Submittal being prepared by the NJDEP will address hydrocarbon and nitrogen oxide emissions as part of a regional analysis designed to meet the ozone standard. Carbon monoxide is usually a localized problem caused by high vehicular activity in urban areas, and should not present any problems for the study area.

3e. Soil Suitabilities

Septic tank absorption fields are relatively efficient treatment systems that use sedimentation, sludge digestion and removal, filtration, adsorption, and organic decomposition to process domestic wastewater. Soil characteristics strongly influence the degree of the wastewater treatment, and subsequent efficiency of the systems. Certain soils have limitations for the use of absorption fields because of poor drainage, the presence of an impervious layer (fragipan) at a shallow depth, shallow water table, or steep slopes. An analysis of soil suitability for on-site sewage disposal in the RVFPA performed by ESCA-Tech shows that 55 percent have severe limitations (Figure 4-2).

Rockaway, Hibernia, Netcong, and Califon soils have fragipans at depths that restrict downward percolation and force wastewater to move horizontal to the earth's surface. The Pompton, Carlisle, Parsippany, Hibernia, and Califon series soils all have seasonal shallow water tables and present limitations for conventionally designed leaching fields. Areas having a seasonally shallow water table within 76 centimeters (30 inches) of the surface occupy 26 percent of the RVFPA. Steep sloped lands comprise a wide variety of soils (Figure 3-1).

Additional soil constraints are prime aquifer recharge areas and agricultural soils. Prime aquifer recharge areas are considered as having highly permeable soils overlying deposits of Wisconsin stratified drift, earlier glacial drift, and, in some cases, Wisconsin terminal moraine. The areas are predominantly located along the Rockaway River Valley and in the southern corner of the RVFPA and comprise 3,509 ha (8,773 a) or 11 percent of the study area (ESCA-Tech 1977).

Soils that are considered as prime agricultural lands fall within the United States Department of Agriculture-Soil Conservation Service (USDA-SCS) Capability Classes I and II, and are described as having few limitations--based on slope, drainage, texture, and erodibility--that reduce the choice of crops farmed or require moderate conservation practices. A wide variety of soils exhibit these qualities and subsequently are scattered throughout the area, some having been built on. Approximately 7.0 percent of the RVFPA contains soils having few-to-moderate limitations to agricultural development; one-third of these soils has been urbanized. If existing agricultural land is zoned for low-density housing urbanization will not occur, and this land will continue to be used for agricultural purposes.

4. IMPLICATIONS FOR FUTURE POPULATION GROWTH

In summary, the following environmental constraints have been identified:

1. Land Capacity - Approximately 44 percent of the undeveloped residentially zoned land have environmental constraints to development (Table 4-2). Consequently, the constrained saturation population for the RVFPA is 157,990 (exclusive of persons in group quarters, such as hospitals and universities) (Table 4-4).

   Persons in group quarters represent an extremely small number (800) of the RVFPA population (USBC, 1970). This figure is assumed to remain constant. Thus, the constrained residential saturation population of the RVFPA, plus persons in group quarters is 158,790.

2. Land Use Plans - In accord with RVFPA municipal master plans, the amount of residentially zoned land to be reserved for future public uses is insignificant.

3. Water Supply - Water Supply is not a constraint to population growth. Total available in-basin water resources are sufficient to meet future water demands without increasing existing interbasin transfers.

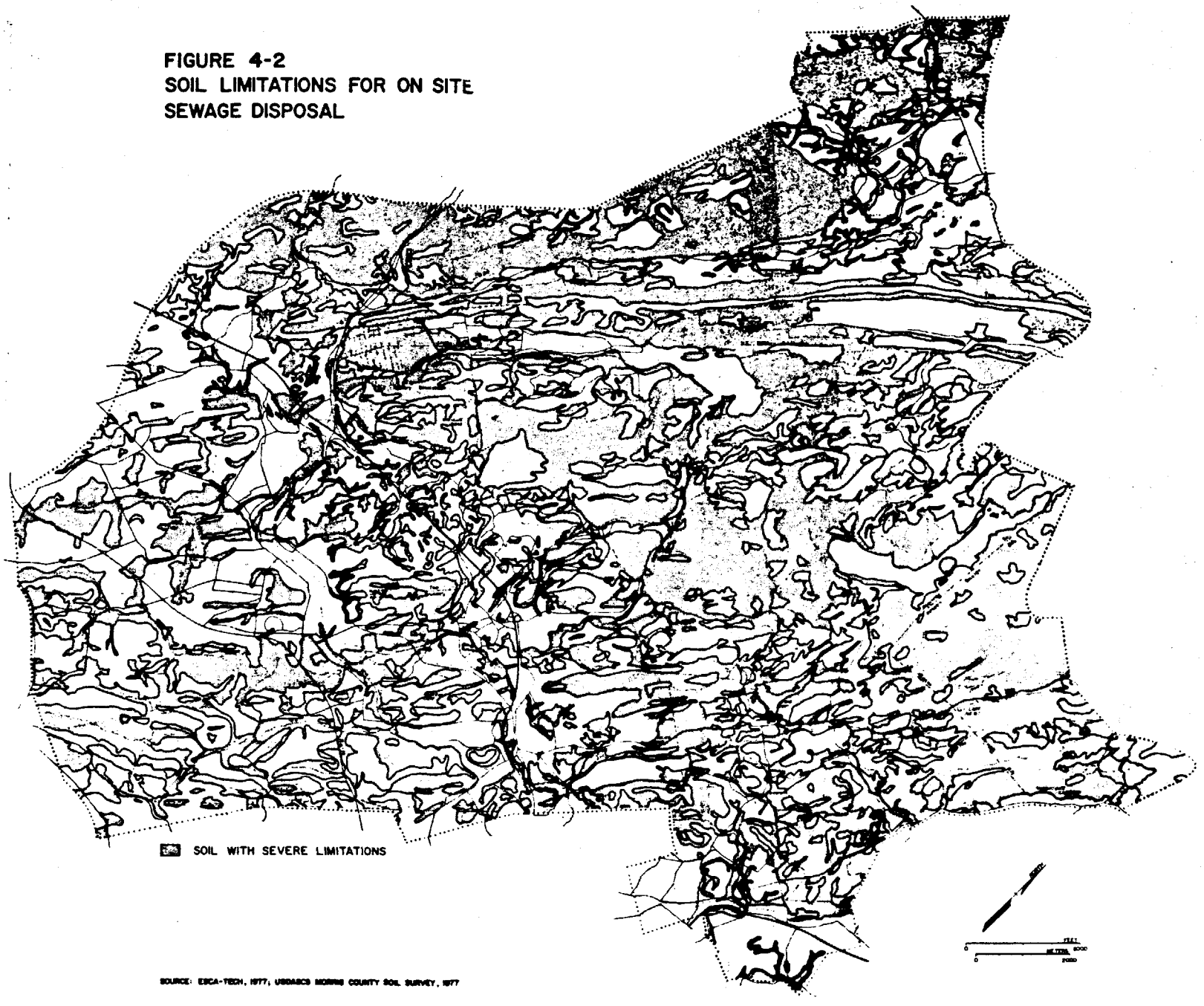
4. Air Quality - Air quality is not a constraint. Carbon Monoxide (CC), SO_2 and TSP concentrations should not exceed standards. Hydrocarbon, ozone, and nitrogen oxide emissions are being addressed through NECRMP.

5. Soils - Over half of the area of the RVFPA has soils considered unsuitable or marginally suitable for on-site waste disposal systems. If sewered, these areas will not constrain growth, but if unsewered these areas will contribute to non-point source pollution, degrading water quality. Each lot will have only enough soil area to adequately filter septic waste sat low densities.

5. PHASING OF FUTURE POPULATION GROWTH

The phasing of population growth to the year 2020 was based on examination of residential construction trends over the past 30 years and on maximum development capacities for each municipality. Specifically, trend analysis was used to project the amount of new housing unit construction expected between 1975 and 2020. Applicable estimates of average household size were used to derive population projections through this 40-year period (Table F-1).

FIGURE 4-2
SOIL LIMITATIONS FOR ON SITE
SEWAGE DISPOSAL



SOURCE: ESCA-TECH, 1977; USDA SCS MORRIS COUNTY SOIL SURVEY, 1977

Table 4-4

Constrained Maximum Saturation Population
Projections for the Rockaway Valley Facility Planning Area

Municipality	Constrained Saturation Population[1]
Boonton Town	11,170
Dover Town	14,840
Kinnelon Borough[2]	6,110
Mountain Lakes Borough[2]	1,150
Rockaway Borough	6,880
Victory Gardens Borough	1,330
Wharton Borough	6,130
Boonton Township	5,680
Denville Township	18,750
Jefferson Township[2]	17,690
Mine Hill Township[2]	5,330
Montville Township[2]	1,160
Parsippany-Troy Hills Township[2]	1,330
Randolph Township[2]	18,100
Rockaway Township[2]	39,610
Roxbury Township[2]	2,730
RVFPA Total[3]	157,990

Notes:
1. All figures are rounded to the nearest 10 persons.
2. RVFPA portion.
3. Sums may not be precise due to rounding and/or metric conversions.

The trend analysis technique involves the projection of future housing units in a community. During the past 30 years, those communities which are already developed have experienced a considerable decline in the rate of new housing construction (NJDLI, 1967-1977; USBC; 1950, 1960, 1970). Therefore, a distinction in analysis was made between them and communities that still possess significant quantities of developable vacant land.

Six communties (Boonton and Dover towns, and Mountain Lakes, Rockaway, Victory Gardens, and Wharton boroughs) have already developed 80 percent of their potential housing units, based on the highest densities permitted by zoning in 1975. In these cases, it was assumed the annual construction rate would gradually decline, as remaining developable land diminished (Appendix F). This produced projections which gradually approach saturation levels.

For the remaining communities, projections beginning with 1985 were based on construction trends over the last 30 years. When a community was anticipated to have developed 80 percent of its potential housing units, the development rate was decreased, as described above.

The population projections illustrate an anticipated increase of about 45 percent (46,000) in the RVFPA population between 1975 and 2020 (Table 4-5). Rockaway Township with a projected increase of approximately 17,000, accounts for 37 percent of the total projected population growth. The RVFPA portions of Mountain Lakes, Rockaway, and Victory Gardens boroughs, and Montville and Parsippany-Troy Hills townships are expected to reach saturation population by 2020. Figures F-1 through F-16 illustrate population projections for the 16 RVFPA communities.

The "Section 208" Water Quality Management Plan for Northeast New Jersey forecasts an RVFPA population of 129,870 for the year 2000 (Table 4-6). This is 6,720 less than the EIS year 2000 projection of 136,590. However, the "208" projection does not include areas of three communities (Mountain Lakes Borough, Montville and Parsippany-Troy Hills townships) that were subsequently added to the RVFPA. If the population projections for these three communities are subtracted from the EIS year 2000 projection for the RVFPA, the figure obtained is 133,050 a difference of only two percent from the "208" figure.

However, both the "EIS" and "208" projections do not reflect consideration of the fact that not all areas of each of these communities should be served by centralized wastewater treatment facilities but rather through the use of small scale solutions (e.g. an SMD). The population figures presented in the third column of Table 4-6 represent those populations that are to be served by the RVPSA plant. (See Chapter 2, Section 5 for more details).

Table 4-5

Population Projections to Year 2020

Municipality	1950[a]	1960[a]	1970[a]	1975[b]	1980	1985	1990	1995	2000	2005	2010	2015	2020	Constrained Saturation Population
Booton Town	7,163	7,981	9,261	8,760	8,760	8,900	8,990	9,140	9,280	9,400	9,520	9,630	9,730	11,170
Dover Town	11,174	13,034	15,039	14,447	14,230	14,380	14,450	14,540	14,610	14,670	14,710	14,740	14,760	14,840
Kinnelon Borough [1]	370	1,220	2,080	2,190	2,460	2,730	2,980	3,270	3,570	3,860	4,150	4,450	4,740	6,110
Mountain Lakes Borough [1]	750	1,080	1,270	1,180	1,170	1,170	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150
Rockaway Borough	3,812	5,413	6,303	6,341	6,680	6,770	6,760	6,820	6,850	6,860	6,870	6,880	6,880	6,880
Victory Gardens Borough	--	1,085	1,027	1,213	1,370	1,350	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330
Wharton Borough	3,853	5,006	5,535	5,287	5,570	5,700	5,760	5,880	5,960	6,010	6,050	6,070	6,090	6,130
Boonton Township	1,155	1,998	3,070	2,981	3,330	3,600	3,880	4,200	4,520	4,770	4,970	5,120	5,240	5,680
Denville Township	6,055	10,632	14,045	13,674	15,140	16,290	16,940	17,540	17,940	18,210	18,390	18,510	18,590	18,750
Jefferson Township [1]	1,690	4,230	8,690	9,280	10,400	11,360	12,290	13,410	14,530	15,350	15,960	16,410	16,740	17,690
Mine Hill Township [1]	1,951	2,970	3,170	3,110	3,370	3,640,	3,910	4,230	4,480	4,670	4,820	4,940	5,020	5,330
Montville Township [1]	210	230	370	350	510	680	830	1,000	1,080	1,120	1,140	1,150	1,160	1,160
Parsippany-Troy Hills Township [1]	1,020	1,090	1,070	1,120	1,090	1,210	1,260	1,290	1,310	1,320	1,320	1,330	1,330	1,330
Randolph Township [1]	2,910	4,940	10,030	12,950	14,200	15,130	15,800	16,420	16,880	17,210	17,460	17,630	17,760	18,100
Rockaway Township [1]	4,370	10,310	18,910	19,370	21,240	23,500	25,690	28,220	30,760	32,730	34,260	35,450	36,380	39,610
Roxbury Township [1]	550	980	1,130	1,160	1,340	1,610	1,870	2,150	2,340	2,470	2,550	2,610	2,650	2,730
RVFPA Total [2]	47,033	72,199	101,000	103,513	110,860	118,020	123,890	130,590	136,590	141,130	144,650	147,400	149,550	157,990

Note: 1. RVFPA portion.
2. Sums may not be precise due to rounding.

Sources: a. USBC; 1950, 1960, 1970.
b. NJDLI; 1975.

Table 4-6

Comparison of Year 2000 Population Projections

Municipality	EIS	"208"	Population[3] to be served by RVRSA Plant
Boonton town	9,280	11,440	7,520
Dover town	14,610	19,240	14,610
Kinnelon borough[1]	3,570	3,328	0
Rockaway borough	6,850	8,320	6,850
Victory Gardens borough	1,330	1,560	1,330
Wharton borough	5,960	7,280	5,770
Boonton township	4,520	4,160	1,650
Denville township	17,940	18,200	16,040
Jefferson township[1]	14,530	9,485	0
Mine Hill township[1]	4,480	3,042	2,730
Randolph township[1]	16,880	17,441	10,260
Rockaway township[1]	30,760	25,480	25,320
Roxbury township[1]	2,340	894	0
Sub-total	133,050	129,870	92,080
Mountain Lakes borough[1]	1,150	--[2]	0
Montville township[1]	1,080	--[2]	720
Parsippany-Troy Hills township[1]	1,310	--[2]	0
Total	136,590	129,870	92,800

Notes: 1. RVFPA portion

2. Not included in "208" population projections.

3. Numbers derived from Table 2-3.

CHAPTER 5

ENVIRONMENTAL IMPACTS OF FEASIBLE ALTERNATIVES

The environmental impacts of any construction project can be short-term and/or long-term primary and/or secondary in nature. Short-term impacts are generally associated with construction: for example, noise, loss of herbaceous vegetation, windblown soil and debris, disturbance of fresh water benthic communities, and disruption of traffic patterns. Long-term impacts are generally associated with operation of the completed facilities, such as changes in the quality and quantity of surface and groundwaters, and land use patterns.

Primary impacts are the immediate effects of the project, such as the removal of vegetation along an interceptor route. Secondary impacts are indirectly related to the project and, consequently, are difficult to predict and quantify. For example, the installation of sewers in rural areas bordering urban centers generally leads to increased residential development in the rural areas. The development itself, and the needs for water, electricity, and municipal services that accompany it, are typical secondary impacts.

1. SHORT-TERM PRIMARY IMPACTS

1a. Soils

Alternatives for Upper Portion of RVFPA

Branch Interceptor (Phase I)

Approximately 127 metric tons (140 tons) of soil is expected to be eroded during construction of this branch interceptor. However, if mitigating measures, such as mulching with hay at 5 metric tons per ha (2 tons per a) are practiced, the loss due to erosion can be reduced by as much as 90 percent. About 10 percent of the length of this interceptor will cross prime agricultural land.

Municipally Owned Wastewater Treatment Plants

Construction of the Wastewater Treatment Plants (WWTP's) and trenching for collector systems will cause disruption and exposure of soils, resulting in some soil loss. However, if standard erosion control techniques are used, the soil loss will be minimal.

Alternatives for the Lower Portion of RVFPA

Jackson Brook Branch Interceptor

Soil loss for the Alternative A routing is expected to be 4.5 metric tons (5.0 tons), while soil losses for Alternative B would be about 8.1 metric tons (9.0 tons). Again, using suggested erosion control techniques the soil loss can be reduced.

1b. Floodplains

Alternatives for Upper Portion of RVFPA

Branch Interceptor (Phase I)

Approximately 38 percent of this branch interceptor will cross the floodplains of Beaver Brook and Hibernia Brook. However, no permanent structures will be built above ground and the effects will be temporary.

Alternatives for the Lower Portion of RVFPA

Jackson Brook Branch Interceptor

The proposed alignments for Alternatives A and B are entirely within the floodplain of Jackson Brook. However the disruption is only temporary and once the construction is completed there will be no impact to the floodplain.

1c. Surface Water

Construction activities in or near aquatic environments will affect their water quality and associated ecosystems. The extent and duration of these effects will depend on many factors:

- The proximity of construction to the waterway
- The time of year when construction occurs

- The techniques used and the duration of the construction activities
- The physical characteristics of the drainage area
- The sensitivities of the indigenous biota

The most significant effect of construction activities on aquatic ecosystems is siltation caused by the removal of vegetation, disturbance of soil layers along stream beds, dredging of stream beds, and dewatering operations. The resulting short-term changes in local erosion and siltation patterns are especially problematic during the installation of interceptors along stream beds and across streams.

Alternatives for Upper Portion of RVFPA

Municipally Owned Wastewater Treatment Plants

Construction of municipally owned and operated local wastewater treatment plants, for the Longwood Valley area, Lake Telemark area, and/or the Green Pond area would generate soil loss from exposed soils and trenching activities. There would be temporary and local degradation of water quality during the construction period due to turbidity and siltation resulting from this increased surface runoff. Sites for these proposed facilities have not been chosen; therefore, it is not possible to calculate the amount of soil loss which might occur. Mitigating measures should be employed to minimize erosion and the resulting turbidity and sedimentation.

Branch Interceptor (Phase I)

Treatment of the Lake Telemark area at the RVRSA would necessitate construction of an interceptor (Phase I). This construction would result in 127 t (140 tn) of soil loss per year of construction. This erosion would result in increased turbidity and siltation in local lakes and streams (Lake Ames, Lake Telemark, and Beaver and Hibernia Brooks).

Alternatives for the Lower Portion of RVFPA

Primary short-term impacts to the lower portion of Rockaway Township, and Randolph and Mine Hill townships vary with each interceptor routing. The proposed Oak Street branch interceptor uses an existing right-of-way and will serve the already urbanized town of

Dover. There may be some increased surface runoff during the construction period but the increase over background conditions should be minimal and adverse effects to surface waters are not expected.

Two alternatives have been proposed to serve the Jackson Brook area of Randolph and Mine Hill townships. Alternative A is routed along the southern bank of Jackson Brook. Construction related runoff from this interceptor will be approximately 4.5 t (5.0 tn). As discussed under the previous alternatives this increased surface runoff will cause temporary turbidity and siltation. Mitigating measures should be employed. The Alternative B routing is similar to Alternative A, but with one significant difference. In order to avoid a local historic site the interceptor crosses Jackson Brook at two points. Jackson Brook has been designated by NJDEP as a trout production water (1979).

The NJDEP has developed Environmental Guidelines for Planning, Designing, and Constructing Interceptor Sewers (NJDEP, 1977)

which specify that surface water crossing excavation and restoration in trout production waters should be avoided from mid-October to the first of September to minimize damage to the fish population. These guidelines further state that: "To avoid siltation due to construction, stockpiling, and dispersal of excess material, disposal or stockpile areas and access routes should not be located within, or in adjacent areas from which siltation would occur to stream corridors and wetlands." These guidelines also have specifications for controlling erosion and sediment, site restoration, and reducing impacts to sensitive areas. Soil loss from the construction of this alternative would be approximately 8.5 t (9.4 tn).

Randolph Township could be serviced by either Mill Brook alternative. Alternative A runs parallel to the east of Rockaway Road, and Alternative B parallel to the west of Rockaway Road. Both alternatives would cross the Rockaway River and connect to the already existing interceptor. Construction related effects of either alternative would be approximately the same; erosion of exposed soils would lead to increased surface runoff causing turbidity and siltation. A stream crossing would increase erosion of the banks, disrupt bottom sediments and cause some siltation. If appropriate precautions are taken during construction, such as use of a silt screen when crossing the river, and NJDEP (1977) guidelines are followed, these effects should be minimal and temporary.

1d. Groundwater

The only construction related impacts to groundwater will be due to dewatering of trenches in areas where branch interceptors will cross shallow water tables. Any local shallow wells adjacent to the interceptor right-of-way will be temporarily dewatered, but upon completion of the construction, groundwater levels will rise to their original position.

1e. Water Supply

The proposed right-of-way for the Branch Interceptor Phase I will possibly pass through the area of influence of two private wells and two public wells that belong to Rockaway Township. However these wells average 46 m (150 ft) in depth and any dewatering that may be necessary should not affect these wells.

1f. Ecologically Sensitive Areas

Alternatives for Upper Portion of RVFPA

Branch Interceptor (Phase I)

Because this interceptor follows existing sewer routes and the Green Pond Road right-of-way, no adverse construction impacts will occur along most of its route. However, the sewer route from Mill Brook northwestward for 500 meters (1,640 ft) is fringed by a noncontiguous forested wetland. This wetland will not be adversely affected if restrictions on construction activities and runoff control plans are implemented along this portion of the interceptor.

Municipally Owned Wastewater Treatment Plants

Future 201 Facilities planning should locate municipally owned wastewater treatment plants on lands which are not environmentally sensitive; consequently, no adverse construction impacts will occur.

Local Septic Management Districts

Because septic systems would be emplaced only on approved sites (which by definition are not environmentally sensitive) for housing construction, and such systems are physically small, no adverse construction impacts to environmentally sensitive areas will occur.

Alternatives for the Lower Portion of RVFPA

Oak Street Branch Interceptor

Because this interceptor follows an existing paved right-of-way to its terminus, no adverse construction impacts to environmentally sensitive areas will occur along its length. However, the forested wetland at its terminus could be adversely affected if construction activities, such as equipment storage and excavated materials, were allowed to encroach on this wetland. Because there are homes with malfunctioning septic systems along the alternate route and near its terminus, this branch interceptor cannot be shortened in order to avoid possible encroachment on this wetland. Therefore, restrictions on construction activities and runoff control plans are necessary at the terminus of the Oak Street Branch Interceptor. No wetlands permit is needed from the Army Corps of Engineers because the average annual flow is less than 0.14 cu m/s (5 cfs), and because encroachment into the wetland should not occur during construction.

Mill Brook Branch Interceptor

Both Mill Brook Interceptor alternatives cross a noncontiguous forested wetland of less than one ha (2.4 a). This wetland is also crossed by the RVRSA interceptor sewer. Construction activities will disrupt the drainage patterns within this environmentally sensitive area. Additional erosion and siltation will also be caused by construction. These adverse construction impacts are unavoidable. Because the average annual flow is greater than 0.14 cu m/s (5 cfs), the Army Corps of Engineers must issue a wetlands construction permit under Section 404 of the Federal Water Pollution Control Act Amendments of 1972.

Jackson Brook Branch Interceptor

Both Jackson Brook Interceptor alternatives are adjacent to a small emergent-open water wetland east of the silk mill along the north bank of Jackson Brook, and are adjacent to a small forested wetland south of the junction of the branch and the RVRSA interceptor sewer. These wetlands, particularly the emergent-open water habitat, are sensitive to disruptions of their existing drainage. Nevertheless, with restrictions on construction activities and implementation of control plans, adverse construction impacts will be avoided. Construction would best be done from the first of September to the fifteenth of October. Because the average annual flow is less than 0.14 cu m/s (5 cfs), no wetlands permit is needed from the Army Corps of Engineers.

1g. Air Quality

The construction of wastewater facilities will result in air contaminant emissions of particulate matter (dust from clearing, excavation, tilling, etc., and a relatively small amount of smoke from diesel-powered equipment exhausts) and gases (HC, SO_2, organics, odors, etc. from diesel-powered equipment, and CO, HC, and nitrogen oxides from interrupted roadway traffic).

Methods available to reduce emissions of dust from construction activities include wetting with water, covering of loaded trucks, and removing dirt from paved roadways. Methods available to reduce excess emissions attributable to roadway traffic interruption are dependent upon suitable construction planning (with respect to land closings, detour routes, etc.) and scheduling (e.g., with respect to peak and off-peak traffic volumes and directions).

If reasonable precautions are taken, adverse air quality impacts can be prevented or minimized. Because of the limited duration of construction activities at any specific location of concern, these short-term air quality impacts are considered to be minimal.

1h. Noise

The only source of noise impact associated with each of the project alternatives is the construction of the interceptor sewers. The impact will be short term and will vary with the duration of the construction period and proximity of sensitive receptors to the construction site.

It is expected that the sewer construction method will be cut and cover. The typical equipment used for this type of sewer construction is a backhoe, truck, crane and paving breaker. The construction noise level for an eight-hour work shift is estimated to be an equivalent sound level of 64 decibles (dBA) at 150 m (500 ft) (USEPA, 1974).

The construction of the Oak Street Interceptor Sewer will have an affect on more receptors than will the other interceptors because of its alignment through an urban area in the Town of Dover.

Construction noise is expected to be noticeable within 300 m (1,000 ft) of the construction site. However, since the work site will continually change as sewer construction proceeds the duration of noise will be relatively short and minimal impact is expected.

Noise impacts can be mitigated by using muffled equipment and by scheduling construction only during daylight hours.

1i. Economics

The range of capital expenditures required for the proposed alternatives will be between $4.15 million and $5.09 million, exclusive of land costs (Chapter 2). Assuming that 50 percent of the capital costs will be devoted to labor, total wages and salaries to construction personnel will range between approximately $2.08 million and $2.55 million. For the purposes of this analysis, an average figure of $2.32 million will be used.

The State of New Jersey imposes a five percent sales tax. The tax does not apply to most food and clothing items, however. Assuming that the average construction worker devotes 10 percent of his income to taxable items, employees will spend approximately $232,000 on such items. This will generate approximately $11,600 of state sales tax revenues during construction.

The total economic benefits resulting from the project will, however, far exceed the dollar value of these revenues alone. For example, it is possible restaurants and retail stores will make additional purchases for expansion of operations in response to increased construction worker spending. Each of the suppliers to these service industries will, in turn, purchase goods and services from still other industries. The inter-industry "linkages," (outputs of industries which are necessary inputs to other industries), will therefore produce a chain reaction, or ripple effect.

This relationship is called a "multiplier effect." A multiplier is a factor that relates the value of a direct expenditure to the expected total value of the resulting economic activity. Using the methodology described in Appendix D, a multiplier of 1.2 has been calculated for Morris County. Consequently, employee expenditures will generate approximately $278,000 in total income to local businesses.

1j. Cultural Resources

No impacts to cultural resources are expected for any of the project alternatives, except for construction of Alternative A of the Jackson Brook Interceptor. The Alternative A alignment passes through the site of a former silk mill which has local historic significance.

Other areas with potential sensitivity and which may contain historic and prehistoric resources are within the service zones of proposed facilities. Therefore, a Phase II cultural resources survey should be conducted for the selected action(s). In addition, a cultural resources specialist should be available to evaluate any artifacts which may be uncovered during construction.

2. LONG-TERM PRIMARY IMPACTS

2a. Soils

Alternatives for Upper Portion of RVFPA

Branch Interceptor (Phase I)

Right-of-way easements for the interceptor will result in the permanent loss of 0.5 ha (1.2 a) of prime agricultural land.

Municipally Owned Wastewater Treatment Plants

This alternative calls for the establishment of local sewers and centralized treatment for the communities of Lake Swannanoa and Cozy Lake in Jefferson Township and Lake Telemark and Green Pond in Rockaway Township. Because of the problems associated with effluent discharge to local surface waters, the waste disposal system should be oriented towards land application of the wastewater. For a successful land application program, sites should be selected carefully, with a thorough evaluation of the prevailing environmental conditions.

There are three major process alternatives available for land application of wastewater. These are 1) slow rate irrigation; 2) overland flow; and 3) rapid infiltration. Each procedure has its particular benefits and drawbacks and the selection of one process over another is largely dependent on the soil conditions, groundwater, topographic features and availability of land in the area (Table 5-1).

The proper soil conditions are essential to the efficient operation of the land application processes. Soil properties such as texture, structure, depth to bedrock, pH, cation exchange capacity, and nutrient levels should be carefully evaluated before selection of a site and processes. Soils in the RVFPA suitable for the three processes of land application are indicated on Table 5-1.

In the Lake Swannanoa and Cozy Lake portions of the RVFPA there are areas of soil conditions favorable to either spray irrigation or rapid infiltration. The Green Pond area is located on a pocket of stratified drift that contains soils adaptable to all three methods of land application. The soils in the Lake Telemark area are shallow and sloped, except for narrow permeable soils along the floodplains of Hibernia Brook. Indications are that soils in this area are more adaptable to the overland flow method.

Various environmental impacts to soils may occur from prolonged application of wastewater. These include waterlogging, changes in soil moisture holding capacity, deflocculation, build up of toxic

Table 5-1

Environmental Conditions Suitable For
Various Land Application Processes [a]

Environmental Conditions	Land Application Process		
	Irrigation	Overland Flow	Rapid Infiltration
1. Soil			
Texture	Clay loams to sandy loams	Clay and clay loams[1]	Sand and sandy loam
Permability cm/hr (in/hr)	0.15 to 50.8 (0.06 to 20.0)	0.5 (0.2)	5.0 to 50.8 (2.0 to 20.0)
Cation Exchange Capacity (meg/100g)	13 to 17	22 to 63	0 to 6
2. Topography			
Slope	0 to 2 percent	2 to 8 percent[2]	0 to 5 percent[3]
Flood potential	Minimal	Minimal	Minimal
Vegetation	Field and forage crops, woodlands	Perennial grass	N/A
3. Geology			
Depth to bedrock m (ft)	1.5 minimum (5.0 minimum)	0.6 minimum (2.0 minimum)	4.6 minimum (15.0 minimum)
Depth to groundwater m (ft)	0.6 minimum (2.0 minimum)	N/A	3.0 minimum (10.0 minimum)
Suitable soils in the RVPA [b]	Annandale Bartley Boonton Califon Edneyville Neshaminy Netcong Otisville Parker Pattenburg Rockaway Washington	Parsippany Haledon Reaville Whippany	Netcong Otisville Parker Riverhead

Notes: N/A = Not Applicable
1. Requires impervious strata at shallow depths.
2. Greater slopes are possible but require extensive earthwork.
3. Overland flow slope lengths are typically 36 to 46 m (120 to 150 ft).

Sources a. EPA, 1978.
b. USDASCS, 1976.

elements, alterations to the soil chemistry, decrease in permeability, and leaching of organic components of the soil (EPA, 1978). However these effects can be controlled through proper site selection and strict adherence to design wastewater application rates.

Local Septic Management Districts

No long-term primary impacts to soils are expected due to this alternative if septic tanks are installed and maintained properly.

Lower Portion of the RVFPA

No long-term primary impacts to soils are expected due to construction of any of the branch interceptors.

2b. Surface Water

In general, all proposed alternatives for Longwood Valley, Green Pond, Lake Telemark (Phase I), and Jackson Brook (Alternatives A and B) would have a long-term beneficial effect on surface water resources by reducing the percentage of failing septic systems (Table 5-2). Elimination of septic tank leachate would reduce coliform levels which currently exceed New Jersey Water Quality Standards in those portions of the RVFPA for which data is available (Tables A-2 through A-6). No adverse long-term effects to surface waters are anticipated from implementation of these alternatives if proper mitigating measures are employed.

No adverse long-term effects are expected from construction of the Oak Street Branch Interceptor or the Mill Brook Interceptor (Alternative A or B).

2c. Groundwater

Alternatives for Upper Portion of RVFPA

Branch Interceptor (Phase I)

A minimal increase in impervious surface area may be associated with this alternative, but the effects on groundwater recharge will be

Table 5-2

Percentage of Septic System Failures and Soil Suitabilities

Drainage Area	Percentage of Failing Septic Systems	Percentage of Soils Unsuitable for Septic Systems
Longwood Valley	NA	NA
Green Pond[a]	10-20	30
Lake Telemark[a]	12	50-60
Jackson Brook[b, c] (Alternatives A and B)	12	60
Oak Street	NA	NA
Mill Brook (Alternatives A and B)	NA	NA

Notes: NA = Not Available

Sources: a. Fitzpatrick, Rockaway Township Department of Health, February 13, 1980.

b. Ferdinando, Township of Randolph, September 17, 1979.

c. Thompson, Township of Mine Hill, September 17, 1979.

slight.

Municipally Owned Wastewater Treatment Plants

A component of this alternative is land application of the treated wastewater. Of the three basic processes, rapid infiltration has the greatest potential for affecting the groundwater. Because of the high infiltration rate there is only minimal potential for removal of wastewater pollutants, producing a nitrified effluent that will eventually reach the water table. Due to this, nitrate contamination of groundwater aquifers is a prime concern, and if heavy metals are present in the wastewater, these too may reach the aquifer.

With spray irrigation, most nutrient removal is accomplished by soils and crop uptake, reducing the potential for groundwater contamination. However, spray irrigation and rapid infiltration will have some environmental effects if not designed and operated properly. These are groundwater levels, rate and direction of flow, changes in quality, and a build up of certain toxic contaminants. Overland flow does not use extensive infiltration for treatment, so in most cases does not adversely effect groundwater.

The elimination of septic systems will have a beneficial effect upon the regional groundwater quality by reducing the potential of groundwater pollution due to leaching of partially treated domestic wastewater.

Local Septic Management Districts

By requiring improvements to improperly functioning septic systems, this alternative will have a beneficial impact on groundwater quality.

2d. Water Supply

No long-term primary impacts to water supply will occur from implementation of any feasible alternative.

2e. Ecologically Sensitive Areas

Alternatives for Upper Portion of RVFPA

Branch Interceptor (Phase I)

No long-term primary impacts to ecologically sensitive areas will occur.

Municipally Owned Wastewater Treatment Plants

No long-term primary impacts to ecologically sensitive areas will occur from properly designed and maintained municipal treatment plants.

Local Septic Management Districts

No long-term primary impacts to ecologically sensitive areas will occur from properly designed and maintained septic systems.

Alternatives for the Lower Portion of RVFPA

Oak Street Branch Interceptor

Restoration of the paved surface along the right-of-way, and erosion control at the terminus of the interceptor will prevent any adverse impacts to the forested wetland.

Mill Brook Branch Interceptor

The disruption in drainage patterns and increased erosion and siltation will cause permanent changes in the wetlands vegetation. This already noncontiguous habitat will be further reduced. The wetland is likely to become increasingly channelized and gully erosion (i.e., erosion of soil by running water) may result, unless revegetation with grasses and shrubs is pursued immediately after the construction is completed. Therefore, construction and revegetation would best be completed during the early fall.

No long-term primary impacts to environmentally sensitive areas will occur if the wetland embankments are restored immediately after the construction is completed, as part of the erosion control plans.

2f. Employment

Fewer than five additional persons will be required to operate and maintain the various proposed facilities. This will be an extremely minor factor in the overall RVFPA labor force and will not result in any significant economic impact.

2g. Financial Implications to Households

The EPA has developed critieria to identify high-cost wastewater projects based on annual household median incomes (EPA, 1979). A project is considered excessively costly when the annual user charges are:

- 1.5 percent of median household incomes less than $6,000.00;
- 2.0 percent of median household incomes between $6,000.00 and $10,000.00;
- 2.5 percent of median household incomes greater than $10,000.00

As of 1970, median family incomes in Jefferson, Rockaway, Mill Hill, and Randolph townships, Dover Town, and Victory Gardens Borough--communities to be served by the proposed facilities--were all in excess of $10,000. Thus, annual users charges should not exceed the 2.5 percent criteria in these communities.

As stated in Chapter 2, projected average annual user charges associated with the Jackson Brook, Oak Street, and Mill Brook interceptors will vary between $88 in 1980 and $67 per household in the year 2000. user costs for the Jefferson and Upper Rockaway facilities will range from $130 (for connecting Lake Telemark in Rockaway Township to RVRSA facilities) to $305 (Lake Swannanoa in Jefferson Township).

With the exception of the Jefferson Township facilities, all alternatives will have user costs within the federal guidelines. Projected annual user costs for separate treatment of Cozy Lake and Lake Swannanoa wastewater ($290 and $305, respectively) are somewhat

higher than Jefferson Township's 1970 calculated guideline of $283. Presumably median family incomes have risen subsequent to 1970, (the latest year for which accurate information is available). Therefore, it is possible user costs would be within the guidelines.

Central treatment for the two Jefferson Township areas would result in considerably lower user costs ($250).

2h. Cultural Resources

The proposed facilities will not directly affect any of the National Register sites in the RVFPA. Ten of the twelve National Register sites are not located within any service area. Two, however, the Alfred T. Ringling Co. property in Jefferson Township and the Friends Meeting House in Randolph Township, are located in the Lake Swannanoa and Jackson Brook Interceptor service areas, respectively. Collection systems to be constructed within each service area should be planned to avoid any adverse effects.

One historic site of local significance, a former silk mill, would be adversely affected by the Jackson Brook Interceptor Alternative A (Chapter 2). Alternative B has been designed to avoid contact with the silk mill.

3. SECONDARY IMPACTS

3a. Physiography and Topography

Expected population growth to the year 2000 in the service area of the Branch Interceptor (Phase I) will result in an increase in impervious surface from 12 to 20 percent. Impervious surface for the Jackson Brook Interceptor service area will increase from 15 to 30 percent. The long-term effects of this increase are discussed under Surface Water Resources.

3b. Soils

Soils impacts from development expected in the two proposed service areas (Branch Interceptor Phase I and Jackson Brook Branch) will be minimal, strictly related to erosion during housing construction. However, because local land-use regulations may be ineffective in prohibiting development on steep slopes along the Branch Interceptor (Phase I), it is possible that development may encroach on the slopes. If this were to occur, soil erosion would be significantly accelerated during housing construction and for some

time after. In addition, this would cause increased flooding and sedimentation within the Hibernia Brook floodplain. These impacts can be reduced by strict enforcement of New Jersey State erosion control regulations.

3c. Surface Water

Lake Telemark (Phase I) and Jackson Brook (Alternatives A and B) are the only two areas that are expected to have appreciable population increases in the service areas of the branch interceptors. The principal effects of this growth will be a rise in NPS loadings and flood flows due to the increase in impervious surfaces that accompany urbanization. The expected increases in NPS pollution and flood flows to the year 2000 for the Jackson Brook and Branch Interceptor (Phase I) service areas are given on Tables 5-3 and 5-4. The increase in NPS throughout the entire RVFPA, by municipality, is given in Table 5-5.

No other secondary effects to surface waters are anticipated as a result of implementing project alternatives.

3d. Groundwater

The minimal increases in impervious surfaces will have a negligible effect upon groundwater recharge and will not significantly reduce base flow in the streams of the area.

The loss of recharge due to the change from septic systems to centralized wastewater collection systems will have a negligible effect upon the total recharge of the aquifer.

3e. Water Supply

Water supply has been demonstrated to be adequate for the constrained population for the RVFPA. The minor increases in population for the service areas of the Jackson Brook Interceptor and the Branch Interceptor (Phase I) will have no effect upon the ability of the respective purveyors to supply water for the service area year 2000 population.

Table 5-3

Change in Non-Point Pollution 1972-2000

Branch Interceptor Service Area	Parameter	1972 kg/d/sq km (lb/d/sq mi)	2000 kg/d/sq km (lb/d/sq mi)	Percent Change
Jackson Brook	Total Nitrogen	22 (19)	29 (25)	30
	Total Phosphorus	2 (2)	4 (3)	100
	BOD_5	82 (70)	197 (168)	140
	Total Suspended Solids	3980 (3390)	9590 (8160)	141
Lake Telemark Phase I	Total Nitrogen	16 (13)	21 (18)	31
	Total Phosphorus	2 (2)	4 (4)	84
	BOD_5	74 (63)	109 (93)	48
	Total Suspended Solids	3700 (3150)	5630 (4790)	52

Note: Based on EPA, 1976.

Table 5-4

Percentage of Increase Flood Flows

Frequency of Recurrance	Percent Increase Over Background To The Year 2000	
	Lake Telemark (Phase I)	Jackson Brook (Alternatives A or B)
2-year	14	13
5-year	10	10
10-year	11	10

Table 5-5

Expected Increase in Non Point Source Pollutants and Flood Flows by Municipality - 1975-2000

Municipality	Non-Point Source Pollutants[1]						Percent Increase in Flood Flow from 1975 to 2000[2]		
	Loading in Nitrogen year 2000 kg/day (lb/day)	Increase from 1975	Loading in Phosphorus year 2000 kg/day (lb/day)	Increase from 1975	Loading in BOD_5 year 2000 kg/day (lb/day)	Increase from 1975	2-year recurrence	5-year recurrence	10-year recurrence
Boonton Town	4.7 (10.3)	4	0.76 (1.7)	6	(41.0) (90.3)	4	1.0	0.4	0.8
Dover Town	6.5 (14.3)	2	1.1 (2.3)	4	56.9 (125.1)	2	0.9	0.2	0.2
Kinnelon Borough	4.2 (9.2)	50	0.7 (1.5)	50	36.9 (81.2)	45	4.9	4.5	4.1
Rockaway Borough	3.3 (7.4)	6	0.5 (1.2)	9	29.2 (64.3)	5	0.7	0.6	0.5
Victory Gardens Borough	0.4 (0.9)	12	0.06 (0.14)	8	3.5 (7.7)	10	0.2	0.2	0.2
Wharton Borough	3.4 (7.5)	7	0.5 (1.2)	9	29.9 (65.8)	6	0.8	0.7	0.6
Boonton Township	5.1 (11.4)	32	0.8 (1.8)	28	45.5 (100.1)	30	4.0	3.5	3.2
Denville Township	14.7 (32.4)	21	2.4 (5.2)	20	128.6 (283.4)	19	3.7	3.1	2.9
Jefferson Township	9.0 (20.0)	22	1.5 (3.2)	23	79.5 (174.9)	25	3.9	3.4	3.1
Mine Hill Township	3.4 (7.4)	23	0.5 (1.2)	20	29.6 (65.0)	22	2.4	2.1	1.9
Randolph Township	13.8 (30.6)	21	2.2 (4.9)	19	121.5 (267.4)	20	3.7	3.3	3.0
Rockaway Township	23.9 (52.8)	17	3.9 (8.6)	19	210.1 (462.2)	17	3.6	2.6	2.0
Roxbury Township	2.6 (5.7)	47	0.4 (0.9)	49	22.6 (49.7)	44	3.5	3.1	2.7
RVFPA TOTAL	95.4 (209.9)	19	14.9 (32.6)	15	834.8 (1,836.9)	18	6.1	5.8	5.1

Notes: 1. This increase is based on increased impervious surface area
2. Based on the Stankowski (1974) relationship of impervious surface to flood flows

3f. Ecologically Sensitive Areas

Alternatives for Upper Portion of RVFPA

Branch Interceptors (Phase I)

The induced population growth will cause development pressures on the wetlands within the service area. Judicious land use planning and zoning ordinances can prevent adverse impacts to these sensitive areas.

Municipally Owned Wastewater Treatment Plants

Since the size of the plants will be basically limited to the handling of existing population, impacts due to increased population growth should be minimal.

Local Septic Management Districts

Because septic management districts will not result in increased population growth, adverse impacts to environmentally sensitive areas will not occur.

Alternatives for Lower Portion of RVFPA

Oak Street Branch Interceptor

Because of the limited extent of this interceptor and because it will serve existing housing, adverse secondary impacts to ecologically sensitive areas will not occur.

Mill Brook Branch Interceptor

Because of the limited extent of this branch interceptor and because it will serve existing houses, adverse secondary impacts to ecologically sensitive areas will not occur.

Jackson Brook Branch Interceptor

Because of the limited extent of this branch interceptor and because it will serve homes that would otherwise exist, no adverse impacts will occur.

3q. Land Use

Secondary land use impacts are generally not anticipated as a result of the alternatives described in Chapter 2. Although limited induced growth is anticipated, the alternatives will not affect the total volume of development expected by the year 2000.

