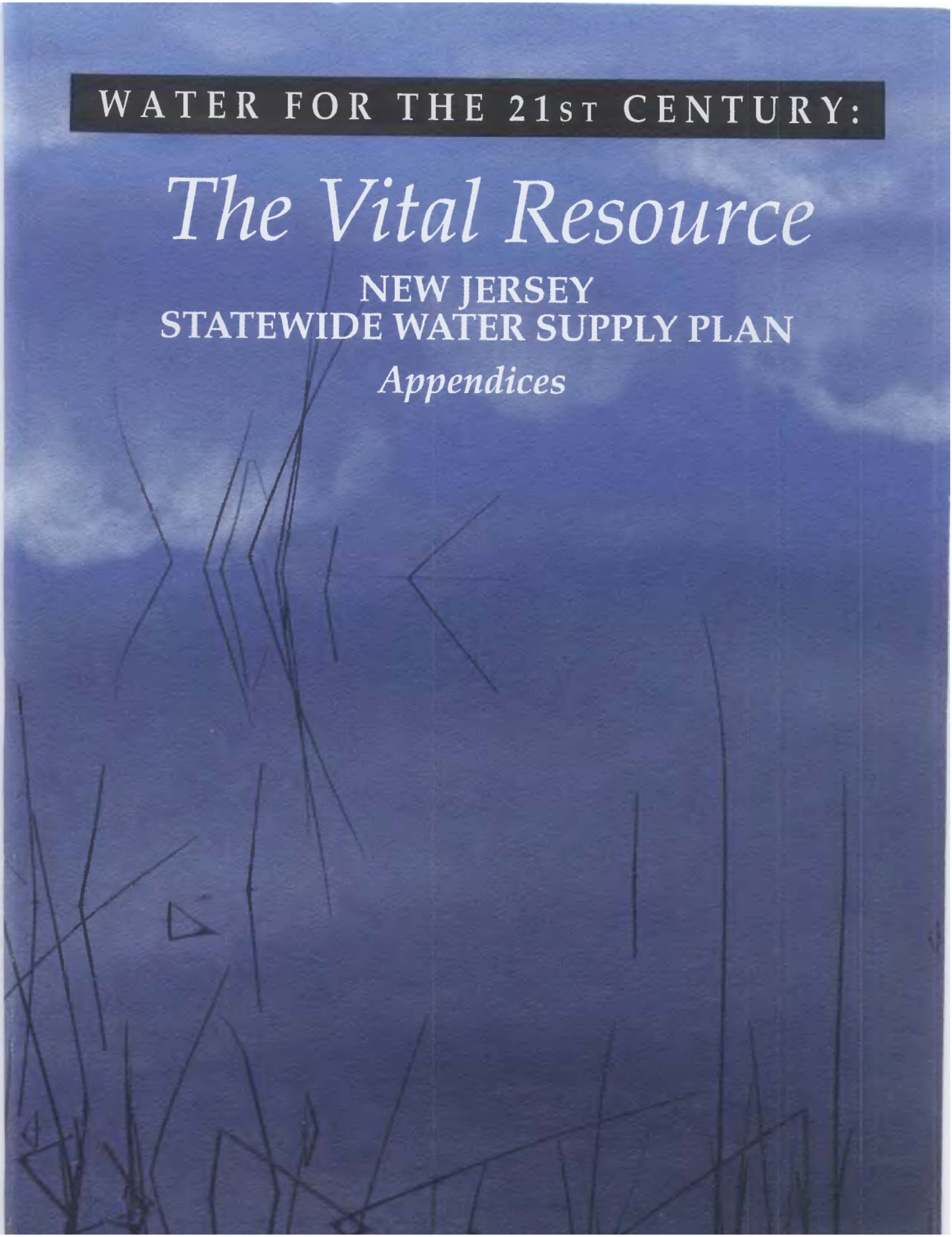
WATER FOR THE 21ST CENTURY:

The Vital Resource

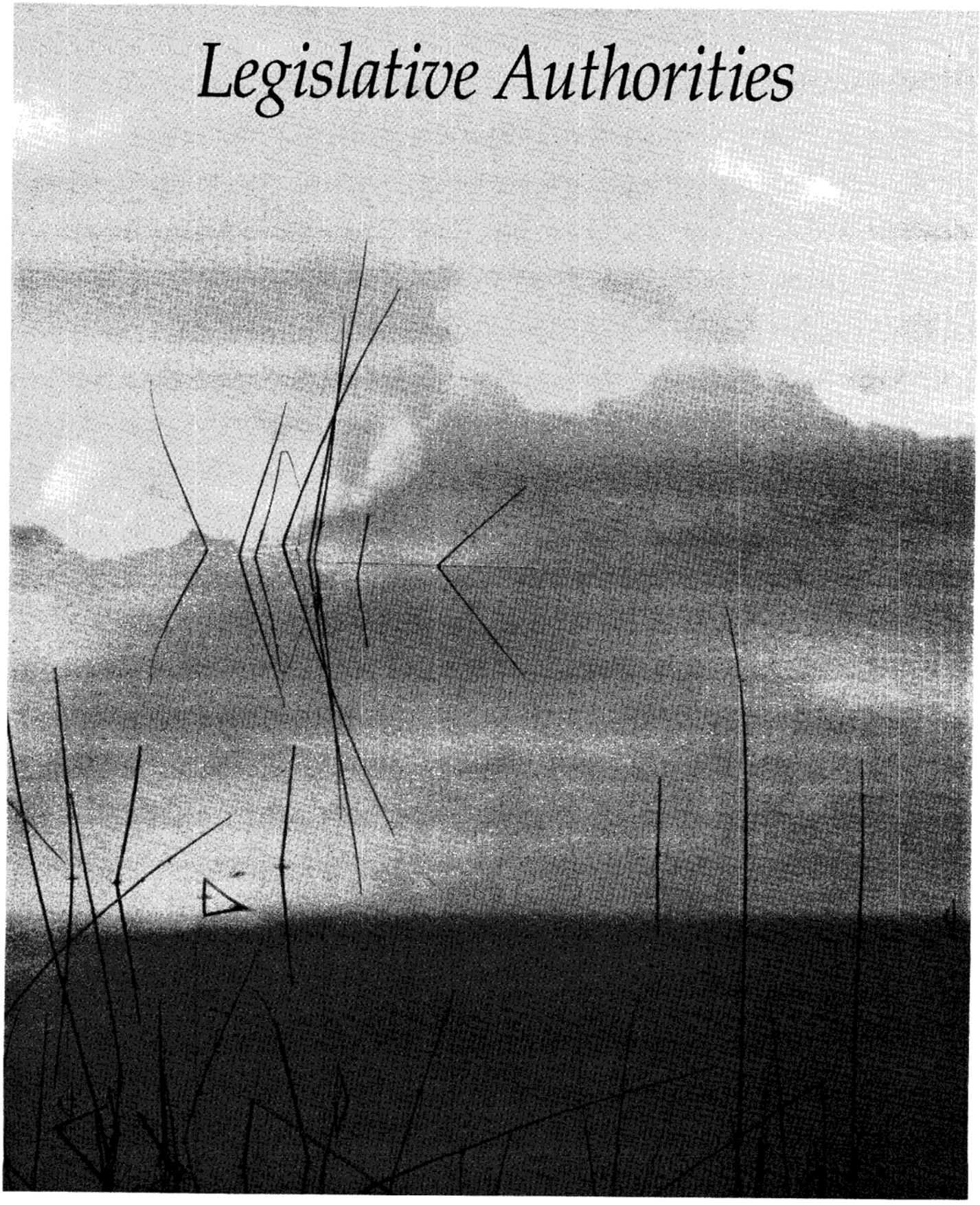
NEW JERSEY STATEWIDE WATER SUPPLY PLAN

Appendices



APPENDIX A

Legislative Authorities



APPENDIX A

C 261-1

P. L. 1981, CHAPTER 261, *approved August 13, 1981*

Senate Committee Substitute for
1980 Senate No. 1610

AN ACT authorizing the creation of a debt of the State of New Jersey by the issuance of bonds of the State in the aggregate principal amount of $350,000,000.00 for the purposes of State or local projects to rehabilitate, repair or consolidate antiquated, damaged or inadequately operating water supply facilities; and to plan, design, acquire and construct various State water supply facilities, all as recommended by the New Jersey Statewide Water Supply Plan; providing the ways and means to pay the interest of such debt and also to pay and discharge the principal thereof; and providing for the submission of this act to the people at a general election; and providing an appropriation therefor.