Alternatives for the Upper Portion of RVFPA

Branch Interceptor (Phase I)

A branch interceptor to serve the Hibernia and Lake Telemark areas of Rockaway Township is proposed as a viable alternative in Chapter 2 (shown as Phase I in Figure 2-2). Federally funded collection systems are contemplated only in these two communities There is also some possibility, however, of induced residential growth in adjacent areas. Connecting sewers to serve such areas would be paid for either by developers or by Rockaway Township.

The potential for induced growth is constrained by a lack of developable residential land. Most developable vacant land in the vicinity of the proposed branch interceptor is zoned for industrial use. Vacant residential land in the vicinity is primarily steeply sloped and thus of limited development potential.

However, if the Rockaway Township housing market is especially strong, induced development generated by sewer installation could possibly occur in steeply sloped areas. Approximately 210 ha (520 a) of steeply sloped lands, zoned at 7.2 hu/ha (2.9 hu/a), are located west of Lake Telemark and Hibernia. If economic conditions are particularly favorable, the presence of sewers could force property values high enough to offset economic difficulties associated with steep slope construction. Increased development pressures could result in construction within this environmentally sensitive area.

The only large non-constrained residential tract in the vicinity is located to the west of Hibernia. The area is approximately 20 ha (50 a) in size and zoned at 7.2 hu/ha (2.9 hu/a). Development is likely if sewerage is provided to existing developed areas of Hibernia. However, because of strong existing that development pressures in Rockaway Township, it is likely that development of this

relatively small area will occur by the year 2000, regardless of whether sewers are installed. The effect of a branch interceptor will be to hasten residential growth rather than to induce development that would not otherwise take place.

Municipally Owned Wastewater Treatment Plants

Municipally owned local wastewater treatment facilities are proposed for the Lake Swannanoa and Cozy Lake areas of Jefferson Township and for the Green Pond and Lake Telemark areas of Rockaway Township. Treatment plants will be sized to serve existing development. Therefore, with local treatment, secondary land use impacts are generally not expected. Some minor in-fill housing on vacant lots within existing residential areas is likely to occur, however.

Septic Management Districts

No significant secondary land use impacts are likely to result from establishment of septic management districts.

Alternatives for Lower Portion of RVFPA

Jackson Brook Branch Interceptor

The Jackson Brook Branch Interceptor will have a potential service area (including presently developed and environmentally constrained lands) of approximately 280 ha (690 a) in Mine Hill Township and 450 ha (1,100 a) in Randolph Township (Table 5-6). The Mine Hill service area includes the most densely populated portion of the township. The Randolph service area includes a rapidly growing residential area.

In Mine Hill Township the potential for induced growth is limited by large lot zoning. The service area contains approximately 110 ha (280 a) of vacant residential land (Table 5-6), of which 60 ha (160 a) is zoned for densities of 2.7 hu/ha (1.1 hu/a) or less. It is likely that sewerage facilities would not be cost-effective at such low densities, since advantages over on-site facilities would probably not be sufficient to justify the high costs per household resulting from the extensive piping required.

The remaining vacant residential land is almost entirely zoned at--7.2 hu/ha (2.9 hu/a)--if both sewers and public water are available--a density suitable for the provision of sewers. However, with the exception of one 30 ha (70 a) tract, vacant lands in this category are generally 4 ha (10 a) or less in size and surrounded by

Table 5-6

Branch Interceptor Service Area[1]

Service Area	Vacant Privately-Owned Land								Developed Land, Public Open Space and Water		Total[2]	
	Residential		Commercial		Industrial		Subtotal					
	ha	(a)	ha	(a)	ha	(a)	ha	(a)	ha	(a)	ha	(a)
Mine Hill Township	110	(280)	0	(0)	40	(90)	130	(370)	130	(320)	280	(690)
Randolph Township	120	(290)	0	(0)	130	(310)	250	(600)	200	(500)	450	(1100)
	230	(570)	0	(0)	170	(400)	400	(970)	330	(820)	730	(1790)

Note: 1. All figures rounded to the nearest 10 gross ha (10 gross a).
2. Sums may not be precise due to rounding and/or metric conversions.

existing residential development. Thus, there is little potential for major subdivision activity.

Because of the scarcity of suitable undeveloped land, development pressures in Mine Hill will not be sufficient to generate subdivision activity beyond that which would otherwise take place. The branch interceptor will, however, prompt an acceleration of development pressures immediately prior to and following its construction. Should the interceptor not be built, similar small-scale development, to be served by septic systems, will occur by 2000.

The majority of vacant land in the Randolph Township service area is zoned for industrial use (Table 5-6). Of the 120 ha (290 a) zoned for residential use, approximately one-third is designated for 2.5 hu/ha (1.0 hu/a), a density at which the provision of sewers is probably not economically feasible. The remaining undeveloped residential land is a contiguous area of 70 ha (180 a), zoned at 4.2 hu/ha (1.7 hu/a). The installation of sewers will increase the attractiveness of the area to developers. However, it is important to note that Randolph has been one of the fastest growing RVFPA communities in recent years (Table 4-1). Therefore, the one or possibly two major subdivisions sufficient to develop the area will probably be in existence by the year 2000 whether or not the branch interceptor is built. Thus, the effect of the branch interceptor will thus be to merely hasten development.

If the branch interceptor is not constructed, wastewater treatment can be provided through either private package treatment plants or on-site systems. Alternatively, sewers could possibly be financed and constructed by Randolph Township or local developers. Package treatment plants with land application systems are a particularly viable option, as they do not require NPDES permits. For example, a facility of this type is in use at the Rockaway Mall in Rockaway Township.

Mill Brook and Oak Street Branch Interceptors

The Mill Brook Interceptor is intended to relieve existing sewers in Randolph Township and Victory Gardens Borough. The Oak Street Branch Interceptor will relieve existing sewers in Rockaway Township and Dover Town. No secondary land use impacts are expected as there will be no increase in developable sewered land.

3h. Industrial and Commercial Development

The proposed alternatives will have little effect on decisions by industrial and office developers to locate in the RVFPA. "Industrial location decisions depend primarily on access to labor and to external markets, with the influence of public sewer service usually being

small" (EPA, 1978). However, firms already planning to locate in the Morris County area may be encouraged to invest in newly sewered portions of RVFPA.

Thus, although the total volume of industrial and office development in the RVFPA will not be affected, locational advantages of newly sewered areas are likely to be enhanced at the expense of nearby unsewered areas. Undeveloped areas likely to benefit in this manner include approximately 130 ha (310 a) zoned industrial in Randolph Township, 40 ha (90 a) zoned for "Planned Industrial Parks" in Mine Hill Township, and additional areas of Rockaway Township zoned for industry.

Secondary impacts to commercial land use, aside from offices are not anticipated. Commercial location is principally related to population distribution and access to households (EPA, 1978). Over the next 20 years impacts to population distribution are not expected (discussed below).

3i. Environmentally Sensitive Areas

The development of newly sewered areas could possible result in adverse impacts to environmentally sensitive areas. Rockaway Township is particularly susceptible to encroachment on such areas because of strong development pressures. For example, if there is a strong housing market, development could possibly occur in steeply sloped areas adjacent to the proposed Lake Telemark Branch Interceptor. These environmentally sensitive areas will be far less susceptible to development if the municipally-owned wastewater treatment option is selected for the Lake Telemark area. Under the latter alternative, a small treatment plant will be sized for existing homes only.

The Mine Hill and Randolph service areas contain only small areas of floodplains and wetlands that have not been developed. However, the approximately 30 ha (80 a) of prime agricultural lands located in the service areas will possibly be subject to development pressures.

In the absence of laws and regulations to protect environmentally sensitive lands, development of such areas is likely to occur whenever economically feasible. Environmental constraints to development have often not been particularly effective. For example, in the Mine Hill and Randolph service areas, fully 90 ha (230 a) of steeply sloped land have been developed to date. Further, as land becomes increasingly scarce, environmentally sensitive areas will often become increasingly attractive to developers.

In order to protect environmentally sensitive areas, federal construction grants for this project will be conditional upon prohibition of hook-ups to the system from new development located in floodplains and wetlands. This will minimize the possibility of

induced growth in such environmentally sensitive areas. The following type of grant conditions will be used:

- The grantee shall submit to EPA and the NJDEP an approvable facilities plan amendment, including maps that clearly delineate all specific vacant parcels of land which are partially or wholly within the 100-year floodplain as defined by the USDHUD, or within wetlands, as defined by USFWS.

- The grantee shall agree that for a period of 50 years no sewer hookup to the facilities included in the scope of the grant will be permitted within presently undeveloped wetlands or floodplains designated in this EIS unless approved by the EPA Regional Administrator.

- This condition is intended to benefit any person, private organization or governmental entity which may have an interest in the avoidance of future development in the designated areas. Any such beneficiary may seek to enforce compliance in the courts of the State of New Jersey. Notice of intent to seek such enforcement must first be given to the EPA Regional Administrator, the NJDEP, the grantee, and affected governmental entities.

- If the EIS delineates any vacant parcels which will be affected by this special condition, the grantee will conduct a public hearing within 60 days of submission.

In addition, more effective local controls are needed to protect other environmentally sensitive areas such as steeply sloped lands, while also permitting the orderly development of non-sensitive areas. The immediate concern is to mitigate the relatively minor adverse land-use impacts anticipated as a result of this project. However, a more central objective should be to protect environmentally sensitive lands in the RVFPA from any urban intrusion.

As discussed in Chapter 4, several RVFPA municipalities employ large-lot zoning to protect environmentally sensitive areas. However, it appears low-density zones are often assigned more on the basis of traditional development patterns than as a tool to protect particular sensitive areas. Thus, while remote and inaccessible environmentally sensitive lands are generally located in low-density zones, environmentally sensitive areas located in the path of suburban expansion are often not protected. Floodplains, prime aquifer recharge areas, and wetlands are particularly endangered in this manner. Conversely, low-density zones designated for environmental protection often include substantial areas without environmental constraints.

It is urged, therefore, that low-density zones be tailored more specifically to protect sensitive lands. Also, cluster zoning should be explored more extensively as a device to conserve open space while permitting energy efficient residential development at moderate densities.

3j. Population Growth and Distribution

Significant impacts to population growth are not expected over the next 20 years. Sewerage will result in short-term population increases in the Townships of Mine Hill, Randolph, and Rockaway, due to increased development pressures. However, because of limited potential for induced growth in newly sewered areas, projected population levels for the year 2000 will not be affected by the proposed facilities.

The Lake Telemark branch interceptor will possibly result in population growth in adjacent steeply sloped areas, given favorable economic conditions. However, because of economic and architectural difficulties associated with steep slope construction, it is unlikely that the total volume of residential construction in Rockaway Township will be significantly affected by the year 2000. The effect of the branch interceptor will more likely be a slight shift in population distribution from lower Rockaway Township to the Lake Telemark-Hibernia area.

3k. Economics

Property values are likely to increase substantially in areas to be sewered. A recent study of suburban land values found that sewered land values averaged four times the value of unsewered property. Increases in land values were found to generally occur just prior to sewerage, in anticipation of increased development potential (EPA, 1978).

Values of existing developed properties will also be enhanced. On the basis of a recent study conducted in Morris County, the average market value of homes in sewered areas is likely to exceed the value of comparable homes without sewers by at least $2,000 (EcolSciences, 1975).

Because property value increases are not expected to result in significant long-term population increases, they will not be ofset by increased public service needs. Therefore, the installation of sewers will result in a net expansion of real estate tax revenues in the townships of Mine Hill, Randolph, Rockaway, and Jefferson.

31. Cultural Resources

Two National Register historic sites, the Alfred T. Ringling Co. property in Jefferson Township and the Friends Meeting House in Randolph Township--located in the Lake Swannanoa and Jackson Brook Interceptor service areas, respectively--are not likely to be affected by potential future developments. Other National Register properties within the RVFPA are not located within any service area and are not anticipated to experience secondary impacts. A Phase II cultural resources survey should be conducted, however, in areas in which construction is to take place and in areas in which other historic and prehistoric resources may be present.

3m. Air Quality

The NJDEP, EPA, Northeast Corridor Regional Modeling Program (NECRMP) and the New Jersey State Implementation Plan (SIP) are all involved in various aspects of predicting and/or regulating ambient air quality levels in the RVFPA. Predicted TSP and SO_2 levels are expected to be satisfactory, and ozone concentrations and hydrocarbon and nitrogen oxide emissions will be controlled as part of a regional strategy. The Air Quality Constraints section of this EIS (Chapter 4) contains a more detailed discussion of these issues.

4. BASINWIDE SECONDARY IMPACTS

Increased population growth in the RVFPA will result in certain secondary impacts, regardless of whether or not the interceptor and wastewater system proposed in this EIS are constructed. This is because the development demand will continue and be accommodated through the use of septic systems and package treatment plants. These will result in a similar population growth basinwide to that generated by the feasible alternatives.

4a. Topography

Population growth will increase the total impervious surface in the RVFPA. Using a relationship developed from the study of 537 municipalities in New Jersey by Stankowski (1974) that relates the percentage of impervious surface as a function of population density the changes in impervious surface area for the RVFPA communities has been estimated (Table 5-7). For the total RVFPA area, the increase over present impervious surface will be 23 percent. Approximately five percent of the total land area will be converted to impervious surface area.

Table 5-7

Change in Impervious Surface

Municipality	Population Density persons/ha (a) 1975	2000	Impervious Surface Percent 1975	2000	Area ha (a) 1975	2000	Percent Increase in Impervious Surface
Boonton Town	14.12 (5.69)	15.19 (6.11)	52	54	324 (800)	337 (831)	4
Dover Town	19.52 (7.89)	19.86 (8.03)	62	63	452 (1,117)	460 (1,135)	2
Kinnelon Borough	1.31 (0.53)	2.38 (0.96)	12	18	200 (495)	301 (743)	50
Rockaway Borough	15.09 (6.09)	16.38 (6.61)	54	57	227 (561)	240 (592)	6
Victory Gardens Borough	37.90 (15.16)	41.56 (16.62)	90	94	29 (72)	30 (75)	4
Wharton Borough	10.08 (4.08)	11.21 (4.53)	43	46	230 (567)	246 (607)	7
Boonton Township	1.28 (0.52)	1.94 (0.78)	12	16	278 (687)	371 (916)	33
Denville Township	3.89 (1.57)	5.14 (2.08)	25	30	877 (2,167)	1052 (2,601)	20
Jefferson Township	1.40 (0.56)	2.20 (0.89)	14	18	927 (2,290)	1191 (2,945)	28
Mine Hill Township	4.00 (1.61)	5.76 (2.33)	25	31	194 (480)	241 (595)	24
Randolph Township	3.78 (1.53)	4.98 (2.01)	24	29	820 (2,028)	992 (2,450)	20
Rockaway Township	1.78 (0.72)	2.83 (1.14)	16	21	1733 (4,283)	2275 (5,621)	30
Roxbury Township	0.92 (0.37)	1.78 (0.71)	11	16	138 (341)	201 (496)	45
				Total[1]	7,221 (15,888)	8,911 (19,607)	23

Note: 1. Sums may not be precise due to rounding and/or metric conversions.

4b. Surface Water

Population growth will affect surface water resources in two ways. Increased impervious surface will increase flood flows as well as NPS pollution. The expected change in flood flows for the communities in the RVFPA is presented in Table 5-5. These changes were calculated based on the work by Stankowski (1974) that relates the amount of impervious surface to flood flows for various recurrence intervals. The increase in peak flood flows in the more rural areas, such as Kinnelon Borough, Jefferson Township, and Rockaway Township will be partially abated by wetlands and extensive vegetation, which act to reduce flood peaks in downstream areas. Any channeling of tributaries in these regions, however, will reduce the growth of aquatic plants, increasing the velocity and capacity of the floodway. Increases in the more urbanized areas can be handled by stormwater control systems with storage facilities that will release peak flows to the river slowly reducing their sudden effect.

Secondly, the increased population will cause an increase in NPS loading of nitrogen, phosphorus, and Biochemical Oxygen Demand (BOD) to the Rockaway River and its tributaries (Table 5-5). This analysis is based on expected increases in impervious surface and average runoff areal loading rates developed by EPA (EPA, 1976). The average increases for the RVFPA were less than 20 percent.

Controlling NPS pollution requires implementing the Best Management Practices outlined in the Northeast New Jersey Water Quality Management Plan (NJDEP, 1976). Because the principal controllable NPS pollutant for the RVFPA is suspended solids from residential land use, the best approach is to reduce such problems at the source. Control measures may include improved street sweeping, revegetation of buffers around natural water courses, and improved erosion control for construction.

4c. Groundwater

The availability of groundwater to public consumption for the year 2000 has been demonstrated in the previous chapters. The impacts secondary growth will have on the groundwaters of the basin as a whole is limited to reduced recharge and altering of water quality.

The increase in impervious surface water will reduce the number of available sites for recharge, the magnitude of which is dependent on where these surfaces are placed. Development in areas of high recharge, such as along the Rockaway River Valley, would have a greater effect on reducing the volume of recharge than development in the northern mountainous areas or along the moraine. It is anticipated that development will occur in the areas north of the Rockaway River Valley, thereby minimizing the reduction in recharge. In addition, there will be a loss of recharge due to conversion of

homes with on-site wastewater disposal system to the sewer system, but it is expected to be insignificant.

An area of greater concern is groundwater quality. Areas in northern New Jersey with similar geomorphic conditions have been experiencing contamination of valley fill aquifers by industrial wastes. The principal water source for the RVFPA is the valley fill aquifer, and prime consideration should be given to preservation of its groundwater quality. It is recommended that both existing and future industrial development be carefully evaluated in order to determine the methods of disposal of their discharges and the quality of that discharge.

5. ADVERSE ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED AND STEPS TO BE TAKEN TO MINIMIZE HARM

In general, unavoidable impacts from the implementation of the proposed alternatives will be construction related, temporary, and minimal. The NJDEP has formulated guidelines to reduce adverse environmental effects during construction of interceptors (NJDEP, 1978). These measures include avoiding construction in stream corridors, wetlands, and areas with a high water table, or on steep slopes and highly erodable, acidic soils. Reseeding exposed soils with quick growth ground cover, and mulching after seeding is also recommended. In order to minize adverse impacts, contractors must be required to institute these measures.

Erosion may be reduced by installing water diversion structures, diversion ditches, hay bales, sedimentation basins; by seeding, mulching or sodding areas to provide temporary protection; and by covering stockpiled soil with netting or mulch.

The contractor shall schedule and conduct his operations to minimize erosion of soils and to prevent silting and muddying of streams, rivers, impoundments, and lands adjacent to or affected by the work. Construction of drainage facilities and performance of other work which will contribute to the control of erosion and sedimentation shall be carried out as soon as practicable. The area of bare soil exposed at any one time by construction operations shall be kept to a minimum.

The contractor shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water, or storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method sufficiently to reduce the amount of sediment contained in the water to allowable levels, as determined by the state. These methods may include installing water diversion structures, diversion ditches, hay bales and sedimentation basins; seeding, mulching or sodding areas to provide temporary protection, and covering stockpiled soils with netting or mulch.

Clearing operations will be confined only to those areas where absolutely necessary. Clearing will be limited to that right-of-way where construction will commence within thirty days. In environmentally sensitive areas, clearing will commence only within seven days of construction, and temporary soil stabilization measures must be employed.

Restoration will begin as soon as an area is no longer needed for construction, stockpile, or access. All areas must be restored to at least as good a condition as existed prior to construction. In wetland areas, the original drainage conditions must be restored to the extent possible. Special conditions will be required for slopes. Restoration will be reinspected one year after project completion. Any seeding, planting, or stabilization which has not succeeded will be redone.

Both Mill Brook alternatives and Jackson Brook Alternative B involve a stream crossing. Additional measures must be taken to control stream bank erosion and stream bed disruption when constructing in these waters. These measures include the use of rip-rapping, sandbagging, sodding, and, if necessary, jute or excelsior blankets to protect the banks. Fill and a silt screen should be used when crossing the stream.

Surface water crossings should be scheduled to minimize harm to fish populations. Construction in non-trout and trout maintenance waters should be scheduled between September 1 and March 1, and in trout production waters between September 1 and October 15 (NJDEP, 1978).

Jackson Brook has been designated by the state as a trout production water and the Rockaway River is a non-trout stream (NJDEP, 1979). All construction in streams should take place during periods of low flow. Where significant stream flow is encountered, temporary diversion channels with artificially stabilized banks or large culverts should be employed to minimize the potential for erosion.

Construction activities will produce noise, especially during the operation of heavy equipment, and would degrade the aesthetic quality of an area for the duration of construction. Therefore, no work shall be done before 7:00 AM or after 6:00 PM, local time on a working day, or at any time on Sunday and legal holidays, except as necessary for the proper care and protection of work already performed, or during emergencies. The contractor shall observe local ordinances regarding working hours. The contractor shall make every effort to minimize noises caused by his operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise.

Dust and other particulate matter will be released into the atmosphere, creating temporary air pollution in the vicinity of the construction site. However, these effects can be minimized by periodic sweeping and wetting down of the construction site.

Dust will be controlled by water sprinkling, and sweeping of paved areas, water sprinkling and mulching on unpaved areas. Natural materials, such as chippings from on-site vegetation, should be used for mulching whenever possible. The use of calcium chloride or petroleum products for dust control will be prohibited. Vegetation cleared from the rights-of-way will not be disposed of by burning. Equipment shall be provided with the proper exhaust emission control devices. The contractor will be responsible for observing local and federal anti-pollution ordinances.

Traffic will be controlled with the use of detour signs and/or police officers to direct motorists around construction sites. Alternative routes in construction areas will be maintained for emergency vehicular use. One open lane will be maintained for alternating traffic flow in areas where roadway reconstruction takes place.

Three alternatives would create long-term adverse effects which could not be mitigated. If constructed, Jackson Brook Alternative A would affect a historic site of local significance, a former silk mill. However, selection of Jackson Brook Alternative B avoids this mill. Both Mill Brook alternatives (A and B), if implemented, would result in elimination of part of the noncontiguous wetland located near the Rockaway River. Loss of this part of the wetland cannot be avoided.

In order to protect environmentally sensitive areas from development, EPA Step 2 and Step 3 grants to the municipalities should contain conditions. These conditions will prohibit future development in environmentallly sensitive areas from connecting to any system receiving grants. The grant conditions will, therefore, strongly discourage future development in environmentally sensitive areas. One such condition is that zoning regulations for municipalities in the RVFPA should be modified to protect environmentally sensitive lands, delineated in the DEIS, from indiscriminate development. Specifically, the following areas should be protected:

Environmental Constraint Category	Total Open Land hectares (acres)	
Steep Slopes	3,940	(9,750)
Floodplains	570	(1,400)
Wetlands	1,100	(2,720)
Historic Sites	20	(60)
Prime Aquifer Recharge Areas	320	(760)
Prime Agricultural Lands	40	(100)

FEDERAL, STATE, LOCAL AND OTHER SOURCES FROM WHICH COMMENTS HAVE BEEN REQUESTED

Federal Agencies:

Advisory Council on Historic Preservation
Army Corps of Engineers
Council on Environmental Quality
Department of Agriculture
Department of the Army
Department of Commerce
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of the Interior
Environmental Protection Agency
Geological Survey

United States Senate:

Honorable William Bradley
Honorable Harrison Williams

United States House of Representatives:

Honorable James Courter
Honorable Millicent Fenwick

State Agencies:

Department of Community Affairs
Department of Environmental Protection
Department of Health
Historical Preservation Office
Office of the Public Advocate
State Museum

Office of the Governor:

Honorable Brendan Byrne

New Jersey State Senate:

Honorable John Dorsey
Honorable Walter Foran
Honorable James Vreeland, Jr.

New Jersey State Assembly:

Honorable Arthur Albohn
Honorable James Barry, Jr.
Honorable Barbara Curran
Honorable Dean Gallo
Honorable Barbara McConnell
Honorable Rosemarie Totaro
Honorable Karl Weidel

Regional Agencies:

Interstate Sanitation Commission
Tri-State Regional Planning Commission
Rockaway Valley Regional Sewerage Authority

Local Agencies:

Morris County:
- Board of Chosen Freeholders
- Chamber of Commerce
- Municipal Utilties Authority
- Park Commission
- Planning Commission

Municipal:

Borough of Kinnelon:
- Honorable Glenn Sisco, Mayor
- Environmental Commission
- Planning Board

Borough of Mountain Lake:
- Honorable Carol Rufener, Mayor
- Environmental Commission
- Planning Board

Borough of Rockaway:
- Honorable Robert Johnson, Mayor
- Planning Board

Borough of Victory Gardens:
- Honorable Lorraine Harvey, Mayor
- Planning Board

Borough of Wharton:
- Honorable Harry Marks, Jr., Mayor
- Planning Board

Town of Boonton:
- Honorable Emidio Cacciabene, Mayor
- Planning Board

Town of Dover:
- Honorable John Rice, Mayor
- Planning Board

Township of Boonton:
- Honorable Everett Dayton, Mayor
- Environmental Committee
- Planning Board

Township of Denville:
- Honorable John O'Keefe, Mayor
- Environmental Commission
- Planning Board

Township of Jefferson:
- Honorable Horace Chamberlain, Mayor
- Environmental Commission
- Planning Board

Township of Mine Hill:
- Honorable Martin Rutenberg, Mayor
- Environmental Commission
- Planning Board

Township of Montville:
- Honorable Fredrick E. Eckhardt, Mayor
- Environmental Commission
- Planning Board

Township of Parsippany:
- Honorable John T. Fahy, Mayor
- Planning Board

Township of Randolph:
- Honorable Elizabeth Jaeger, Mayor
- Environmental Committee
- Planning Board

Township of Rockaway:
- Honorable William Bishop, Mayor
- Environmental Commission
- Planning Board

Township of Roxbury:
- Honorable Russell Diana, Mayor
- Environmental Commission
- Planning Board

Groups and Organizations:

Association of New Jersey Environmental Commissions
Boonton Historical Society
Boonton-Montville League of Women Voters
Boonton Shade Tree Commission
Clear Water Action Project
Denville League of Women Voters
Denville Library
Elson T. Killam Associates
Environmental Assessment Council
Friends of Towpath Trail
Home Builders Association of Somerset & Morris
Knarr-Richards, Associates
League for Conservation Legislation
Lee T. Purcell Associates

Morris Highland's Audubon Society
Mountain Lakes League of Women Voters
Murray Lehrer Real Estate
National Wildlife Federation
New Jersey Conservation Foundation
New Jersey Public Interest Research Group
New Jersey State Federation of Sportsmen's Clubs
New York-New Jersey River Conference
Passaic River Coalition
Randolph League of Women Voters
Rockaway River Watershed Association
Rockaway Township Library
Sierra Club
Tourne Valley Coalition
208 Policy Advisory Committee
Water Resources Research Institute
Youth Environmental Society

Individuals

Clifford Boyce
Lorraine Caruso
Richard Christie
Al Couvrette
Carole Crossman
Clifford Day
John V. DeGrace
Ella F. Fillippone
Michael Fitzpatrick
Peter Fox
William Francisco
Michael Havrisko
Robert Heath
Andrew Hric
Richard Irwin
Robert Kennedy
Betty Anne Lane
Peter Lane
Joseph J. Maraziti, Jr.
Charles Neqel
Diane Nelson
Vivian Perlmutter
Fletcher N. Platt, Jr.
Hugh Platt
Howard Rasmussen
Gwen Ross
Martin Rutenberq
Susan Small
Earl Schleicher
Barbara Schreiber
Mimi Schwartz
Ed Secco
Susan Shaw
Marion Smith
Linda Stansfield
Ken Staudt
Ellie Sterling
Constance Stroh
Joseph Sudd
Grace Teese
A. R. Thompson
Jerry Uhriq
Nancy A. Updeqraff
Robert Werner
Raymond Zabihach
Muriel Zimmerman

GLOSSARY

Aquifer Recharge - The process by which water is added to the aquifer, either through rainfall, underflow, or seepage from rivers.

Amphipod - any of a large group of small crustaceans, such as the sand flea, and crayfish.

cation - An ion that bears a positive charge.

Conglomerate - a sedimentary rock containing rounded fragments corresponding in size to gravel and pebbles embedded in a finer cementing material.

dBA - Sound level measured, in decibels, on the A-weighting network.

Dip - The angle at which a stratum or any planar feature is inclined when referred to a horizontal plane.

Drawdown - The lowering of the water table surface by pumping.

Evapotranspiration - The process by which water is evaporated from wet soil surfaces and transpired by plants.

Extensive Stratified Drift - Large, thick deposits of sand and gravel laid down by meltwater streams originating at the glacier edge, consisting largely of sand and gravel.

Fault - A fracture or fracture zone along which there has been displacement of the sides relative to one another parallel to the fracture.

Fragipan - A loamy, brittle, subsurface horizon, almost impermeable to water and can be a few inches to several feet thick.

Gneiss - A coarse-grained rock in which bands rich in granular minerals alternate with bands rich in mica.

Induced Recharge - Process by which pumping of a well near a river causes a reversal of natural water table slopes, causing water from the river to seep into the well.

Infiltration - The flow or movement of water through the soil surface into the groundwater.

Intermontane - Lying between mountains.

Isopod - Any of a large group of small crustaceans with seven pair of legs.

Joint - Fracture in rock, generally more or less vertical or transverse to beds along which no appreciable movement has occurred.

Loam - Soil composed of nearly equal quantities of sand, silt, and clay.

Macrophyte - terrestrial and aquatic plants large enough to be seen with the naked eye.

Meltwater Channel - Channel resulting from the erosion caused by the melting of snow or glacial ice.

Metamorphosed rock - Rock altered by temperature and pressure.

Microphyte - Microscopic plants, such as one-celled algae.

Oligochaete - Any of a group of terrestrial or aquatic invertebrates with an elongated, segmented body, such as the earthworm or leech.

Paleozoic - One of the eras of geologic time lasting from approximately 600 million years ago to 225 million years ago.

Pan layers - A hard, cementlike layer, crust, or horizon of soil within or just beneath the surface; may be compacted, indurated, or very high in clay content.

Permeability - The capacity of rock for transmitting fluid.

Pliestocene - The earlier of the two time periods comprising the Quaternary Period, lasting from approximately 1,000,000 years ago to 11,000 years ago. Included within this time period is the Wisconsinian Glaciation.

Precambrian - All rocks formed before the Cambrian. This era involves geologic time previous to the last 600 million years.

Quartzite - A granular metamorphic rock consisting essentially of quartz.

Recent Age - That period of time since the last ice age (Wisconsin) to the present.

Scour - Erosion, especially by moving water.

Terminal Moraine - A deposit of unsorted glacial drift at or near places marking the termination of important glacial advances.

Triassic - Earliest of the three periods of the Mesozoic Era, lasting from 225 million years ago to 175 million years ago.

ABBREVIATIONS USED

a	acre
AQCR	Air Quality Control Region
AWT	Advanced Wastewater Treatment
BOD	Biochemical Oxygen Demand
BTPB	Boonton Town Planning Board
BTpPB	Boonton Township Planning Board
Btu	British Thermal Unit
°C	degrees Celsius
Cal	Calories
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeters
cm/hr	centimeters per hour
CO	Carbon Monoxide
cu m	cubic meters
cu m/d	cubic meters per day
cu m/d/km	cubic meter per day per kilometer
cu m/d/sq km	cubic meters per day per square kilometer
cu m/s	cubic meters per second
dBA	decibles
DeTPB	Denville Township Planning Board
DO	Dissolved Oxygen
DTPB	Dover Town Planning Board
EIS	Environmental Impact Statement

EPA	Environmental Protection Agency
°F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
ft	feet
FW-1	Fresh Water, class one
FW-2	Fresh Water, class two
gpcd	gallons per capita daily
gpd	gallons per day
gpm	gallons per minute
ha	hectares
HC	Hydrocarbons
hu	housing units
I/I	Infiltration/Inflow
in	inches
in/hr	inches per hour
JTPB	Jefferson Township Planning Board
KBPB	Kinnelon Borough Planning Board
Kj	Kilojoules
km	kilometers
km/hr	kilometer per hour
kwr	kilowat-hour
lpcd	liters per capital daily
lpd	liters per day
lpm	liters per minute
m	meters
$\mu g/m^3$	micrograms per cubic meter
MA7CD10	ten-year seven consecutive day low flow

MCPB	Morris County Planning Board
Mfg	Manufacturing
mg	million gallons
mgd	million gallons daily
mgd/mi	million gallons daily per mile
mgd/sq mi	million gallons daily per square mile
mg/l	milligrams per liter
MHTPB	Mine Hill Township Planning Board
mi	miles
mi/hr	miles per hour
ml	milliliters
MLBPB	Mountain Lakes Borough Planning Board
MTPB	Montville Township Planning Board
mg/m^3	micrograms per cubic meter
NAAQS	National Ambient Air QUality Standards
NAPHCC	National Association of Plumbing, Heating, and Cooling Contractors
NECRMP	Northeast Corridor Regional Modeling Program
NH_3	ammonia unionized
NH_4^+	ammonia ionized
NJAC	New Jersey Annotated Code
NJDEP	New Jersey Department of Environmental Protection
NJDIED	New Jersey Department of Industrial and Economic Development
NJDLI	New Jersey Department of Labor and Industry
NJGS	New Jersey Geological Survey
NJODEA	New Jersey Office of Demographic and Economic Analysis
NMHC	Non-Methane Hydrocarbons

No	Number
NO_x	oxides of nitrogen
NO_2	Nitrogen Dioxide
NPDES	National Pollutant Discharge Elimination System
NPS	Non-point source (pollution)
O_3	ozone
O&M	Operation and Maintenance
ppm	parts per million
PRM	Program Requirements Memorandum
PSD	Prevention of Significant Deterioration
PTHTPB	Parsippany-Troy Hills Township Planning Board
RaTPB	Randloph Township Planning Board
RBPB	Rockaway Borough Planning Board
ROW	Right-of- Way
RTPB	Rockaway Township Planning Board
RVFPA	Rockaway Valley Facilities Planning Area
RVRSA	Rockaway Valley Regional Sewage Authority
RxTPB	Roxbury Township Planning Board
sec/yr	seconds per year
SIP	State Implementation Plan
SMD	Septic Management District
SO_2	Sulfur Dioxide
sq ft/d	square feet per day
sq km	square kilometers
sq m/d	square meters per day
sq mi	square miles
Veg	Vegetation

t	metric ton
TKN	Total Kjeldahl Nitrogen
tn	short ton
TSP	Total Suspended Particulates
Twp	Township
USBC	United States Bureau of the Census
USDA-SCS	United States Department of Agriculture-Soil Conservation Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VGBPB	Victory Gardens Borough Planning Board
WBPB	Wharton Borough Planning Board
WWTP	Wastewater Treatment Plant

CORRESPONDING METRIC AND ENGLISH UNITS

Metric	English
Celsius (°C)	Fahrenheit (°F)
centimeter (cm)	inch (in)
cubic meters/day (cu m/d)	million gallons/day (mgd)
hectare (ha)	acre (a)
kilometer (km)	mile (mi)
liter (l)	gallon (g)
liters per capita day (lpcd)	gallons per capita day (gpcd)
meter (m)	foot (ft)
meters per second (mps)	feet per second (fps)
metric ton (metric ton)	ton (ton)
milligrams/liter (mg/l)	parts per million (ppm) (this is an approximate equivalent)
square meter (sq m)	square foot (sq ft)

REFERENCES

Ahlert, Robert C. and others, June, 1979. Analysis of Nitrification in the Passaic Basin, prepared for the office of Areawide Planning, Division of Water Resources, NJDEP. Trenton, NJ

Allemand, E., 1976. Reptiles and Amphibians. New Jersey, Audubon 2:11-14.

Banio, George M., Frank J. Markewicz and Joseph W. Miller, Jr., 1970. Geologic, Hydrologic and Well Drilling Characteristics of the Rocks of Northern and Central New Jersey. New Jersey Bureau of Geology and Topography. Trenton, NJ.

Baumwall, Harold (oral communication). August 20, 1979. Conversation between Harold Baumwall, Tax Assessor, Rockaway Township, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Bishop, Bonnie (oral communication). July 6, 1979. Conversation between Bonnie Bishop, Secretary to the Planning Board, Randolph Township, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Boonton Town Planning Board. 1974. The Boonton Plan. 61 pp.

Boonton Township Planning Board. 1979. Boonton Township Master Plan. 60 pp.

Bull, John and John Farrand. 1977. The Audubon Society Field Guide to North America Birds; Eastern Region. Alfred A. Knopf, Inc., NY 775 pp.

Catlin, Robert and Associates. June 1976. A Natural Resource Inventory for the Township of Denville, prepared for the Denville Township Environmental Commission. Denville, NJ.

Chauaravallati, Ed (oral communication). July 26, 1979. Conversation between Ed Chauaravallati, Real Estate Agent, Morris County, NJ and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Christie, Richard E. (oral communication). July 10, 1979 Conversation between Richard E. Christie, Sanitary Inspector, Rockaway Township, NJ and John Falkenbury, Environmental Engineer, WAPORA, Inc., New York, NY.

Christie, Richard E. (oral communication). July 30, 1979. Conversation between Richard E. Christie, Sanitary Inspector, Rockaway Township, NJ and Kathleen Murray, Biologist, WAPORA, Inc., New York, NY.

Cinquina, J. 1979. Mammals. New Jersey Audubon 2:19-22

Clean Air Act. 1970. Public Law 91-604. 91st congress. December 31, 1970.

Clean Air Act Amendments. 1977. Public Law 95-95. 95th Congress. August 7, 1978.

Collins, Joseph T., and J. Huheey, J. Knight, and H. Smith. 1978. Standard Common and Current Scientific Names for North American Amphibians and Reptiles. Society for the Study of Amphibians and Reptiles, Miscellaneous Publications, Herpetological Circular No. 7. 36 pp.

Conant, R. 1975. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin Cf., Boston, MA. 429 pp.

Council of Economic Advisors. 1978. Economic Report of the President and Annual Report of the Council of Economic Advisors, Transmitted to the Congress January 1978. Washington, D.C. 381 pp.

Cross, Dorothy, 1941. The Archaeology of New Jersey, Vol. I. Archaeological Society of New Jersey and the New Jersey State Museum, Trenton, NJ.

Cross, Gloria (oral communication). August 20, 1979. Conversation between Gloria Cross, Tax Assessor, Boonton Township, NJ and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Danco, George. 1979. Toxic Chemicals Found in Wharton Well. The (Morristown) Daily Record, (7 August), page 2

Davis, Stanley N. and Roger J. M. DeWiest, 1966. Hydrogeology, John Wiley and Sons, Inc. New York, NY. 461 pp.

Denville Township Planning Board. 1975. A Comprehensive Revision to the Master Plan Report for the Township of Denville. 77 pp.

Di Yanni, Edward (oral communication). August 20, 1979. Conversation between Edward Di Yanni, Tax Assessor, Victory Gardens Borough, NJ Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Di Yanni, Lena (oral communication). August 20, 1979. Conversation between Lena Di Yanni, Tax Assessor, Dover Town, NJ and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Dover Town Planning Board. 1976. Town of Dover Master Plan. 10 pp.

Dyksen, John (oral communication). August 20, 1979. Conversation between John Dyksen, Tax Assessor, Denville Township, NJ and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

EcolSciences, Inc. 1975. Environmental Assessment for Sewer Service Expansion, Parsippany - Troy Hills, New Jersey. 50 pp.

Environmental Protection Agency. 1972. Guidelines for Erosion and Sediment Control Planning and Implementation. Office of Research and Monitoring, U.S. Environmental Protection Agency, Washington, D.C. EPA-R2-72-015.

Environmental Protection Agency. 1972. National Primary and Secondary Ambient Air Quality Standards. Federal Register 32(84) Part II: 8182-8201.

Environmental Protection Agency. 1974. Background Document for Proposed Portable Air Compressor Noise Emission Regulations. EPA 550/9-74-016. Washington, D.C.

Environmental Protection Agency. 1974. Construction Grant Regulations, Federal Register, February 11, 1974. Washington, D.C.

Environmental Protection Agency. December 27, 1975a. National Interim Primary Drinking Water Regulations. 40 CFR 141, as amended. Washington, D.C.

Environmental Protection Agency. 1975b. Compilation of Air Pollutant Emission Factors. Second Edition. Publication AP-42. Appendix D. Research Triangle Park, North Carolina. 53 pp.

Environmental Protection Agency. 1976. Areawide Assessment Procedures Manual, Volume I & II Municipal Environmental Research Laboratory, Office of Research and Development, USEPA, Cincinnati, Ohio. EPA-600/9-76-014.

Environmental Protection Agency. 1976a. Areawide Assessment Procedures Manual, Appendix H, Municipal Environmental Research and Development Laborarory. Cincinnati, Ohio.

Environmental Protection Agency. 1976b. Quality Criteria for Water. USEPA, Washington, DC.

Environmental Protection Agency. 1978a. Innovative and Alternative Technology Assessment Manual. Municipal Environmental Research Laboratory. Cincinnati, Ohio.

Environmental Protection Agency. 1978b. National Ambient Air Quality Standards, States Attainment Status. Federal Register 43(43) Part II: 8962-9059.

Environmental Protection Agency. 1978c. Water Use and Conservation at Federal Facilities in the Washington, D.C. Metropolitan Area, prepared by WAPORA, Inc. for the Environmental Protection Agency, Region III, Philadelphia, Pennsylvania, 64+pp.

Environmental Protection Agency. 1978d. Construction Costs for Wastewater Conveyance Systems. 430/9-77-015. Office of Water Program Operations (WH-547) Washington, D.C.

Environmental Protection Agency. 1978. Manual for Evaluating Secondary Impacts of Wastewater Treatment Facilities. USEPA, Office of Air, Land, and Water Use, Office of Research and Development, Washington, D.C. 175 pp.

Environmental Protection Agency. 1978, 1979. National Pollution Discharge Elimination System Permit and Monitoring Reports for the Rockaway Valley Regional Sewage Autority. USEPA, Region II, New York, NY. Var.

Environmental Protection Agency. 1979a. Air Quality Analysis for New Jersey - New York and Mid-Hudson AQMA. 902/4-78-006. EPA Region II. New York, New York.

Environmental Protection Agency. 1979b. National Emissions Data System Point Source Listing. Air Quality Control Region 043: New Jersey-New York-Connecticut. Morris county, New Jersey. April 18, 1979.

Environmental Protection Agency. 1979. Requirements Memorandum No. 79-8. USEPA, Office of Water and Hazardous Materials. Washington, D.C.

Environmental Protection Agency. Region II Rockaway Valley, Historic Sites (file materials).

ESCA-Tech. October 1977. Final Report Land Use Inventory and Survey of Existing Constraints and Uses - Rockaway Valley Regional Sewerage Authority. Morris County, NJ.

Fairbrothers, David E., and Mary Y. Hough. 1973. Rare or Endangered Vascular Plants of New Jersey. New Jersey State Museum, Trenton. Science Notes No. 14. 53 pp.

Fairbrothers, David and Edwin Moul. no date. Aquatic Vegetation of New Jersey. Extension Bulletin 382. Extension Service, College of Agriculture, Rutgers - The State University. New Brunswick, NJ. 107 pp.

Federal Register. May 24, 1977. Executive Order 11990, Protection of Wetlands.

Federal Register. July 24, 1979a. Executive Order 12148, Federal Emergency Management; Amendment to Executive Order 11988 (May 24, 1977), Floodplain Management. 44:43239.

Federal Register. February 6, 1979b. National Register of Historic Places.

Federal Register. May 8, 1980. Determination of Sole Source Aquifer Status for Aquifers Underlying Western Essex and Southeastern Morris Counties, New Jersey. Vol. 45, No. 91.

Femminelli, Charles (oral communication). August 20, 1979. Conversation between Charles Femminelli, Tax Assessor, Kinnelon Borough, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Ferdinando, Clement (written communication). September 17, 1979. Letter from Clement Ferdinando, Health Officer, Township of Randolph, Randolph Township, New Jersey to John Falkenbury, Environmental Engineer, WAPORA, Inc., New York, New York.

Fitzpatrick, F. Michael (written communication). February 13, 1980. Letter from F. Michael Fitzpatrick, Director of Health and Welfare, Rockaway Township Department of Health and Welfare, Rockaway Township, New Jersey to John Falkenbury, Environmental Engineer, WAPORA Inc., New York, New York.

Fransisco, William (oral communication). September 2, 1980. Conversation between William Fransisco, Executive Director, Rockaway Valley Regional Sewerage Authority, Boonton, New Jersey, and Kathleen Murray, Biologist, WAPORA, Inc. New York, New York.

Freeze, R. Allan and John A. Cherry. 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 550 pp.

Garofalo, S. Charles (oral communication). July 26, 1979. Conversation between S. Charles Garofalo, Director, Department of Industrial and Economic Development, Morris County, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Gaynor, John (oral communication). August 20, 1979. Conversation between John Gaynor, Tax Assessor, Mine Hill Township, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Gayton, Edith (oral communication). August 29, 1979. Conversation between Edith Gayton, Municipal Clerk, Victory Gardens Borough, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Geraghty and Miller, Inc., 1978. An Evaluation of Groundwater Resources of the Rockaway River Valley within the Communities of Denville, Boonton Township, Town of Boonton, Montville and Mountain Lakes, NJ. 72+ pp.

Gill, Harold E. and John Vecchioli, 1965. Availability of Groundwater in Morris County, New Jersey. New Jersey Division of Water Policy and Supply, Special Report 25. Trenton, NJ.

Godin, Alfred J. 1977. Wild Mammals of New England. The John Hopkins University Press, Baltimore, MD 304 pp.

Hamill, Barker (Oral communication). November 27, 1979. Conversation between Barker Hamill, Supervising Environmental Engineer, NJDEP, Trenton, NJ and Kathleen Murray, Biologist, WAPORA, Inc., New York, NY.

Hardy, Elizabeth (oral communication). August 6, 1979. Conversation between Elizabeth Hardy, Director of the Water and Sewer Authority, Denville Township, NJ and Charles Marcus, Planner, WAPORA, Inc., New York, NY.

Hartman, Jerry (oral communication). July 6, 1979. Conversation between Jerry Hartman, Secretary to the Planning Board, Rockaway Township, NJ and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Held, Joanne (oral communication). July 11, 1979. Conversation between Joanne Held of New Jersey Department of Environmental Protection, Trenton, NJ, and David Bush, Air Scientist, WAPORA, Inc., New York, NY.

Hino, M. 1968. Maximum Ground Level Concentration and Sampling Time. Atmospheric Environment. Volume 2. Pergamon Press, New York, NY 149-165 pp.

Holzworth, G. C. 1972. Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States. EPA Publication AP-101 Research Triangle Park, NC. 118 pp.

Hopkins, Thomas (oral communication). August 3, 1979. Conversation between Thomas Hopkins, Municipal Clerk, Boonton Town, NJ, and Charles Marcus, Planner, WAPORA, Inc., New York, NY.

Jefferson Township Planning Board. 1978. Jefferson Township Master Plan. var.

Jersey Central Power Light (oral communication). July 17, 1979. Conversation between Jersey Central Power and Light Sales Representative Morristown, New Jersey and David Bush, Air Scientist, WAPORA, Inc., New York, NY.

Jersey City Department of Public Works, Division of Engineering. 1977. Jersey City Reservoir Operational Records. Jersey City, New Jersey.

Jones, James (oral communications). August 20, 1979. Conversation between James Jones, Tax Assessor, Mountain Lakes Borough, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Kennedy, Rod (oral communication). August 20, 1979. Conversation between Rod Kennedy, Tax Collector, Wharton Borough, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Killam Associates, Elson T. and Environmental Assessment Council, 1977. (DRAFT) Facilities Plan for the Rockaway Valley Regional Sewerage Authority Wastewater Treatment Facilities, Morris County, NJ. Prepared for US Environmental Protection Agency, New York, NY.

Killam Associates, Elson T. 1978. Sewer System Evaluation Survey - Infiltration Interim Report - Phase II A. Prepared for Rockaway Valley Regional Sewerage Authority, Morris County, New Jersey.

Kinnelon Borough Planning Board. 1978. Land Use and Land Use Plan, Borough of Kinnelon. 9 pp.

Kurisko, Paul (oral communication). January 16, 1980. Conversation between Paul Kurisko, Basin Manager, Office of Construction Grants, New Jersey Department of Environmental Protection, Trenton, New Jersey, and Charles Marcus, Planner, WAPORA, Inc., New York, New York.

Lewis, J. Volney and Henry B. Kummel. 1950. Geologic Map of New Jersey. State of New Jersey Department of Conservation and Economic Development, Atlas Sheet 40.

Linsley, Ray K. and Joseph B. Franzini. 1964. Water Resources Engineering. McGraw-Hill Book Company, New York, NY. 650 pp.

Lohman, S. W., 1972. Groundwater Hydraulics. US Geological Survey Professional Paper 708, Washington, D. C. 69 pp.

Lucey, Carol S., 1972. Geology of Morris County in Brief. New Jersey Bureau of Geology and Topography. Trenton, NJ. 13 pp.

Lucey, Carol S. (oral communication). May 2, 1980. Conversation between Carol Lucey, New Jersey Department of Environmental Protection, Division of Water Resources, Trenton, New Jersey, and James Mack, Geologist, Wapora, Inc. New York, New York.

Maraziti, Jr., Joseph J. (written communication). July 6, 1976. Letter from Joseph J. Maraziti, Jr., Attorney, to William H. Francisco, Jr., Chairman, Rockaway Valley Regional Sewerage Authority, Boonton, New Jersey.

Maynard, Thomas (oral communication). June 3, 1980. Conversation between Thomas Maynard, Federal Emergency Management Agency, U.S. Department of Housing and Urban Development, Washington, D.C. and James Mack, Geologist, WAPORA, Inc. New York, New York.

McCarthy, Dorothy (oral communication). August 20, 1979. Conversation between Dorothy McCarthy, Tax Assessor, Rockaway Borough, NJ and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

McClane, A. J. 1974. Freshwater Fishes of North America. Holt, Rhinehart and Winston, New York, NY. 212 pp.

McCudden, Francis (oral communication). August 3, 1979. Conversation between Francis McCudden, Treasurer, Rockaway Township, NJ, and Charles Marcus, Planner, WAPORA, Inc., New York, NY.

McDonald, Aim (oral communication). July 6, 1979. Conversation between Aim McDonald, Secretary to the Planning Board, Denville Township, NJ and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Meisler, Harold, 1976. Computer Simulation Model of the Pleistocene Valley-Fill Aquifer in Southwestern Essex and Southeastern Morris Counties, New Jersey. US Geological Survey Water-Resources Investigations 76-25. Trenton, NJ. 64 pp.

Mine Hill Planning Board. 1977. Mine Hill Township Summary Master Plan. var.

Mitchko, Arthur (oral communication). August 20, 1979. Conversation between Arthur Mitchko, Tax Assessor, Jefferson Township, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Montville Township Planning Board. 1976. Montville Township Master Plan. 86 pp.

Morris County Board of Taxation, 1979. Abstract of Ratables, Morris County, NJ. 4 pp.

Morris County Planning Board. 1972. Morris County Master Plan-Open Space Element. 50 pp.

Morris County Planning Board. 1975. Master Plan-Future Land Use Element. 85 pp.

Morris County Planning Board. 1978. Average Sales Prices for Residential Property.

Mountain Lakes Borough Planning Board. 1978. Land Use Element Master Plan Borough of Mountain Lakes. 5 pp.

Municipal Land Use Law. 1975. Laws of New Jersey Chapter 291. August, 1975.

National Aeronautics and Space Administration (NASA). 1976-1978. Earth Resources Observation Satellites infrared photographs.

National Association of Plumbing, Heating and Cooling Contractors, 1978. National Plumbing Code. Washington, D.C.

National Oceanic and Atmospheric Administration (NOAA). 1975. Local Climatological Data. Environmental Data Service. National Climatic Center. Asheville, NC.

Nelson, Thorsten (oral communication). August 7, 1979. Conversation between Thorsten Nelson, Municipal Utilities Authority Director, Randolph Township, NJ, and Charles Marcus, Planner, WAPORA, Inc., New York, NY.

New Jersey Annotated Code 7: 9-4, December 2, 1974. New Jersey Surface Water Quality Standards, as amended.

New Jersey Department of Environmental Protection. 1975. New Jersey Standards for Soil Erosion and Sediment Control. New Jersey State Soil Conservation Committee. New Jersey Department of Environmental Protection. Trenton, New Jersey.

New Jersey Department of Community Affairs. 1977. Thirty-Ninth Annual Report of the Division of Local Government Services. New Jersey Department of Community Affairs, Trenton, NJ. var.

New Jersey Department of Environmental Protection. 1973. New Jersey Ambient Air Quality Standards. New Jersey Administrative Code. Chapter 27, Subchapter 27. Trenton, New Jersey.

New Jersey Department of Environmental Protection. 1974. Preliminary Report on Wasteload Allocation for the Upper Rockaway River Basin (303)e Report). Trenton, New Jersey.

New Jersey Department of Environmental Protection. 1974. Surface Water Quality Standards, Docket No. DEP 012-74-11, NJDEP - Division of Water Resources, Trenton, NJ.

New Jersey Department of Environmental Protection. 1975. Geologic Overlay Sheets 22 and 25. NJDEP, Trenton, New Jersey.

New Jersey Department of Environmental Protection. 1977. Draft Statewide Water Supply Master Plan. NJDEP - Division of Water Resources, Tenton, NJ. 115 pp.

New Jersey Department of Environmental Protection. May 1977. Environmental Guidelines for Planning, Designing, and Constructing Interceptor Sewers. New Jersey Department of Environmental Protection. Trenton, New Jersey.

New Jersey Department of Environmental Protection. October 1978. Inventory of Existing Dischargers Northeast 208 Study Area Task 4.1. NJDEP - Water Resources Division, Trenton, NJ.

New Jersey Department of Environmental Protection. 1978. Endangered, Threatened, Peripheral, Undetermined, Declining and Extirpated Wildlife Species in New Jersey. Endangered and Nongame Species Project, Trenton, New Jersey. 14 pp.

New Jersey Department of Environmental Protection. 1979a. Air Quality in New Jersey Compared with Air Quality Standards. Trenton, NJ.

New Jersey Department of Environmental Protection. 1979b. Northeast New Jersey Water Quality Management Plan. NJDEP - Water Resources Division, Trenton, NJ.

New Jersey Department of Environmental Protection. 1979c. Legal and Institutional Inventory and Analysis for the Establishment of Septic Tank Management Districts. 208 Areawide Water Quality Management Planning Working Paper. Trenton, New Jersey.

New Jersey Department of Labor and Industry. 1973. Covered Employment Trends in New Jersey by Geographical Areas of the State.

New Jersey Department of Labor and Industry. 1978. Conrid employment trends in New Jersey by geographical areas of the state.

New Jersey Department of Labor and Industry. 1967-1977. Summary, New Jersey Residential Building Permits.

New Jersey Department of Labor and Industry. 1977. New Jersey Official Population Estimates. 21 pp.

New Jersey Local Property Tax Bureau. 1968, 1971, 1973. Local Property Tax Data.

New Jersey Public Service Electric and Gas Company (oral communication). July 17, 1979. Conversation between PSE&G Sales Representative, Newark, New Jersey and David Bush, Air Scientist, WAPORA, Inc., New York, NY.

Newman, Walters and Bert Salwen, 1977. Amerinds and their Paleoenvironments in Northeastern North America, Annals of the New York Academy Sciences. 288 pp.

Nichols, William D., 1968. Groundwater Resources of Essex County, New Jersey. New Jersey Division of Water Policy and Supply, Special Report 28. Trenton, New Jersey.

Pandullo Quirk Associates. In (preparation). Ecological Survey - data summary tables - Berkshire Valley Road Environmental Impact Statement. In preparation for New Jersey Department of Transportation, Trenton, NJ. var.

Parsippany-Troy Hills Township Planning Board. 1976. Parsippany-Troy Hills Township Master Plan. var.

Perugini, Michael (oral communication). August 20, 1979. Conversation between Michael Perugini, Tax Assessor, Roxbury Township, New Jersey, and Joseph Toniolo, Planner, WARPORA, Inc., New York, NY.

Photographic Interpretation Corporation, 1978. Air Photo Environmental Analysis of the Passaic River Basin, for the New York District of the US Army Corps. of Engineers. New York, NY.

Platt, Fletcher N., Jr. (oral communication) May 23, 1980. Conversation between Fletcher N. Platt, Jr., E.T. Killam

Associates, Denville, New Jersey, and James E. Shirk, Manager of Water Resources, WAPORA, Inc. New York, New York.

Plechata, Buddy (oral communication). August 20, 1979. Conversation between Buddy Plechata, Tax Assessor, Parsippany-Troy Hills Township, New Jersey, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Pound, Charles E. and Ronald W. Crites and Robert G. Smith. 1975. Cost-Effective Comparison of Land Application and Advanced Wastewater Treatment. U.S. Environmental Protection Agency, Office of Water Programs Operations, Washington, D.C.

Raab, Robert (oral communication). December 6, 1979. Conversation between Robert Raab, Project Monitor, US Environmental Protection Agency Region II, New York, NY and John F. Falkenbury, Project Manager, WAPORA, Inc. New York, NY.

Rahn, Perry H., 1968. The Hydrogeology of an Induced Streambed Infiltration Area. Groundwater, Vol. 7, 21-32 pp.

Randall, Allan D., 1977. The Clinton Street - Ballpark Aquifer in Binghamton and Johnson City, New York. New York State Department of Environmental Conservation, Bulletin 73. Albany, New York.

Randolph Township Planning Board. 1979. Master Plan Update for the Township of Randolph. 52 pp.

Rasmussen, William C. and Gordon E. Andreansen, 1959. Hydrologic Budget of the Beaver Creek Basin, Maryland. US Geological Survey Water Supply Paper 1472. Washington, D.C.

Ritchie, William A., 1965. The Archaeology of New York State. Natural History Press, Garden City, New York.

Robbins, C. S., B. Brunn, and H. Zim, 1966. Birds of North America. Golden Press, New York. 340 pp.

Robichaud, Beryl and Murray Buell, 1973. Vegetation of New Jersey. Rutgers University Press, New Brunswick New Jersey. 340 pp.

Rockaway Borough Planning Board. 1978. Land Use Element of the Master Plan for the Borough of Rockaway. 19 pp.

Rockaway Township Department of Health, 1980. Sites of on-site system failures (file material).

Rockaway Township Planning Board. 1976. Comprehensive Revision Master Plan. 62 pp.

Roxbury Township Planning Board. 1977. A Comprehensive Revision to the Master Plan Report for the Township of Roxbury. 23 pp.

Rusnack, Mary (oral communication). August 6, 1979. Conversation between Mary Rusnack, Municipal Clerk, Boonton Township, NJ, and Charles Marcus, Planner, WAPORA, Inc., New York, NY.

Salwen, Bert. 1975. Post Glacial Environemnts and Cultural Change in the Hudson River Basin, Man in the Northeast.

Selfridge, Wayne (oral communication). January 7, 1980. Conversation between Wayne Selfridge, Bureau Chief, New Jersey Department of Labor and Industry, Trenton, New Jersey and Charles Marcus, Planner, WAPORA, Inc., New York, New York.

Schneider, Phillip (oral communication). August 20, 1979. Conversation between Phillip Schneider, Tax Assessor, Montville, Township, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Schrabisch, 1909. Indian Rock Shelters in Northern New Jersey and Southern New York, in The Indians of Greater New York and the Lower Hudson, Anthrop. Papers of the American Museum of Natural History. 8 pp.

Speiser, R. 1977. A Preliminary Report on the Breeding Birds of the Ramapo Mountains and the Western Hudson Highlands. Unpublished Mahwah, NJ. 21 pp.

Staley, John (oral communication). August 20, 1979. Conversation between John Staley, Tax Assessor, Randolph Township, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Stankowski, S.J. 1974. Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization. Special Report no. 38, U.S. Geological Survey, Water Resources Division, Trenton, New Jersey.

Tappan, G. G. 1976. Birds. New Jersey Audubon 2: 14-18.

Tetra-Tech, Inc., 1978. Determination of Available Potable Water Supply in the Rockaway Valley Regional Sewerage Authority Service Area, Morris County, New Jersey, prepared for the US Environmental Protection Agency, Environmental Impacts Branch, New York, NY.

Thiel, Ruth (oral communication). August 6, 1979. Conversation between Ruth Thiel, Secretary to the Planning Board, Roxbury Township, NJ, and Charles Marcus, Planner, WAPORA, Inc., New York, NY.

Thompson, Blanche (written communication). September 17, 1979. Letter from Blanche Thompson, Deputy Township Clerk, Township of Mine Hill, Mine Hill, New Jersey, to John Falkenbury, Environmental Engineer, WAPORA, Inc., New York, New York.

Todd, David Kieth, 1959. Grounwater Hydrology. John Wiley and Sons, New York, NY. 333 pp.

Tottorato, Ms. (oral communication). April 11, 1979. Conversation between Ms. Tottorato, Hamilton Township Department of Public Works, Division of Water Pollution Control, Hamilton, New Jersey, and Hank Innerfeld, Oceanographer, WAPORA, New York, New York.

Trimmer, Patricia (oral communication). August 6, 1979. Conversation between Patricia Trimmer, Secretary to the Sewer Authority, Wharton Borough, NJ, and Charles Marcus, Planner, WAPORA, Inc., New York, NY.

U.S. Army Corps of Engineers. 1974. Fish and Wildlife Management Plan for Picatinny Arsenal. 18 pp.

U.S. Bureau of the Census. 1950. General Characteristics of the Population. Washington, DC.

U.S. Bureau of the Census. 1960. General Characteristics of the Population. Washington, DC.

U.S. Bureau of the Census. 1970. General Characteristics of the Population. Washington, DC.

U.S. Department of Agriculture, Soil Conservation Service. 1976. Soil Survey of Morris County, New Jersey. U.S. Department of Agriculture, Washington, D.C. 111p.

U.S. Department of the Interior Fish and Wildlife Service. 1976 and 1979. Endangered and Threatened Wildlife and Plants. Federal Register October 27, 1976, 47180-47198 pp.; January 17, 1979, 3636-3654 pp.

U.S. Department of the Interior Fish and Wildlife Service. September 1978. Fish and Wildlife Resources Associated with the Passaic River Basin New Jersey and New York, prepared for the United States Army Corps of Engineers, New York District.

U.S. Geological Survey, 1967. Water Resources Data for New Jersey. Water year - 1967. USGS - Water Resources Division, Trenton, NJ.

U.S. Geological Survey. 1970. Water Resources Data for New Jersey. Water year - 1970. USGS - Water Resources Division, Trenton, NJ.

U.S. Geological Survey. 1971. Water Resources Data for New Jersey. Water year 1971. USGS - Water Resources Division, Trenton, NJ.

U.S. Geological Survey. 1972. Water Resources Data for New Jersey. Water year 1972. USGS - Water Resources Division, Trenton, NJ.

U.S. Geological Survey. 1973. Water Resources Data for New Jersey. Water year - 1973. USGS - Water Resources Division, Trenton, NJ.

U.S. Geological Survey. 1974. Water Resources Data for New Jersey. Water year - 1974. USGS - Water Resources Division, Trenton, NJ.

U.S. Geological Survey. 1975. Water Resources Data for New Jersey. Water year - 1975. USGS - Water Resources Division, Tenton, NJ.

U.S. Geological Survey. 1976. Water Resources Data for New Jersey. Water year - 1976. USGS - Water Resources Division, Trenton, NJ.

U.S. Geological Survey. 1977. Water Resources Data for New Jersey. Water year 1977. USGS - Water Resources Division, Trenton, NJ.

Victory Gardens Planning Board. 1976. Victory Gardens Master Plan. var.

Walton, William C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation. Illinois State Water Survey Bulletin 49. Urbana, Illinois.

Walton, William C., 1970. Groundwater Resource Evaluation. McGraw-Hill Book Company, New York, New York. 659 pp.

Washington Suburban Sanitary Commission, 1974, Final and Comprehensive Report Washington Suburban Sanitary Commission's Water Conservation/Wastewater Reduction, Customer Education, and Behavioral Change Program. Hyattsville, Maryland.

Wharton Borough Planning Board. 1978, Wharton Master Plan. 24 pp.

Whitely, Louis (oral communication). June 6, 1979. Conversation between Louis Whitely, Transportation Engineer, New Jersey Department of Transportation, Trenton, NJ, and Charles Marcus, Planner, WAPORA, Inc., New York, NY.

Widmer, Kemble, Haig Kasabach, and Phillip Nordstrome. 1966. Water Resources Resume of State Atlas Sheet No. 23, Parts of Bergen, Morris and Pssaic Counties. New Jersey Bureau of Geology and Topography. Trenton, New Jersey. 33 pp.

Widmer, Kemble, 1974. Land Orientated Reference Data for New Jersey. New Jersey State Geological Survey Bulletin 74. Trenton, NJ.

Williams, Lorraine E., Edward S. Rutsch and Karen A. Flinn. 1978. Cultural Resources Sensitivity Analysis of the Passaic River Basin. Prepared for the Passaic River Basin Study Group, US Army Corps of Engineers, New York District, September 15, 1978.

Zabihach, Raymond (oral communication). October 25, 1978. Conversation between Raymond Zabihach, Planner, Morris County Planning Board, Morris County, NJ and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Zabihach, Raymond (oral communication). June 6, 1978. Conversation between Raymond Zabihach, Planner, Morris County Planning Board, Morris County, NJ, and Joseph Toniolo, Planner, WAPORA, Inc., New York, NY.

Zabihach, Raymond (oral Communication). September 19, 1979. Conversation between Raymond Zabihach, Planner, Morris County Planning Board, Morris County, New Jersey and Joseph Toniolo, Planner, WAPORA, Inc. New York, New York.

LIST OF PREPARERS

This EIS was prepared by WAPORA, Inc., under the technical direction of USEPA Region II Environmental Impact Branch personnel Daniel Sullivan, Stephen Arella, and Robert Raab. The WAPORA staff members who prepared this document and their areas of responsibility are described below.

John Falkenbury	Project Management/Water Resources/ Wastewater Engineering
James Coyle	Project Management
James Shirk	Water Resources/Wastewater Engineering
Hank Innerfeld	Water Resources/Wastewater Engineering
Kathleen Murray	Water Resources/Biology
James Mack	Geology
Joel Soden	Air Quality
David Bush	Air Quality
Steven Wolf	Noise
Howard Schwartz	Aquatic Ecology
Judith Eastwood	Terrestrial Ecology
Gregory Greene	Terrestrial Ecology
Mark Schiffman	Planning/Socioeconomics
Joseph Toniolo	Planning/Socioeconomics
Charles Marcus	Planning/Socioeconomics
Karen Wollaeger	Cultural Resources
Beverly Dolinsky	Public Participation

APPENDIX A

FIGURES AND TABLES SUPPORTING THE TEXT

Table A-1

Growth Trends in Employment in Morris County

Employment Sector	1966 No. of Jobs	1966 % of Total Jobs	1976 No. of Jobs	1976 % of Total Jobs	Changes 1966-1976 No. of Jobs	Changes 1966-1976 % Growth
Manufacturing Ind.	34,364	49	42,122	36	7,758	23
Wholesale/Retail Trade	15,900	23	28,056	24	12,156	76
Transportation	1,470	2	3,200	3	1,730	118
Communications & Utilities	2,832	4	3,614	4	862	30
Small Services & Amusement	10,013	14	25,651	22	15,646	156
Finance, Insurance, Real Estate	1,290	2	7,494	6	6,204	481
Contract Construction	3,284	5	4,535	4	1,251	38
Mining, Agriculture Other	626	1	1,107	1	481	77
Total Covered[1] Employment	69,779	100	115,867	100	46,088	66

Note: Sums may not be precise due to rounding.

Source: NJDLI, 1966-1977.

Table A-2

Covered Jobs[1] by Municipality

Municipality	Total Employment				Changes in Employment	
	1973		1978		1973-1978	
	Number	Percent	Number	Percent	Number	Percent
Boonton Town	2807	6.6	3294	5.9	487	17.3
Dover Town	9089	21.3	7636	13.8	-1453	-16.0
Kinnelon Borough	402	0.9	714	1.3	312	77.6
Mountain Lakes Borough	646	1.5	817	1.5	171	26.5
Rockaway Borough	2577	6.0	2153	3.9	-424	16.5
Victory Gardens Borough	0	0	0	0	0	0
Wharton Borough	1926	4.5	2175	3.9	249	12.9
Boontown Township	1619	3.8	2101	3.8	482	30.0
Denville Township	3194	7.5	3975	7.2	781	24.5
Jefferson Township	881	2.1	928	1.7	47	5.3
Mine Hill Township	81	0.2	82	0.1	1	1.2
Montville Township	3239	7.6	4186	7.6	947	29.2
Parsippany-Troy Hills Township	10472	24.5	15209	27.4	4737	45.2
Randolph Township	898	2.1	2666	4.8	1768	197.0
Rockaway Township	1431	3.4	4963	9.0	3532	246.8
Roxbury Township	3408	8.0	4513	8.1	1105	32.4
Total RVFPA[2]	42670	100.0	55412	100.0	12742	30.0

Note: 1. "Covered Jobs" is a count of full and part-time employees who worked or received compensation during the payroll period including the twelfth day of the month as reported on quarterly employer contribution reports.
2. Sums may not be precise due to rounding.

Source: NJDLI, 1973, 1978.

Table A-3

Median Family Incomes, 1970

Municipality	Median Income
Boonton Town	$ 11,469
Dover Town	10,895
Kinnelon Borough	18,278
Mountain Lakes Borough	22,423
Rockaway Borough	11,505
Victory Gardens Borough	10,516
Wharton Borough	11,720
Boonton Township	14,026
Denville Township	13,103
Jefferson Township	11,322
Mine Hill Township	11,752
Montville Township	14,950
Parsippany-Troy Hills Twp.	12,781
Randolph Township	13,815
Rockaway Township	13,061
Roxbury Township	12,642
RVFPA	12,550[1]
Morris County	13,421
NY-NJ	11,847

Source: USBC, 1970.

Note: 1. WAPORA estimate.

Table A-4

Total and Per Capita Expenditures on Public Services in 1976

Municipality (Population)[1]	Public Service Sector: General Gov't.	Judiciary	Public Safety	Public Works	Health & Welfare	Recreation & Conservation	Education (excluding schools)	Statutory Expenditures	CETA & Other Public Employ	Total Municipal Function	Capital Improvements	Debt Service
Boonton Town (9,320)	$208,804[3] ($22.40)	$20,656 ($2.22)	$477,502 ($51.23)	$428,932 ($46.02)	$75,496 ($8.10)	$51,213 ($5.49)	$10,000 ($1.07)	$125,300 ($13.44)	$37,430 ($4.02)	$1,435,333 ($154.01)	0 0	$63,431 ($6.81)
Dover Town (15,645)	$476,896 ($30.48)	$55,200 ($3.53)	$696,031 ($44.49)	$633,281 ($40.48)	$97,869 ($6.26)	$89,100 ($5.70)	$83,400 ($5.33)	$236,524 ($15.12)	$38,569 ($2.47)	$2,406,970 ($153.85)	$20,000 ($1.28)	$162,140 ($10.36)
Kinnelon Borough (7,970)	$206,013 ($25.85)	$10,661 ($1.34)	$315,815 ($39.62)	$347,317 ($43.58)	$41,728 ($5.24)	$54,622 ($6.85)	$65,000 ($8.16)	$67,538 ($8.47)	0 0	$1,108,694 ($139.11)	$41,160 ($5.16)	$26,660 ($3.35)
Mountain Lakes Borough (4,795)	$129,964 ($27.10)	$8,370 1.75	$304,061 ($63.41)	$180,495 ($37.64)	$8,938 ($1.86)	$66,930 ($13.96)	$16,900 ($3.52)	$79,998 ($16.68)	$31,601 ($ 6.59)	$827,258 ($172.53)	$16,000 ($3.34)	$50,817 ($10.60)
Rockaway Borough (6,660)	$139,484 ($20.94)	$7,345 ($1.10)	$247,653 ($37.19)	$273,152 ($41.01)	$19,548 ($2.94)	$38,785 ($5.82)	$27,818 ($4.18)	$81,202 ($12.19)	$51,580 ($7.74)	$886,568 ($133.12)	0 0	$22,168 ($ 3.33)
Victory Gardens[2] Borough (1213)	$50,445 ($41.59)	$11,300 ($9.32)	$35,300 ($29.10)	$22,200 ($18.30)	$700 ($0.58)	$2,000 ($1.65)	0 0	$4,000 ($3.30)	0 0	$125,995 ($103.82)	$3,400 ($2.80)	0 0
Wharton Borough (5,720)	$164,541 ($28.77)	$6,735 ($1.18)	$287,732 ($50.30)	$235,247 ($41.13)	$18,294 ($3.20)	$83,328 ($14.57)	$23,827 ($4.17)	$68,577 ($11.99)	0 0	$888,287 ($155.29)	$15,000 ($2.62)	$89,771 ($15.69)
Boonton Township (3,245)	$89,790 ($27.67)	$6,615 ($2.04)	$136,729 ($42.14)	$103,510 ($31.90)	$5,675 ($1.75)	$10,200 ($3.14)	0 0	$16,341 ($5.04)	0 0	$369,560 ($113.86)	$25,000 ($7.70)	$12,760 ($3.93)
Denville Township (14,560)	$486,227 ($33.39)	$43,724 ($3.00)	$808,189 ($55.51)	$354,789 ($24.37)	$86,696 ($5.95)	$73,020 ($5.02)	$116,245 ($7.98)	$198,326 ($13.62)	$17,894 ($1.23)	$2,185,110 ($150.01)	0 0	$98,914 ($6.79)
Jefferson Township (15,580)	$496,022 ($31.84)	$26,330 ($1.69)	$711,398 ($45.66)	$947,542 ($60.81)	$122,748 ($7.88)	$60,150 ($3.86)	$13,600 ($0.87	$150,811 ($9.68)	$108,400 ($6.96)	$2,637,002 ($169.26)	$10,700 ($0.69	$84,620 ($5.43)
Mine Hill Township (3,690)	$54,172 ($14.68)	$8,293 ($2.25)	$145,920 ($39.54)	$117,452 ($31.82)	$14,042 ($3.81)	$5,336 ($1.47)	0 0	$32,118 ($8.70)	$10,450 ($2.83)	$462,993 ($125.47)	$20,000 ($5.42)	$3,300 ($0.89)
Montville Township (12,850)	$352,701 ($27.45)	$16,065 ($1.25)	$692,863 ($53.91)	$703,144 ($54.72)	$45,282 ($3.52)	$45,450 ($3.54)	$41,150 ($3.20)	$126,200 ($9.82)	$74,605 ($5.76)	$2,096,862 ($163.18)	0 0	$64,400 ($5.01
Parsippany-Troy Hills Twp. (57,910)	952,512. ($16.45)	$47,093 ($0.81)	$2,128,514 ($36.76)	2,045,075 ($35.31)	$214,660 ($3.71)	$399,048 ($6.89)	$329,475 ($5.69)	$333,321 ($5.76)	$186,396 ($3.22)	$6,636,097 ($114.59)	$12,500 ($0.22)	$20,167 ($0.35)
Randolph Township (15,030)	$577,486 ($38.42)	$33,730 ($2.24)	$758,674 ($50.48)	$734,451 ($48.87)	$107,124 ($7.13)	$136,459 ($9.08)	$66,379 ($4.42)	$204,099 ($13.58)	$48,179 ($3.21)	$2,666,581 ($177.42)	$30,000 ($2.00)	$352,213 ($23.43)
Rockaway Township (20,010)	$599,766 ($29.97)	$32,109 ($1.60)	$859,050 ($42,93)	$813,690 ($40.67)	$71,348 ($3.57)	$108,323 ($5.41)	$81,500 ($4.07)	$230,052 ($11.50)	$105,000 ($5.25)	$2,900,838 ($144.97)	$29,000 ($1.45)	$269,544 ($13.47)
Roxbury Township (17,340)	$574,215 ($ 33.12)	$47,115 ($ 2.72	$574,141 ($ 33.10)	$799,990 ($46.14)	$105,452 ($6.08)	$134,222 ($7.74)	$105,452 ($6.06)	$162,005 ($9.34)	$6,150 ($0.35)	$2,508,304 ($144.65)	0 0	$104,821 ($ 6.22)
Total State in Thousands (7,431,750)	$242,340 ($32.61)	$15,370 ($2.07)	$514,225 ($69.19)	$343,282 ($46.19)	$60,661 ($8.18)	$64,117 ($ 8.63)	$44,111 ($5.94)	$144,535 ($19.45)	$96,526 ($12.99)	$1,525,187 ($205.23)	$16,936 ($2.28)	$146,977 ($19.78)

Notes: 1. N.J. Department of Community Affairs, 1977.
2. Figures for Victory Gardens are based on 1978 municipal budget and 1975 population estimate.
3. Total Expenditure - Per capita expenditure appears in parenthesis immediately below.

Source: N.J. Dept. of Community Affairs, Division of Local Government Services, 1977.

Table A-5

Sewer Charges by Municipality

Boonton Town [a]

Residential - $15/year /dwelling unit
Commerical - $20/year /establishment

Victory Gardens Borough [b]

Residential - $15/year /dwelling unit
Commercial - $125/year / establishment

Wharton Borough [c]

Residential - charges based on number of dwelling units:

Number of units	Annual charge
1	$62.12/year
2	$124.20/year
3	$186.28/year
4 or more	$372.60/year

Commercial - charges based on number of employees

Number of employees	Annual charge
less than 5	$62.12/year
5 to 10	$80.68/year
more than 10	$\frac{\text{number of employees}}{4} \times \$62.12$

Boonton Township [d]

Residential - $40/year /dwelling unit
Commercial - charges based on water use:

Water used (gal.)	Annual charge /establishment
0 - 60,000	34¢/1,000 gal.
60,000 - 168,000	32¢/1,000 gal.
168,000 - 276,000	30¢/1,000 gal.
over 276,000	28¢/1,000 gal.

Sources:
a. Hopkins, Boonton Town, August 3, 1979.
b. Garyton, Victory Gardens, August 6, 1979.
c. Trimmer, Wharton Borough, August 6, 1979.
d. Rusnack, Boonton Township, August 6, 1979.

Table A-5 (continued)

Sewer Charges by Municipality

Denville Township [e]

Residential - $67/year/ dwelling unit
Commercial - Variable user charge based on size of water meter

Randolph Township [f]

Residential - charges based on housing type

Housing Type	Annual charge
Single family	$140/year
One bedroon apartment	$70/year
Two or more bedroom apartment	$90/year

Commercial - $125/year for the first 20,000 gal.
plus 75¢ for each additional 1000 gal.

Rockaway Township [g]

Residential - $27/year/dwelling unit
Commercial - $25/year/ establishment

Sources:
e. Hardy, Denville Township, August 6, 1979.
f. Nelson, Randolph Township, August 7, 1979.
g. McCudden, Rockaway Township, August 3, 1979.
h. Thiel, Roxbury Township, August 6, 1979.

Table A-6

Tax Rates

Municipality	Tax Rates ($Per $100 assessed value)		
	Property (including tax)	School	Market Value (percent)
Boonton Town	4.99[a]	2.01	NA
Dover Town	6.49[b]	1.94	45.0
Kinnelon Borough	4.20[c]	2.22	100.0
Mountain Lakes Borough	7.52[d]	3.00	50.0
Rockaway Borough	3.24[e]	1.19	100.0
Victory Gardens Borough	3.83[f]	2.15	100.0
Wharton Borough	5.42[g]	1.43	50.0
Boonton Township	4.76[h]	1.52	37.0
Denville Township	5.00[i]	1.10	51.0
Jefferson Township	3.60[j]	2.11	73.0
Mine Hill Township	2.71[k]	2.18	100.0
Montville Township	4.50[l]	2.08	52.5
Parsippany-Troy Hills	4.57[m]	2.12	53.6
Randolph Township	4.10[n]	2.62	50.0
Rockaway Township	5.57[o]	1.51	55.0
Roxbury Township	3.71[p]	2.07	100.0

Note: NA = Not Available

Sources:
a. Morris County Board of Taxation, 1979.
b. Di Yanni, Dover Town Tax Assessor's Office, August 20, 1979.
c. Femmenelli, Kinnelon Borough Tax Assessor's Office, August 20, 1979.
d. Jones, Mountain Lakes Borough Tax Assessor's Office, August 20, 1979.
e. McCarthy, Rockaway Borough Tax Assessor's Office, August 20, 1979.
f. Di Yanni, Victory Gardens Borough Tax Assessor's Office, August 20, 1979.
g. Kennedy, Wharton Borough Tax Assessor's Office, August 20, 1979.
h. Cross, Boonton Township Tax Assessor's Office, August 20, 1979.
i. Dyksen, Denville Township Tax Assessor's Office, August 20, 1979.
j. Mitchko, Jefferson Township Tax Assessor's Office, August 20, 1979.
k. Gaynor, Mine Hill Township Tax Assessor's Office, August 20, 1979.
l. Schneider, Montville Township Tax Assessor's Office, August 20, 1979.
m. Plechata, Parsippany-Troy Hills Twp. Tax Assessor's Office, Aug. 20, 1979.
n. Staley, Randolph Township Tax Assessor's Office, August 20, 1979.
o. Baumwell, Rockaway Township Tax Assessor's Office, August 20, 1979.
p. Perugini, Roxbury Township Tax Assessor's Office, August 20, 1979.

Table 4-7

Legal History of Rockaway Valley Regional Sewerage Authority

Date of Court Order	Provision
April 27, 1967	- required of Jersey City to prepare an engineering report on the sewage treatment plant at Boonton. - required construction of alterations to improve the sewage treatment plant to allow for treatment in accordance with state standards.
August 8, 1968	- prohibited the issuance of building or plumbing permits for any new building which would require connection to the sewage treatment facility. Allowed for limiting gallonage allocations to the municipalities, but required a court order to permit connections. - required infiltration/inflow studies on branch sewers and main interceptors.
May 16, 1970	- required the appointment of the state as a receiver to provide proper operation and maintenance of the plant and gave the state representative the power to engage all services and firms as required to restore the sewage treatment plant to proper and effective operation. - Jersey City was relieved of the long outstanding contracts to provide free sewage treatment. - The RVRSA was formed and assumed the ownership and operation of the wastewater treatment plant and interceptor system. - RVRSA assumed any responsibility that Jersey City may have had under the Order of April 27, 1967.

Source: Maraziti and Maraziti, July 6, 1975

Table A-8

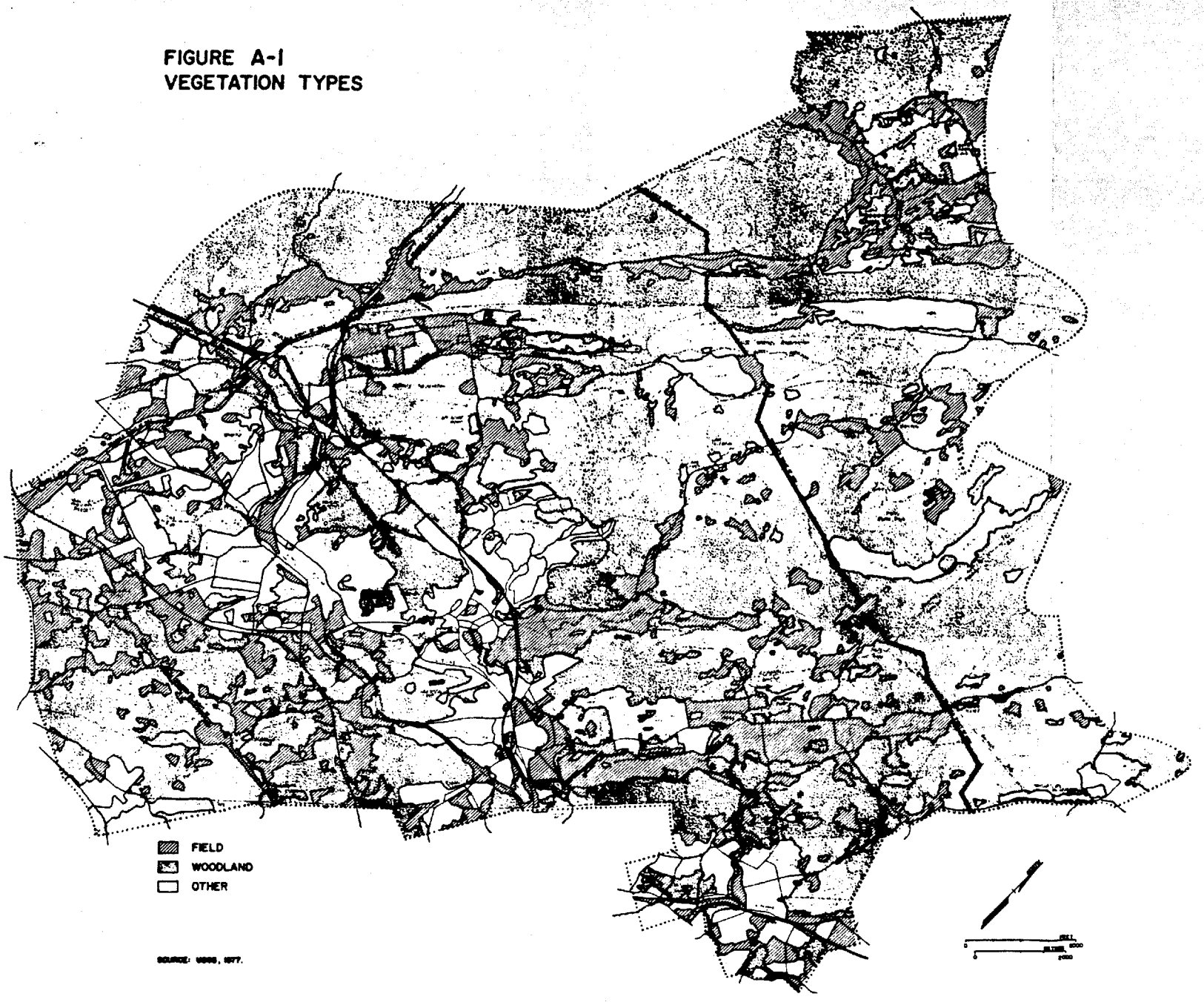
Pertinent Wastewater Treatment Data
Rockaway Valley Facility Planning Area

Time Period		Average Daily Effluent				
		BOD		Suspended Solids		Flow cu m/d (mgd)
		mg/l	Percent Removal	mg/l	Percent Removal	
May 1, 1978 - July 31, 1978		12.56	86.35	7.92	91.34	30,700 (8.10)
Aug. 1, 1978 - Oct. 31, 1978		12.9	87.0	7.45	94.0	28,400 (7.49)
Nov. 1, 1978 -Jan. 31, 1979		11.3	90.9	7.91	93.1	32,200 (8.50)
Feb.1, 1979 - April 31, 1979		13.22	85	13.83	86.0	38,300 (10.12)
Annual Average*		12.50	87.3	9.28	91.1	32,400 (8.55)
NPDES Permit Limitations	Minimum	None	85.0	None	90.0	None
	Average	20	None	9.0	None	34,100 (9.0)
	Maximum	30	None	14.0	None	None

Note: * 35,967 cu m (47,040 cubic yards) of dried sludge were produced in 1978.

Source: EPA, 1978, 1979

FIGURE A-1
VEGETATION TYPES



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
HARRISBURG AREA OFFICE
100 Chestnut Street, Room 310
Harrisburg, Pennsylvania 17101

NOV 19 1980

Mr. Stephen Y. Arella, Chief
New Jersey/Puerto Rico Section
Environmental Impacts Branch
U.S. Environmental Protection Agency
26 Federal Plaza
New York, New York 10278

Dear Mr. Arella:

This responds to your letter of September 3, 1980, to Regional Director Larsen requesting information on the presence of endangered species within the Rockaway Valley Regional Sewerage Authority 201 Facility Plan area, Morris County, New Jersey.

The small whorled pogonia is being proposed as an endangered species but its known distribution in New Jersey does not include Morris County (copy of notice from September 11, 1980, Federal Register enclosed). Neither the endangered bald eagle, peregrine falcon, nor Indiana bat is known to occur in the project area described in Figure 2-3, Proposed Service Areas (Draft) that accompanied your letter.

Except for occasional transient species, no federally listed or proposed species under our jurisdiction are known to exist in the project impact area. Therefore, no Biological Assessment of further Section 7 consultation is required with the Fish and Wildlife Service (FWS). Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered.

The authority for responding to requests for species lists and initial Section 7 consultation has been delegated to Area Managers of the FWS. In the future, please address such requests for the States of New Jersey, Pennsylvania and New York to this office.

This response relates only to endangered species under our jurisdiction. It does not address other FWS concerns under the Fish and Wildlife Coordination Act or other legislation.

A compilation of federally listed endangered and threatened species in New Jersey is enclosed for your information.

Sincerely yours,

Norman R. Chupp
Area Manager

Enclosures

FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES IN NEW JERSEY

Common Name	Scientific Name	Status	Distribution
FISHES:			
Sturgeon, shortnose*	Acipenser brevirostrum	E	Hudson and Delaware Rivers plus other Atlantic coastal rivers
REPTILES:			
Turtle, green*	Chelonia mydas	T	Oceanic summer visitor coastal waters
Turtle, hawksbill*	Eretmochelys imbricata	E	Oceanic summer visitor coastal waters
Turtle, leatherback*	Dermochelys coriacea	E	Oceanic summer resident coastal waters
Turtle, loggerhead*	Caretta caretta	T	Oceanic summer resident coastal waters rarely nests: Cape May and Atlantic Counties
Turtle, Atlantic Ridley*	Lepidochelys kempii	E	Oceanic summer resident coastal waters
BIRDS:			
Eagle, bald	Haliaeetus leucocephalus	E	Entire state
Falcon, American peregrine	Falco peregrinus anatum	E	Entire state - re-establishment to former breeding range in progress
Falcon, Arctic peregrine	Falco peregrinus tundrius	E	Entire state migratory - no nesting
MAMMALS:			
Cougar, eastern	Felis concolor cougar	E	Entire state - probably extinct
Whale, blue*	Balaenoptera musculus	E	Oceanic
Whale, finback*	Balaenoptera physalus	E	Oceanic
Whale, humpback*	Megaptera novaeangliae	E	Oceanic
Whale, right*	Eubalaena spp. (all species)	E	Oceanic
Whale, sei*	Balaenoptera borealis	E	Oceanic
Whale, sperm*	Physeter catodon	E	Oceanic
MOLLUSKS:			
None			
PLANTS:			
None			

*Except for sea turtle nesting habitat, principal responsibility for these species is vested with the National Marine Fisheries Service.