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey:*

1. This act shall be known and may be cited as the "Water Supply Bond Act of 1981."

2. The Legislature finds and determines that:

a. The health, safety, welfare, commerce and prosperity of the people of the State depend on the availability of a safe, adequate and reliable supply of water.

b. Pursuant to the New Jersey Statewide Water Supply Plan, specific projects will be recommended to provide additional supplies of water, new transmission and distribution capabilities for existing supplies, increased reserve and emergency response capabilities, and increased water quality benefits which may reduce or eliminate the need for advanced wastewater treatment levels in certain areas.

c. This plan will further recommend specific projects to provide for the consolidation of deficiently operating facilities, in order to insure adequate services in the quantity and quality of water delivered, and to provide for the rehabilitation and repair of antiquated or damaged water supply facilities, thereby helping to conserve our vital water resources through leakage reduction and lending increased support to New Jersey's revitalization and economic development.

d. The sum of $350,000,000.00 is needed at this time to adequately implement the recommendations of this plan.

3. As used in this act:

a. "Bonds" means the bonds authorized to be issued, or issued under this act;

b. "Commission" means the New Jersey Commission on Capital Budgeting and Planning;

c. "Commissioner" means the Commissioner of Environmental Protection;

d. "Construct" and "construction" mean, in addition to the usual meaning thereof, acts of construction, reconstruction, replacement, extension, improvement and betterment;

e. "Cost" means the cost of acquisition or construction of all or any part of a project and of all or any real or personal property, agreements and franchises deemed by the department to be necessary or useful and covenient therefor or in connection therewith, including interest or discount on bonds, costs of issuance of bonds, cost of geological and hydrological services, administrative cost, interconnection testing, engineering and inspection costs and legal expenses, costs of financial, professional and other estimates and advice, organization, operating and other expenses prior to and during such acquisition or construction, and all such other expenses as may be necessary or incident to the financing, acquisition, construction and completion of such project or part thereof and the placing of the same in operation, and also such provisions for a reserve fund, or reserves for working capital, operating, maintenance or replacement expenses and for payment or security or principal of or interest on bonds during or after such acquisition or construction as the State Comptroller may determine;

f. "Department" means the Department of Environmental Protection;

g. "Project" means any work relating to water supply facilities;

h. "Real property" means lands, within or without the State, and improvements thereof or thereon, any and all rights-of-way, water, riparian and other rights, and any and all easements, and privileges in real property, and any right or interest of any kind or description in, relating to or connected with real property;

i. "Water supply facilities" means and refers to the real property and the plants, structures, interconnections between existing water supply facilities, machinery and equipment and other property, real, personal and mixed, acquired, constructed or operated, or to be acquired, constructed or operated, in whole or in part by or on behalf of the State, or of a political subdivision of the State

or any agency thereof, for the purpose of augmenting the natural water resources of the State and making available an increased supply of water for all uses, or of conserving existing water resources, and any and all appurtenances necessary, useful or convenient for the collecting, impounding, storing, improving, treating, filtering, conserving or transmitting of water, and for the preservation and protection of these resources and facilities and providing for the conservation and development of future water supply resources, and facilitating incidental recreational uses thereof.

4. Bonds of the State of New Jersey are authorized to be issued in the aggregate principal amount of $350,000,000.00 for the purposes of providing loans for State or local projects for the rehabilitation, repair or consolidation of antiquated, damaged or inadequately operating water supply facilities, and to plan, design, acquire and construct State water supply facilities, all as recommended by the New Jersey Statewide Water Supply Plan.

5. a. The commissioner shall adopt such rules and regulations as are necessary and appropriate to carry out the provisions of this act. The commissioner shall review and consider the findings and recommendations of the commission in the administration of the provisions of this act.

b. The department, or the New Jersey Water Supply Authority, as the case may be, shall, in coordination with the Board of Public Utilities, develop a program to charge any water supply user which benefits from any project funded pursuant to this act, to the maximum extent practicable and feasible, for the full cost of planning, designing, acquiring, constructing and operating that project.

6. The bonds shall be serial bonds and known as "Water Supply Bonds" and as to each series, the last annual installment thereof (subject to redemption prior to maturity) shall mature and be paid not later than 35 years from the date of its issuance but may be issued in whole or in part for a shorter term. Said bonds shall be issued from time to time as the issuing officials herein named shall determine.

7. The Governor, State Treasurer and Comptroller of the Treasury or any two of such officials (hereinafter referred to as "the issuing officials") are hereby authorized to carry out the provisions of this act relating to the issuance of said bonds, and shall determine all matters in connection therewith subject to provisions hereof. In case any of said officials shall be absent from the State or incapable of acting for any reason, his powers and duties shall be exercised and performed by such person as shall be authorized by law to act in his place as a State official.