Region 5 7/18/79

City	Channel No. Present	Proposed
[illegible], Washington	235, 274, 292A	235, 274, 293

9. Authority to instituted rule making proceedings, showings required, cut-off procedures, and filing requirements are contained in the attached Appendix and are incorporated by reference herein. NOTE: A showing of continuing interest is required by paragraph 2 of the Appendix before a channel will be assigned.

10. Interested parties may file comments on or before October 24, 1980, and reply comments on or before November 13, 1980.

11. For further information concerning this proceeding, contact Myra G. Kovey, Broadcast Bureau, (202) 632-7792. However, members of the public should note that from the time a Notice of Proposed Rule Making is issued until it is no longer subject to Commission consideration or court review, all *ex parte* contacts are prohibited in Commission proceedings, such as this one, which involve channel assignments. An *ex parte* contact is a message (spoken or written) concerning the merits of a pending rule making other than comments officially filed at the Commission or oral presentation required by the Commission.

Federal Communications Commission.

Henry L. Baumann,

Chief, Policy and Rules Division, Broadcast Bureau.

Appendix

1. Pursuant to authority found in Sections 4(i), 5(d)(1), 303 (g) and (r), and 307(b) of the Communications Act of 1934, as amended, and Section 0.281(b)(6) of the Commission's Rules, IT IS PROPOSED TO AMEND the FM Table of Assignments, Section 73.202(b) of the Commission's Rules and Regulations, as set forth in the *Notice of Proposed Rule Making* to which this Appendix is attached.

2. *Showings required.* Comments are invited on the proposal(s) discussed in the Notice of Proposed Rule Making to which this Appendix is attached. Proponent(s) will be expected to answer whatever questions are presented in initial comments. The proponents of a proposed assignment is also expected to file comments even if it only resubmits or incorporates by reference its former pleadings. It should also restate its present intention to apply for the channel if it is assigned, and, if authorized, to build the station promptly. Failure to file may lead to denial of the request.

3. *Cut-off procedures.* The following procedures will govern the consideration of filings in this proceeding.

(a) Counterproposals advanced in this proceeding itself will be considered, if advanced in initial comments, so that parties may comment on them in reply comments. They will not be considered if advanced in reply comments. (See § 1.420(d) of Commission Rules.)

(b) With respect to petitions for rule making which conflict with the proposal(s) in this Notice, they will be considered as comments on the proceeding, and Public Notice to this effect will be given as long as they are filed before the date for filing initial comments herein. If they are filed later than that, they will not be considered in connection with the decision in this docket.

4. *Comments and reply comments; service.* Pursuant to applicable procedures set out in Sections 1.415 and 1.420 of the Commission's Rules and Regulations, interested parties may file comments and reply comments on or before the dates set forth in the *Notice of Proposed Rule Making* to which this Appendix is attached. All submissions by parties to this proceeding or persons acting on behalf of such parties must be made in written comments, reply comments, or other appropriate pleadings. Comments shall be served on the petitioner by the person filing the comments. Reply comments shall be served on the person(s) who filed comments to which the reply is directed. Such comments and reply comments shall be accompanied by a certificate of service. (See § 1.420(a), (b) and (c) of the Commission Rules.)

5. *Number of copies.* In accordance with the provisions of Section 1.420 of the Commission's Rules and Regulations, an orginal and four copies of all comments, reply comments, pleadings, briefs, or other documents shall be furnished the Commission.

6. *Public inspection of filings.* All filings made in this proceeding will be available for examination by interested parties during regular business hours in the Commission's Public Reference Room at its headquarters, 1919 M Street, N.W., Washington, D.C.

[FR Doc. 80-26502 Filed 9-10-80; 8:45 am]

BILLING CODE 6712-01-M

INTERSTATE COMMERCE COMMISSION

49 CFR Part 1080

[Ex Parte No. 364 (Sub-1)]

Freight Forwarder Contract Rates—Implementation of Pub. L. 96-296

AGENCY: Interstate Commerce Commissioner.

ACTION: Extension of time to notice of proposed rulemaking.

SUMMARY: The Commission proposed, by notice at 45 FR 53190, August 11, 1980, to modify existing rules to allow the filing of contract rates between freight forwarders and rail and water carriers. The notice of proposed rulemaking set September 10, 1980 as the due date for comments. A 30-day extension has been requested on behalf of various ocean carriers and ocean ratemaking conferences. While the changes accomplished in Pub. L. 96-296 are straightforward, there appear to be some complications regarding the impact and implementation of this statutory change, notably, with respect to water carriers subject to the Shipping Act of 1916. We will grant the 30-day extension. In view of the 180-day time limit, no further extensions will be authorized.

DATES: The comment period is extended until October 10, 1980.

ADDRESS: Send comments to: Office of Proceedings, Room 5356, Interstate Commerce Commission, Washington, D.C. 20423.

FOR FURTHER INFORMATION CONTACT: Richard B. Felder, (202) 275-7693, or Jane Mackall, (202) 275-7656.

(49 U.S.C. 10321, 10703(a)(4)(E), 10749, and 10766(b), 5 U.S.C. 553)

Decided: August 26, 1980.

By the Commission, Darius W. Gaskins, Jr., Chairman.

Agatha L. Mergenovich,

Secretary.

[FR Doc. 80-27866 Filed 9-10-80; 8:45 am]

BILLING CODE 7035-01-M

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

Endangered and Threatened Wildlife and Plants; Proposal To Determine "Isotria medeoloides" (Small Whorled Pogonia) to be an Endangered Species

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposal.

SUMMARY: The U.S. Fish and Wildlife Service proposes to determine a plant, *Isotria medeoloides* (small whorled pogonia), to be an Endangered species under the authority contained in the Endangered Species Act of 1973. Historically, this plant has been known to occur in 49 counties in 17 eastern States and Canada. In 1979, it was known to occur in 12 counties in 11 different States and one county in Ontario, Canada. The continued existence of this species is endangered by taking of the plants and the loss of habitat. A determination of *Isotria medeoloides* to be an Endangered species would implement the protection provided by the Endangered Species Act of 1973 as amended.

DATES: Comments from the public must be received by November 10, 1980. Comments from the Governors of affected States must be received by December 10, 1980.

FOR FURTHER INFORMATION CONTACT: Mr. Richard Dyer, U.S. Fish and Wildlife Service, Department of the Interior, One Gateway Center, Suite 700, Newton Corner, MA 02158.

ADDRESSES: Comments and materials concerning this proposal, preferably in triplicate, should be sent to the Regional Director, U.S. Fish and Wildlife Service, One Gateway Center, Suite 700, Newton Corner, MA 02158. Comments and materials received will be available for public inspection during normal business hours at the Service's Office of Endangered Species at the above address.

SUPPLEMENTARY INFORMATION: *Isotria medeoloides* (small whorled pogonia) is often referred to as the rarest orchid in America. There are only 16 known populations in the eastern United States and Canada. Approximately 150–175 individual plants occur at these 16 sites. The plant can be found in a variety of forest types but is most often associated with relatively open areas in deciduous hardwoods; either beech-birch-maple or oak-hickory. The spectrum of habitats includes dry, rocky, wooded slopes to moist streambanks.

One or two yellowish-green flowers appear from mid-May in the south to mid-June in the north above a whorl of 5 or 6 light green, elliptic, somewhat pointed leaves. The sepals are up to 2.5 cm long and help distinguish this species from the other member of the genus, *Isotria verticillata*. At maturity the plants are 9.5—25 cm tall.

The continued existence of this plant is being threatened by the inadvertent loss of populations to habitat alteration, such as golf courses, housing complexes etc., and taking by collectors for other than commercial purposes. Today there are nearly as many, if not more, dried specimens of *Isotria medeoloides* in herbaria than are known to exist in the wild. This rule proposes to determine *Isotria medeoloides* to be Endangered, and implements the protection provided by the Endangered Species Act of 1973. Critical Habitat is not being proposed. The following paragraphs further discuss the sections to date involving this plant, the threats to the plant, and effects of the proposed action.

The United States placed this species on a provisional list in the Annex to the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere (CNPWP) during a conference held in Mar del Plata, Argentina, 18–22 October, 1965. Sections 2 and 8 of the Endangered Species Act of 1973 as amended, provide the U.S. implementing legislation of this Convention. The President, by Executive Order 11911 (41 FR 15583–15684), designated the Secretary of the Interior to act on behalf of and to represent the U.S. in all regards as required by the CNPWP, and required that he consult with other departments and agencies as required.

This species was placed on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) at the original plenipotentiary conference in Washington, D.C. in February and March, 1973.

Background

Section 12 of the Endangered Species Act of 1973 directed the Secretary of the Smithsonian Institution to prepare a report on those plants considered to be endangered, threatened, or extinct. This report, designated as House Document No. 94–51, was presented to Congress on January 9, 1975. On July 1, 1975, the Director published a notice in the Federal Register (40 FR 27823–27924) of his acceptance of the report of the Smithsonian Institution as a petition within the context of Section 4(c)(2) of the Act, and of his intention thereby to review the status of the plant taxa named within. On June 16, 1976, the Service published a proposed rule in the Federal Register (41 FR 24523–24572) to determine approximately 1,700 vascular plant species to be Endangered species pursuant to Section 4 of the Act. This list of 1,700 plant taxa was assembled on the basis of comments and data received by the Smithsonian Institution and the Service in response to House Document No. 94–51 and the July 1, 1975, Federal Register publication. *Isotria medeoloides* was included in the July 1, 1975, notice of review and the June 16, 1976, proposal.

Following the June 16, 1976, proposal, hundreds of comments were received from individuals, conservation organizations, botanical groups, business and professional organizations. Few of these comments were specific in nature in that they did not address individual plant species. Most comments addressed the program or the concept of endangered plants and their protection and regulation. These comments are summarized in the April 26, 1978, Federal Register publication of a final rule which also determined 13 plant species to be Endangered or Threatened species (43 FR 17909–17916). Additional comments which are received during the comment period for this proposal will be summarized in the final rule.

In the June 24, 1977 Federal Register (42 FR 32373–32381), the Service published a final rule detailing the regulations to protect Endangered and Threatened plant species. The rule established prohibitions and a permit procedure to grant exceptions, under certain circumstances, to the prohibitions.

The Endangered Species Act Amendments of 1978 require that all proposals over two years old be withdrawn. A one year grace period was given to proposals already over two years old. On December 10, 1979, the Service published a notice withdrawing the June 16, 1976, proposal along with four other proposals which had expired. The Service now has sufficient new information to warrant reproposing *Isotria medeoloides*.

Critical Habitat is not being proposed for *Isotria medeoloides* primarily because of the history of taking of this species and the lack of taking prohibitions in the Act. Bringing further general public attention to existing populations via Critical Habitat designation would in itself be a threat to the plant.

The Department has determined that this is not a significant rule and does not require the preparation of a regulatory analysis under Executive Order 12044 and 43 CFR 14.

Summary of Factors Affecting the Species

Section 4(a) of the Endangered Species Act (16 U.S.C. 1531 *et seq.*) states that the Secretary of Interior shall determine whether any species is an Endangered species or a Threatened species due to one or more of the five factors described in Section 4(a) of the Act. These factors and their application to *Isotria medeoloides* (small whorled pogonia) are as follows:

Isotria medeoloides

(1) *Present or threatened destruction, modification or curtailment of its habitat or range. Isotria medeoloides* has historically been known to occur in 49 counties in 17 eastern States and Canada. Today it is known to exist in 12 counties in 11 different States and one county in Ontario, Canada as noted in Table 1.

Table 1.—*Distribution of Isotria Medeoloides (Small Whorled Pogonia)*

State	County	Town
Connecticut	Hartford	Middletown.
	Litchfield	Brookfield.
	New Haven	New Haven.
	New London	Stratford.
	New London	Ledyard.
	New London	Lyme.
	New London	Waterford.
	Windham	Pomfret.
Georgia	Rabun[1]	Chattahoochee National Forest.
	Habersham	Chattahoochee National Forest.
Illinois	Randolph[1]	
Massachusetts	Hampshire	East Hadley.
Michigan	Berrien[1]	Hebert.
Missouri	Bollinger	Glen Allen.
New Hampshire	Belknap	Alton.
	Belknap	Meredith.
	Strafford	Madbury.
	Strafford	Milton.
	Strafford	Barrington.
	Merrimack[1]	Epsom.
	Grafton	Squam Lake.
	Carroll	Brookfield.
	Carroll[1]	Madison.
New Jersey	Bergen	Franklin Lakes.
	Bergen	Closter.
	Mercer	Trenton.
	Sussex[1]	Montague.
	Sussex	Sparta.
New York	Nassau	Hampstead.
	Onondaga	Manlius.
	Rockland	Tappantown.
	Suffolk	Wyandanch.
	Ulster	Olive.
	Washington	Fort Edward.
Maine	Kennebec[1]	Kent's Hill.
	Cumberland	North Sebago.
	Oxford	Norway.
Maryland	Montgomery	North Chevy Chase.
	Montgomery	Bethesda.
North Carolina	Macon[1]	Nantahala National Forest.
	Harnett	Unknown.
	Henderson	Hendersonville.
	Surry	Mount Airy.
Pennsylvania	Centre[1]	Port Matilda.
	Green	Rogersville.
	Montgomery	Willow Grove.
	Berks	Reading.
	Philadelphia	Philadelphia.
	Chester	West chester.
	Monroe	East Stroudsburg.
Rhode Island	Providence[1]	Glocester.
	Kent	West Greenwich.
South Carolina	Oconee[1]	Sumter National Forest.
Vermont	Chittenden	Burlington.
Virginia	Buckingham	Unknown.
	Gloucester[1]	White Marsh.
	James City	Williamsburg.
	New Kent	Unknown.
Canada	Elgin[1]	Mount Salem.

[1] Extant populations in 1979/1980.

A short assessment of the species status in Canada and by state is as follows:

Connecticut: Historically, *Isotria medeoloides* has been collected from eight towns in the State (Mehrhoff, 1978). There is only one plant now known to exist and that is on private land in the town of Mystic. This plant has not flowered in recent years and was transplanted from the wild. Thus it is not listed in Table 1. Although the vitality of this plant is questionable it is the only known "successful" transplantation.

Georgia: Previous to this rule there has never been a record of occurrence for *Isotria medeoloides* in Georgia. Three populations are now known to have occurred although only one population of five plants was extant in 1979. This population formerly consisted of 15–22 plants when first discovered in the late 1960's. All three sites are on the Chatahoochee National Forest, however, one of the three sites was recently eradicated by road expansion.

Illinois: The Randolph County population is the only known station in the State. In 1979 there was one plant found at this site. A report of a Pope County population is erroneous.

Maine: The North Sebago population formerly consisted of six or seven plants when first discovered in 1954. One plant was seen in 1976 and none have appeared since. The site is on privately owned land and has not been disturbed (Eastman, 1978). The Norway population has not been relocated nor is it now known to exist. In 1923 approximately 35 plants were counted at the Norway site in a partly open woodland of beech and red maple (Eames, 1926). The largest known population occurs in Kent's Hill, Kennebec County. An estimated 50–75 plants were discovered at this site in 1980.

Maryland: This species has not been collected in Maryland since 1930. The former localities in North Chevy Chase and Bethesda have been absorbed by the expanding suburban sprawl of Washington, D.C. *Isotria medeoloides* is believed to be extirpated in the State (Broome, et al., 1979).

Massachusetts: There is one old record of occurrence for this plant in East Hadley, MA. It has not been recorded in the State since 1899 and efforts to find individuals knowledgeable of its existence in Massachusetts have been unsuccessful (Coddington and Field, 1978).

Michigan: Isotria medeoloides is protected under State law as an endangered species. The Berrien County site consisted of two plants in 1979. Twelve plants were known to occur in 1959 and seven plants in 1970 (Case and Schwab, 1971). The area is being slowly developed, further endangering the only known colony in Michigan.

Missouri: There is one old 1897 record for this species on a wooded limestone hill near Glen Allen. This population has not been rediscovered after several searches (Steyermark, 1963). There is some question about its original occurrence in the State.

New Hampshire: Historically, *Isotria medeoloides* has been collected from eight towns in central New Hampshire. There are two extant populations in the State, one in the town of Epsom that has been watched by local botanists for several years, the other, discovered in 1980, in the town of Madison. In 1979, 12 plants were extant at the Epsom site. Fourteen plants were noted at the Madison site, with three additional plants about one quarter of a mile away. Both areas are on private land, however, ownership of the land and the potential for development are unknown.

New Jersey: Approximately eight plants were observed in the town of Montague in 1979. The plants are on privately owned land and there is no known threat to the population. Other than this locality the most recent record for the State was near Franklin Lakes where approximately 30 plants were noted in 1935. None are now known to exist at this site. The other reported localities are of ancient vintage and no longer believed to exist.

New York: There are six historical records for the small whorled pogonia in the State. Most of the records are from the late 1800's thru the early 1900's with precise localities unknown. The Manlius population was originally discovered in 1961 when several plants were noted. In recent years only one plant has been seen at this site with the last appearance in 1976. There are no known extant populations (Mitchell, et al., 1980).

North Carolina: The second largest known population of 27 plants occurs on the Nantahala National Forest. The Forest Service is aware of the locality and has modified timber management practices within a small area to protect the plants. There is only a very slight economic impact resulting from protecting the area. The Forest Service has been most conscientious in carrying out their responsibilities under the Endangered Species Act. Field personnel and timber markers have been trained in identification and are aware of the need to protect the plants. No other populations are known to exist in the State.

Isotria medeoloides is listed as an endangered plant in North Carolina. The legislation protecting endangered plants in the State prohibits their removal from private property without the landowner's permission, and prohibits commerce in the species. In addition, when a State listed species occurs on

lands administered by the U.S. Forest Service, as is the case for *Isotria medeoloides* in North Carolina, the Forest Service will protect the species as though it were Federally listed.

Pennsylvania: There are six historical and one presently known locality of *Isotria medeoloides* in Pennsylvania. There are two extant populations in Port Matilda which were seen in 1979. One site contained three plants and the other contained two. The plants are on private land and logging operations have been voluntarily restricted at the specific sites. The other locality records for the plant are a minimum of 50 years old and the orchid's continued existence at these sites is doubtful (Wiegman, 1979).

Rhode Island: Twelve plants in Glocester, Rhode Island, were known to exist in 1979. This population has been monitored since 1947 and has shown a gradual decline of individual plants. The site is on privately owned land and adjacent lots have been cleared for houses. A national conservation organization is presently pursuing acquisition of this site. A second population in West Greenwich, Rhode Island has also been monitored since 1957 when 23 plants were noted. In 1961 there were 15 plants at this site, in 1973, four plants. In 1978 no plants were found and none have been seen since (Church and Champlin, 1978).

South Carolina: Three plants were seen in 1979, on the Sumter National Forest. Previous to the preparation of the proposed rulemaking the Forest Service was not aware of the plants at this site. Compliance with Forest Service policies as stated in the January 1980 Manual on Wildlife and Fish Management Amendment No. 136 should help insure the protection of this population. No other populations are known to exist in the State.

Vermont: The Burlington, Vermont locality was found in 1902. A golf course now occupies the site. The referenced habitat of "hemlock woods" appears to be an exception to the general rule of deciduous hardwoods. No other localities are known (Countryman, 1978).

Virginia: The Williamsburg, Virginia population appears to be one of the most well known sites of *Isotria medeoloides*. In 1921 the late E. J. Grimes described the area and noted 15 plants (Grimes, 1921). In 1979, only one plant was known to occur at what is believed to be the same area. The habitat for the species still exists but is being threatened by residential development. There are no other known extant populations in the State.

Canada: There is only one record of occurrence in Canada. Two populations of two plants each were found near Mount Salem in 1977 (Stewart, 1977). The status of this population has not chnged.

A summary of the species' status shows that approximately 150–175 plants at 16 different sites were known to exist in the eastern United States and Canada at the end of the 1979–1980 field seasons. Three of these sites are located on U.S. Forest Service land. The remainder are believed to be on privately owned land.

Many people feel that the disclosure of specific localities will further endanger the species' continued existence. Due to the documented history of taking for scientific purposes those fears are not unfounded. On the other hand, many former localities, some dating back to the late 1800's, have been inadvertently lost to habitat alteration. Based on herbaria label data and recent field checks of these sites, shopping malls, housing developments, and golf courses now mark the localities of historical populations. Any conservation program for the species must balance these two somewhat opposing factors.

Other reasons for the species' disappearance throughout its range are not so clear. Some populations such as the one in Glocester, Rhode Island, have been monitored for a period of years and there has been a gradual decline in the number of individual plants from 28 in 1947 to four in 1978. However, in 1979, 12 plants were seen. Other known populations have displayed similar characteristics. One popular source (Correll, 1950) states that the species may remain dormant for up to 20 years, however, this has not been substantiated from available scientific evidence.

Except for the three populations on Forest Service land, the remaining extant localities occur on private lands where specific ownership has not yet been determined. In certain instances, lands adjacent to these known localities are being cleared for house lots, further endangering the continued existence of the species.

(2) *Overutilization for commercial, sporting, scientific or educational purposes.* Collecting for scientific purposes has contributed to the loss of many plants. There are specimens of *Isotria medeoloides* in all major eastern institutional herbaria and many private collections. In several instances the available literature documents the removal of specimens for "the scientific record." Wildflower garden enthusiasts are known to have taken this species from the wild and attempted transplantation to a more convenient locality. The rarity of this orchid makes it the object of interest by professionals and amateurs alike.

(3) *Disease or predation* (including grazing). Not applicable to this species.

(4) *The inadequacy of existing regulatory mechanisms.* There is no provision in the Endangered Species Act which would offer the species protecton from collectors or private actions. Only the States of Michigan and North Carolina have officially listed *Isotria medeoloides* as an endangered plant. Michigan legislation provides prohibition against "taking" of the orchid. Also under Michigan Public Act No. 203, the Department of Natural Resources has been given responsibility for conducting "investigations on fish, plants, and wildlife in order to develop information relating to population, distribution, habitat needs, limiting factors and other biological and ecological data to determine management measures necessary for their continued ability to sustain themselves successfully." The key in this State program is the indentification and protection of habitats using available State laws and regulations.

The legislation protecting Endangered plants in North Carolina prohibits their removal from private property without the landowner's permission, and prevents commerce in the species. In addition, when a State listed species occurs on lands administered by the U.S. Forest Service, as is the case for *Isotria medeoloides* in North Carolina, the Forest Service will protect the species as though it were Federally listed.

The Forest Service's regulations prohibit removing, destroying, or damaging any plant that is classified as a threatened, endangered, rare, or unique species (42 FR 2956–2962). These regulations, however, may be difficult to enforce, and do not provide all of the protection and funding mechanisms furnished by the Endangered Species Act.

Official listing under the Endangered Species Act of 1973, as amended, will provide a means by which various conservation and recovery actions can be implemented to insure the continued existence of this plant throughout its range.

(5) *Other natural or man-made factors affecting its continued existence.* The species' biology is not well understood but there is evidence of continuing decline in several known populations. The limited number and size of existing populations are cause for concern as natural factors could lead to the extinction of the species.

Although populations lost by habitat alteration are obvious, the habitats of

some declining populations have not "significantly" changed over the period of observance. Many theories could be advanced in attempts to explain the species' apparent natural decline. What is apparent may be due to no one factor but a number of factors acting interdependently. Natural successional changes, microclimatic parameters and failure or success in reproductive mechanisms are but a few of the unknown aspects of the species' biology that need to be understood before the reasons for the decline can be understood and hopefully reversed.

Critical Habitat

Critical Habitat is not being proposed for *Isotria medeoloides*, due to the extreme rarity of this orchid, the documented history of taking, and the great interest in this species by many botanists and wildflower enthusiasts. It would not be prudent or in the best interest of the species to bring further attention to site specific areas via Critical Habitat designation.

Effects of This Proposal if Published as a Final Rule

In addition to the effects discussed above, the effects of this proposal if published as a final rule would include, but would not necessarily be limited to, those mentioned below.

The Act and implementing regulations published in the June 24, 1977 Federal Register set forth a series of general prohibitions and exceptions which apply to all Endangered plant species. The regulations referred to above, which pertain to Endangered plants, are found at § 17.61 of 50 CFR and are summarized below.

With respect to *Isotria medeoloides*, all prohibitions of section 9(a)(2) of the Act, as implemented by Section 17.61, would apply. These prohibitions, in part, would make it illegal for any person subject to the jurisdiction of the United States to import or export, transport in interstate or foreign commerce in the course of a commercial activity, or sell or offer for sale this species in interstate or foreign commerce. Certain exceptions could apply to agents of the Service and State conservation agencies. The Act and Section 17.62 of the regulation also provide for the issuance of permits to carry out otherwise prohibited activities involving Endangered species under certain circumstances.

Section 7(a) of the Act provides that each Federal agency shall confer with the Secretary on any agency action which is likely to jeopardize the continued existence of any species proposed to be listed under Section 4. Section 7(a) of the Act also requires Federal agencies to evaluate their actions with respect to any species which is listed as Endangered or Threatened. This protection would accrue to *Isotria medeoloides* if it is later determined to be Endangered as a result of this proposal.

Provisions for Interagency Cooperation which implement Section 7 of the Act are codified at 50 CFR Part 402. If published as a final rule this proposal would require Federal agencies to insure that activities they authorize, fund, or carry out, are not likely to jeopardize the continued existence of *Isotria medeoloides*. The Critical Habitat clause would not be applicable since Critical Habitat is not being officially designated.

Since populations of *Isotria medeoloides* are known to occur on U.S. Forest Service lands in North Carolina and South Carolina, the Forest Service would be required to carry out programs for the species' conservation, and to insure that its actions are not likely to jeopardize the species' continued existence. The Forest Service's regulations prohibit removing, destroying, or damaging any plant that is classified as a threatened, endangered, rare, or unique species (36 CFR 261.9(b)), and are consistent with the purposes of the Act. No other impact on Federal activities is foreseen.

National Environmental Policy Act

A draft environmental assessment has been prepared in conjunction with this proposal. It is on file at the Service's Regional Office, One Gateway Center, Suite 700, Newton Corner, MA 02158, and may be examined during regular business hours. A determination will be made at the time of final rulemaking as to whether this is a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102(2)(C) of the National Environmental Policy Act of 1969.

Public Comments Solicited

The Director intends that if a rule is finally adopted it will be as accurate and effective as possible in the conservation of any Endangered or Threatened species. Therefore, any comments or suggestions from the public, other concerned governmental agencies, the scientific community, industry, private interests, or any other interested party concerning any aspect of these proposed rules are hereby solicited. Comments particularly are sought concerning:

(1) Biological or other relevant data concerning any threat (or the lack thereof) to the species included in this proposal;

(2) Additional information concerning the range and distribution of this species;

(3) Current or planned activities in the subject areas.

If promulgated, the regulations on *Isotria medeoloides* will take into consideration the comments and any additional information received by the Director, and such communications may lead him to adopt final regulations that differ from this proposal.

This proposal is being published under the authority contained in the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*; 87 Stat. 884). The primary author of this proposed rule is Mr. Richard Dyer, U.S. Fish and Wildlife Service, Department of the Interior, One Gateway Center, Suite 700, Newton Corner, MA 02158 (617/829-9318).

Literature Cited

Broome, C. R., A. O. Tucker, J. L. Reveal and N. H. Dill. 1979. Rare and endangered vascular plant species in Maryland. U.S. Fish and Wildlife Service, Region 5, Newton Corner, MA.

Case, F. W., and W. Schwab. 1971. *Isotria medeoloides*, the small whorled pogonia in Michigan. The Michigan Botanist, volume 10, No. 1.

Church, G.L. and R. L. Champlin. 1978. Rare and endangered vascular plant species in Rhode Island. U.S. Fish and Wildlife Service, Region 5, Newton Corner, MA.

Coddington, J. and K. G. Field. 1978. Rare and endangered vascular plant species in Massachusetts. U.S. Fish and Wildlife Service, Region 5, Newton Corner, MA.

Correll, D. S. 1950. Native orchids of North America north of Mexico. Chronica Botanica Company, Waltham, MA.

Countryman, W. D. 1978. Rare and endangered vascular plant species in Vermont. U.S. Fish and Wildlife Service, Region 5, Newton Corner, MA.

Eames, E. G. 1926. *Pogonia affinis* in Maine. Rhodora 28: 31-34.

Eastman, L. M. 1978. Rare and endangered vascular plant species in Maine. U.S. Fish and Wildlife Service, Region 5, Newton Corner, MA.

Grimes, E. J. 1921. A new station for *Pogonia affinis*. Rhodora 28:31-34.

Mehrhoff, L. J. 1978. Rare and endangered vascular plant species in Connecticut. U.S. Fish and Wildlife Service, Region 5, Newton Corner, MA.

Mitchell, R. C., C. J. Sheviak and J. K. Dean. 1980. Rare and endangered vascular plant species in New York. U.S. Fish and Wildlife Service, Region 5, Newton Corner, MA.

Stewart, W. T. 1977. The smaller whorled pogonia, an orchid new to Canada. Ont. Field. Biol. 31:56-58.

Steyermark, J. A. 1963. Flore of Missouri. The Iowa State University Press, Ames, Iowa.

Wiegman, P. G. 1979. Rare and endangered vascular plant species in Pennsylvania.

U.S. Fish and Wildlife Service, Region 5, Newton Corner, MA.

Accordingly, it is hereby proposed to amend Part 17, Subchapter B of Chapter I, Title 50 of the Code of Federal Regulations, as set forth below:

1. It is proposed to amend § 17.12 by adding, in alphabetical order, the following to the list of plants:

§ 17.12 Endangered and threatened plants.

Species		Historic range	Status	When listed	Critical habitat	Special rule
Scientific name	Common name					
Orchidaceae. *Isotria medeoloides*	Orchid family: Small whorled pogonia	Canada and U.S.A. (CT, GA, IL, MA, MD, ME, MI, MO, NH, NJ, NY, NC, PA, RI, SC, VA, and VT)	E	———	NA	NA

Dated: September 3, 1980.

Lynn A. Greenwalt,

Director, Fish and Wildlife Service.

[FR Doc. 80-27257 Filed 9-10-80; 8:45 am]

BILLING CODE 4310-55-M

50 CFR Part 80

Federal Aid in Fish and Wildlife Restoration

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Correction, proposed revisions to regulations applicable to the Federal Aid in Wildlife Restoration Act and the Federal Aid in Fish Restoration Act.

SUMMARY: In FR 80-26250 appearing at page 57471 in the Federal Register of August 28, 1980, a portion of the proposed rules was inadvertently omitted. This notice publishes the omitted text.

DATES: The original date for receipt of comments is extended to October 31, 1980.

ADDRESSES: Any comments on the proposed requirements should be submitted to the Chief, Division of Federal Aid, U.S. Fish and Wildlife Service, Washington, D.C. 20240.

FOR FURTHER INFORMATION CONTACT: Charles K. Phenicie, Chief, Division of Federal Aid, U.S. Fish and Wildlife Service, Washington, D.C. 20240, telephone 703/235-1526.

SUPPLEMENTARY INFORMATION: On page 57471, the following should be added as § 80.1 (d) through (j):

§ 80.1 Definitions.

* * * * * * *

(d) *Secretary.* The Secretary of the Interior or his designated representative.

(e) *Director.* The Director of the U.S. Fish and Wildlife Service, or his designated representative. The Director serves as the Secretary's representative in matters relating to the administration and execution of the Federal Aid Acts.

(f) *Regional Director.* The Regional Director of the U.S. Fish and Wildlife Service, or his designated representative.

(g) *Federal Aid Manual.* The publication of the U.S. Fish and Wildlife Service which contains policies, standards and procedures required for participation in the benefits of the Acts.

(h) *Project.* A program of related undertakings necessary to fulfill a defined need which is consistent with the purposes of the Act.

(i) *Comprehensive fish and wildlife management plan.* A document describing the State's plan for meeting the long-range needs of the public for fish and wildlife resources, and the system for managing the plan.

(j) *Federal Aid Funds.* Funds provided under Federal Aid Acts.

Section 80.2 is added as follows:

§ 80.2 Eligibility.

Participation in the benefits of the Acts is limited to State fish and wildlife agencies as specified below:

(a) Federal Aid in Sport Fish Restoration—Each of the 50 States, the Commonwealth of Puerto Rico, Guam, the Virgin Islands, and American Samoa.

(b) Federal Aid in Wildlife Restoration—Each of the 50 States, the Commonwealth of Puerto Rico, Guam, and the Virgin Islands; except that the benefits afforded by Section 4(b) of the Act relating to hunter education projects are limited to the 50 States.

Dated: September 8, 1980.

M. J. Spear,

Acting Director, U.S. Fish and Wildlife Service.

[FR Doc. 80-27256 Filed 9-10-80; 8:45 am]

BILLING CODE 4310-55-M

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Parts 611 and 672

Groundfish of the Gulf of Alaska: Approval of Fishery Management Plan Amendment; Proposed Implementing Regulations

AGENCY: National Oceanic and Atmospheric Administration (NOAA)/ Commerce.

ACTION: Notice of approval of part of fishery management plan amendment; proposed rulemaking.

SUMMARY: Part of amendment number 8 to the Fishery Management Plan for the Groundfish Fishery of the Gulf of Alaska, submitted by the North Pacific Fishery Management Council (Council), is approved. The amendment submitted by the Council contains seven subparts, including the change of the management year to conform to the calendar year, and the elimination of any plan expiration date. Six subparts are approved. The seventh is still being reviewed by the Secretary of Commerce (Secretary). Regulations to implement the approved portions of the amendment are proposed for public comment.

DATE: Written comments are invited until October 20, 1980.

ADDRESS: Comments should be sent to: Denton R. Moore, Chief, Permits and Regulations Division, National Marine Fisheries Service, 3300 Whitehaven Street, NW., Washington, D.C. 20235, Telephone: (202) 634-7432.

FOR FURTHER INFORMATION CONTACT: Mr. Robert W. McVey, Director, Alaska Region, National Marine Fisheries

APPENDIX B

EARTH RESOURCES, GEOLOGY, AND HYDROLOGY

1. EARTH RESOURCES

1a. Physiography and Topography

The RVFPA, located within the Appalachian Highlands (one of eight major physiographic regions in the United States) is comprised of two of the Highlands' seven subdivisions, the New England and Piedmont provinces.

The New England Province (the New Jersey Highlands) occupies the western and central portions, approximately 95 percent, of the RVFPA. The rocks are mostly Precambrian to Cambrian granites and gneisses which are highly folded and faulted. A series of parallel northeast-southwest trending ridges traverse the western portion of the area.

The Piedmont province, located in the eastern five percent of the RVFPA, is separated from the New Jersey Highlands by a prominent border fault and consists of Triassic sandstones and shales deposited in intermontane basins formed during continental rifting.

During the Pleistocene time period, four main glacial advances overode the RVFPA. The Wisconsin ice advance deposited thick layers of sand, gravel, and clay in its drainage channels and a wide blanket of till over areas north of Wharton, Dover, and Denville. The till, thin on the steep mountain slopes and thick in the valleys, modified the pre-glacial topography. The Rockaway River Valley was a major meltwater channel, resulting in deposition of unconsolidated sands and gravels along the pre-glacial channel. The river course from Washington Pond to Boonton Reservoir is partially controlled by bedrock faults and joints.

In the northern half of the RVFPA the topography is characterized by ridges with flat tops and steep walled valleys. South of the Rockaway River, the terrain is similar to the northern section except that the valleys are deeper and narrower. Although near Dover the Rockaway River Valley is wide and flat, the river valley is generally narrow and level to gently sloping.

1b. Steep Slopes

Steep slopes, 15 percent and greater, are significant because construction in these areas may increase slope instability and

significantly accelerate erosion of surface soils. Steep slope areas are depicted in Figure 3-1.

1c. Floodplains

Flood prone wetlands and floodplains (Figure 3-2) represent locations where the probability of a 100-year flood occurring during any particular year is approximately one percent (a 100-year floodplain according to the U.S. Department of Housing and Urban Development (Mayard, FEMA, June 3, 1990)).

2. GEOLOGY

2a. Bedrock Geology

Two types of bedrock are in the RVFPA, the Precambrian cystalline rock, occupying the majority, and the sedimentary deposits. The sedimentary deposits are found along Green Pond Mountain (Paleozoic Age), and near Boonton Reservoir (Triassic Age). A fault zone that strikes southwest-northeast separates the Triassic rocks from the Precambrian ones.

The Precambrian rocks consist of crystalline gneiss and limestone. The gneiss usually occurs in tabular masses which strike northeast and dip steeply to the south. The limestone is found as small isolated masses within the gneissic complex. Numerous fractures intersect throughout this complex (Table B-1).

The Paleozoic aged rocks consist of conglomerate, sandstone, quartzite, shale, and limestone. They occur in a northeast-southwest trending belt traversing the northern part of the RVFPA.

Triassic rocks, known as the Newark Group, underlie the eastern tip of the RVFPA and consist of alternating soft sandstone and shales, separated by three extruded basalt flows.

2b. Surficial Geology

Unconsolidated deposits mantle the bedrock surface throughout the RVFPA. These deposits are as a rule of local distribution and consist of clay, silt, sand, gravel, and boulders.

The Wisconsin (last) glaciation left a prominent terminal moraine that extends irregularly east to west across the RVFPA. South of the

Table B-1

Geologic Formations/Aquifers of the Rockaway Valley Facility Planning Area

Period	Formation	Thickness m (ft)	Lithology	Aquifer/Aquifer Characteristics	Aquifer Thickness m (ft)	Hydrology	Assoc. Topography: Soil
Quaternary (0 - [1]mya)	Glacial Drift	0 to 54 (0 to 180)	Wisconsin deposits: sorted stream channel sands and gravels; lacustrine clays	Aquifer is stratified unconsolidated sand and gravel. Separating these layers are beds of silts and clays which cause local confined groundwater conditions recharged from direct precipitation on outcrop areas and/or adjacent bedrock	2-13 (8-43)	In bedrock valleys transmissibility: range - 2,540 [3] 190,000 gpd/ft; average - 97,000 gpd/ft. Storage coefficient is 3.9×10^{-4} Well yield; range-28-1,6000 gpm; average 544 gpm	Ancient bedrock valleys filled with Wisconsin glacial - fluvial sediments and glacial outwash. Nearly level to slightly undulating. Local occurrences of kames, eskers, kettles, etc.
			unsorted clays, sands and gravels deposited directly by glacial ice.	These deposits are not significant sources of water; they function more as partial confining beds. Also included are slowly permeable drift from Illinoian and Kansan glaciation - patchy outcrops	variable thickness	Low transmissibility	Low rounded hills, fine sand to clay loam soils.
					0-9 (0-30)	Low transmissibility	Low linear hills and valley bottoms.
Triassic (180-225 mya)	Brunswick Formation	1800-2400 (6,000 - 8,000)	Interbedded, soft red sandstone, shales conglomerates, and arkoses	Secondary porosity and permeability due to highly fractured and jointed zones; maximum yield is at 90-150m(300-500 ft) depth; overlying material affects well yields. Ground water is hard and iron rich	60-150 (200-500)	Well yields - 4 to 650 gpm, Specific capacity range from 0.03 to 33.3 gpm/ft of drawdown and average 4.6 gpm/ft	Wide rolling lowlands; sandy clay loam soil
Devonian (375 - 425 mya)	Cornwall Sh[4] Kanouse Sa[5]	300±(1000±) 65 (215)	Various consolidated sedimentary rock deposits including; dark thick bedded shale; coarse quartz conglomerate; soft red shale massive bluish grey limestone; and arkosic quartzite.	Shales have poor water bearing properties because of low permeability. Water bearing ability of the sandstones varies considerably dependent on the local extent of interconnecting fractures and degree of solution weathering Limestones have developed secondary porosity through solution enlargement of fractures. Wells tapping extensive solution channels are capable of large sustained yields. Recharge derived from direct precipitation on outcrops and percolation through overlying drift.	15-900 (50-3000)	In sandstone two wells yield 290 and 100 gpm; specific capacities range from 6.44 to 210 gpm/ft In limestone yields of 40-380 gpm have been reported; specific capacities range from 15.2 to 2.8 gpm/ft	Limestones and shales form valley bottoms and low rolling hills. Sandstone, conglomerate and quartzite form high steep sided ridges and hill slopes
Silurian (425 - 470 mya)	Decker Ln Longwood Sh Green Pond Cgl[6]	15 (50) 60± (200±) 450± (1,500±)					
Ordovician (470-525 mya)	Martinsburg Sh. Jacksonburg Ln[7]	900± (3000±) 40-45 (135-150)					
Cambrian (525-600 mya)	Kittatinny Ln Hardyston Qz[8]	760-900 (2500-3000) 1-60 (5-200)					
Precambrian (600-4700 mya)	Byram Losee and Pochuck Gneisses and Franklin Ln	Unknown	Gneisses of both sedimentary and igneous origin; crystalline limestone	Secondary permeability and porosity in rock fractures and in interstices of the upper weathered rock. Yields range widely-dependent on lateral extent and depth of fracturing; groundwater ranges from soft to moderately hard with some areas containing excessive iron concentrations (0.3 mg/l)	Unknown	Well yields-(Morris County) range- 4 to 400 gpm with 73% of well yields less than 100 gpm at 67m (223 ft) depth specific capacities range from 0.06 to 15.1 gpm /ft and averaged 1.8 gpm/ft	Appalachian Highland province - New Jersey Uplands; high ridges with plateau-like summits and steep slopes; thick rocky soils in areas not covered by glacial drift.

Notes: 1. mya = Million Years Ago
2. 1 GPD/ft = 12.418 LPD/m
3. 1 GPM = 3.785 LPm
4. Sh = Shale
5. Sa = Sandstone
6. Cgl = Conglomerate
7. Ln = Limestone
8. Qz = Quartzite

Source: Richard P. Brown Associates, 1974; Cornwell and Rooney. 1976; Harper, 1977; USEPA, 1977.

terminal moraine are patches of earlier glacial drift whose age cannot be determined accurately. This drift is generally thin but in some places attains a thickness of 9 m (30 ft).

Wisconsin glacial drift covering the northern two thirds of the RVFPA, and consisting of till, sand, gravel, and silt, and clay, falls into three general classes; terminal moraine, ground moraine, and stratified drift. The terminal moraine is the southern most extent of the Wisconsin Glaciation in this area. This moraine consists typically of till, sand, and gravel and is generally quite thick. The sand and gravel is poorly sorted and unstratified due to its deposition directly by glacial ice.

North of the terminal moraine is an area of ground moraine. These deposits are thin, averaging 2 to 4 m (5 to 12 ft) thick, and consist of an unsorted mixture of boulders, silt, and clay.

Wisconsin age stratified drift and clays comprise the sediments of the Rockaway River floodplain and also occur as low terraces along drainage channels north of the terminal moraine. These deposits make up only 18 percent of the surface area of the basin, with the balance being glacial material. Well logs along the river valley indicate that this material is highly variable in composition and thickness, as evidenced by cross sections shown on Figures B-1 and B-2. Overall the thickness of the Wisconsin stratified drift ranges from very shallow in the upland drainage channels to 46 m (150 ft) or more along the Rockaway River Valley.

Unconsolidated sediments of recent age are confined to areas adjacent to present day streams. These deposits consist of clay, silt, and fine sand with gravel.

2c. Soils

Soils in the RVFPA are both transported and residual. The transported soils, products of erosion, are found in the tills that drape the Highlands and the floodplains adjacent to streams. The residual soils are formed in place from material weathered from bedrock.

The soils of the region may be grouped into three general categories based on geologic parent material, drainage, and topography. These categories are: young glacial till soils (limited to the Highlands); organic deposits, glacial lake sediments, or glacial outwash soils (lowlands and drainage channels); and old glacial deposits, or material weathered from bedrock soils (Randolph and south Denville townships) (Table B-2).