8. Bonds issued in accordance with the provisions of this act shall be a direct obligation of the State of New Jersey and the faith and credit of the State are pledged for the payment of the interest thereon as same shall become due and the payment of the principal at maturity. The principal and interest of such bonds shall be exempt from taxation by the State or by any county, municipality or other taxing district of the State.

9. The bonds shall be signed in the name of the State by the Governor or by his facsimile signature, under the Great Seal of the State, and attested by the Secretary of State, or an assistant Secretary of State, and shall be countersigned by the facsimile signature of the Comptroller of the Treasury. Interest coupons attached to said bonds shall be signed by the facsimile signature of the Comptroller of the Treasury. Such bonds may be issued notwithstanding that any of the officials signing them or whose facsimile signature appear on the bonds or coupons shall cease to hold office at the time of such issue or at the time of the delivery of such bonds to the purchaser.

10. a. The bonds shall recite that they are issued for the purposes set forth in section 4 of this act and that they are issued in pursuance of this act and that this act was submitted to the people of the State at the general election held in the month of November, 1981, and that it received the approval of the majority of votes cast for and against it at such election. Such recital in said bonds shall be conclusive evidence of the authority of the State to issue said bonds and of their validity. Any bonds containing such recital shall in any suit, action or proceeding involving their validity be conclusively deemed to be fully authorized by this act and to have been issued, sold, executed and delivered in conformity therewith and with all other provisions of statutes applicable thereto, and shall be incontestable for any cause.

b. Such bonds shall be issued in such denominations and in such form or forms, whether coupon or registered as to both principal and interest, and with or without such provisions for interchangeability thereof, as may be determined by the issuing officials.

11. When the bonds are issued from time to time the bonds of each issue shall constitute a separate series to be designated by the issuing officials. Each series of bonds shall bear such rate or rates of interest as may be determined by the issuing officials, which interest shall be payable semiannually; provided that the first and last periods may be longer or shorter, in order that intervening semiannual payments may be at convenient dates.

12. The bonds shall be issued and sold at such price not less than the par value thereof and accrued interest thereon, and under such terms, conditions and regulations as the issuing officials may prescribe, after notice of said sale, published at least once in at least three newspapers published in the State of New Jersey, and at least once in a publication carrying municipal bond notices and devoted primarily to financial news, published in New Jersey or the city of New York, the first notice to be at least 5 days prior to the day of bidding. The said notice of sale may contain a provision to the effect that any or all bids in pursuance thereof may be rejected. In the event of such rejection or of failure to receive any acceptable bid, the issuing officials, at any time within 60 days from the date of such advertised sale, may sell such bonds at private sale at such price not less than the par value thereof and accrued interest thereon and under such terms and conditions as the issuing officials may prescribe. The issuing officials may sell all or part of the bonds of any series as issued to any State fund or to the Federal Government or any agency thereof, at private sale, without advertisement.

13. Until permanent bonds can be prepared, the issuing officials may, in their discretion, issue in lieu of the permanent bonds temporary bonds in such form and with such privileges as to registration and exchange for permanent bonds as may be determined by the issuing officials.

14. The proceeds from the sale of the bonds shall be paid to the State Treasurer and be held by him in a separate fund, and be deposited in such depositories as may be selected by him to the credit of the fund, which fund shall be known as the "Water Supply Fund".

15. a. The moneys in said "Water Supply Fund" are hereby specifically dedicated and shall be applied to the cost of the purposes set forth in section 4 of this act, and all such moneys are hereby appropriated for such purposes, and no such moneys shall be expended for such purposes (except as otherwise hereinbelow authorized) without the specific appropriation thereof by the Legislature, but bonds may be issued as herein provided notwithstanding that the Legislature shall not have then adopted an act making specific appropriation of any said moneys. Any act appropriating moneys from the "Water Supply Fund" shall identify the particular project or projects to be funded by such moneys.

b. At any time prior to the issuance and sale of bonds under this act, the State Treasurer is hereby authorized to transfer from any available money in the Treasury of the State to the credit of

the "Water Supply Fund" such sum as he may deem necessary. Said sum so transferred shall be returned to the treasury of this State by the treasurer thereof from the proceeds of the sale of the first issue of bonds.

c. Pending their application to the purpose provided in this act, moneys in the "Water Supply Fund" may be invested and reinvested as other trust funds in the custody of the State Treasurer in the manner provided by law. Net earnings received from the investment or deposit of such fund shall be paid into the General State Fund.

16. In case any coupon bonds or coupons thereunto appertaining or any registered bond shall become lost, mutilated or destroyed, a new bond shall be executed and delivered of like tenor, in substitution for the lost, mutilated or destroyed bonds or coupons, upon the owner furnishing to the issuing officials evidence satisfactory to them of such loss, mutilation or destruction, proof of ownership and such security and indemnity and reimbursement for expenses as the issuing officials may require.

17. Accrued interest received upon the sale of said bonds shall be applied to the discharge of a like amount of interest upon said bonds when due. Any expense incurred by the issuing officials for advertising, engraving, printing, clerical, legal or other services necessary to carry out the duties imposed upon them by the provisions of this act shall be paid from the proceeds of the sale of said bonds, by the State Treasurer upon warrant of the Comptroller of the Treasury, in the same manner as other obligations of the State are paid.

18. Bonds of each series issued hereunder shall mature in annual installments commencing not later than the tenth year and ending not later than the thirty-fifth year from the date of issue of such series, and in such amounts as shall be determined by the issuing officials, and the issuing officials may reserve to the State by appropriate provision in the bonds of any series the power to redeem all or any of such bonds prior to maturity at such price or prices and upon such terms and conditions as may be provided in such bonds.

19. The issuing officials may at any time and from time to time issue refunding bonds for the purpose of refunding in whole or in part an equal principal amount of the bonds of any series issued and outstanding hereunder, which by their terms are subject to redemption prior to maturity, provided such refunding bonds shall mature at any time or times not later than the latest maturity date of such series, and the aggregate amount of interest to be paid on the refunding bonds, plus the premium, if any, to be paid on the

bonds refunded, shall not exceed the aggregate amount of interest which would be paid on the bonds refunded if such bonds were not so refunded. Refunding bonds shall constitute direct obligations of the State of New Jersey, and the faith and credit of the State are pledged for the payment of the principal thereof and the interest thereon. The proceeds received from the sale of refunding bonds shall be held in trust and applied to the payment of the bonds refunded thereby. Refunding bonds shall be entitled to all the benefits of this act and subject to all its limitations except as to the maturities thereof and to the extent herein otherwise expressly provided.

20. To provide funds to meet the interest and principal payment requirements for the bonds issued under this act and outstanding, there is hereby appropriated in the order following:

a. Revenue derived from the collection of taxes as provided by the "Sales and Use Tax Act," P. L. 1966, c. 30 (C. 54:32B–1 et seq.) as amended and supplemented, or so much thereof as may be required; and

b. If in any year or at any time funds, as hereinabove appropriated, necessary to meet interest and principal payments upon outstanding bonds issued under this act, be insufficient or not available then and in that case there shall be assessed, levied and collected annually in each of the municipalities of the counties of this State a tax on real and personal property upon which municipal taxes are or shall be assessed, levied and collected, sufficient to meet the interest on all outstanding bonds issued hereunder and on such bonds as it is proposed to issue under this act in the calendar year in which such tax is to be raised and for the payment of bonds falling due in the year following the year for which the tax is levied. The tax thus imposed shall be assessed, levied and collected in the same manner and at the same time as other taxes upon real and personal property are assessed, levied and collected. The governing body of each municipality shall cause to be paid to the county treasurer of the county in which such municipality is located, on or before December 15 in each year, the amount of tax herein directed to be assessed and levied, and the county treasurer shall pay the amount of said tax to the State Treasurer on or before December 20 in each year.

If on or before December 31 in any year the issuing officials shall determine that there are moneys in the General State Fund beyond the needs of the State, sufficient to meet the principal of bonds falling due and all interest payable in the ensuing calendar year,

then and in the event such issuing officials shall by resolution so find and shall file the same in the office of the State Treasurer, whereupon the State Treasurer shall transfer such moneys to a separate fund to be designated by him, and shall pay the principal and interest out of said fund as the same shall become due and payable, and the other sources of payment of said principal and interest provided for in this section shall not then be available, and the receipts for said year from the tax specified in subsection a. of this section shall thereon be considered and treated as part of the General State Fund, available for general purposes.