Till soils from young glacial material are deep, well-drained to somewhat poorly drained, gently sloping to steep, gravelly, sandy, and

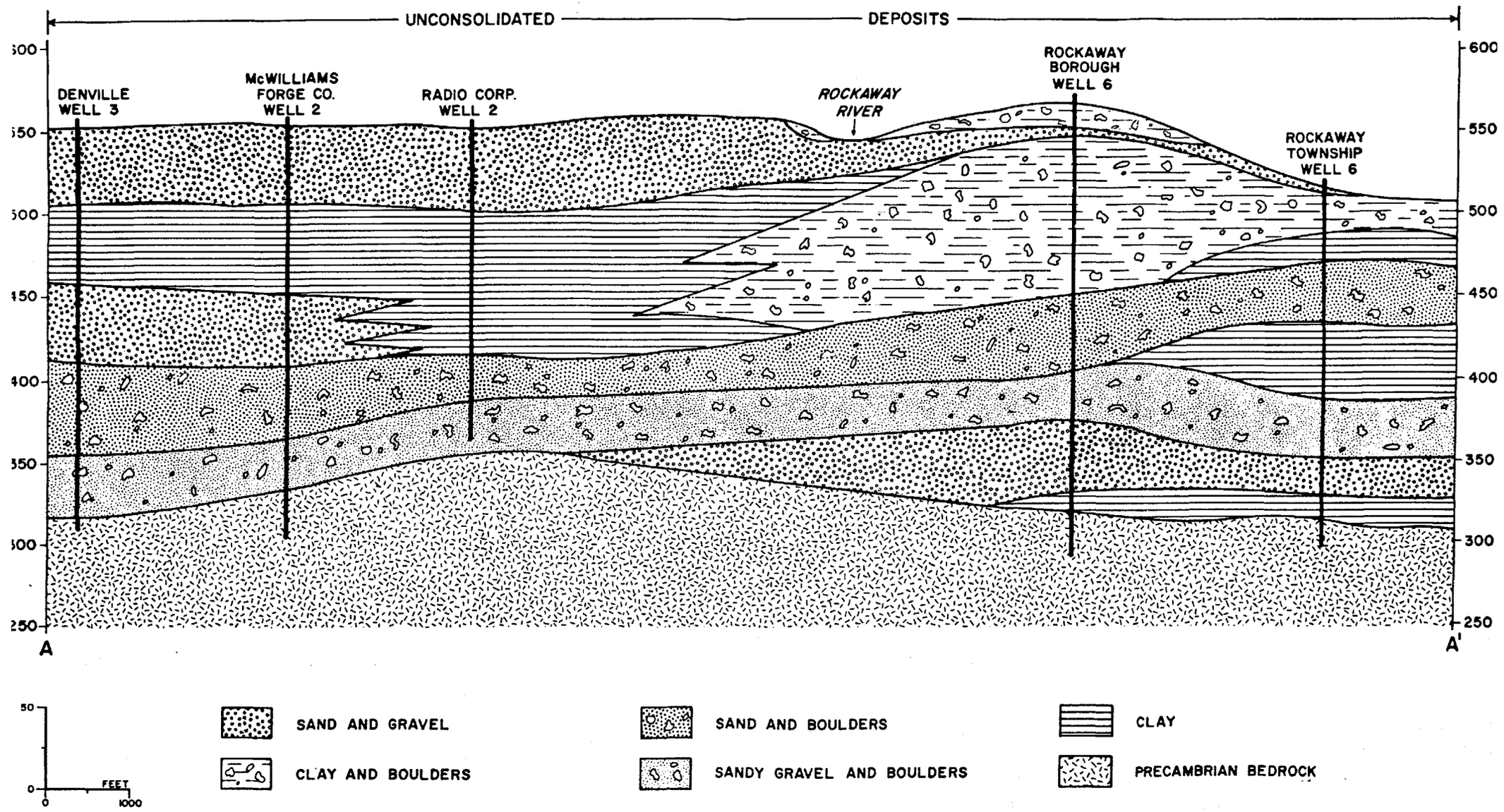


FIGURE B-1 GENERALIZED GEOLOGIC CROSS SECTION AA'

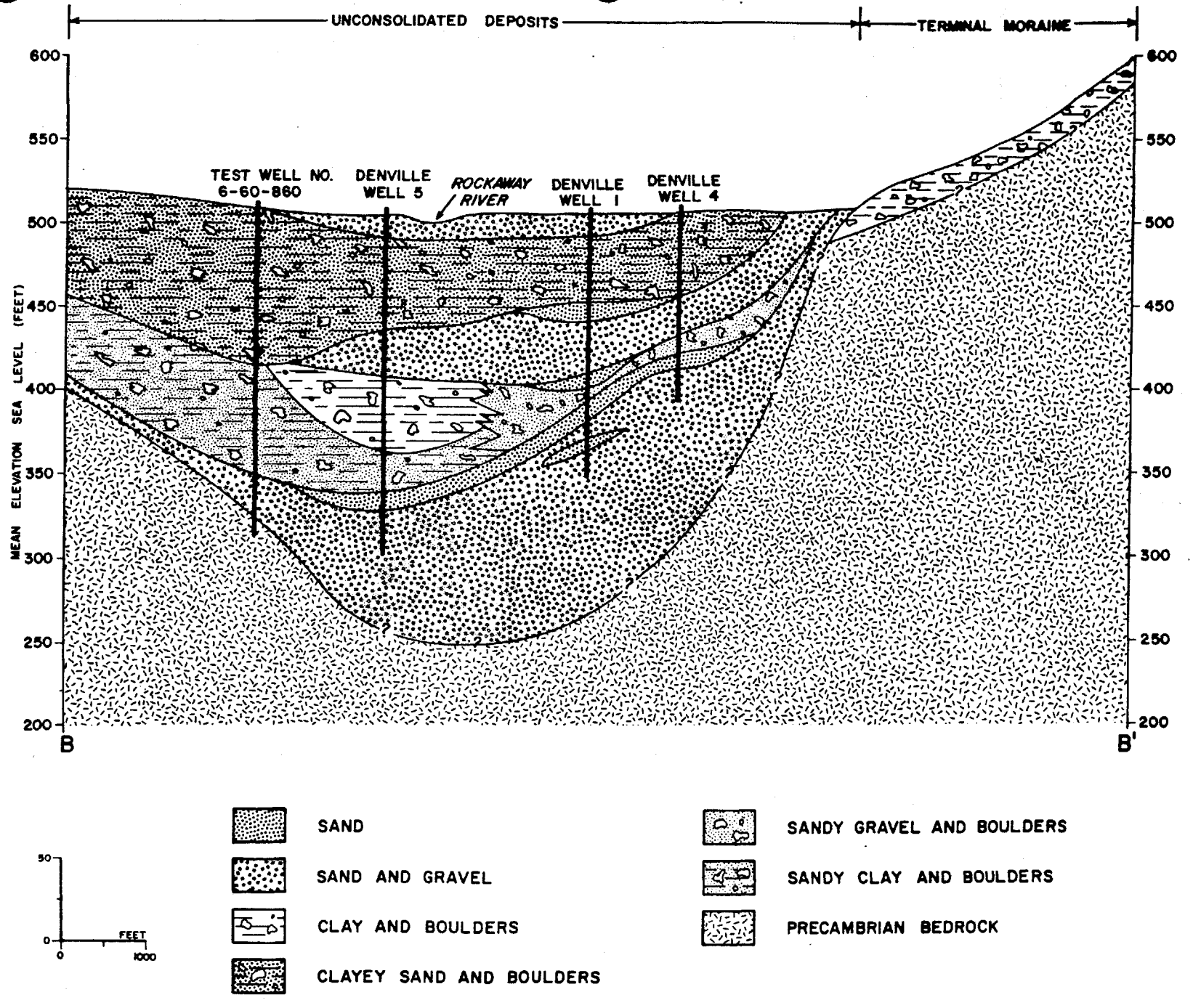


FIGURE B-2 GENERALIZED GEOLOGIC CROSS SECTION B B'

Table B-2

Major Soil Types in the Rockaway Valley Facility Planning Area

GENERAL CLASSIFICATION	MAJOR SOIL SERIES	COMPOSITION	TOPOGRAPHIC POSITION and PARENT MATERIAL	PERMEABILITY cm/hr (in/hr)	SEPTIC SUITABILITY m (ft)
Soils formed in young glacial till	Rockaway	Cobbly sandy loam to gravelly sandy loam o Fragipan in lower part of profile	Found in uplands Formed in sandy loam glacial till consisting mainly of granitic material	Above fragipan: moderate:1.5-5.0(0.6-2.0) fragipan:slow: .0.5(0.2)	Moderate to severe: needs deep ditches: lateral seepage above fragipan: steep slopes
	Ribomia	Gravelly loam to very firm gravelly sandy loam Fragipan in lower part of profile	Found in depressions, along water courses and at the base of steep slopes Formed in glacial till and colluvium dominated by granite gniess	Above fragipan: moderate:1.5-5.0(0.6-20) fragipan: slow: <.5 (< 0.2) Seasonal water table	Severe: seasonal high water table at a depth of 0.1-0.4 (0.5-1.5) lateral seepage over fragipan
	Netcong	Gravelly sandy loam to sandy loam	Found on rolling uplands in a narrow belt on the front of the terminal moraine Formed in gravelly and cobbly sandy loam glacial till consisting mainly of granite gneiss.	Moderately rapid to rapid .5.0-15.0 (2.0-6.0)	Slight: stony in places
	Riverhead	Gravelly sandy loam to loose gravelly loamy sand and loamy sand	Found on undulating outwash terraces and basins Formed in sandy and gravelly outwash	Moderately rapid:5.0->15.0 (2.0->6.0)	Slight: hazard of ground water pollution
Soils formed in organic deposits, glacial lake sediments or glacial outwash	Pompton	Sandy loam to loose gravelly sandy loam	Found on terraces, outwash plains and gently sloping swales that extend into uplands Formed in sandy and gravelly glacial outwash	Moderately rapid: 5.0-15.0(2.0- 6.0) Seasonal water table	Severe: seasonal high water table at a depth of 0.1-0.4 (0.5-1.5)
	Carlisle	Highly decomposed muck to decomposed muck containing many fibers and pieces of wood	Found in depressions that were formerly or are now partly occupied by lakes or ponds Formed by the gradual filling of lakes with organic water	Rapid: >15.0 (>6.0)	Severe: frequent flooding: seasonal seasonal high water table at surface;low bearing strength
	Parsippany	Silt loam to firm silty clay loam	Found in nearly level basins of former glacial lakes Formed in stratified sediment of lacustrine origin	Slow: <0.5-1.5 (<0.2-0.6)	Severe: frequent flooding;seasonal high water table at a depth of 0-0.3 (0-1)
	Freehold	Sandy loam to gravelly loamy sand and gravelly sandy loam	Found on outwash plains and isolated depressions in narrow waterways Formed in outwash containing mostly granitic material	Moderately rapid: 5.0-15.0 (2.0-6.0); High seasonal water table	Severe: frequent flooding: seasonal high water table at a depth of 0-0.3 (0-1)
Soil formed in old glacial deposits or in material weathered from bedrock	Edneyville	Gravelly loam to sandy loam with occasional sandy clay loam	Found on the gently rolling tops of ridges and stony side slopes Formed in granitic material weathered in place from bedrock or moved a short distance and redeposited in waterways	Moderate: 1.5 - 5.0 (0.6-120)	Slight: granite gneiss bedrock at depth of 1.0-3 (4-10)
	Parker	Very gravelly sandy loam to sandy loam with much coarse fragments	Found on irregularly shaped ridgetops and elongated areas on the sides of ridges Formed in granitic material with a large amount of angular stones, cobbles and gravel	Moderately rapid: 5.0->15.0 (2.0->6.0)	Slight to moderate: depth to bedrock should be greater than 3 (10)
	Califon	Loam to loamy sand and clay loam Fragipan in lower part of profile	Found in waterways or seepage areas at the base of slopes in the granitic gneiss uplands Formed in local colluvium or in deeply weathered till derived mainly from granite gneiss	Above fragipan: moderate: 1.5-5.0 (0.6-2.0) fragipan: slow: <0.5 (<0.2)	Severe: seasonal highwater table perched at a depth of 0.1-1.2 (0.5-4)

Source: USDASCS, 1976

stony loams. These soils all have pan layers in the lower part of their profile which restrict drainage.

Soils formed in organic deposits, glacial lake sediments, or outwash vary greatly from deep, well-drained, sandy loams that overlie stratified outwash to poorly drained, nearly level mucks, silt loams or sandy loams, that overlie stratified lacustrine sand, silt, or clay.

Soils formed from old glacial deposits or from material weathered from bedrock are dominantly loamy and deeply weathered, and have more clay in the subsoil than in the surface layer or in the substratum. They are deep, excessively drained to poorly drained, gravelly to very gravelly sandy loams, that overlie granite gneiss.

2d. Prime Agricultural Lands

The U.S. Department of Agriculture Soil Conservation Service (USDA-SCS) has determined that some soils in Morris County are prime agricultural land based on general characteristics. These soils are described as falling within Agricultural Capability Classes I and II:

Class I — Soils having few limitations that restrict management on the growth of adapted plants. These soils are nearly level, deep, well-drained, and of moderately coarse texture.

Class II — Soils having some limitations that reduce the choice of plants or require moderate conservation practices. These limitations include a moderate risk of erosion unless protected by adequate plant cover and localized areas of poor drainage (USDA-SCS, 1976).

Areas within the RVFPA that have few to moderate limitations for crop development as established by the USDA-SCS are shown on Figure 3-3.

3. AQUIFERS

3a. Precambrian Aquifer

The crystalline rocks of Precambrian age have been divided into four distinct geologic formations, but their hydrologic properties are virtually similar.

The Precambrian rocks are metamorphosed (original) sedimentary and igneous rocks and subsequently have no primary porosity. Virtually all storage and movements of groundwater in these rocks occurs in fractures that have been enlarged by weathering. The water yields of wells is largely dependent upon the number and size of the

fractures encountered and whether or not they are connected to a source of recharge.

Although some wells tapping the Precambrian rocks may produce enough water for a few small industries and others may provide adequate for domestic use, development of significant regional groundwater supplies from the Precambrian rocks is not possible. Water from the Precambrian rocks in Morris County generally is of suitable chemical quality for most uses, however iron occurs in objectionable concentrations in some areas (Gill and Vecchioli, 1965).

3b. Paleozoic Aquifers

Approximately 15 percent of the RVFPA is underlain by Paleozoic sedimentary rock. Rock types include black shale, sandstone, conglomerate and limestone. These rocks are minor aquifers in the study area because of their limited areal extent and variable water bearing properties.

Very little information is available regarding the chemical quality of water from the Paleozoic rocks; however, except for hardness-forming constituents, the water is probably of a suitable quality for most uses (Gill and Vecchioli, 1965).

3c. Triassic Aquifers

Only a small portion of the RVFPA is underlain by Triassic aquifers. These rocks are shale and sandstone beds that are generally capable of sustaining moderate to large yields to wells. Presently there are no wells tapping these deposits in the RVFPA.

Except for hardness-forming constituents, water from the Triassic rocks generally does not contain objectionable concentrations of any chemical constituents (Gill and Vecchioli, 1965).

3d. Quaternary Aquifers

Approximately 85 percent of the groundwater used in the RVFPA is obtained from Wisconsin and Pre-Wisconsin glacial drift. The deposits of stratified drift are the most important producers and they are capable of sustaining yields of 760 liters per minute (200 gallons per minute) or more of suitable quality water that meets public standards (Gill and Vecchioli, 1965). Because the outwash deposits were laid down by meltwater streams in a fluctuating environment, the layers of sand and gravel will thin abruptly or pinch out, giving way to lenses

of silt and clay. For this reason, the sand and gravel aquifers tapped for water in Dover may be totally different from the ones used in Rockaway, Denville or Boonton. Figures B-1 and B-2, which are generalized cross sections through the stratified drift deposits of the Rockaway River Valley, illustrate the discontinuous nature of these deposits, both horizontally and vertically.

The variability of outwash deposits has allowed for confined and unconfined groundwater conditions to occur. Unconfined groundwater occurs in areas not mantled by glacial till and are related to the present day alignment of the surface drainage network. Confined groundwater occurs where the stratified drift deposits are overlain by clay or silt.

Yields of 47 wells that tap the Quarternary aquifer in the RVFPA range from 190 lpm (50 gpm) to 6150 lpm (1625 gpm) and average 1890 lpm (500 gpm) (Table B-3). The wells are shallow, with depths ranging from 8 to 62 m (25 to 205 ft). There is no apparent relationship between depth and yield for the Quarternary aquifers.

Water from the stratified drift deposits does not contain any objectionable concentrations of chemical constituents except for hardness-forming constituents. Analysis of water samples from selected wells tapping the stratified drift deposits adjacent to the Rockaway River show concentrations of manganese and iron exceeding state potable limits. The highest value of manganese and iron occur in the Town of Boonton Well No. 3 and are 1.60 mg/l and 3.06 mg/l respectively (Geraghty and Miller, 1978). The high concentrations may be attributable to induced infiltration of surface water, which dissolves iron rich minerals as it passes through the underlying earth materials.

4. RECHARGE

. Precipitation is the most important source of water entering the RVFPA. The average annual rainfall for the area is 115 to 120 cm (46 to 48 in) or 3,210 cubic meters per day per square kilometer (2.2 million gallons daily per square mile), giving an average daily input of 984,000 cu m (260 mgd) for the whole basin.

Precipitation either infiltrates the surficial deposits, is released to the atmosphere through evapotranspiration, or flows overland to streams as storm runoff. The various types of soils and surficial deposits in the RVFPA have differing infiltration rates, causing non-uniform recharge of the aquifers. Areas overlying stratified drift deposits, in which soils have permeabilities of moderately rapid to rapid are considered to be prime aquifer recharge areas (Figure 3-4). However, certain areas of the stratified drift aquifer are confined, restricting vertical percolation. These areas are recharged in part from the underlying and adjacent bedrock (Gill and Vecchioli, 1965). The recharge of the Paleozoic formations is

Table B-3

Records of Selected Wells in the Rockaway Valley Facility Planning Area

Map No.	Local No.	Owner	Year Drilled	Total Depth m(ft)	Screen Setting m(ft)	Aquifer	Static Water Level m(ft)	Yield lps(gpm)	Drawdown m(ft)	Specific Capacity lps/m (gpm/ft)
1	1	Aircraft Radio Corp.	-	-	-	Quaternary	-	-	-	-
2	2	"	-	-	-	Quaternary	-	-	-	-
3	3	"	1955	24 (80)	20-24 (65-80)	Quaternary	1 (4)	9 (150)	11 (36)	0.8 (4)
4	1	Boonton Boro	1930	13 (43)	6-13 (20-43)	Quaternary	4 (14)	24 (382)	4 (13)	6 (30)
5	2	"	1930	11 (38)	6-11 (20-38)	Quaternary	3 (10)	25 (400)	4 (14)	6 (29)
6	3	"	1946	8 (25)	6-8 (20-25)	Quaternary	1 (4)	16 (250)	5 (17)	3 (15)
7	4	"	1957	31 (102)	23-31 (76-102)	Quaternary	-	21 (340)	-	-
8	5	"	1958	32 (106)	23-31 (75-102)	Quaternary	4 (13)	19 (300)	5 (17)	4 (18)
9	6	"	1965	18 (60)	16-18 (55-60)	Quaternary	-	38 (600)	-	-
10	3	Mountain Lake	1947	19 (64)	10-19 (32-64)	Quaternary	3 (11)	38 (600)	6 (20)	6 (30)

Table B-1 (continued)

Map No.	Local No.	Owner	Year Drilled	Total Depth m(ft)	Screen Setting m(ft)	Aquifer	Static Water Level m(ft)	Yield lps(gpm)	Drawdown m(ft)	Specific Capacity lps/m (gpm/ft)
11	-	N.J. Power & Light	1955	22 (75)	16-22 (55-75)	Quaternary	1 (4)	14 (225)	10 (32)	1 (7)
12	-	Advance Pressure Casting Inc	1959	26 (87)	23-26 (77-87)	Quaternary	3 (11)	5 (78)	16 (54)	0.4 (2)
13	1	Denville	1928	44 (146)	33-44 (109-146)	Quaternary	3 (9)	26 (406)	11 (37)	2 (11)
30	2	"	1931	41 (136)	38-41 (126-136)	Quaternary	flows	48 (760)	9 (30)	5 (25)
31	3	"	1948	40 (132)	35-40 (117-132)	Quaternary	0.6 (2)	46 (737)	12 (40)	4 (18)
14	4	"	1958	35 (117)	29-35 (96-117)	Quaternary	3 (10)	34 (542)	22 (74)	1 (7)
15	5	"	1961	60 (198)	54-60 (178-198)	Quaternary	6 (20)	64 (1018)	7 (23)	9 (44)
16	1	Hewlett-Packard	1960	38 (125)	27-36 (89-119)	Quaternary	0 (0)	34 (548)	28 (92)	1 (6)
17	1	Central Morris Industrial Park	1958	46 (153)	43-46 (142-153)	Quaternary	1 (5)	19 (300)	38 (125)	0.4 (2)

Table B-3 (Continued)

Map No.	Local No.	Owner	Year Drilled	Total Depth m(ft)	Screen Setting m(ft)	Aquifer	Static Water Level m(ft)	Yield lps(gpm)	Drawdown m(ft)	Specific Capacity lps/m (gpm/ft)
19	4	Rockaway Township	1963	46 (150)	-	Quaternary	-	24 (375)	-	-
18	6	"	1967	50 (163)	48-50 (159-163)	Quaternary	6 (20)	34 (538)	27 (90)	1 (6)
22	1	Rockaway Boro	1922	15 (52)	11-15 (39-49)	Quaternary	1 (4)	22 (346)	8 (28)	3 (13)
21	2	"	1924	14 (48)	9-13 (29-44)	Quaternary (now abandoned)	0.3 (1)	16 (250)	11 (36)	1 (7)
25	3	"	1943	43 (140)	30-43 (100-140)	Quaternary (now abandoned)	Flows	50 (800)	24 (80)	2 (10)
24	4	"	1955	26 (85)	21-26 (69-84)	Quaternary	3 (9)	22 (351)	17 (56)	1 (6)
23	5	"	1958	32 (105)	-	Quaternary	1 (3)	7 (119)	20 (65)	0.4 (2)
20	6	"	1974	27 (90)	23-27 (77-90)	Quaternary	3 (10)	25 (400)	12 (41)	2 (10)
26	2	Radio Corp. of America	1956	122 (400)	>17 (>57)	Precambrian	10 (32)	2 (27)	57 (188)	0.02 (0.1)

Table B-3 (continued)

Map No.	Local No.	Owner	Year Drilled	Total Depth m(ft)	Screen Setting m(ft)	Aquifer	Static Water Level m(ft)	Yield lps(gpm)	Drawdown m(ft)	Specific Capacity lps/m (gpm/ft)
27	3	Radio Corp. of America	1956	166 (543)	>19 (>63)	Precambrian	6 (21)	14 (219)	54 (179)	0.2 (1)
28		McWilliam Forge Co.	1943	80 (265)	-	Precambrian	Flows	7 (110)	-	-
29		"	1967	46 (150)	-	Precambrian	Flows	19 (300)	-	-
33	1	Town of Dover	1925	20 (65)	10-20 (35-65)	Quaternary	3 (9)	63 (1000)	3 (10)	21 (100)
34	2	"	1939	22 (72)	16-22 (52-72)	Quaternary (now abandoned)	3 (11)	76 (1200)	3 (11)	22 (109)
35	3	"	1940	23 (74)	16-23 (53-74)	Quaternary	2 (8)	102 (1625)	5 (17)	20 (95)
32	4	"	1962	42 (138)	36-42 (118-138)	Quaternary	-	92 (1455)	-	-
36	5	"	1973	19 (64)	13-19 (44-64)	Quaternary	4 (14)	96 (1529)	4 (15)	21 (102)
38	1	Wharton Borough	1953	13 (42)	10-13 (32-42)	Quaternary	3 (9)	33 (530)	6 (20)	4 (20)

Table B-3 (continued)

Map No.	Local No.	Owner	Year Drilled	Total Depth m(ft)	Screen Setting m(ft)	Aquifer	Static Water Level m(ft)	Yield lps(gpm)	Drawdown m(ft)	Specific Capacity lps/m (gpm/ft)
38	2	Wharton Borough	1960	10 (33)	8-10 (27-32)	Quaternary	4 (14)	31 (500)	3 (11)	9 (45)
39	3a	"	1959	12 (40)	-	Quaternary	3 (11)	16 (250)	0.1 (0.5)	103 (500)
37	3b	"	1971	19 (64)	12-19 (39-64)	Quaternary	1 (4)	95 (1500)	4 (13)	24 (114)
40	1	Heddion Oil Water Co.	1924	31 (102)	-	Precambrian	-	8 (25)	-	-
41	2	"	1946	28 (92)	-	Precambrian	Flows	23 (75)	-	-
42		Heddon Oil Water Co.	-	46 (150)	>17 (>56)	Precambrian	-	2 (35)	-	-
47	1	Mine Hill Water Co.	1955	30 (100)	>12 (>38)	Precambrian	5 (18)	2 (25)	23 (77)	0.06 (0.3)
43	2	"	1955	30 (100)	>6 (>21)	Precambrian	6 (20)	3 (45)	9 (30)	0.2 (1)
48	3	"	1958	45 (148)	>8 (>27)	Precambrian	0.3 (1)	1 (20)	6 (19)	0.2 (1)

Table B-3 (continued)

Map No.	Local No.	Owner	Year Drilled	Total Depth m(ft)	Screen Setting m(ft)	Aquifer	Static Water Level m(ft)	Yield lps(gpm)	Drawdown m(ft)	Specific Capacity lps/m (gpm/ft)
46	15	Randolph Township	1968	-	-	Precambrian		17 (55)	-	-
44	16	"	1969	76 (250)	-	Precambrian	1 (3)	7 (108)	43 (142)	0.1 (0.7)
49	430A	Picatinny Arsenal	-	27 (90)	-	Quaternary	-	25 (400)	-	-
50	410	"	-	33 (108)	-	Quaternary	6 (20)	28 (450)	-	-
51	302	"	-	34 (110)	-	Quaternary	2 (7)	35 550	-	-
52	130	"	-	42 (137)	>37 (>120)	Quaternary	7 (22)	36 (575)	-	-
53	129	"	-	37 (120)	>30 (>98)	Quaternary	7 (22)	39 (615)	-	-
54	1	Clifden Rock Tool Co.	1952	26 (87)	>23 (>77)	Precambrian	0.3 (1)	3 (50)	22 (74)	0.1 (0.6)

mostly derived from direct precipitation on the outcrop, or in places where drift deposits overlie these formations, the recharge is from percolation. The Precambrian formations are recharged in the outcrop areas at the highest elevations.

Another important source of recharge to the stratified drift deposits is induced stream bed infiltration. Under static or nonpumping conditions the movement of groundwater is toward the Rockaway River. Under pumping conditions, the gradient is reversed and there is a movement of the water towards the pumping wells.

Pumping tests performed on wells in the Boonton well field indicate vertical leakage and near stabilization of water levels. This suggests induced recharge from the Rockaway River, although sufficient data is not available to prove this conclusively. In Dover and Wharton pumping tests showed no evidence of induced recharge (Geraghty and Miller, 1978). An analysis of the exchange between the river and aquifers using stream gauging, indicated that for the reach between Denville and Rockaway Borough, the river loses water at an average rate of 1,153 cubic meters per day per kilometer (0.49 million gallons daily per mile) (Tetra Tech, 1978).

5. HYDROLOGIC BUDGET

A hydrologic budget has been prepared that accounts for all inflow to and outflow from the RVFPA.

5a. Inflow

Inflow is almost wholly derived from precipitation falling within the RVFPA and over the long term has averaged 984,100 cu m/d (260 mgd). During the drought years (1961 to 1967) rainfall averaged 11 percent less than the longterm average decreasing the water input to as low as 832,700 cu m/d (220 mgd).

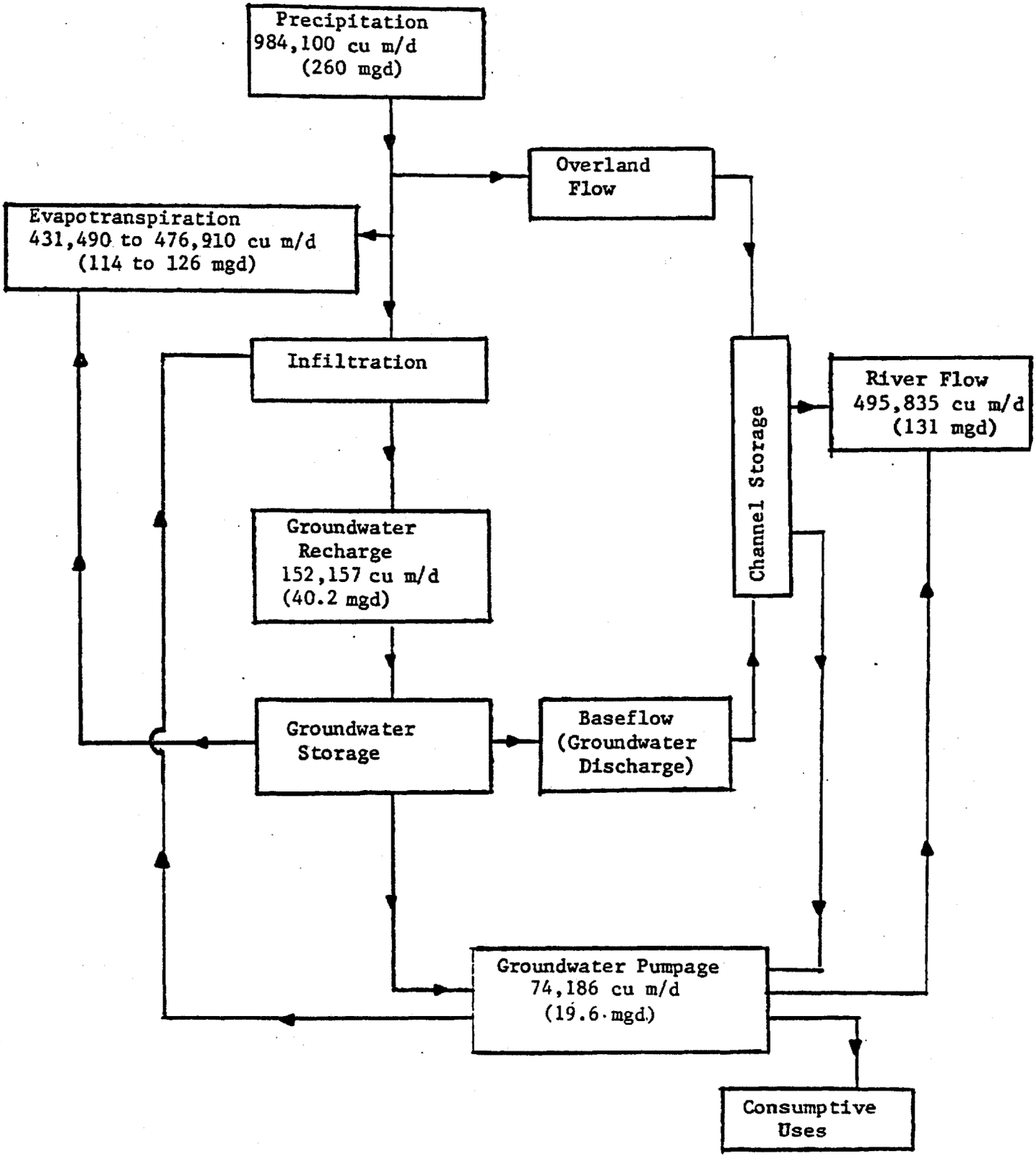
5b. Outflow

Outflow consists of three components, streamflow out of the study area, evapotranspiration and groundwater pumpage (Figure B-3).

Longterm continuous streamflow records are available for the Upper Rockaway River Basin from the USGS stream gauging station directly above the Boonton Reservoir. The data shows a highly variable flow whose yearly mean based on 34 years of records is 495,835 cu m/d (131 mgd). Average discharge between 1960 to 1977 was 488,265 cu m/d (129 mgd) and for the drought years between 1961 and 1966 it was 352,000 cu m/d (93 mgd).

Figure B-3

Hydrologic Cycle of the Rockaway Valley Facility Planning Area



Evapotranspiration losses are calculated to range from 50 to 55 cm (20 to 22 in) or 431,490 to 476,910 cu m/d (114 to 126 mgd), approximately 45 to 55 percent of total annual precipitation (Killam, 1977). Evapotranspiration depends primarily upon meteorological factors, soil moisture, groundwater levels, type of soil and vegetation characteristics. It is usually very small in the winter, increases rapidly in the spring, reaches a maximum in July and decreases rapidly in the autumn (Walton, 1970).

Groundwater pumpage within the RVFPA was 74,186 cu m/d (19.6 mgd) in 1976, of which some was returned to the groundwater system via septic tank-tilefield waste disposal systems and lawn sprinkling (Tetra Tech, 1978). Another portion was discharged to the sewage treatment plant outside the RVFPA, effectually removing this water from the study area. From 1978 to 1979 the wastewater flow from the treatment plant was 32,400 cu m/d (8.5 mgd), including 3,785 cu m/d (1 mgd) from infiltration. Because of the large amount of variable conditions involved, it is difficult to accurately determine the consumptive use specifically for the RVFPA, but it is estimated to range between 28,400 to 30,300 cu/ m/d (7.5 to 8.0 mgd).

5c. Calculated Hydrologic Budget

Based on the above discussion of average inflow and outflow volumes a hydrologic budget equation can be used to demonstrate the water balance for the RVFPA. The equation is as follows:

$$P = R + ET + p \pm s$$

Where:

P = precipitation in the RVFPA, 984,100 cu m/d (260 mgd)

R = runoff (measured as stream flow) from the RVFPA, 495,835 cu m/d (131 mgd)

ET = average evapotranspiration losses from the RVFPA, 454,200 cu m/d (120 mgd)

p = average consumptive use of groundwater, 29,523 cu m/d (7.8 mgd)

s = change in storage, 0. Because groundwater pumpage is less than annual recharge, net annual change in storage is zero.

Therefore Calculated Outflow (P^1) =

$$P^1 = R + ET + p \pm s$$

P^1 = 495,835 cu m/d + 454,200 cu m/d + 29,523 cu m/d - 0

P^1 = 979,558 cu m/d

$P^1 \simeq P$ with P = 984,100 cu m/d

The net difference between P (inflow) and P^1 (calculated outflow which should ideally equal the inflow) is:

Net difference = P - P^1
= 984,100 cu m/d - 979,558 cu m/d
= 4,542 cu m/d (1.2 mgd)

In an ideally perfect hydrologic budget, water gains should equal water losses. However, the small discrepancy (4,542 cu m/d (1.2 mgd) indicates that the numbers are reasonable and of the correct order of magnitude.

5d. Evaluation of Recharge Rates

Streamflow consists of two components, direct surface runoff and groundwater discharge (baseflow). Groundwater discharge maintains streamflow between runoff producing events and is at a maximum during spring and early summer and least in late summer and fall months. Annual base flow depends upon antecedent groundwater stage, as well as amount and distribution of annual precipitation. Where there is no long term change in storage, baseflow is approximately equal to groundwater recharge. The low flow period of the Upper Rockaway River lasts approximately from July to October, during which almost all precipitation is used by evapotranspiration and baseflow (Killam, 1977). A statistical analysis of the discharge at the USGS gauging station indicates that from 1938 to 1970 the 90 day lowest mean discharge is 168,432 cu m/d (44.5 mgd). Calculations of recharge, based on the infiltration rates for the surficial material covering the entire PVFPA yield a figure 152,157 cu m/d (40.2 mgd). The close correlation indicates that the recharge rates are reasonable and that approximately 20 percent of total precipitation or 151,400 to 166,540 cu m/d (40 to 44 mgd) infiltrates to the groundwater system. This is a long term average and will vary from year to year. The significance of the 90 day low flow is that this is the minimum flow that can be expected to occur for 30 consecutive days every two years. The 151,400 to 166,540 cu m/d (40 to 44 mgd) is then the maximum amount of groundwater that can be withdrawn during the driest part of the year, typically in late summer and early fall when virtually all stream flow consists of base flow. During the drought period, base flow of the Upper Rockaway River dropped to a low of 105,980 cu m/d (28 mgd), indicative of a decrease in net recharge and a reduction in the amount of developable groundwater available (Table B-4).

Table B-4

Aquifer Safe Yield Estimates for Rockaway Valley Facility Planning Area

Aquifer	Areal Extent sq km (sq mi)	Recharge Rate cu m/d/sq km (gpd/sq mi)	Long Term[1] Recharges cu m/d (mgd)	Drought Years[2] Recharge cu m/d (mgd)	Consumptive Use cu m/d (mgd)	Surplus (+)[5] or Deficit (-) in Storage cu m/d (mgd)
Quaternary Age stratified drift	83 (32)	876 (600,000)	75700 (20.0)	68130 (18)	28388[3] (7.5)	+39742.5 (+10.5)
Quarternary Age terminal moraine	36 (14)	292 (200,000)	10598 (2.8)	9432 (2.4)	less than[4] 1893 (0.50)	+7191.5 (+1.9)
Precambrian Age crystallines	148 (57)	365 (250,000)	52990 (14.0)	45420 (12)	less than[4] 3785 (1.0)	+41635 (+11.0)
Ground moraine overlying Paleozoic age rocks	44 (17)	292 (200,000)	12869 (3.4)	11453 (3.0)	minimally[4] used - less than 11366 (0.30)	+10219.5 (+2.7)

Notes:
1. Based on an average long term precipitation rate of 108.9 cm (42.9 in).
2. Based on 1961-1966 average annual precipitation of 94.9 cm (37.4 in).
3. Assuming all public supply wells tap the stratified drift and that the major component of flow to the wastewater treatment plant is from areas served by public water systems. Imported water is subtracted while infiltration and inflow is included.
4. Tapped essentially by self supplied industrial and residential. Wastewater recharged on site.
5. Based on recharge rates for drought years.

Source: NJGS, 1974
Tetra Tech, 1978
Well records (Appendix A)

5e. Stratified Drift Productivity

Quaternary age stratified sand and gravel deposits comprise slightly more than 25 percent of the RVFPA surface area and provide over 85 percent of the public water supply. These deposits are predominantly recharged through rain falling on the outcrop areas. It is important to consider these deposits separately because of their intense use and potential for additional withdrawals.

Due to the lack of data needed to prepare a hydrologic budget specifically for these deposits, estimates of groundwater availability by this method are not possible. An alternative approach involves the examination of recharge rates. A comparison of baseflow volumes to recharge rates conducted in the above discussion indicates that recharge values for the stratified drift are reasonable.

The average recharge rate for the stratified drift along, within the RVFPA deposits is 910 cu m/d/sq km (0.65 mgd/sq mi) (New Jersey Geological Survey, 1974) and the area occupied is approximately 82 sq km (32 sq mi). Multiplying the two yields a recharge of about 75,700 cu m/d (20 mgd) for a year of normal precipitation. However the productivity of wells tapping the stratified drift along the Upper Rockaway River Valley will vary significantly depending on the local hydrogeology, the amount of impervious surface, the horizontal and vertical extent of the deposits and the amount of induced infiltration from the river. Considering these factors, the 75,700 cu m/d (20 mgd) figure should be viewed as a conservative estimate of the amount of developable groundwater, based on present recharge rates, from the Quaternary stratified sand and gravel aquifer.

APPENDIX C

WATER RESOURCES

1. WATER QUALITY

The headwaters of the Rockaway River are located in the Bear Fort and Green Pond Mountains (NJDEP, 1979b). The river enters the RVFPA in Jefferson Township and flows south, west of the Picatinny Arsenal, to the junction of Stephans Brook. It then follows a northeasterly course through Rockaway Township, Wharton, Dover, Randolph, Rockaway Borough, Denville, and Boonton Township leaving the study area at the Boonton Reservoir.

All of the surface waters in the RVFPA (Figure C-1) are classified by NJDEP as FW-2 waters except Stephans Brook, north of the Berkshire Valley Tract, which is FW-1. A description of these New Jersey surface water quality standards can be found on Table C-1. Average, high and low flows for the Rockaway, and the ten-year seven consecutive day low flow (MA7CD10) are shown on Table C-2.

Water quality data for the Upper Rockaway, with the exception of the USGS information, is rare. The Northeast New Jersey Water Quality Management Plan (208 Plan) relyed on the USGS data, supplemented by other historical information for their description of the Upper Rockaway River water quality (NJDEP, 1979b). A one-year study on nitrification in the Passaic Basin was conducted by a group at Rutgers University. This study included three sites in the RVFPA, one of which was USGS gauging station No. 01-3805 (Table C-3). The values are consistent with those of the USGS gauging station and do not indicate degradation of the river as it flows downstream.

Annual water quality data for the Upper Rockaway River from the United States Geological Survey (USGS) gauging station No. 01-3805, just upstream of the Boonton Reservoir, show dissolved oxygen (DO) values for 1967 to 1977 ranging from 4.7 to 16.9 milligrams per liter. The average value of 8.9 mg/l is well above the state standard of 4.0 mg/l (Tables C-4, C-5 and C-6).

High concentrations of nitrate, nitite, and phosphates, accompanied by high pH values, provide an environment which accelerates the growth of algae and other aquatic material. The nitrate values for the Upper Rockaway do not exceed the federal maximum of 10 mg/l. Total phosphorus values generally average below the state standard of 0.05 mg/l, but the range of 0.01 to 0.76 mg/l indicates non compliance, particularly during the summer months. The New Jersey Drinking Water Act Primary Drinking Water Regulations assume the same values as the EPA National Interim Primary Drinking Water Regulations (Hamill, NJDEP, November 27, 1979). These federal regulations set maximum nitrate levels at 10 mg/l (EPA, 1975a). The

Table C-1

Surface Water Class Definitions

Class	Definition
FW-1	Fresh waters, including rivers, streams, lakes, or other bodies of water which, because of their clarity, color, scenic setting, or other characteristic of aesthetic value or unique special interest, have been designated by authorized state agencies in conformance with laws pertaining to the use of private lands, to be set aside for posterity to represent the natural aquatic environment and its associated biota.
FW-2	Fresh surface waters approved as sources of public water supply. These waters shall be suitable for public potable water supply after such treatment as shall be required by law or regulation. These waters shall also be suitable for the maintenance, migration and propagation of the natural and established biota; and for primary contact recreation; industrial and agricultural water supply and any other reasonable uses.
FW-3	Fresh surface waters suitable for the maintenance, migration and propagation of the natural and established biota; and for primary contact recreation; industrial analysis, cultural water supply and other reasonable uses.

Source: New Jersey Surface Water Quality Standards, New Jersey Annotated Code (NJAC) 7:9-4, as amended.

FIGURE C-I
SURFACE WATER RESOURCES

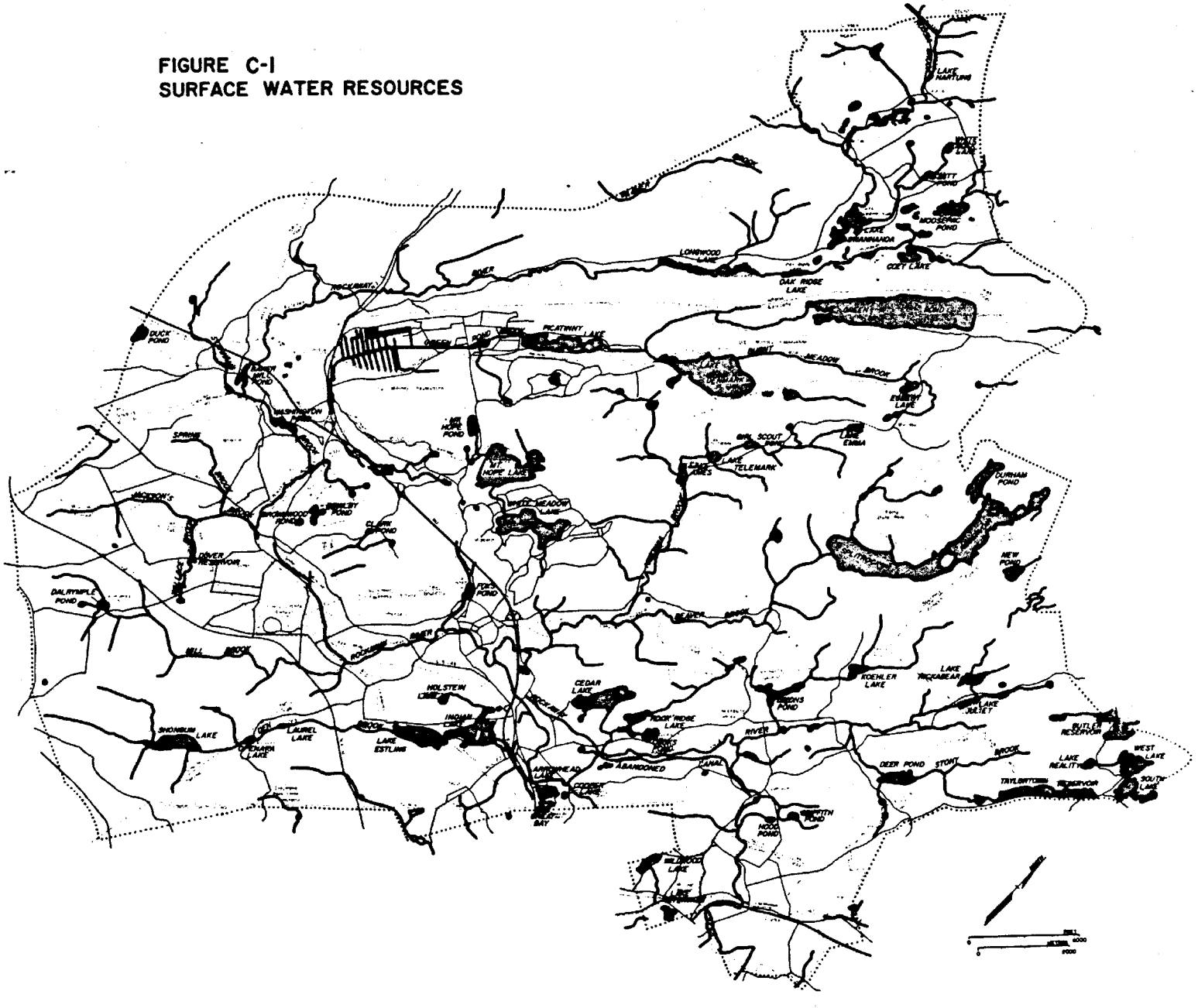


Table C-2

Flow Data for the Upper Rockaway River

Level	Flow cu m/s (cfs)	Date
High[a]	99.40 (3,510)	June 2, 1952
Low*,[a]	0.28 (10)	August 10, 1966
Average[a]	6.26 (221)	1937 - 1977
MA7CD10[b]	0.44 (15.7)	1939 - 1977

Note: * USGS reports practically no flow for some days.

Source: a. USGS, 1977. Water Resources Data for New Jersey, Water Year - 1977.

b. Schopp, Robert, USGS - Water Resources Division, July 31, 1979.

Table C-3

Additional Water Quality Data for the Upper Rockaway River

Site		pH	Temp °C (°F)	DO mg/l	Suspended Solids mg/l	Total Nitrate (NO_3) mg/l	Total Nitrite (NO_2) mg/l	Total Ammonia (NH_4^+) mg/l	Organic Nitrogen (N) mg/l	TKN mg/l
1	avg	7.1	NA	8.0	5	0.36	0.008	0.16	7.68	0.28
	max	8.1	27.0 (80.6)	15.0	21	1.25	0.019	0.15	17.60	0.76
	min	6.6	12.5 (54.5)	5.2	1	0.07	nil	nil	0.11	nil
2	avg	7.5	NA	9.2	8	0.65	0.008	0.16	5.90	0.24
	max	8.6	28.9 (84.0)	15	29	2.20	0.020	0.57	16.00	0.52
	min	6.7	13.0 (55.4)	7.2	2	0.27	nil	nil	0.17	0.04
3	avg	7.6	NA	8.8	11	0.56	0.007	0.15	7.06	0.28
	max	8.1	28.8 (83.8)	11.3	37	1.30	0.020	0.53	14.80	0.50
	min	6.9	9.0 (48.2)	7.4	1	0.19	nil	nil	0.11	nil

Note: NA = Not Applicable.

Site 1 - Rockaway River at Minisink Road near Berkshire Valley and Union Turnpike.
Site 2 - Rockaway River at Rt. 80 near Denville.
Site 3 - Rockaway River at USGS Gauging Station No.01-3805

Source: Ahlert, Robert C. and others, June, 1979. Analysis of Nitrification in the Passaic Basin, prepared for the Office of Areawide Planning, Division of Water Resources, NJDEP.

Table C-4

Surface Water Quality Data for the Upper Rockaway River

(1967 - 1972)

Year		pH	Temp °C (°F)	DO mg/l	BOD mg/l	Fecal(s) Coliform col./100 ml	Total Nitrate (NO_3) mg/l
1967	avg	7.5	13.0(56.0)	10.5	3.0	NA	2.0
	max	8.4	24.0(75.0)	12.6	3.0	NA	3.4
	min	7.0	2.0(35.0)	8.3	3.0	NA	1.1
1970	avg	7.6	14.3(57.7)	10.2	1.2	367	2.3
	max	8.0	21.0(69.8)	14.2	2.2	600	3.1
	min	7.4	0.0(32.0)	8.2	0.2	180	1.0
1971	avg	7.7	15.0(59.0)	8.9	1.2	NA	2.0
	max	9.5	24.1(75.4)	11.4	1.4	NA	2.8
	min	7.0	0.4(32.7)	7.6	0.9	NA	1.0
1972	avg	7.5	16.3(61.3)	10.4	3.0	160	NA
	max	8.3	25.7(78.3)	14.0	3.0	310	NA
	min	6.7	0.9(33.6)	7.9	3.0	8	NA

Note: NA = Not Available
Water quality data for these parameters not available for 1968 and 1969

Source: USGS, 1967, 1970-72, Water Resources Data for New Jersey.

Table C-5

Surface Water Quality Data for the Upper Rockaway River (1973-1977)

Year		pH	Temp °C (°F)	DO mg/l	BOD mg/l	Fecal Coliform Col./100ml	Suspended Solids mg/l	Total Nitrate (NO_3) mg/l	Total Nitrite (NO_2) mg/l	Total Ammonia (NH_4^+) mg/l	Organic Nitrogen (N) mg/l	TKN mg/l	Total Phos. (P) mg/l	Organic Phos. (P) mg/l
1973	avg	7.7	14.3 (57.7)	11.2	2.4	146	NA	0.75	0.02	0.07	0.30	0.48	0.04	0.02
	max	8.1	26.0 (78.8)	16.9	9.0	420	NA	0.92	0.02	0.10	0.43	0.80	0.07	0.03
	min	7.0	2.1 (35.8)	8.2	0.8	20	NA	0.58	0.01	0.04	0.20	0.27	0.02	0.01
1974	avg	7.9	15.4 (59.7)	9.5	2.1	276	NA	0.71	0.03	0.10	0.13	0.23	0.09	0.06
	max	8.9	24.3 (75.7)	14.5	8.8	696	NA	1.40	0.07	0.19	0.20	0.39	0.24	0.19
	min	7.3	0.0 (32.0)	4.7	0.7	106	NA	0.41	0.01	0.03	0.05	0.08	0.02	0.00
1975	avg	7.8	14.6 (58.3)	10.2	1.9	859	6.9	0.42	0.01	0.03	0.21	0.24	0.04	0.01
	max	8.2	25.8 (78.4)	12.8	3.7	4160	11	0.55	0.02	0.12	0.35	0.36	0.06	0.02
	min	7.1	5.6 (42.1)	8.0	0.5	5	2	0.34	0.00	0.00	0.06	0.07	0.01	0.01

Table C-5 (continued)

Year		pH	Temp °C (°F)	DO mg/l	BOD mg/l	Fecal Coliform Col./100ml	Suspended Solids mg/l	Total Nitrate NO_3 mg/l	Total Nitrite NO_2 mg/l	Total Ammonia NH_4^+ mg/l	Organic Nitrogen N mg/l	TKN mg/l	Total Phos. P mg/l	Organic Phos. P mg/l
1976	avg	7.6	17.1 (62.8)	9.7	1.9	392	6	0.38	0.01	0.04	0.26	0.63	0.14	0.03
	max	8.1	23.2 (73.8)	12.2	3.7	800	22	0.44	0.02	0.10	0.40	1.40	0.76	0.09
	min	6.7	7.2 (45.0)	8.2	1.2	70	0	0.28	0.00	0.01	0.17	0.18	0.02	0.01
1977	avg	7.8	14.8 (58.6)	10.6	1.8	195	8	0.48	0.01	0.30	0.36	0.39	0.03	0.03
	max	8.3	23.5 (74.3)	15.0	4.3	640	16	0.52	0.01	0.40	0.38	0.40	0.05	0.03
	min	7.3	0.0 (32.0)	8.4	0.8	66	1	0.43	0.01	0.20	0.33	0.37	0.01	0.02

Note: NA = Not Available

Source: USGS, 1973-1977, Water Resources Data for New Jersey, Water Years 1973-1977

Table C-6

New Jersey Surface Water Quality Standards

for FW-2 Non-Trout Waters

Parameter	Standard
pH, range	6.5 - 8.5
Temperature °C (°F)	
maximum deviation from stream ambient	2.8 (5)
maximum stream ambient	27.8 (82)
Dissolved Oxygen	
minimum 24-hour average	5.0 mg/l
absolute minimum	4.0 mg/l
Fecal Coliform, maximum	200 colonies/100 ml
Total Dissolved Solids, maximum	500 mg/l or 133% of background
Phosphorus (Total P)	0.050 mg/l

Source: NJAC, 1974

average nitrate value for the Rockaway River, as measured by USGS at gauging station No. 01-3805 for the period 1967-1977, is 1.14 mg/l, well below the federal maximum.

The NJDEP has not set an ammonia standard; however, EPA has set a criteria of 0.02 mg/l, as un-ionized ammonia (NH_4) for freshwater aquatic life (EPA, 1976b). The ammonia levels reported by the USGS generally meet EPA guidelines, but the 1977 values were elevated and closely approach the guideline value.

Fecal coliform consistently exceeds NJDEP standards. The average for the period 1967-1977 is 342 colonies per 100 ml, which is above the standard of 200 colonies per 100 ml. Elevated coliform values have resulted in the closing of all the beaches in the RVFPA in recent years (Christie, Rockaway Township, July 30, 1979).

In general, the available data indicates that the quality of the Rockaway River is good. All parameters except fecal coliform and total phosphorus comply with NJDEP Surface Water Quality Standards. A comprehensive inventory of the Rockaway River and its tributaries would be required before a thorough evaluation of its quality could be made.

2. POINT AND NON-POINT SOURCE POLLUTION

Non-point source pollution (NPS), pollutants which do not enter a water body by direct discharge, can have a significant impact on both surface and groundwater quality. Potential sources of NPS are stormwater runoff, leachate from landfills, and wastewater from failing septic systems. Point source discharges, those that enter the water body directly, are listed on Tables C-7 and C-8.

Stormwater runoff varies with land use, season, and the frequency, duration and intensity of precipitation. Each type of land use has characteristic pollutants entrained by its storm runoff. Urban/suburban runoff is characterized by sediments which accumulate on impervious surfaces, i.e., salts; oil and grease; animal, household, and commercial wastes; and fertilizers and pesticides used in home gardens (NJDEP, 1979b). Construction activities contribute to erosion resulting in increased stream sediment. Farming operations increase quantities of sediments, fertilizers, pesticides, and organic wastes in runoff. Forestry and mining activities also increase sediments loads.

A potentially significant form of NPS in the RVFPA Study Area is due to leachate from landfills and chemical dumps. Pollutants

Table C-7

Industrial Dischargers

Municipality	Discharger	NPDES Permit Number	Receiving Stream	Average Flow (mgd)
Boonton [a]	Boonton Molding Co.,Inc.	0003441	Storm Sewer	0.050
Boonton [a]	Drew Chemical Corp.	0028321	Crooked Brook	NA
Boonton Twp [b]	Aircraft Radio Corp.	NA	NA	0.050
Denville [b]	Colonial Properties Inc.	NA	NA	0.005
Dover [b]	Green Hammer Metal Products	NA	NA	0.020
Dover [b]	Metal Hose and Tubing Co.	NA	NA	0.020
Dover [a]	National Hose Co.	002712	Rockaway River	NA
Rockaway [a]	Action Plastics Co.	0025674	Burnt Meadow Brook	0.478
Rockaway [a]	Hewlett Packard Co.	0003077	Hibernia Brook	NA
Rockaway [a]	Howmet Corp. #003	0001635	Rockaway River	1.150
Rockaway [a]	Howmet Corp. #004	0001635	Rockaway River	1.140
Rockaway [a]	Keuffel and Esser Co.	0001261	Beaver Brook	0.056

Table C-7 (continued)

Industrial Dischargers

Municipality	Discharger	NPDES Permit Number	Receiving Stream	Average Flow
Rockaway [a]	McWilliams Forge Co., Inc.	0002496	Rockaway River	NA
Rockaway [a]	Mt. Hope Materials Corp.	0003409	White Meadow Brook	NA
Rockaway Borough [b]	Stapling Machine	NA	NA	0.005
Rockaway Twp [b]	A & F Plastipak	NA	NA	0.006
Rockaway Twp [b]	Inco Container	NA	NA	0.005
Wharton [a]	Air Products & Chemicals	0000523	Rockaway River	0.034
Wharton [a]	L.E. Carpenter & Co.	0003611	Rockaway River	0.030
Wharton [a]	Interpace Corp.	0002593	Rockaway River	0.150
Wharton [b]	Thatcher Glass	NA	NA	0.080

Note: NA = Not Available

Source: a. NJDEP, October, 1978.
b. Killam, 1977.

Table C-8

Municipal-Institutional Dischargers

Municipality	Discharger	NPDES Permit Number	Receiving Stream	Average Flow (mgd)
Jefferson	High Ridge Sewer Co.	0026867	Mitts Pond	0.070
Jefferson	High Ridge Water Co.	0031852	White Rock Lake	NA
Jefferson	Jefferson Twp High and Middle Schools	0021091	Rockaway River Tributary	NA
Kinnelon	Our Lady of the Magnificant	0024457	Butler Reservoir	0.009
Parsippany	Rockaway Valley Regional Sewerage Authority	0022349	Rockaway River	6.600
Randolph	Randolph Twp Board of Education	0026603	Mill Brook	0.140
Rockaway	White Meadow Lake Property Owners Assoc.	0022802	White Meadow Brook	0.002
Rockaway - Dover	U.S. Army Picatinny Arsenal #1	0002500	Green Pond Brook	0.210
Rockaway - Dover	Picatinny Arsenal #2	0002500	Green Pond Brook	0.010
Rockaway - Dover	Picatinny Arsenal #4	0002500	Green Pond Brook	0.010
Rockaway - Dover	Picatinny Arsenal #9	0002500	Green Pond Brook	2.880

Note: NA = Not Available

Source: NJDEP, October, 1978.

resulting from this type of activity range from domestic and food processing wastes to toxic chemicals and carcinogens. Recent evidence shows that several dumps in this area are leaching (Christie, Rockaway Township, July 10, 1979).

Another area of potentially significant NPS is failing septic systems. Fecal coliform levels in the study area averaged above the state standard for FW-2, non trout waters, from 1967 to 1977. These elevated fecal coliform values are indicative of failing septic systems, and interceptor overflow that would occur during wet weather conditions.

3. GROUNDWATER RESOURCES

Quaternary and Precambrian aquifers provide over 95 percent of the groundwater used in the RVFPA. Paleozoic and Triassic aquifers produce the additional water used for municipal supply (Table B-1 and Table C-9).

The crystalline rock of Precambrian age have been divided into four distinct geologic formations, but their hydrologic properties are similar. Although some wells tapping these rocks may provide enough water for a few small industries and for some domestic use, development of significant regional groundwater supplies from the Precambrian rock is not possible.

Approximately 15 percent of the RVFPA is underlain by Paleozoic sedimentary rocks which are minor aquifers in the study area because of their limited areal extent and variable water bearing properties.

Only a small portion of the RVFPA is underlain by Triassic aquifers with no wells presently tapping these deposits.

Approximately 85 percent of the groundwater used in the RVFPA is obtained from Wisconsin and Pre-Wisconsin glacial drift. These deposits of stratified drift are the most important producers, capable of sustaining yields of 760 liters (200 gallons) or more per minute of water suitable for public consumption. The aquifer exists in the confined and unconfined states and at times is in direct communication with the river. Additional discussion of aquifers can be found in Appendix B.

Table C-9

Aquifer Production Capabilities

and Aquifer Water Quality

Characteristic	Aquifer				
	Precambrian	Paleozoic ss[1] + cgl[2]	Paleozoic lm[3]	Triassic	Quaternary
Number of wells	30	2	4	37	47
Range in depth of wells m (ft)	26-250 (85-822)	49 (160)	NA	27-300 (90-985)	8-62 (25-205)
Average yield of wells lpm (gpm)	321 (85)	783 (207)	791 (209)	537 (142)	1892 (500)
Maximum yield of wells lpm (gpm)	1135 (300)	1097 (290)	1438 (380)	2460 (650)	6150 (1625)
Minimum yield of wells lpm (gpm)	15 (4)	473 (125)	151 (40)	15 (4)	189 (50)
Average Specific Capacity lpm/m[4] (gpm/ft)	12.4 (1.0)	NA[5]	90.5 (7.3)	55.8 (4.5)	457.9 (36.9)
Transmissivity sq m/d (sq ft/d)	24-37 (268-400)	NA	NA	310 (3350)	1670 (18090)
Storage coefficient	0.001	NA	NA	0.0005	0.0004
Hardness ppm	60-120	NA	60-180	60-180	120-180
pH	6.4-7.8	NA	NA	7.2-8.1	6.8-8.2
Additional	localized iron concentrations			localized sulfur concentrations	localized manganese and iron concentrations

Notes: 1) ss = sandstone
2) cgl = conglomerate
3) lm = limestone
4) lpm/m = liters per minute per meter
5) NA = not available

Sources: Gill and Vecchioli, 1965; Geraghty and Miller, 1978.

3a. Sole Source Aquifer

The Buried Valley Aquifer System of southeastern Morris and western Essex counties, New Jersey, has recently been designated as a sole source aquifer under the provisions of the Safe Drinking Water Act (Federal Register, 1980). By designating this area as a sole source aquifer any federal financially assisted projects must be reviewed to determine if construction and/or operation may contaminate the aquifer so as to create a significant hazard to public health. The EPA will evaluate such projects and where necessary will conduct an in-depth review, including soliciting public comments where appropriate.

The area designated consists of two distinct regions, a recharge zone (area through which water enters the aquifer) and a stream flow zone (upstream headwaters area which drains into the recharge zone). The recharge zone is south and east of the RVFPA, consisting largely of the communities in the Upper Passaic River Basin. This area directly overlies the Buried Valley Aquifer System. The streamflow source zone lies within the boundaries of the Upper Rockaway River Basin and encompasses all of the RVFPA.

The review of projects planned for the recharge zone is more intensive than those designed for the streamflow source zone. In the recharge zone, infiltrating waters are carefully considered for their potential of actual contamination of the aquifer, while for the streamflow source zone projects are evaluated to determine if they will contaminate the stream, which eventually recharges the aquifer. Because contamination of aquifers by recharging waters is not a prime consideration in the streamflow source zone, a petition has been filed with EPA requesting that the Administrator consider the Wisconsin stratified drift aquifer system of the Upper Rockaway River watershed a sole or principal source aquifer. The aquifer is the principle water source for the major water purveyors in the RVFPA, supplying drinking water for 50 percent or more of the residents of a large territory (310 sq km (120 sq mi)). These facts make the Wisconsin stratified drift aquifer system of the Upper Passaic River Basin eligible for designation as a sole or principle source aquifer system under EPA guidelines. Designation as such would help to control deterioration of groundwater quality in the RVFPA.

3b. Recharge

Precipitation, the most important source of water entering the RVFPA, infiltrates the surficial deposits, is released to the atmosphere through evapotranspiration, or flows overland to streams as stormwater runoff. The various types of soils and surficial deposits

in the RVFPA have differing infiltration rates (Table C-10) causing non uniform recharge of the aquifers. For the purpose of this study, Prime Aquifer Recharge Areas are defined as highly permeable soils overlying deposits of Wisconsin stratified drift, earlier glacial drift and in some cases, Wisconsin terminal moraine (these formations comprise the main constituents of the public water supply) (Figure 3-4). Areas considered to overlie confined aquifers were excluded from consideration as Prime Aquifer Recharge Areas.

Soil descriptions from the Soil Survey of Morris County (1976) were used to determine soil permeability. Soils described as having permeablilities of moderately rapid to rapid were classed as highly permeable, while those described as having permeabilities of moderate to slow were not included. Soils were considered as a whole, i.e., if the whole soil column was described as permeable it was classed permeable. However, if one horizon was described as impermeable, such as a fragipan, the soil was not included in the list of highly permeable soils. Soils selected included: Ad, Cm, KlE, NtB, NtC, OtC, OtD, PaC, PbD, PeC, PeD, PfE, PlB, PlC, PtA, PtB, PvA, Pw, RmA, RmB, RmC, RnB, and Up.

Another important source of recharge to the stratified drift deposits is induced stream bed infiltration. Under static or nonpumping conditions the movement of groundwater is toward the Rockaway River. Under pumping conditions, the gradient is reversed and river water moves towards the pumping well. In addition, the stratified drift deposits, particularly the confined areas, are recharged in part from the underlying and adjacent bedrock.

Table C-10

Groundwater Recharge in the Rockaway Valley Facility Planning Area

Hydrogeologic Unit	Recharge Rate[a] cu m/d/sq Km (gpd/sq mi)	Area Underlain by Unit[b] sq km (sq mi)	Recharge to Unit cu m/d (mgd)
Quaternary age stratified drift	876 (650,000)	83 (32)	72,708 (20.0)
Quaternary age terminal moraine	292 (200,000)	36 (14)	10,512 (2.8)
Precambrian age crystallines	365 (250,000)	148 (57)	54,020 (14.0)
Ground moraine overlying Paleozoic age Rocks	292 (200,000)	44 (17)	12,848 (3.4)
		Total Groundwater Recharge[1]	150,088 (40.2)

Note: 1. Sums may not be precise due to rounding and/or metric conversions.

Source: a. NJGS, 1974.
b. Tetra Tech, 1978.

4. WATER SUPPLY

4a. Surface Water Utilization

Most municipal drinking water supplies within the basin are obtained from groundwater sources. There are presently three reservoirs in operation:

- Boonton Reservoir - built 1904, capacity of 29 million cu m (7,700 mg) owned and operated by the Jersey City Water Department. At all times, Jersey City is required to release a minimum of 26,495 cu m/d (7 mgd) from the Boonton Reservoir to augment flow in the lower Rockaway River. In 1976 the average diversion at the reservoir was 263,000 cu m/d (69.4 mgd).

- Splitrock Reservoir - completed 1948, capacity of 12 million cu m (3,300 mg), owned and operated by the Jersey City Water Department.

- Boonton-Taylortown Reservoir - capacity 0.47 million cu m (125 mg) supplies only a portion of Boonton's water, with an average of 851 cu m/d (0.22 mgd) diverted to Boonton in 1976.

4b. Groundwater Utilization

The communities within the RVFPA are served by several different water purveyors (Table 3-1). Four purveyors, the Denville Township Water Department, the Boonton Town Water Department, the Dover Water Company and the Rockaway Borough Water Department, supply over 75 percent of the public water consumed in the RVFPA. The central part of Mine Hill Township and the southeastern portion of Randolph Township are supplied by the Morris County Municipal Utilities Authority from wells outside the basin, but maintenance and operation of the water districts is controlled by the respective municipalities (Figure 3-5).

The combined consumption for the various water purveyors in the RVFPA in 1977 was 37,472 cu m/d (9.9 mgd) and the annual average was 13.8 million cu m (3,656 mg). Approximately 10 percent of this was supplied from well fields outside the basin, particularly from the Almatong well field located in the southwestern corner of Randolph Township. It is also estimated that an additional 17,000 cu m/d (4.5 mgd) is consumed by self-supplied industrial, commercial, and

institutional users and 19,700 cu m/d (5.2 mgd) is derived from self-supplied domestic well pumpage (Tetra-Tech, 1978).

Estimates of per capita consumption were developed from 1976 daily flow rates reported by purveyors and estimates of population served. It is indicated in the Draft New Jersey Statewide Water Supply Master Plan (NJDEP, 1977) that approximately 242 liters per capita daily (64 gallons per capita daily) are consumed in typical indoor household usages, while an additional 38 to 76 lpcd (10 to 20 gpcd) are used for outsoor purposes. Estimated water consumption for the communities within the RVFPA ranged from 276 to 625 lpcd (73 to 165 gpcd) and averaged approximately 473 lpcd (125 gpcd) (Table 3-1).

APPENDIX D

AIR QUALITY

The RVFPA is highly rural or suburban with relatively few major point sources of air contaminants which would significantly affect the air quality of the area (i.e., Whippany Paper and Thatcher Glass Manufacturing). There are other facilities which have the potential to emit more than 91 metric tons (100 short tons) per year of any of the major air contaminants (EPA, 1979b). The major emission sources in the RVFPA are traffic-related (i.e., carbon monoxide, hydrocarbons, and nitrogen oxides from automobiles, trucks, and buses).

The Clean Air Act Amendments of 1977 direct each state to determine the National Ambient Air Quality Standards (NAAQS) attainment status of each of its Air Quality Control Regions (AQCR) or their sub-areas. The air quality and attainment status designations for the various contaminants follow, and ambient air quality data are summarized in Table D-1.

There are many sources of total suspended particulates (TSP), including dust and combustion smoke, ash from the attrition and entrainment of minerals, and other dry materials. The monitors located in or near the RVFPA recorded levels within the TSP standards and the RVFPA is designated as being in attainment.

Fossil fuel-fired power plants are the major sources of sulfur dioxide (SO_2) releases, which usually exert their significant effects for several miles. Recorded levels in the RVFPA are within the SO_2 standards and the entire AQCR is designated as being in attainment.

Nitrogen dioxide (NO_2) is primarily formed in the atmosphere on a regional basis from the nitrogen oxide emitted by vehicular traffic, power plants, and other combustion sources. The monitored levels of NO_2 are within the standard and the entire AQCR is designated as being in attainment.

Carbon monoxide (CO) levels vary markedly with location since they are highly dependent upon proximity to major roadways and parking areas. Monitors located within the cities of Morristown, Paterson, and Somerville recorded many violations of the eight-hour CO standard, but the less developed RVFPA should show few, if any, violations. Although the central business districts of Somerville, Paterson, and Morristown are designated as not meeting the CO standards, the RVFPA is designated as being in attainment.

Hydrocarbon emissions result from incomplete combustion of carbonaceous fuel and industrial process evaporative losses. The major source of man-made hydrocarbons is automobiles. The nearby non

Table D-1

Representative New Jersey Air Quality Data for 1978

Contaminant (Units)	Averaging Period	Location	Mean[1]	Max.	2nd Max.	No > Standard Primary	No > Standard Secondary
TSP ($\mu g/m^3$)	24 hr.	Chester	30.9 (geo)	94	87	0	0
		Florham Park	33.5 "	105	74	0	0
		Dover	44.9 "	163	138	0	1
SO_2 (ppm)	3 hr.	Morristown		0.077	0.070	0	0
		Paterson		0.124	0.117	0	0
		Somerville		0.068	0.068	0	0
	24 hr.	Morristown		0.051	0.047	0	0
		Paterson		0.062	0.058	0	0
		Somerville		0.043	0.041	0	0
	Annual	Morristown		0.009			
		Paterson		0.011			
		Somerville		0.010			
NO_2 (ppm)	Annual	Elizabeth	0.034				
		Newark	0.044				
		Phillipsburg	0.021				
CO (ppm)	1 hr.	Morristown		25.9	24.4	0	0
		Paterson		22.2	21.9	0	0
		Somerville		18.2	15.3	0	0
	8 hr.	Morristown		18.1	14.7	396	81
		Paterson		14.5	10.1	19	6
		Somerville		10.9	10.6	13	3
Lead ($\mu g/m^3$)	3 mo.	Jersey City		2.133	1.030	1	1
		Newark		2.096	1.485	1	1
O_3 (ppm)	1 hr.	Chester		0.185	0.155	5(226)[2]	5(226)[2]
		Somerville		0.133	0.128	4(52)[2]	4(52)[2]
Smokeshade[3] (COH per 1000 lineal feet)	24 hr.	Morristown		1.93	1.83	0	NA
		Paterson		2.58	2.34	0	NA
		Somerville		2.42	2.05	0	NA
	Annual	Morristown	0.73				
		Paterson	0.88				
		Somerville	0.50				

Notes:

1. None of the annual means exceeded either the appropriate primary or secondary standard.

2. The Federal primary standard was recently relaxed to 0.12 ppm. The numbers without parentheses are the excesses of the National primary and secondard standard; the numbers in parentheses are the excesses of the New Jersey primary and secondary standard.

3. The New Jersey alert criterion for air stagnation episodes is 3.0 COH per 1000 lineal foot.

NA = Not Applicable

COH = Coefficent of haze.

Source: NJDEP, 1979

methane hydrocarbon monitors recorded numerous violations of the standard. There is no hydrocarbon attainment status; the national standard is actually a guideline for achieving the oxidant standard.

Ozone constitutes a regional problem attributed primarily to hydrocarbon emissions and subsequent atmospheric transport and reactions. Many violations of the one-hour primary and secondary ozone standards were recorded near the RVFPA. The entire New Jersey-New York-Connecticut Interstate AQCR is designated as not meeting the ozone standard.

Smokeshade is a measure of the fine, dark particulates suspended in the air. These result from stationary and mobile combustion, and other sources as well. It is related to atmospheric visibility. The levels recorded in or near the RVFPA are within the New Jersey alert criterion for air stagnation episodes. There are no federal standards.

APPENDIX E

CULTURAL RESOURCES

1. PREHISTORY

The RVFPA is relatively undeveloped; however, as few intensive archaeological surveys have been conducted in the area, the number of known sites of prehistoric occupation is minimal. The highest densities occur in the vicinity of water courses, lakes, and small brooks. Known densities are especially high along Beaver Brook and the Rockaway River (Figure E-1).

Human occupation of the whole Passaic River Basin, including the RVFPA, began with small groups of hunter-gatherers of the Paleo-Indian Tradition circa 11,000 B.C. in an environment characterized by coniferous forests (similar to those found today in Canada) and open park-tundra (Newman and Salwen, 1977). Excavations within and adjacent to the Passaic River Basin indicate a relatively continuous occupation of the area from Paleo-Indian through Proto-historic times (circa 1700 A.D.).

In contrast to highest densities, which can be expected along water courses and in valleys where occupation tended to be more intensive, smaller hunting sites and nut gathering stations are likely to occur on high well drained ground near brooks and lakes. Some upland sites can be expected in the oak-hickory forest. At least six rock shelters showing positive proof of cultural succession have been identified in Morris County on the borders of the study area near Boonton (Williams, 1978; Schrabisch, 1909).

Rock shelters, high quality stone outcrops, lower river terraces, and swamp margins exhibit high probability of Paleo-Indian occupation. Swamp margins left by draining glacial lakes were particularly favored sites (Ritchie, 1965). Site locations for later periods are likely to be similar to those of the Paleo-Indian tradition, but with a heavier concentration along the lower river terraces.

2. HISTORY

Historic occupation of the entire Passaic River Basin began with Dutch agricultural settlements. By the beginning of the 18th century they covered the central basin and lower valley. Settlement of the Highlands, in which most of the RVFPA is located, progressed more slowly. Development followed the routes of waterways from the edge of

the Highlands, where rivers spilled down into the central basin. These settlements became highly developed as the 19th century progressed.

The existence of hydropower sites, Highland iron resources, and transportation routes to the east encouraged continued growth throughout the 19th century. Boonton is the largest of these historic settlements within the study area. Several blast furnaces from the Boonton Iron Works and the Split Rock Furnace, the Morris Canal, and numerous homes and public structures from this era remain. Many of these are National Register of Historic Places properties (Table E-1, Figure E-1).

A 17th century settlement has been identified on the Vesco and Seabury properties near Boonton. In addition, a number of 18th century farms were scattered throughout the RVFPA. Some of these are still intact and included in the National Register.

In addition to National Register properties, there are a significant number of sites of state and local interest.

FIGURE E-1
CULTURAL RESOURCES

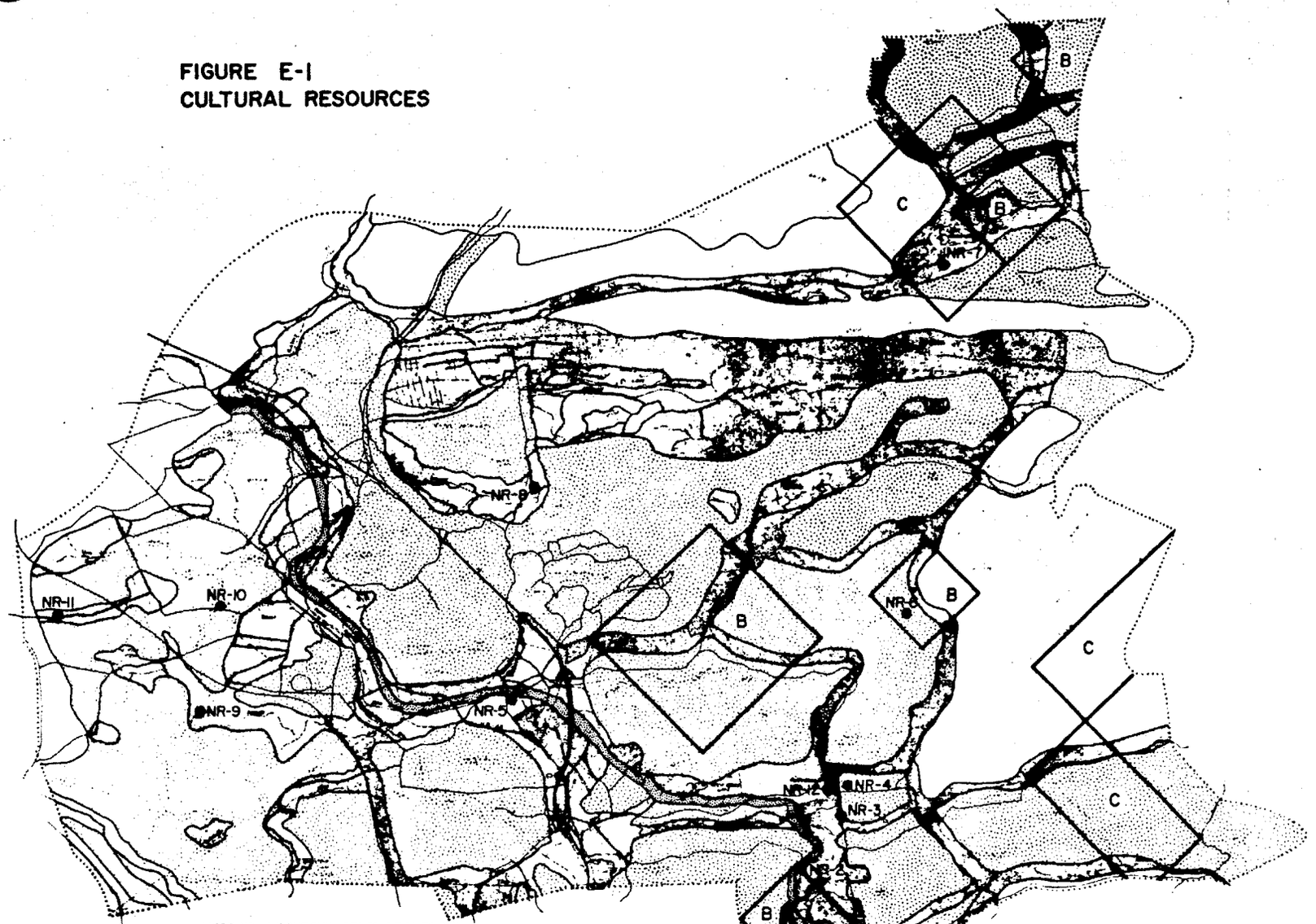


Table E-1

Cultural Resources Inventory

Sites Listed in the National Register of Historic Places

NR-1	Boonton Railroad Station Route 202
NR-2	Morris Canal
NR-3	Rockaway Valley Methodist Church, 1842 Valley Road
NR-4	Dixon Farm. Rockaway Valley Road a. Aaron Miller House, ca 1760 b. Forge Keepers House, ca 1840 c. Dixon's Mill, ca 1800 d. Cyrus Dixon House, ca 1855 e. Barn, ca 1898
NR-5	Col. Joseph Jackson House, Rockaway Borough Public Library late 18th - early 19th century
NR-6	Split Rock Furnace, ca 1790 & 1820 Base of Splitrock Reservoir
NR-7	Alfred T. Ringling Co., ca 1913 Manor Headquarters Alfred T. Ringling Co. Manor R.T. Richards Circus Headquarters
NR-8	Ford Faesch Manor House, "Stone House Farm", ca 1771, Mt. Hope Road
NR-9	Davis Tuttle Cooperage, ca early 19th century
NR-10	Friends Meeting House Quaker Avenue & Quaker Church Road
NR-11	D.L. Bryant Distillery, ca 1869 1547 Sussex Turnpike
NR-12	Adam Miller House, ca 1867 Rockaway Valley Road

Sites Eligible for the National Register of Historic Places

E-1	Boonton Historic District Main, Church, Birch, Cornella and Cedar Streets
E-2	Boonton Iron Works, ca 1831
E-3	Abandoned Railroad Embankment
E-4	Vesco Property
E-5	Seabury Property
E-6	Peers House and Barn, pre-Revolutionary War Lathrop Avenye

Note : Locations of sites are presented in Figure E-1

Sources: Federal Register, February 6, 1979;
Williams, 1978.

APPENDIX F

DETERMINATION OF UPPER LIMIT TO FUTURE GROWTH

Establishment of an upper limit to future growth in the RVFPA is based upon the consideration of expected future household sizes, quantity of developable land, and anticipated development densities. This analysis also includes consideration of environmental factors.

1. ESTIMATED FUTURE AVERAGE HOUSEHOLD SIZES

Average household sizes in the Towns of Boonton and Dover, the Boroughs of Rockaway and Wharton, and the Townships of Mine Hill and Parsippany-Troy Hills have declined steadily during the period 1960-1976 (Table F-1).

With regard to lower limits, the characteristics of residential areas in Mine Hill and Denville Townships indicate that future household sizes are not likely to average below 3.0. At least 90 percent of the total in each community is contained in one and two-family structures (USBC, 1970). Further, as residential construction during the 1970's has been almost exclusively houses of this type (NJDLI, 1970-1975), it is reasonable to assume neighborhoods with this type of housing will attract, to a large extent, families with children. In addition, the area's suburban environment, which has been a factor in attracting young families into the communities, it is likely to be maintained through the application of municipal master plans.

Compared to neighborhoods in other RVFPA municipalities, residential areas in Boonton Town, Dover Town, Rockaway Borough, and Wharton Borough, Parsippany-Troy Hills Township and Randolph Township contain a relatively high percentage (20 to 25) of multi-family structures (USBC, 1970). Based on an average household size of 2.2 persons per multi-family unit, therefore, an overall lower limit of 2.8 is reasonable for household sizes in these communities.

The estimation of single most probable average household size at saturation was based on projections (made by the MCPB) to the year 1990. Specifically, the ratio of county average household size to each municipal average household size between 1940 and 1976 was extrapolated linearly to the year 1990. Projections do not exceed the limits discussed above (Table F-1).

Except for Victory Gardens Borough (no 1960 data available), average household sizes in the remaining seven municipalities (Boroughs of Kinnelon and Mountain Lakes and the Townships of Boonton, Jefferson, Montville, Rockaway and Roxbury) increased between 1960 and 1970 (USBC, 1960, 1970). The 1970 figures are assumed to represent the upper limit in household size. This is based upon:

Table F-1

Average Household Sizes

Municipality	1960	1970	1976[1]	1980[1]	1990[1]
Boonton Town	3.20	3.13	2.94	2.83	2.80[2]
Dover Town	3.30	3.11	2.92	2.81	2.80[2]
Kinnelon Borough	3.73	3.87	3.68	3.59	3.49
Mountain Lakes Borough	3.94	4.06	3.87	3.77	3.67
Rockaway Borough	3.45	3.35	3.16	3.06	2.96
Victory Gardens Borough	NA	3.65	3.46	3.36	3.26
Wharton Borough	3.33	3.21	3.02	2.92	2.82
Boonton Township	3.19	3.38	3.19	3.09	3.00
Denville Township	3.50	3.49	3.30	3.19	3.09
Jefferson Townsip	3.34	3.40	3.21	3.10	3.00
Mine Hill Townsip	3.58	3.51	3.32	3.22	3.12
Montville Township	3.50	3.82	3.63	3.53	3.43
Parsippany Troy Hills Township	3.72	3.25	3.06	2.87	2.77
Randolph Township	3.63	3.47	3.28	3.12	3.02
Rockaway Township	3.63	3.69	3.50	3.39	3.29
Roxbury Township	3.45	3.66	3.47	3.20	3.10
Morris County	3.49	3.40	3.21	3.11	2.83
United States	3.30	3.14	2.92	2.74	2.50

Notes: 1. MCPB estimate.
2. WAPORA estimate.
3. NA - Not available

Source: USBC, 1960, 1970.

1) The decline in average household size in each of these municipalities (including Victory Gardens) since 1970;
2) The projected decline in County and national future average household size trends are projected over the long term future.

For the same reasons future household sizes are not likely to average below 3.0 discussed for the Townships of Mine Hill and Denville.

Household size averages at saturation for the remaining eight municipalities were based on projections made by the MCPB. These figures were considered reasonable as the projections do not exceed the average household size limits developed above. Further, they reflect long term declining county and national trends.

2. ESTIMATED AMOUNT OF DEVELOPABLE LAND

A detailed analysis of current existing land use (Table F-2) and zoning maps for each of the 16 municipalities in the RVFPA indicates that the net amount of undeveloped land zoned for residential development, exclusive of environmentally constrained land, is approximately 6,460 ha (15,960 a) (Table F-3). A net ha (a) is defined as a gross ha (a) minus land used for streets; the determination of a net hectare (acre) for residential, commercial, and industrial land uses is based upon existing development patterns in each municipality (Table F-4). This figure includes 170 ha (420 a) in commercial and mining zones which may be developed for residential use. Approximately two-thirds of the 6,460 ha (15,960 a), (i.e. 4,232 ha (10,461 a)) may be developed at densities no greater than 2.5 hu/ha (1.0 hu/a). Zoning covering the remaining land (with the exception of 9 ha (23 a)) permits development densities ranging between 2.7 and 24.7 hu/ha (1.0 and 10.0 hu/a).

3. EXISTING NUMBER OF MAXIMUM HOUSING UNITS AT SATURATION DEVELOPMENT

To determine the maximum number of housing units in each RVFPA municipality at saturation development, the boroughs, towns and townships were initially divided into two residential land categories. They are:

1) Existing developed land areas; and
2) Undeveloped land, zoned for residential use.

Each is estimated to have different development potential.

4. EXISTING DEVELOPED RESIDENTIAL AREAS

Examination of 1970 census data for housing and observations from a field survey of residential neighborhoods in the RVFPA indicate the area's overall housing stock is in good condition. Significant redevelopment of these neighborhoods in unlikely. Therefore, it is reasonable to assume the estimated number of housing units located in

Table F-2

Land Use in the Rockaway Valley Facility Planning Area[1]

Category	Boonton Town[a]		Dover Town[b]		Kinnelon Borough[2c]	
	Developed	Undeveloped	Developed	Undeveloped	Developed	Undeveloped
Residential	210 (530)	50 (130)	300 (750)	20 (50)	110 (280)	920 (2280)
Commercial	10 (30)	10 (20)	40 (110)	0 (0)	0 (0)	0 (0)
Industrial	30 (70)	20 (60)	70 (160)	20 (60)	0 (0)	50 (130)
Public & Semi-Public	70 (180)	0 (0)	60 (140)	0 (0)	30 (70)	0 (0)
Parks & Open Spaces	0 (0)	40 (100)	0 (0)	80 (190)	0 (0)	130 (310)
Streets	100 (240)	30 (70)	120 (300)	10 (30)	40 (90)	310 (770)
Railroads/ Utilities	10 (30)	0 (0)	10 (30)	0 (0)	0 (0)	0 (0)
Water	0 (0)	40 (90)	0 (0)	0 (10)	0 (0)	80 (200)
TOTAL[3]	430 (1080)	190 (470)	600 (1490)	130 (340)	180 (440)	1490 (3690)

Note: 1. Units are in gross ha (gross a) except residential, commercial, and industrial categories which are in net ha (net a) (see Appendix F). Numbers are rounded to nearest 10 ha(a).
2. RVFPA
3. Sums may not be precise due to rounding and/or metric conversions.

Sources: a. BTPB, 1974
b. DTPB, 1976
c. KBPB, 1978

Table F-2 (continued)

Land Use in the RVFPA [1]

Category	Mountain Lakes Borough [2a]		Rockaway Borough [b]		Victory Gardens Borough [c]	
	Developed	Undeveloped	Developed	Undeveloped	Developed	Undeveloped
Residential	70 (180)	0 (0)	130 (310)	40 (90)	20 (60)	0(10)
Commercial	0 (0)	0 (0)	20 (50)	20 (50)	0 (0)	0 (0)
Industrial	0 (10)	0 (0)	20 (50)	70 (170)	0 (0)	0 (0)
Public & Semi-Public	30 (70)	0 (0)	40 (90)	0 (0)	0 (0)	0 (0)
Parks & Open Spaces	0 (0)	40 (90)	0 (0)	0 (0)	0 (0)	0 (0)
Streets	20 (50)	0 (0)	50 (130)	30 (70)	10 (20)	0 (0)
Railroads/ Utilities	0 (10)	0 (0)	0 (10)	0 (0)	0 (0)	0 (0)
Water	0 (0)	10 (20)	0 (0)	10 (20)	0 (0)	0 (0)
TOTAL [3]	120 (320)	50 (110)	260 (640)	170 (400)	30 (80)	0(10)

Note: 1. Units are in gross ha (gross a) except residential, commercial, and industrial categories which are in net ha (net a) (see Appendix F). Numbers are rounded to nearest 10 ha (a).
2. RVFPA portion.
3. Sums may not be precise due to rounding and/or metric conversions.

Sources: a. MLBPB, 1978
b. RBPB, 1978
c. VGBPB, 1976

Table F-2(continued)

Land Use in the RVFPA [1]

Category	Wharton Borough[a]		Boonton Township[b]		Denville Township[c]	
	Developed	Undeveloped	Developed	Undeveloped	Developed	Undeveloped
Residential	130 (330)	60 (150)	590 (1460)	1060 (2620)	960 (2360)	1100 (2730)
Commercial	20 (40)	0 (0)	0 (10)	0 (0)	30 (80)	100 (250)
Industrial	40 (100)	140 (340)	70 (170)	0 (10)	50 (130)	170 (410)
Public & Semi-Public	10 (30)	0 (0)	160 (400)	0 (0)	300 (740)	0 (0)
Parks & Open Spaces	0 (0)	30 (70)	0 (0)	90 (220)	0 (0)	140 (340)
Streets	40 (110)	30 (70)	70 (180)	120 (290)	230 (560)	230 (570)
Railroads/ Utilities	20 (40)	0 (0)	0 (0)	0 (0)	40 (100)	0 (0)
Water	0 (0)	20 (40)	0 (0)	60 (140)	0 (0)	160 (400)
TOTAL[2]	260 (650)	280 (670)	890 (2220)	1330 (3280)	1610 (3970)	1900 (4700)

Note: 1. Units are in gross ha (gross a) except residential, commercial, and industrial categories which are in net ha (net a) (see Appendix F). Numbers are rounded to nearest 10 ha(a).
2. Sums may not be precise due to rounding and/or metric conversions.

Sources: a. WBPB, 1978
b. BTPPB, 1979
c. DeTPB, 1975

Table F-2 (continued)

Land Use in the RVFPA [1]

Category	Jefferson Township [2a]		Mine Hill Township [2b]		Montville Township [2c]	
	Developed	Undeveloped	Developed	Undeveloped	Developed	Undeveloped
Residential	810 (1990)	3200 (7910)	160 (390)	150 (360)	40 (90)	320 (780)
Commercial	50 (120)	250 (610)	0 (10)	0 (0)	0 (0)	0 (0)
Industrial	10 (20)	210 (530)	0 (10)	220 (540)	10 (20)	30 (70)
Public & Semi-Public	320 (780)	0 (0)	10 (30)	0 (0)	0 (0)	0 (0)
Parks & Open Spaces	0 (0)	700 (1720)	0 (0)	70 (170)	0 (0)	0 (10)
Streets	100 (250)	410 (1010)	40 (100)	60 (150)	10 (20)	60 (150)
Railroads/ Utilities	20 (50)	0 (0)	40 (90)	0 (0)	0 (0)	0 (0)
Water	0 (0)	120 (290)	0 (0)	0 (10)	0 (0)	0 (10)
TOTAL [3]	1310 (3210)	4890 (12,070)	250 (630)	500 (1230)	60 (130)	410 (1020)

Notes: 1. Units are in gross ha (gross a) except residential, commercial, and industrial categories which are in net ha (net a) (see Appendix F). Numbers are rounded to nearest 10 ha(a).
2. RVFPA.
3. Sums may not be precise due to rounding out/or metric conversions.

Sources: a. JTPB, 1978
b. MHTPB, 1977
c. MTPB, 1976

Table F-[illegible]ontinued)

Land Use in the RVFPA[1]

Category	Parsippany-Troy Hills Township[2a]		Randolph Township[2b]		Rockaway Township[2c]	
	Developed	Undeveloped	Developed	Undeveloped	Developed	Undeveloped
Residential	60 (140)	30 (80)	960 (2380)	1090 (2690)	960 (2360)	2990 (7400)
Commercial	0 (0)	0 (0)	70 (180)	40 (90)	60 (160)	120 (300)
Industrial	0 (0)	0 (0)	90 (220)	200 (490)	220 (550)	660 (1640)
Public & Semi-Public	0 (0)	0 (0)	200 (500)	0 (0)	2530 (6250)	0 (0)
Parks & Open Spaces	0 (0)	30 (80)	0 (0)	280 (680)	0 (0)	1280 (3150)
Streets	10 (30)	10 (20)	190 (470)	220 (560)	310 (770)	850 (2110)
Railroads/ Utilities	0 (0)	0 (0)	50 (110)	0 (0)	150 (370)	0 (0)
Water	0 (0)	0 (0)	0 (0)	30 (80)	0 (0)	690 (1710)
TOTAL[3]	70 (170)	70 (180)	1560 (3860)	1860 (4590)	4230 (10460)	6590 (16310)

Notes: 1. Units are in gross ha (gross a) except residential, commercial, and industrial categories which are in net ha (net a) (See Appendix F). Numbers are rounded to nearest 10 ha (a).
2. RVFPA portion.
3. Sums may not be precise due to rounding and/or metric conversions.

Sources: a. PTHTPB, 1976
b. RaTPB, 1979
c. RTPB, 1976

Table F-2 (continued)

Land Use in the RVFPA[1]

Category	Roxbury Township[2a] Developed	Roxbury Township[2a] Undeveloped	Total Developed	Total Undeveloped
Residential	30 (80)	210 (530)	5540 (13,690)	11,240 (27,810)
Commercial	0 (0)	0 (0)	300 (790)	540 (1,320)
Industrial	30 (80)	370 (920)	640 (1,590)	2160 (5,370)
Public & Semi-Public	0 (10)	0 (0)	3760 (9,290)	0 (0)
Parks & Open Spaces	0 (0)	420 (1030)	0 (0)	3330 (8160)
Streets	40 (90)	90 (230)	1380 (3410)	2460 (6100)
Railroads/ Utilities	50 (130)	0 (0)	390 (970)	0 (0)
Water	0 (0)	0 (0)	0 (0)	1220 (3020)
TOTAL[3]	150 (390)	1090 (2710)	12,010 (29,740)	20,950 (51,780)

Notes: 1. Units are in gross ha (gross a) except residential, commercial, and industrial categories which are in net ha (net a) (see Appendix F). Numbers are rounded to nearest 10 ha (a).

2. RVFPA portion

3. Sums may not be precise due to rounding and/or metric onversions.

Sources: a. RxTPB, 1977

Table F-3

Estimated Developable Vacant Hectares (Acres) by Permitted Residential Density

Municipality	Maximum Permitted Densities hu/ha (hu/a)					Total
	2.5 (1.0) or less	2.7 (1.1) to 4.9 (2.0)	5.2 (2.1) to 9.9 (4.0)	10.1 (4.1) to 24.7 (10.0)	25.0 (10.1) or greater	
Boonton Town	0 (0)	0 (0)	0 (0)	47 (115)	1 (3)	48 (118)
Dover Town	0 (0)	0 (0)	0 (0)	12 (30)	1 (3)	13 (33)
Kinnelon Borough [1]	642 (1586)	0 (0)	0 (0)	0 (0)	0 (0)	642 (1586)
Mountain Lakes Borough [1]	0 (0)	0 (0)	1 (3)	0 (0)	0 (0)	1 (3)
Rockaway Borough	0 (0)	0 (0)	26 (65)	8 (18)	0 (0)	34 (83)
Victory Gardens Borough	0 (0)	0 (0)	0 (0)	0 (0)	1 (3)	1 (3)
Wharton Borough	0 (0)	0 (0)	33 (81)	6 (17)	3 (7)	42 (105)
Boonton Township	376 (930)	78 (194)	31 (76)	0 (0)	0 (0)	485 (1200)
Denville Township	158 (391)	397 (979)	38 (93)	1 (4)	0 (0)	594 (1467)
Jefferson Township [1]	1053 (2603)	510 (1260)	0 (0)	0 (0)	0 (0)	1563 (3863)
Mine Hill Township [1]	0 (0)	77 (190)	26 (65)	8 (21)	3 (7)	114 (283)
Montville Township [1]	139 (343)	17 (41)	7 (17)	0 (0)	0 (0)	163 (401)
Parsippany-Troy Hills Twp. [1]	0 (0)	8 (20)	12 (31)	0 (0)	0 (0)	20 (51)
Randolph Township [1]	506 (1252)	165 (407)	26 (64)	0 (0)	0 (0)	697 (1723)
Rockaway Township [1]	1358 (3356)	94 (231)	348 (859)	76 (188)	0 (0)	1876 (4634)
Roxbury Township [1]	0 (0)	165 (409)	0 (0)	0 (0)	0 (0)	165 (409)
Total [2]	4232 (10,461)	1511 (3731)	548 (1354)	158 (393)	9 (23)	6458 (15,962)

NOTE: 1. RVFPA
2. Sums may not be precise due to rounding and/or metric conversions.

Table F-4

Determination of Net Hectare (Acre) Percentages

Municipality	Percent of Gross Hectare (Acre) Excluded for Streets by Use		
	Residential	Commercial	Industrial
Boonton Town[a]	25	25	10
Dover Town[b]	25	25	10
Kinnelon Borough[c]	25	25	10
Mountain Lakes Borough[d]	20	20	10
Rockaway Borough[e]	25	25	10
Victory Gardens Borough[f]	25	25	10
Wharton Borough[g]	15	15	10
Boonton Township[h]	10	10	10
Denville Township[i]	15	15	10
Jefferson Township[j]	10	10	10
Mine Hill Township[k]	20	20	10
Montville Township[l]	15	15	10
Parsippany-Troy Hills Township[m]	20	20	10
Randolph Township[n]	15	15	10
Rockaway Township[o]	20	20	10
Roxbury Township[p]	20	20	10

Sources:
a. BTPB, 1974.
b. DTPB, 1976.
c. KBPB, 1978.
d. MLBPB, 1978.
e. RBPB, 1978.
f. VGBPB, 1976.
g. WBPB, 1979.
h. BTpPB, 1979.
i. DeTPB, 1975.
j. JTPB, 1978.
k. MHTPB, 1977.
l. MTPB, 1976.
m. PTHTPB, 1976.
n. RaTPB, 1979.
o. RTPB, 1976.
p. RxTPB, 1977.

existing residential areas will be maintained over the long-term future (Table F-5).

5. UNDEVELOPED LAND, ZONED FOR RESIDENTIAL USE

The second category of residential land includes all undeveloped residential land zoned at a variety of densities (Table F-3). Because of zoning requirements throughout the RVFPA for large minimum size building lots, development densities have historically equalled maximum densities permitted under each municipality's zoning regulations. Further, residential developments which are currently being constructed or which are proposed for the near future (within two years) indicates that historical density trends are being maintained (Zabihach, MCPB, September 19, 1979). The number of housing units which may be constructed on vacant, developable, residential land for each municipality are presented in Table F-6. The addition of existing and potential housing units yields the maximum number of housing units which may be constructed in each municipality.

6. CONCLUSION

The product of average household size and the total number of housing units at saturation development yields saturation population for an area. Saturation populations for each RVFPA municipality (considering existing zoning regulations and environmental constraints) are presented in Table F-7.

Table F-5

Existing Average Development Density
Characteristics in the Rockaway Valley Facility Planning Area

Municipality	Residential Land Developed net ha	(net a)	Existing hu	Average Density hu/ha	(hu/a)
Boonton Town	210	(530)	3032	14.1	(5.7)
Dover Town	300	(750)	4992	16.6	(6.7)
Kinnelon Borough [1]	110	(280)	640	5.7	(2.3)
Mountain Lakes Borough [1]	70	(180)	305	4.2	(1.7)
Rockaway Borough	130	(310)	2058	16.3	(6.6)
Victory Gardens Borough	20	(60)	378	15.6	(6.3)
Wharton Borough	130	(330)	1790	13.3	(5.4)
Boonton Township	590	(1460)	1011	1.7	(0.7)
Denville Township	960	(2360)	4473	4.7	(1.9)
Jefferson Township [1]	810	(1990)	3130	4.0	(1.6)
Mine Hill Township [1]	160	(390)	994	6.4	(2.6)
Montville Township [1]	40	(90)	96	2.7	(1.1)
Parsippany-Troy Hills T. [1]	60	(140)	367	6.4	(2.6)
Randolph Township [1]	960	(2380)	4010	4.2	(1.7)
Rockaway Township [1]	960	(2360)	5814	6.2	(2.5)
Roxbury Township [1]	30	(80)	334	10.4	(4.2)
Total [2]	5540	(13,690)	33424	5.9	(2.4)

Note: 1. RVFPA portion.
2. Sums may not be precise due to rounding and/or metric conversions.

Sources: USBC, 1970; NJDLI, 1969-1974.

Table F-6

Estimation of Total Housing Units at Saturation Development

Municipality	Number of Existing Hu[1] in 1975	Number of Potential Hu on Vacant Land Suitable for Resid. Development[a]	Number of Total Hu at Saturation Development[b]
Boonton Town	3,032	958	3,990
Dover Town	4,992	309	5,301
Kinnelon Borough[2]	640	1,110	1,750
Mountain Lakes Borough[2]	305	9	314
Rockaway Borough	2,058	266	2,324
Victory Gardens Borough	378	30	408
Wharton Borough	1,790	385	2,175
Boonton Township	1,011	882	1,893
Denville Township	4,473	1,595	6,068
Jefferson Township[2]	3,130	2,766	5,896
Mine Hill Township	994	713	1,707
Montville Township[2]	96	242	338
Parsippany-Troy Hills Township[2]	367	112	479
Randolph Township[2]	4,010	1,983	5,993
Rockaway Township[2]	5,814	6,225	12,039
Roxbury Township[2]	334	545	879
RVFPA Total[3]	33,424	18,130	51,554

Notes: 1. Hu = Housing Units
2. RVFPA portion
3. Sums may not be precise due to roundin-

Sources: a. NJDLI, 1969-1974.
b. Estimated.

Table F-7

Computation of Constrained Saturation Population

Municipality	Existing Housing Units (1975)	Maximum Potential Housing Units on Total Developable Vacant Land (Excluding Environmentally Constrained Land)				Total Potential Housing Units	Average Household Size	Constrained Saturation Population
		Zoning Category	Maximum Development Density hu/ha (hu/a)	Net Vacant Land ha(a)	Potential New Housing Units			
Column A	Column B	Column C	Column D	Column E	Column F (Col. DxE)	Column G (Col. B+E)	Column H	Column I (Col. GxH)
Boonton Town	3032	R-1A R-2A R-2B R-3A B-4 Subtotal	19.8 (8.0) 19.8 (8.0) 17.3 (7.0) 34.6 (14.0) 34.6 (14.0)	44 (108) 1 (3) 2 (4) 0 (1) 1 (2) 48 (118)	864 24 28 14 28 958	3990	2.80	11,122
Dover Town	4992	R-1 C-1 Subtotal	14.3 (5.8) 111.2 (45.0)	12 (30) 1 (3) 13 (33)	174 135 309	5301	2.80	14,843
Kinnelon Borough*	640	R Subtotal	1.7 (0.7)	642 (1586) 642 (1586)	1110 1110	1750	3.49	6108
Mountain Lakes Borough*	305	R-A Subtotal	7.2 (2.9)	1 (3) 1 (3)	9 9	314	3.67	1152

NOTE: *RVFPA portion.

Table F-7 (continued)

Computation of Constrained Saturation Population

Municipality	Existing Housing Units (1975)	Maximum Potential Housing Units on Total Developable Vacant Land (Excluding Environmentally Constrained Land)				Total Potential Housing Units	Average Household Size	Constrained Saturation Population
		Zoning Category	Maximum Development Density hu/ha (hu/a)	Net Vacant Land ha(a)	Potential New Housing Units			
Column A	Column B	Column C	Column D	Column E	Column F (Col.DxE)	Column G (Col. B+E)	Column H	Column I(Col.GxH.)
Rockaway Borough		R-1A	5.4 (2.2)	15 (36)	79			
		R-1	7.2 (2.9)	8 (21)	61			
		R2	10.9 (4.4)	4 (9)	40			
		R3	17.3 (7.0)	4 (9)	63			
		O-B	7.2 (2.9)	3 (8)	23			
	2058	Subtotal		34 (83)	266	2324	2.96	6879
Victory Gardens Borough		MF	25.0 (10.1)	1 (3)	30			
	378	Subtotal		1 (3)	30	408	3.26	1330
Wharton Borough		R-1	5.4 (2.2)	31 (77)	169			
		R-100	8.6 (3.5)	2 (4)	14			
		R-65	14.3 (5.8)	4 (11)	64			
		RM-65	21.5 (8.7)	2 (5)	44			
		A	30.9 (12.5)	3 (7)	88			
		P	14.3 (5.8)	0 (1)	6			
	1790	Subtotal		42 (105)	385	2175	2.82	6134

NOTE: [a]RVFPA portion.

Table F-7 (continued)

Computation of Constrained Saturation Population

Municipality	Existing Housing Units (1975)	Maximum Potential Housing Units on Total Developable Vacant Land (Excluding Environmentally Constrained Land)				Total Potential Housing Units	Average Household Size	Constrained Saturation Population
		Zoning Category	Maximum Development Density hu/ha (hu/a)	Net Vacant Land ha(a)	Potential New Housing Units			
Column A	Column B	Column C	Column D	Column E	Column F (Col. DxE)	Column G (Col. B+E)	Column H	Column I (Col. GxH)
Boonton Township	1011	R-1	1.2 (0.5)	376 (930)	465	1893	3.00	5679
		R-2	2.7 (1.1)	42 (105)	116			
		R-3	3.7 (1.5)	36 (89)	134			
		R-4	5.4 (2.2)	31 (76)	167			
		Subtotal		485(1200)	882			
Denville Township	4473	R-C	2.7 (1.1)	164 (404)	444	6068	3.09	18,750
		R-1	2.7 (1.1)	233 (575)	633			
		R-2	7.2 (2.9)	30 (73)	212			
		R-2A	9.6 (3.9)	8 (20)	78			
		R-3	14.3 (5.8)	0 (1)	6			
		R-4	21.5 (8.7)	1 (3)	26			
		C	1.2 (0.5)	158 (391)	196			
		Subtotal		594(1467)	1595			
Jefferson Township*	3130	R-E	0.7 (0.3)	700(1730)	519	5896	3.00	17,688
		R-1	1.7 (0.7)	353 (873)	611			
		R-2	2.7 (1.1)	172 (424)	466			
		R-3	3.5 (1.4)	338 (836)	1170			
		Subtotal		1563(3863)	2766			

NOTE: *RVFPA portion.

Table F-7 (continued)

Computation of Constrained Saturation Population

Municipality	Existing Housing Units (1975)	Maximum Potential Housing Units on Total Developable Vacant Land (Excluding Environmentally Constrained Land)				Total Potential Housing Units	Average Household Size	Constrained Saturation Population
		Zoning Category	Maximum Development Density hu/ha (hu/a)	Net Vacant Land ha(a)	Potential New Housing Units			
Column A	Column B	Column C	Column D	Column E	Column F (Col. DxE)	Column G (Col. B+E)	Column H	Column I(Col. GxH)
Mine Hill Township*		R-130	2.7 (1.1)	46 (114)	125			
		R-60	2.7 (1.1)	31 (76)	84			
		R-30	7.2 (2.9)	26 (65)	189			
		R-GA	24.7 (10.0)	8 (21)	210			
		R-SR	37.1 (15.0)	3 (7)	105			
	994	Subtotal		114 (283)	713	1707	3.12	5326
Montville Township*		R-1	1.0 (0.4)	139 (343)	137			
		R-3	4.0 (1.6)	17 (41)	66			
		R-4	5.4 (2.2)	6 (15)	33			
		R-5	7.2 (2.9)	1 (2)	6			
	96	Subtotal		163 (401)	242	338	3.43	1159
Parsippany-Troy Hills Township*		R-1	2.7 (1.1)	8 (20)	22			
		R-3	7.2 (2.9)	12 (31)	90			
	367	Subtotal		20 (51)	112	479	2.77	1327

NOTE: *RVFPA portion.

Table F-7 (continued)

Computation of Constrained Saturation Population

Municipality	Existing Housing Units (1975)	Maximum Potential Housing Units on Total Developable Vacant Land (Excluding Environmentally Constrained Land)				Total Potential Housing Units	Average Household Size	Constrained Saturation Population
		Zoning Category	Maximum Development Density hu/ha (hu/a)	Net Vacant Land ha(a)	Potential New Housing Units			
Column A	Column B	Column C	Column D	Column E	Column F (Col. DxE)	Column G (Col. B+E)	Column H	Column I (Col. GxH)
Randolph Township[1]		RLD-3	0.7 (0.3)	85 (210)	63			
		R-1	2.5 (1.0)	421 (1042)	1042			
		R-2	4.2 (1.7)	165 (407)	692			
		R-3	7.2 (2.9)	26 (64)	186			
	4010	Subtotal		697 (1723)	1983	5993	3.02	18,099
Rockaway Township[1]		R-88	1.2 (0.5)	1138 (2813)	1407			
		R-44	2.5 (1.0)	71 (175)	175			
		R-25	4.2 (1.7)	94 (231)	393			
		R-20	5.4 (2.2)	130 (322)	708			
		R-15	7.2 (2.9)	196 (483)	1401			
		R-13	8.4 (3.4)	22 (54)	184			
		R-6	18.0 (7.3)	5 (13)	95			
		RMF	24.7 (10.0)	56 (139)	1390			
		OR	20.0 (8.0)	15 (36)	288			
	5814	M	1.2 (0.5)	149 (368)	184	12,039	3.29	39,608
		Subtotal		1876 (4634)	6225			
Roxbury Township[1]		OS/GU	2.7 (1.1)	101 (250)	275			
		R-2	4.2 (1.7)	64 (159)	270			
	334	Subtotal		165 (409)	545	879	3.10	2725
RVFPA Total[2]	33,424			6458 (15962)	18,130	51,554		157,979

NOTE: 1.RVFPA portion.
2.Sums may not be precise due to rounding and/or metric conversions.

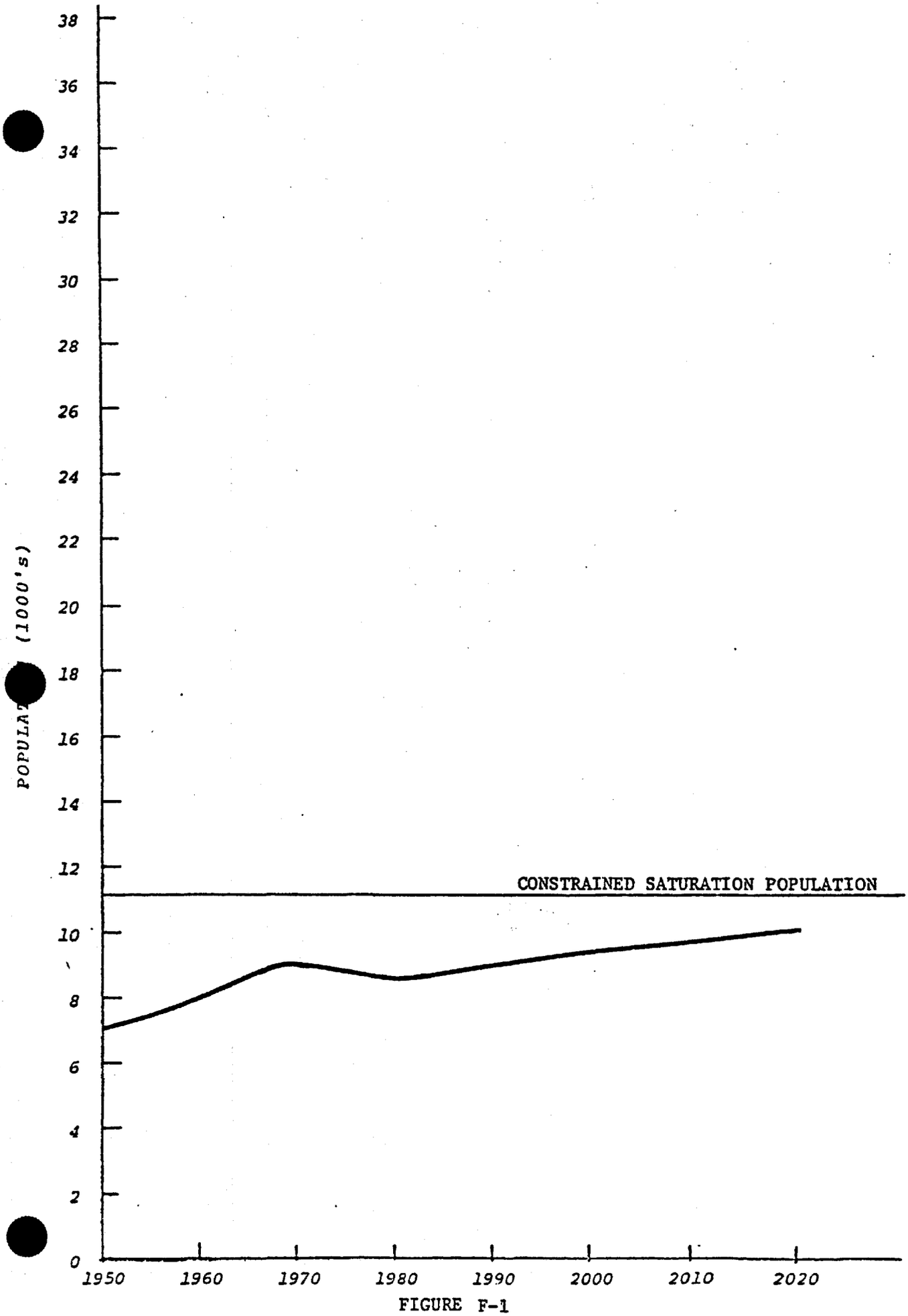


FIGURE F-1

POPULATION GROWTH CURVE FOR BOONTON TOWN

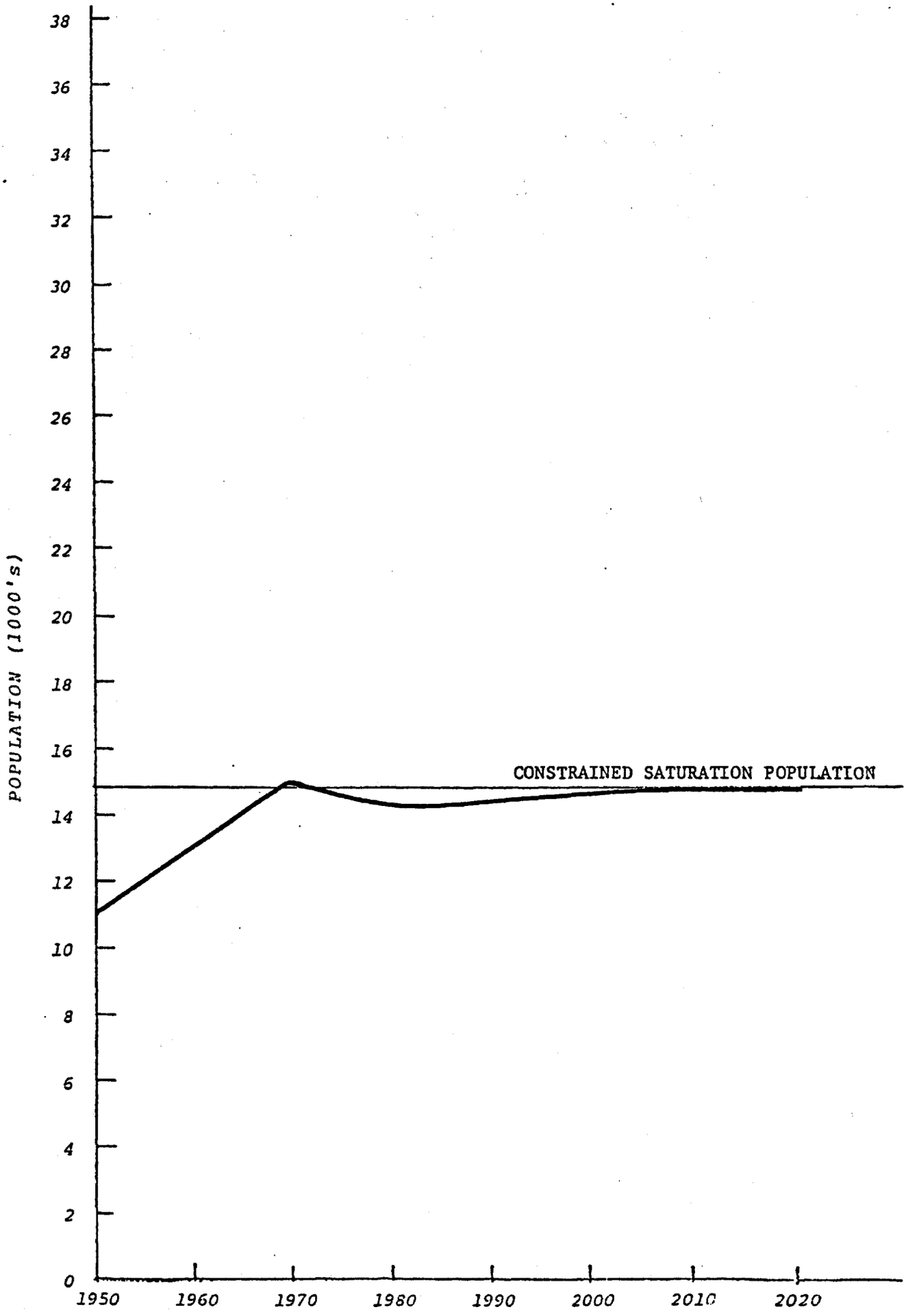


FIGURE F-2

POPULATION GROWTH CURVE FOR DOVER TOWN

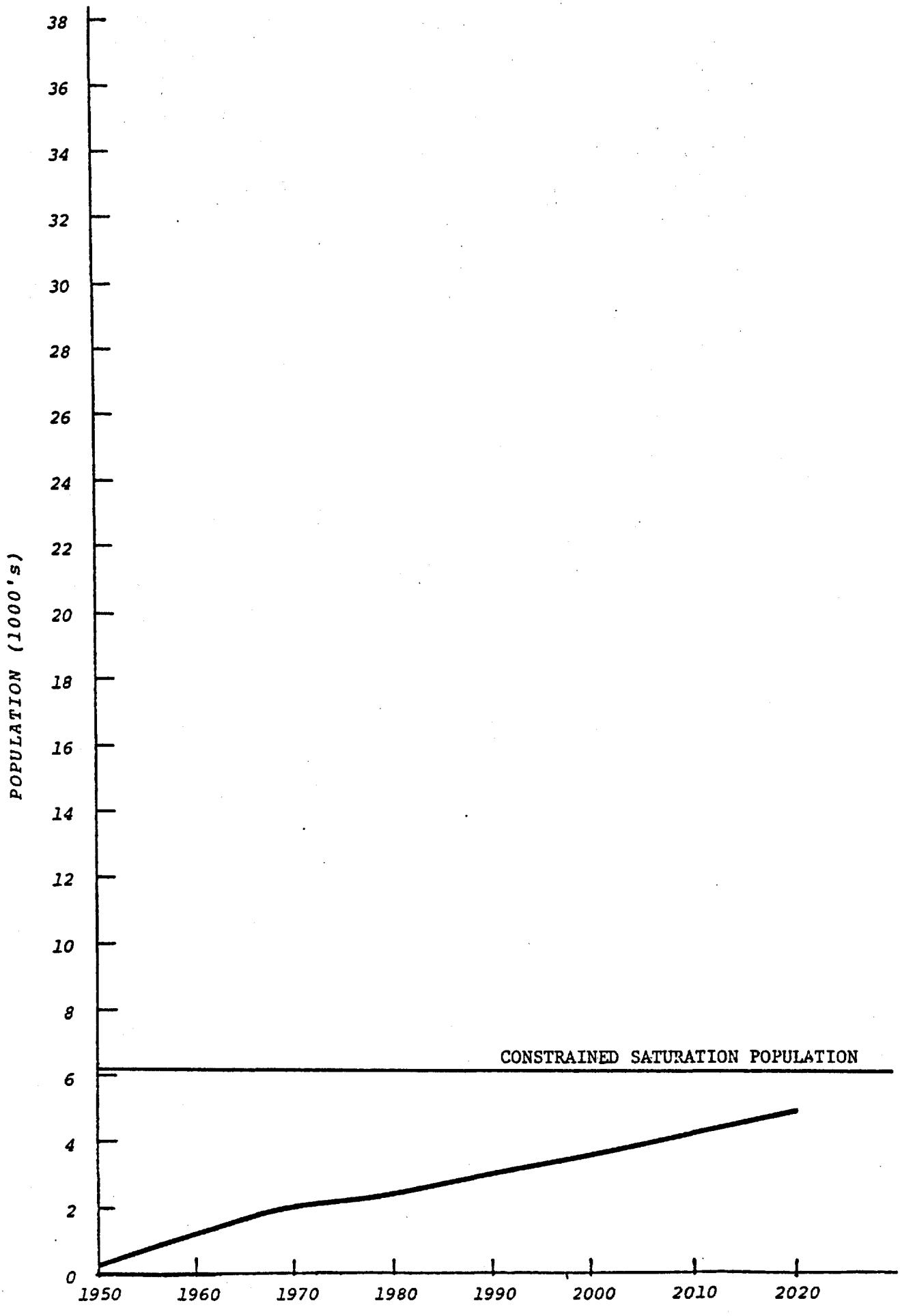


FIGURE F-3

POPULATION GROWTH CURVE FOR KINNELON BOROUGH (RVFPA PORTION)

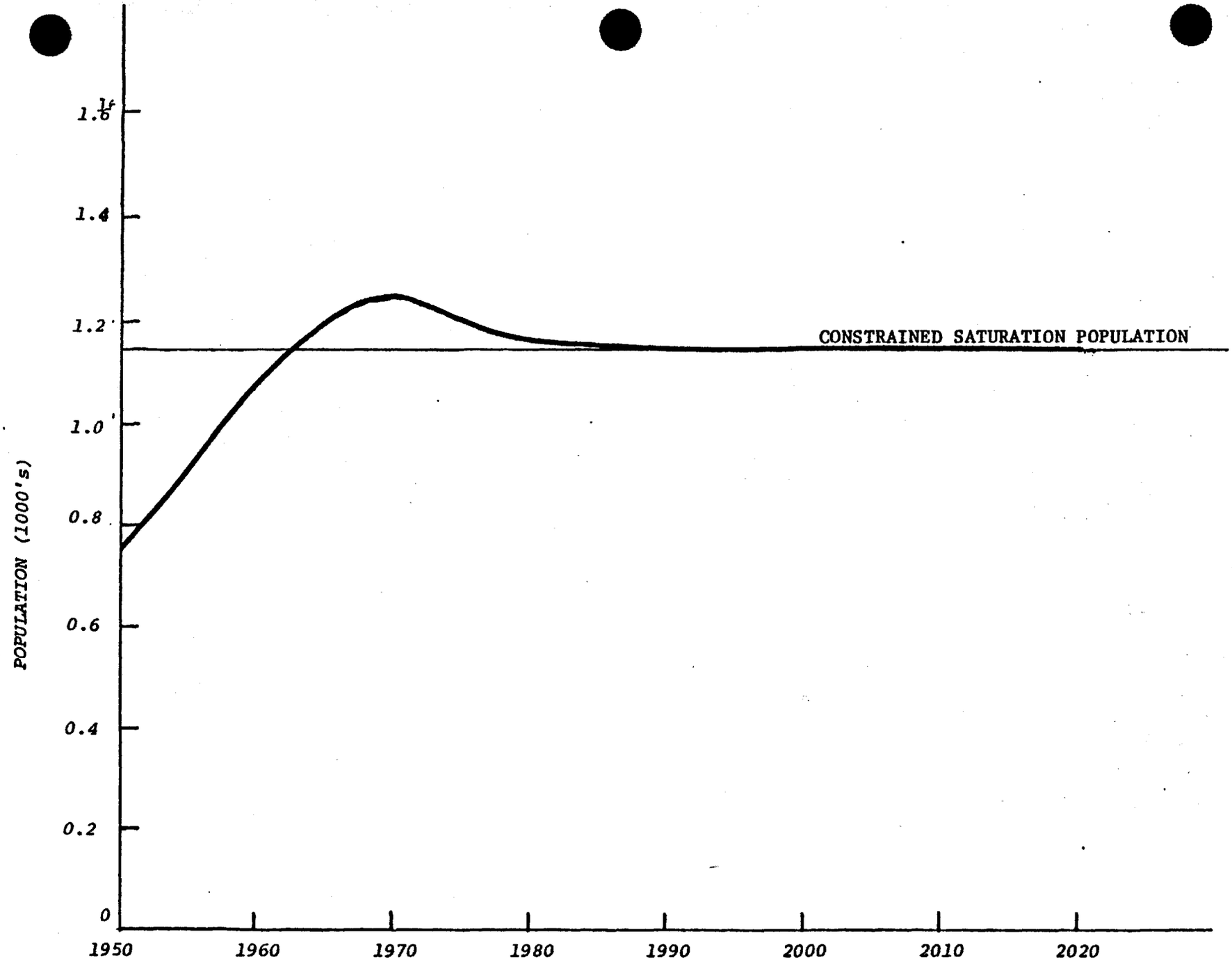


FIGURE F-4

POPULATION GROWTH CURVE FOR MOUNTAIN LAKES BOROUGH (RVFPA PORTION)

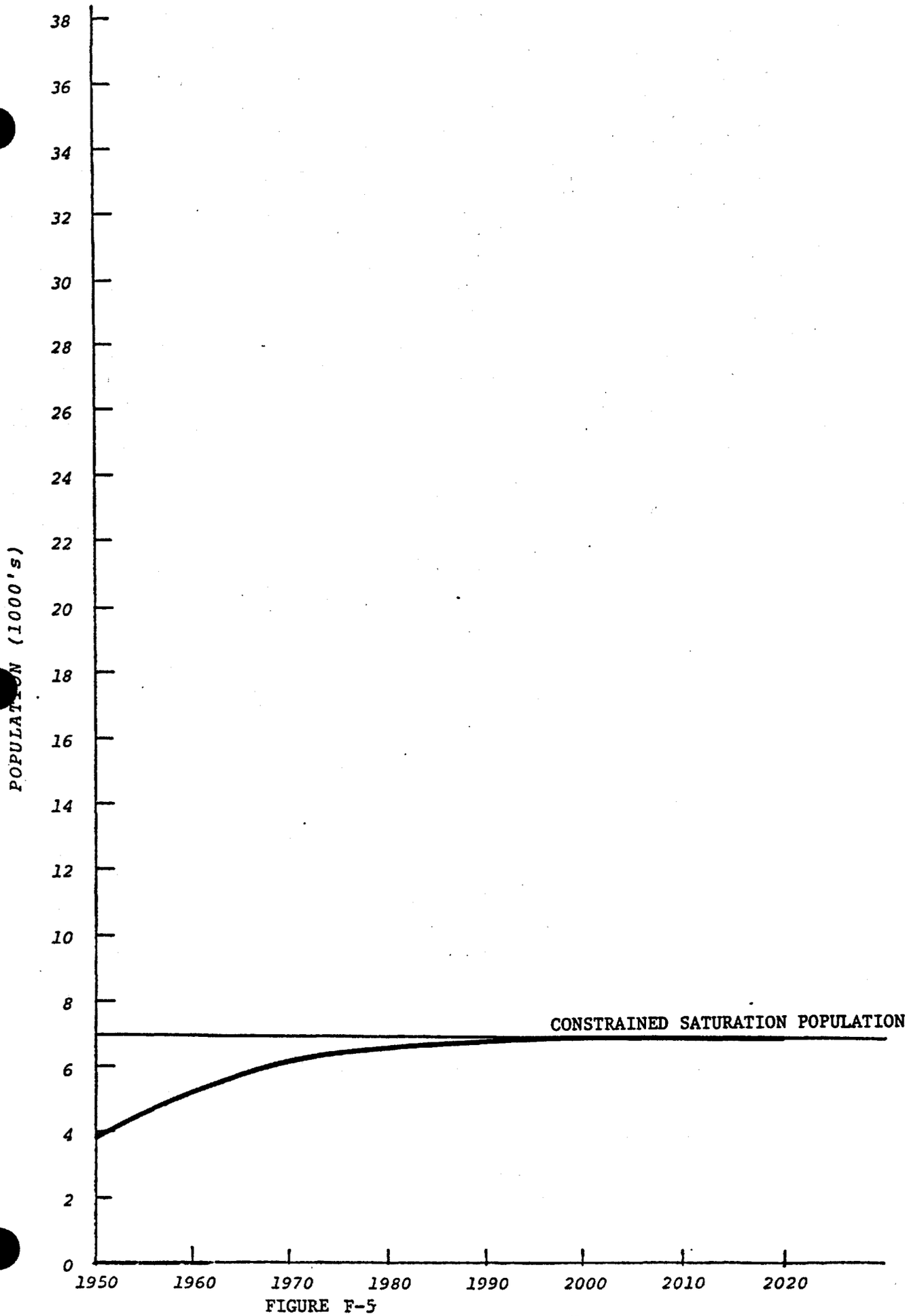


FIGURE F-5

POPULATION GROWTH CURVE FOR ROCKAWAY BOROUGH

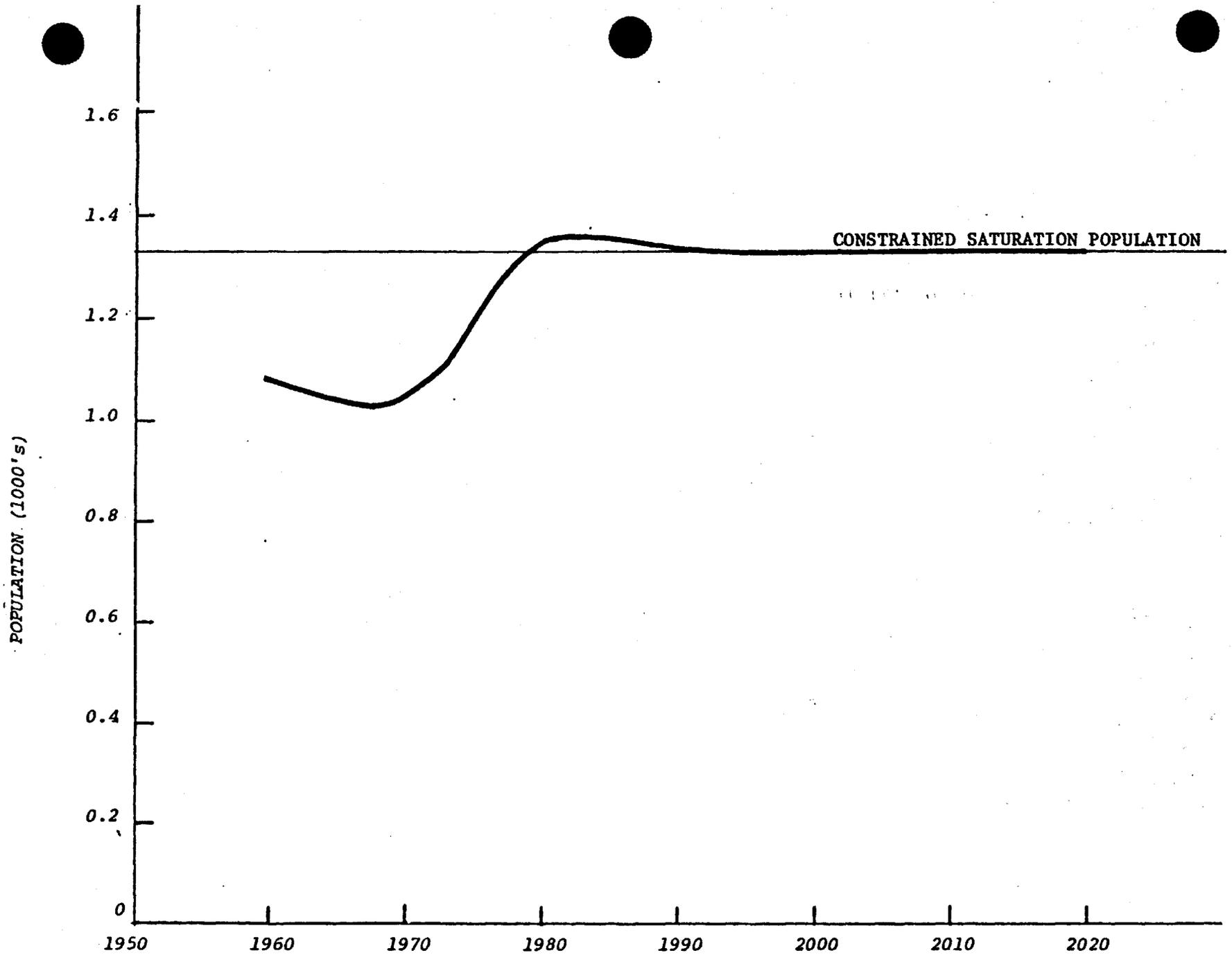


FIGURE F-6

POPULATION GROWTH CURVE FOR VICTORY GARDENS BOROUGH

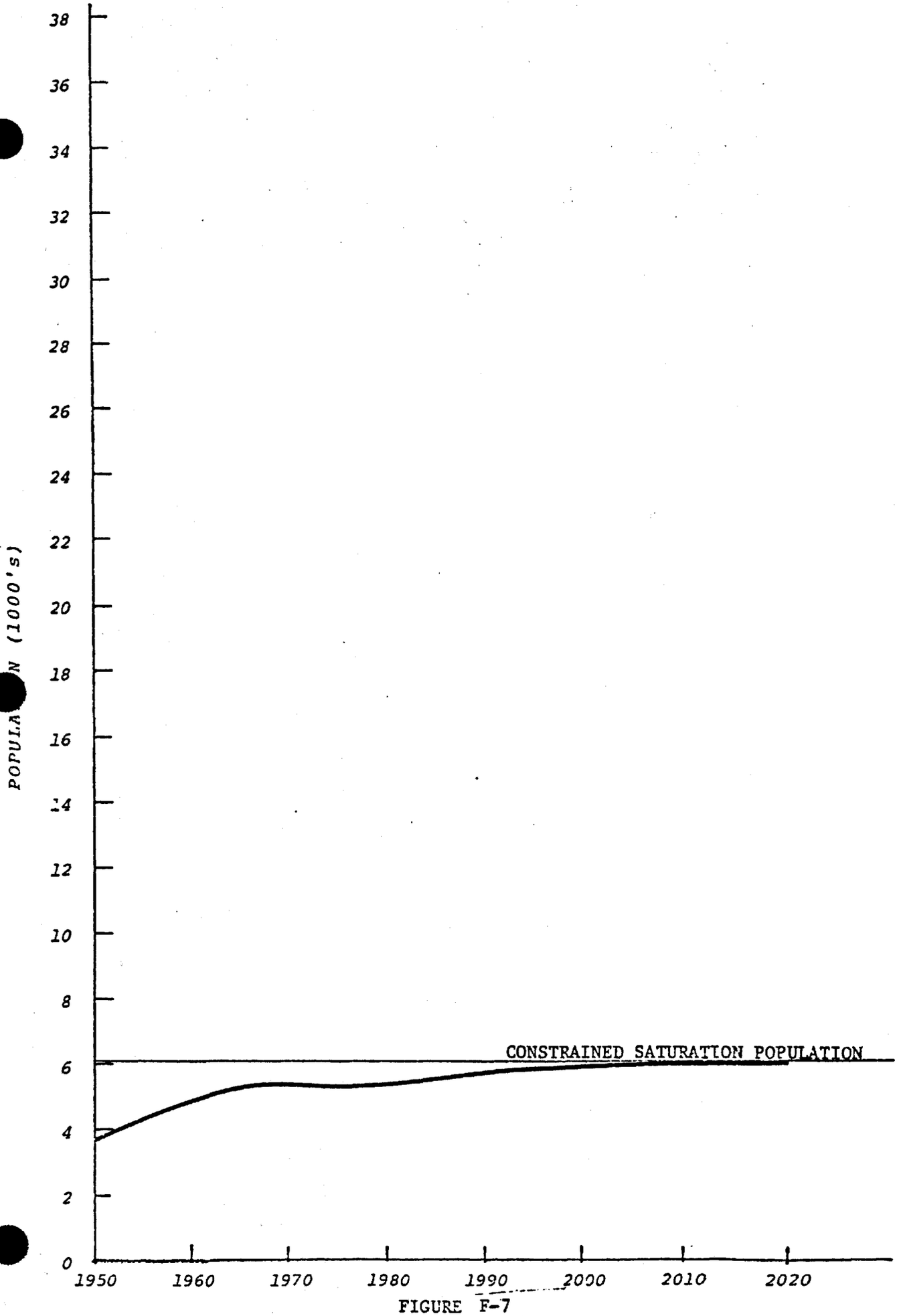


FIGURE F-7

POPULATION GROWTH CURVE FOR WHARTON BOROUGH

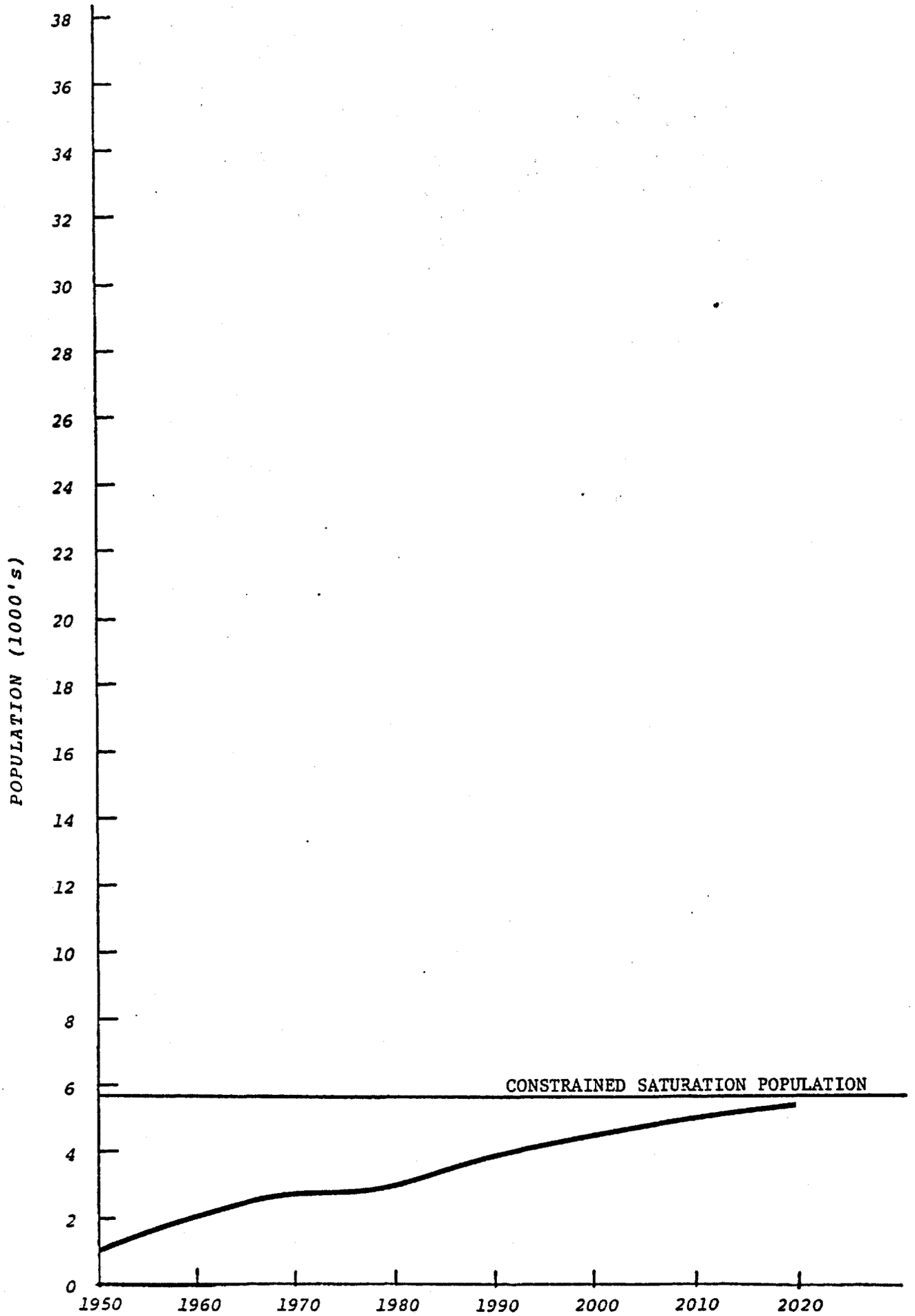


FIGURE F-8

POPULATION GROWTH CURVE FOR BOONTON TOWNSHIP

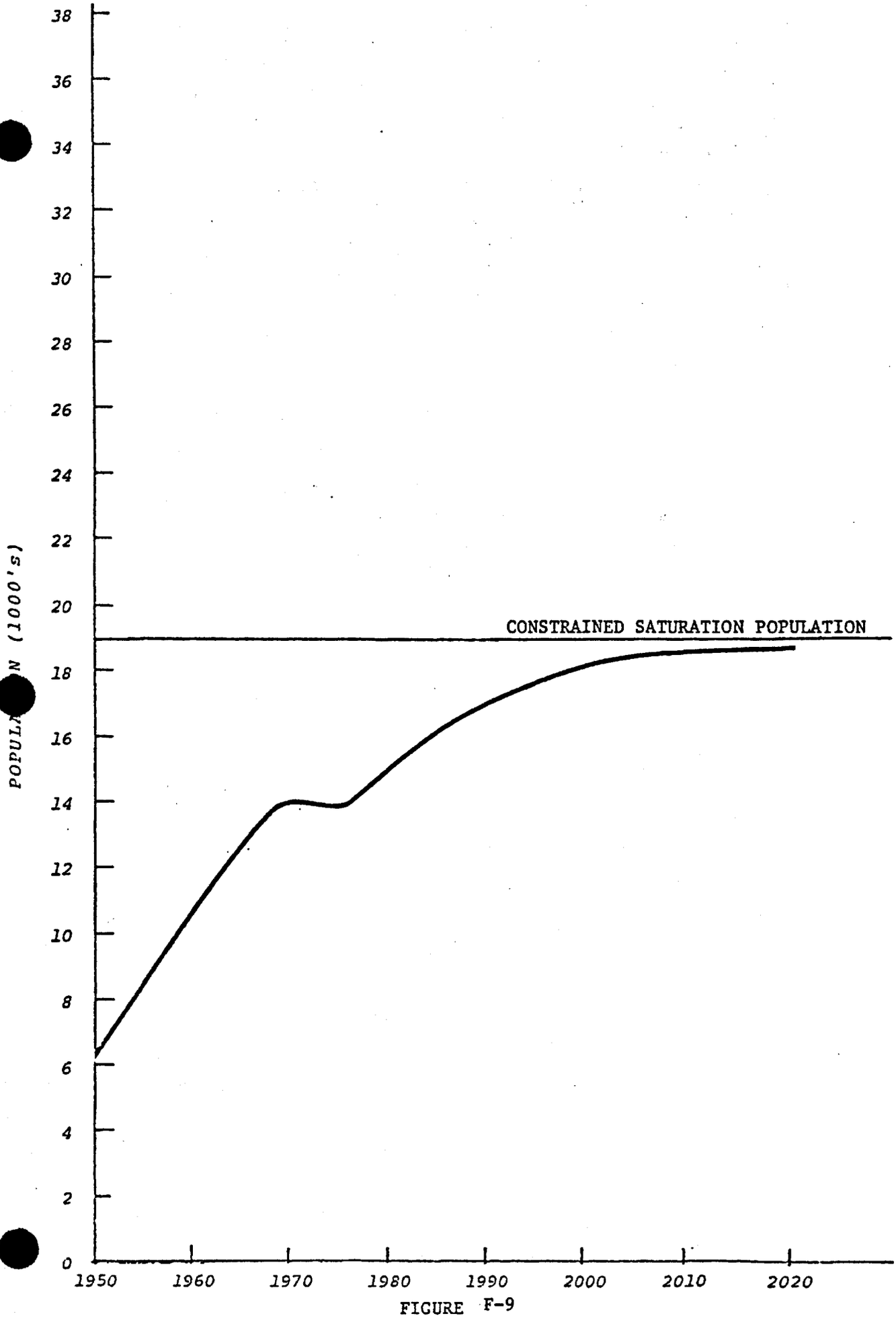


FIGURE F-9

POPULATION GROWTH CURVE FOR DENVILLE TOWNSHIP

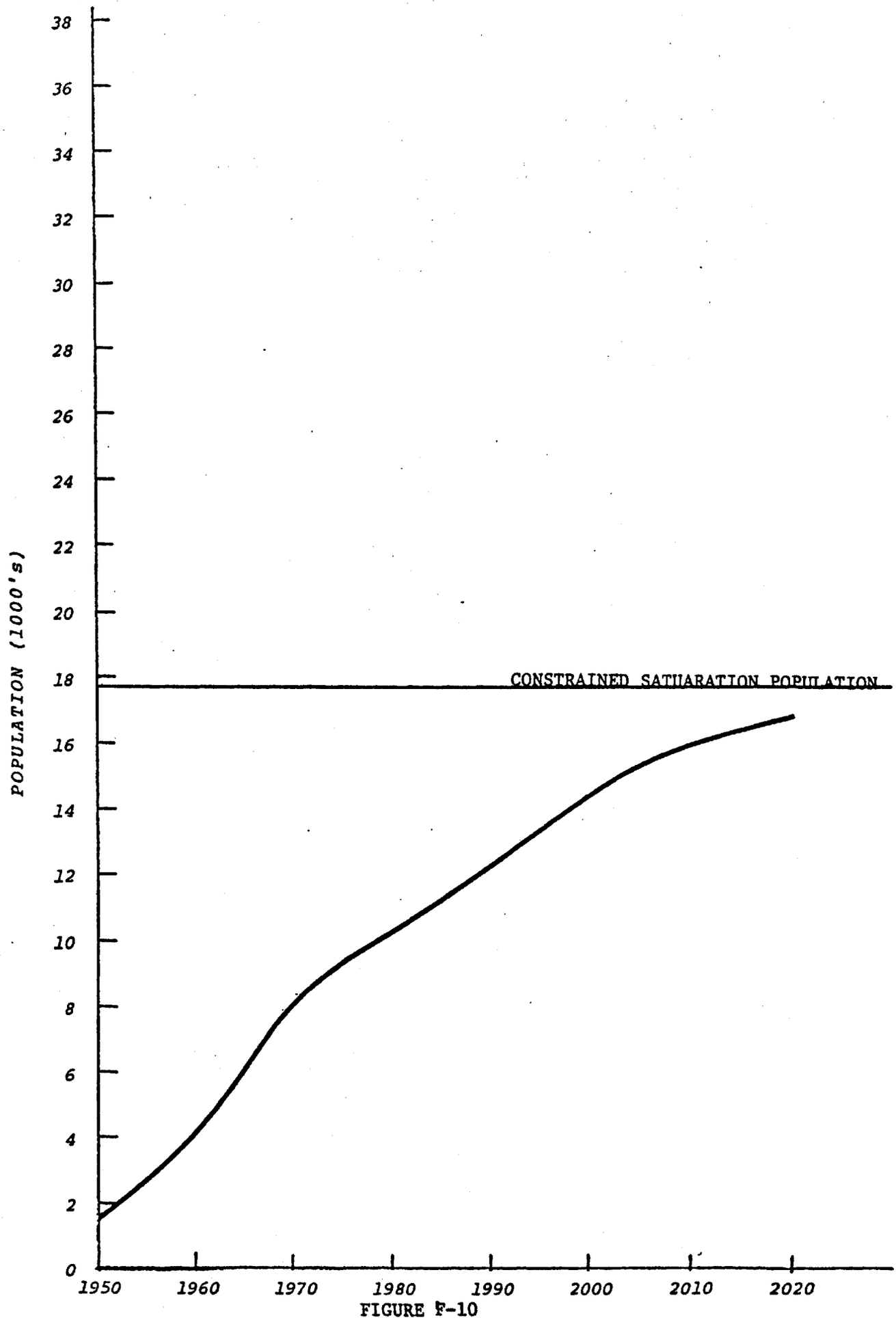


FIGURE F-10

POPULATION GROWTH CURVE FOR JEFFERSON TOWNSHIP (RVFPA PORTION)

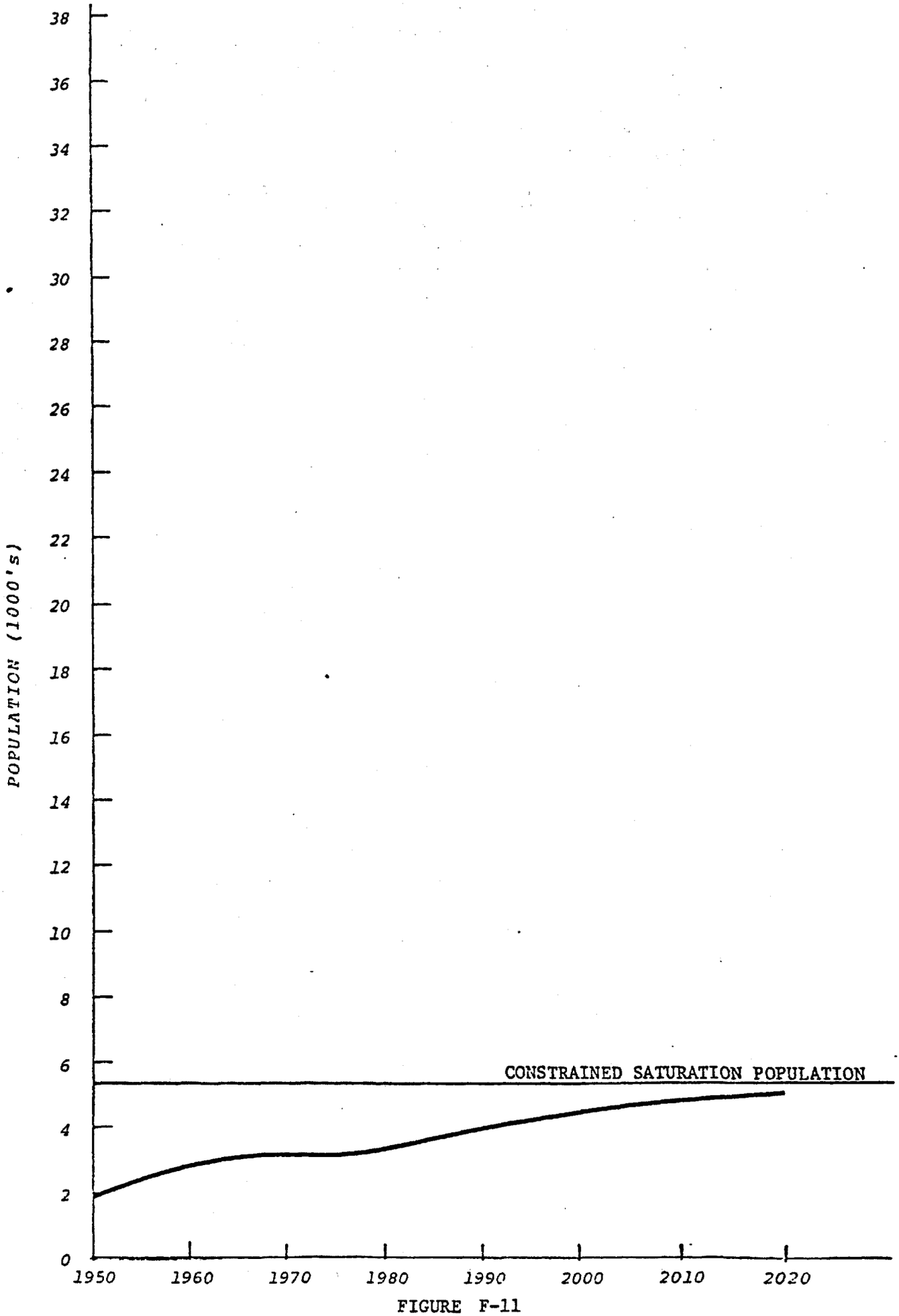


FIGURE F-11

POPULATION GROWTH CURVE FOR MINE HILL TOWNSHIP (RVFPA PORTION)

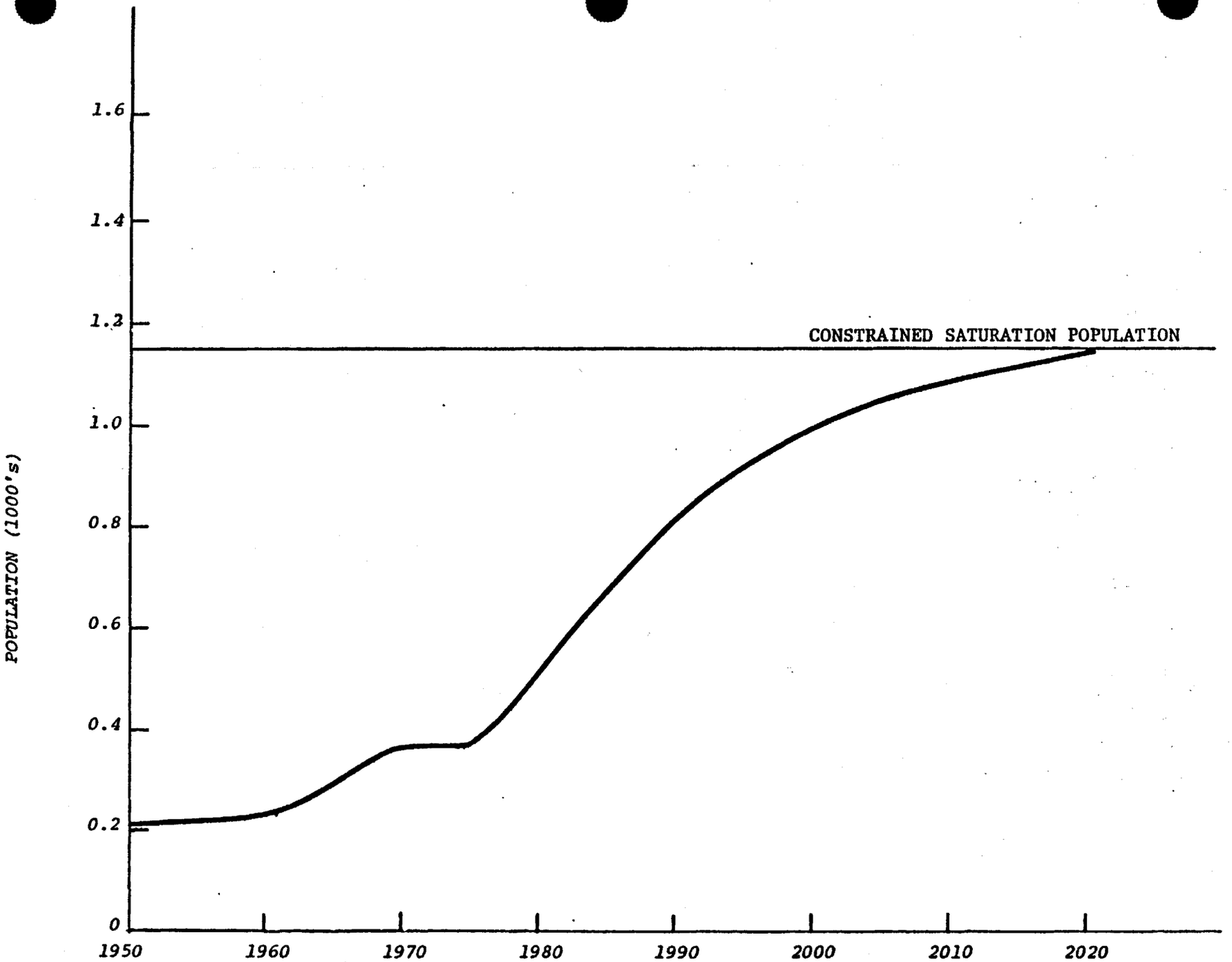


FIGURE F-12

POPULATION GROWTH CURVE FOR MONTVILLE TOWNSHIP (RVFPA PORTION)

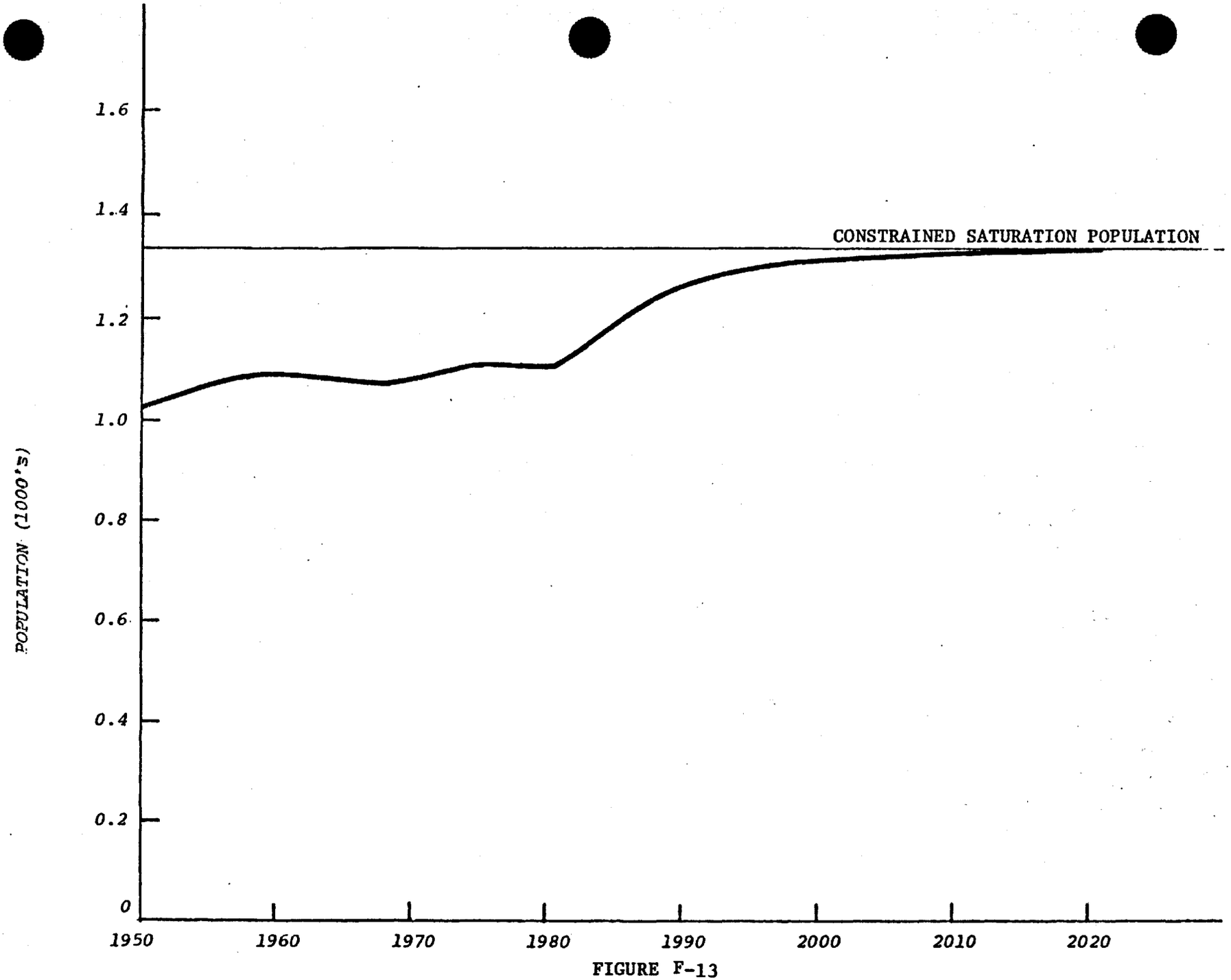


FIGURE F-13

POPULATION GROWTH CURVE FOR PARSIPPANY-TROY HILLS TOWNSHIP (RVFPA PORTION)

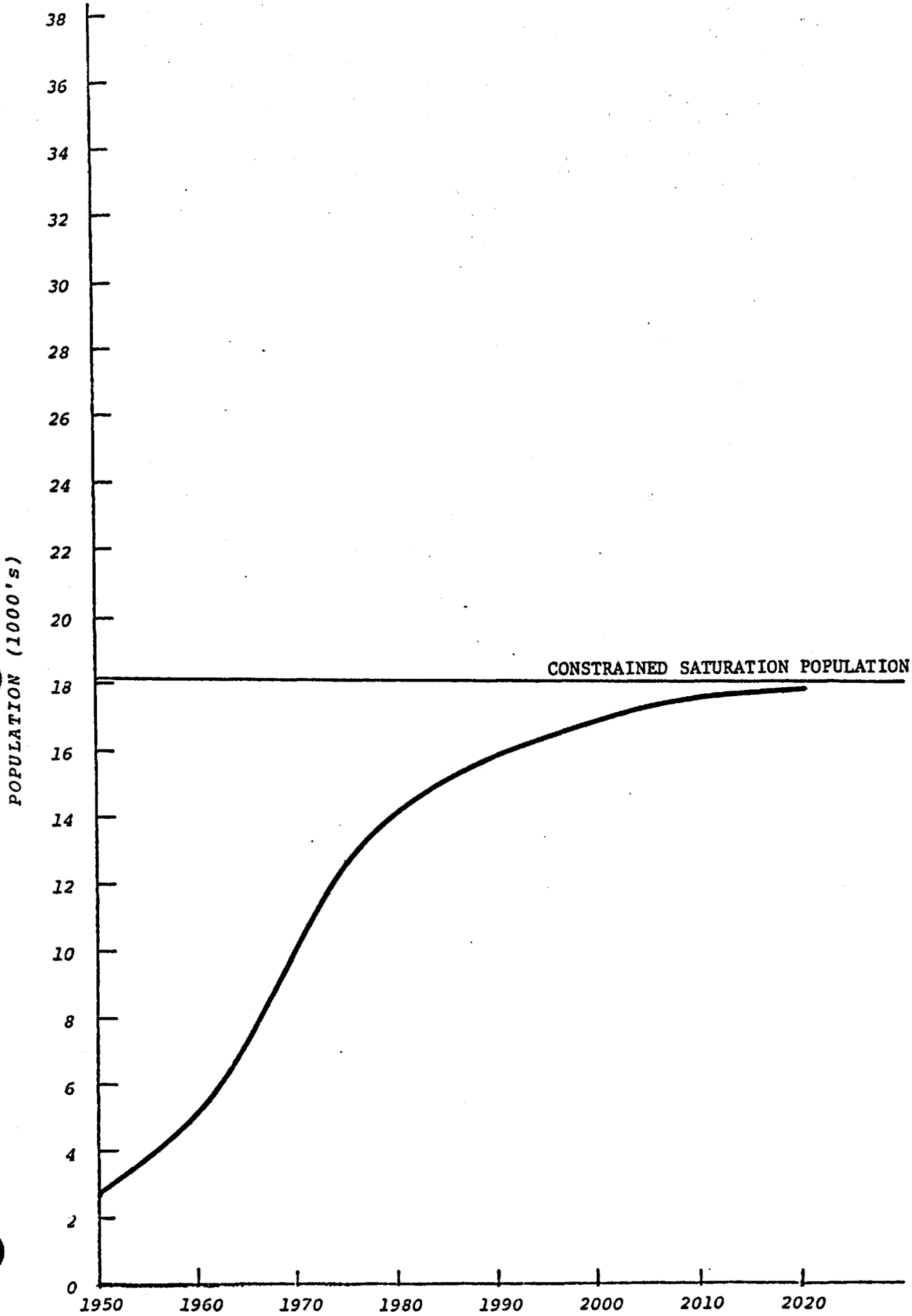


FIGURE F-14

POPULATION GROWTH CURVE FOR RANDOLPH TOWNSHIP (RVFPA PORTION)

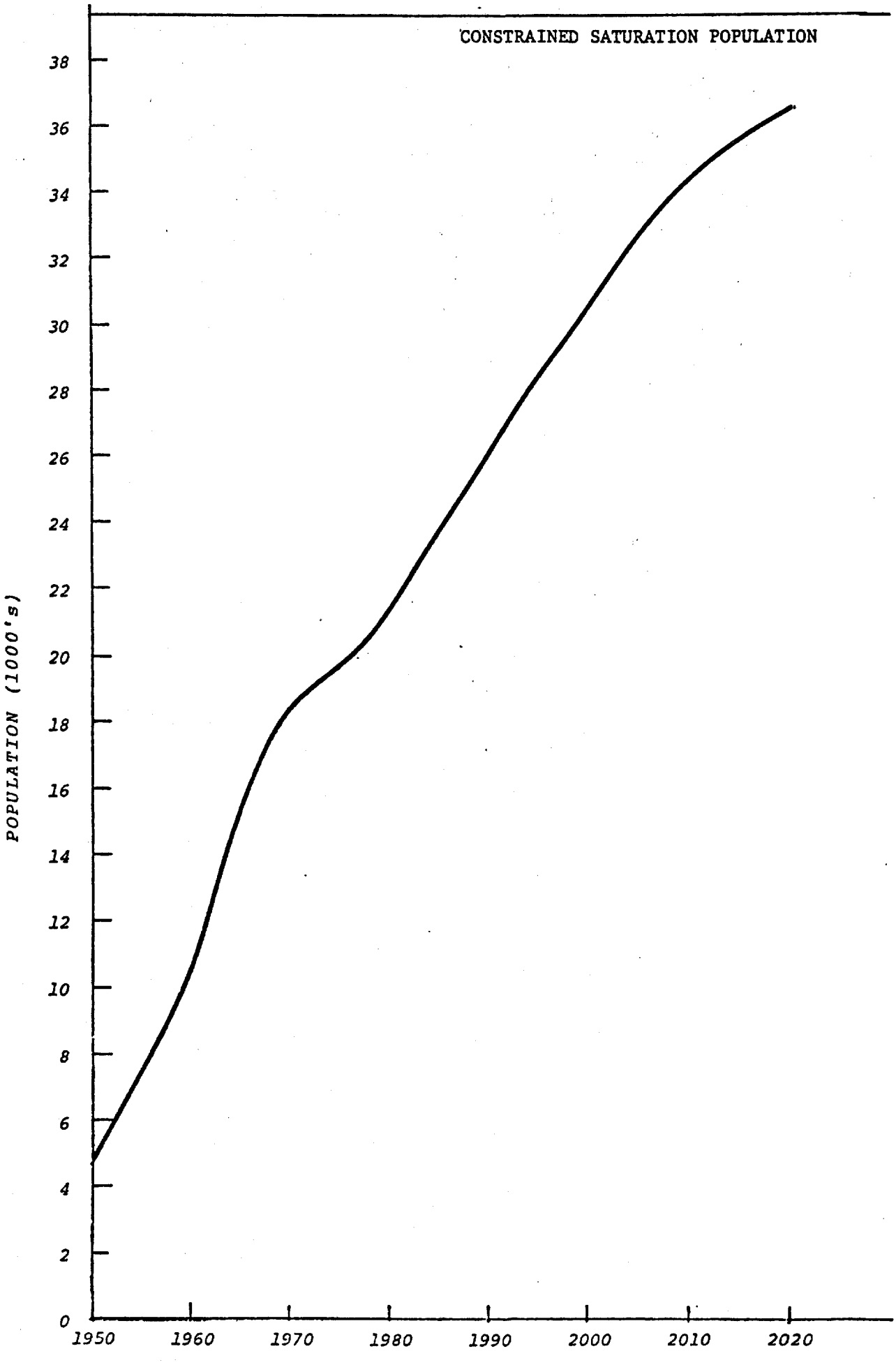


FIGURE F-15

POPULATION GROWTH CURVE FOR ROCKAWAY TOWNSHIP (RVFPA PORTION)

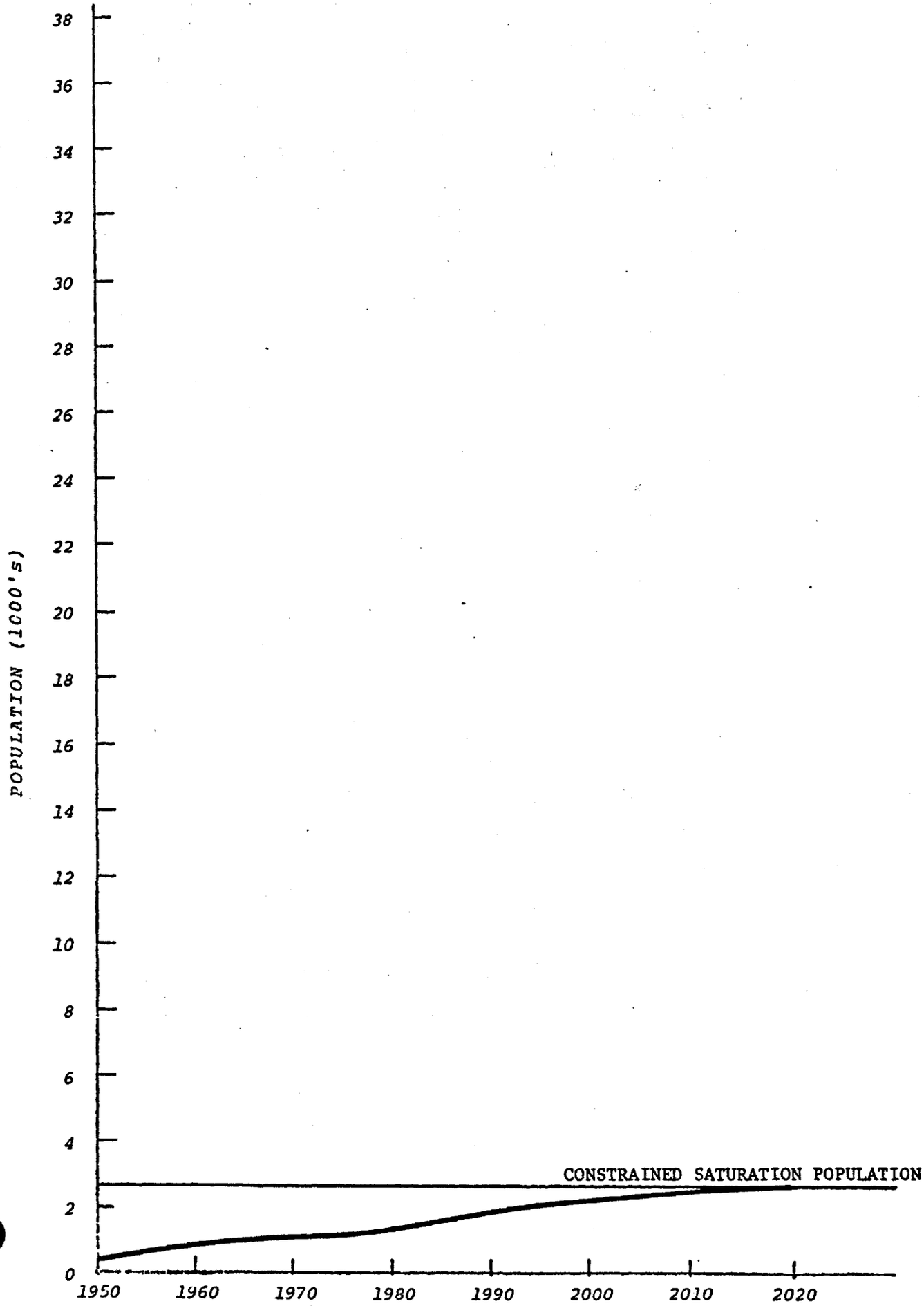


FIGURE F-16

POPULATION GROWTH CURVE FOR ROXBURY TOWNSHIP (RVFPA PORTION)

APPENDIX G

DERIVATION OF A MULTIPLIER FOR MORRIS COUNTY

The concept of a regional multiplier is based upon the idea that any expenditure by a firm, government, or individual will lead to additional expenditures by those receiving the initial outlay. The size of the multiplier is dependent on two factors.

First, there are "leakages" out of the economy of the area being studied. These leakages reduce the size of the original expenditure effect during each successive cycle through the economy. It is usually assumed these leakages affect a constant proportionate reduction of the expenditure impact, so that the impact will be reduced to zero after an infinite number of cycles. In reality, if the leakages are at all significant, the expenditure effect becomes negligible after only a small number of rounds.

The major forms of leakage out of the economy are three: taxes, consumer savings, and imports. Taxes siphon purchasing power away from consumers both directly through taxes on income and indirectly through taxes on property, goods, and services. Consumer savings represent generally a small part of a consumer's disposable income that is not spent on the consumption of goods or services. Imports may be especially significant at the regional level, because a significant porportion of the goods and materials purchased within a region are likely to originate in other areas. The import effect is important in diffusing the impact of expenditures in one region over other regions.

Second, there is the effect of a change in regional income on the level of government transfer payments such as unemployment compensation and welfare payments into a region. These transfer payments act as automatic stabilizers on a regional economy. When unemployment within a region also increases, the level of transfer payments also increases, reducing the total drop in regional income. Similary, when regional income decreases, the level of transfer payments increases. This, too, reduces the total drop in regional income. When regional income increases, however, the level of transfer payments decreases. This reduces the multiplier effect of any increased expenditure within the region.

1. GENERAL FORM OF THE MULTIPLIER

Total regional income is the sum of local consumption spending, local investment spending, government spending within the region, and net exports (this last term may be negative). Algebraically,

$$Y = C(Yd, T) + I + G + X - M(C(Yd, T))$$

where:

Y = total regional income.
Yd = disposable personal income.
T = government transfer spending.
C(Yd, T) = consumption out of available income (disposable income plus transfer payments).
I = local investment spending.
G = local government spending.
X = regional exports.
M(C(Yd, T)) = spending for imports out of total consumption spending.

The variables included in the expression for regional income can be formulated as follows:

1. Disposable income, which is total personal income minus taxes, is assumed to be a constant proportion of total personal income: $Yd = aY$.

2. Consumption spending is assumed to be a linear function of disposable income and transfer payments: $C = b + c(Yd + T) = b + c(aY + T)$.

3. Spending on imports is taken as a linear function of total consumption spending: $M = n + mc(aY + T)$.

4. As mentioned, the level of T is influenced by the level of Y, so that $T = T(Y)$. Because T is a declining function of Y, $\frac{\delta T}{\delta Y} < 0$.

Then $Y = b + c(aY + T(Y)) + I + G + X - n - mc(aY + T(Y))$.

$$\text{Then } dY = c(adY + \frac{\delta T}{\delta Y} dY) + dI + dG + dX - mc(adY + \frac{\delta T}{\delta Y} dY).$$

This expression produces the regional multiplier for changes in government expenditures, private investment spending, and regional exports as a function of:

a = the proportion of disposable to total personal income.
c = the propensity to spend disposable income.
M = the percent of total consumption spent on imported goods and services.
$\frac{\delta T}{\delta Y}$ = the change in the level of transfer payments due to changes in the level of regional income.

A numerical estimate of the multiplier can be derived on the basis of estimates of these parameters.

2. ESTIMATION OF THE PARAMETERS

The derivation of "a," the proportion of disposable income to total personal income, is based on 1970 census data, as current income estimates for Morris County are not available. Based on a 1970 Morris County mean family income of $15,233 (USBC, 1970), an average household of a married couple and one child would pay 9.7 percent and 1.6 percent of annual income in federal and state taxes, respectively (filing jointly, with three exemptions).

In addition, the State of New Jersey imposes a five percent sales tax. The tax does not apply to most food and clothing items, however. Assuming that an average family devotes 10 percent of its income to taxable items, the tax captures approximately one-half percent of an average family's income.

The total percentage of income captured by these various taxes is approximately 0.097 + 0.016 + 0.005 = 0.118. Therefore, a = 1.0 - 0.118 = 0.882.

National data on consumer spending over the last decade indicates that consumption fluctuates at about 91 percent of disposable income. Therefore, c equals 0.91 (Council of Economic Advisors, 1978). For purposes of this analysis, the average and marginal propensities to consume are assumed to be equal. This is a widely used practice as data on the marginal propensity may fluctuate significantly over time. Further, any increases in regional income probably will be distributed widely among different income groups with widely differing marginal propensities. Therefore, the use of average propensity probably will give a reasonable approximation of the proportion of additional income actually spent.

The estimate of $\frac{\delta T}{\delta Y}$ considers only the reduction in unemployment benefits which will result from an increase in regional income and employment. A value of $\frac{\delta T}{\delta Y} = \frac{-(V)(U)(K)}{S}$ where:

V = the current average weekly benefit under the unemployment compensation program.

U = the percentage of total unemployed receiving benefits.

K = the proportion of the increased expenditures going to wages.

S = the current average weekly wage in the area.

The value of V as determined from 1978 statistics on total benefit payments and the average number of claims per week in Morris County is $85.15 (Selfridge, NJDLI, January 7, 1980).

The value of U depends on: the number of jobs created, the percentage of total unemployed workers actually receiving unemployment benefits and the impact of new job opportunities on attracting more individuals into the labor force.

An estimated 62 percent of Morris County's total unemployed received benefits during an average week of 1978 (Selfridge, NJDLI, January 7, 1980).

The value of K depends upon the percentage of total county-wide expenditures going to labor. As there are no statistics on this percentage for Morris County, the national average of 75 percent was used (Council of Economic Advisors, 1978).

The value of S was determined by dividing $15,233, the Morris County mean family income for 1970 (USBC, 1970), by 52 to obtain $292.94.

Given the parameter values:

$$\frac{\delta T}{\delta Y} = \frac{-(V)(U)(K)}{S} = \frac{-(85.15)(0.62)(0.75)}{292.94} = -0.135$$

This indicates that for every dollar of extra income generated in the county, approximately 13.5 cents less is received in unemployment benefits.

Finally, it is assumed that Morris County residents spend about three-quarters of their disposable income on goods and services imported from outside the county. Therefore, m is estimated to be approximately 0.75.

Thus:

$$\text{Multiplier} = \frac{1}{1 - c(1-m)\left(a + \frac{\delta T}{\delta Y}\right)}$$

$$\text{Multiplier} = \frac{1}{1 - 0.91(1-0.75)(0.882 - 0.135)}$$

$$\text{Multiplier} = 1.20$$