21. Should the State Treasurer, by December 31 of any year, deem it necessary, because of insufficiency of funds to be collected from the sources of revenues as hereinabove provided, to meet the interest and principal payments for the year after the ensuing year, then the treasurer shall certify to the Comptroller of the Treasury the amount necessary to be raised by taxation for such purposes, the same to be assessed, levied and collected for and in the ensuing calendar year. In such case the Comptroller of the Treasury shall, on or before March 1 following, calculate the amount in dollars to be assessed, levied and collected as herein set forth in each county. Such calculation shall be based upon the corrected assessed valuation of such county for the year preceding the year in which such tax is to be assessed, but such tax shall be assessed, levied and collected upon the assesed valuation of the year in which the tax is assessed and levied. The Comptroller of the Treasury shall certify said amount to the county board of taxation and the county treasurer of each county. The said county board of taxation shall include the proper amount in the current tax levy of the several taxing districts of the county in proportion to the ratables as ascertained for the current year.

22. For the purpose of complying with the provisions of the State Constitution this act shall, at the general election to be held in the month of November, 1981, be submitted to the people. In order to inform the people of the contents of this act, it shall be the duty of the Secretary of State, after this section shall take effect, and at least 15 days prior to the said election, to cause this act to be published in at least 10 newspapers published in the State and to notify the clerk of each county of this State of the passage of this act, and the said clerks respectively, in accordance with the instructions of the Secretary of State, shall cause to be printed on each of the said ballots, the following:

If you approve the act entitled below, make a cross (×), plus (+), or check (√) mark in the square opposite the word "Yes." If you disapprove the act entitled below, make a cross (×), plus (+), or check (√) mark in the square opposite the word "No."

If voting machines are used, a vote of "Yes" or "No" shall be equivalent to such markings respectively.

	Yes.	WATER SUPPLY BOND ISSUE Should the "Water Supply Bond Act of 1981," which authorizes the State to issue bonds in the amount of $350,000,000.00 for the purposes of rehabilitating, repairing or consolidating antiquated, damaged or inadequately operating water supply facilities, and for the planning, design, acquisition and construction of water supply facilities, all as recommended by the New Jersey Statewide Water Supply Plan, and providing the ways and means to pay and discharge the principal thereof, be approved?
	No.	INTERPRETIVE STATEMENT Approval of this act would authorize the sale of $350,000,000.00 in bonds to be used for the rehabilitation, repair or consolidation of existing water supply facilities and for the planning, design, acquisition and construction of water supply facilities, all as recommended by the New Jersey Statewide Water Supply Plan, to solve water supply problems in different areas of New Jersey and to assure the availability of safe, adequate and reliable water supplies to the people of the State.

The fact and date of the approval or passage of this act, as the case may be, may be inserted in the appropriate place after the title in said ballot. No other requirements of law of any kind or

character as to notice or procedure except as herein provided need be adhered to.

The said votes so cast for and against the approval of this act, by ballot or voting machine, shall be counted and the result thereof returned by the election officer, and a canvass of such election had in the same manner as is provided for by law in the case of the election of a Governor, and the approval or disapproval of this act so determined shall be declared in the same manner as the result of an election for a Governor, and if there shall be a majority of all the votes cast for and against it at such election in favor of the approval of this act, then all the provisions of this act not made effective theretofore shall take effect forthwith.

23. There is appropriated the sum of $5,000.00 to the Department of State for expenses in connection with the publication of notice pursuant to section 22.

24. The commissioner shall submit to the State Treasurer and the commission with the department's annual budget request a plan for the expenditure of funds from the "Water Supply Fund" for the upcoming fiscal year. This plan shall include the following information: a performance evaluation of the expenditures made from the fund to date; a description of programs planned during the upcoming fiscal year; a copy of the regulations in force governing the operation of programs that are financed, in part or whole, by funds from the "Water Supply Fund"; and an estimate of expenditures for the upcoming fiscal year.

25. Immediately following the submission to the Legislature of the Governor's Annual Budget Message the commissioner shall submit to the relevant standing committees of the Legislature, as designated by the President of the Senate and the Speaker of the General Assembly, and to the special joint legislative committee created pursuant to Assembly Concurrent Resolution No. 66 of the 1968 Legislature, as reconstituted and continued by the Legislature from time to time, a copy of the plan called for under section 24 of this act, together with such changes therein as may have been required by the Governor's budget message.

26. Not less than 30 days prior to the commissioner entering into any contract, lease, obligation, or agreement to effectuate the purposes of this act, the commissioner shall report to and consult with the special joint legislative committee created pursuant to Assembly Concurrent Resolution No. 66 of the 1968 Legislature as reconstituted and continued from time to time by the Legislature.

27. This section and sections 22 and 23 shall take effect immediately and the remainder of the act shall take effect as and when provided in section 22.

P. L. 1981, CHAPTER 262, *approved August 13, 1981*

Senate Committee Substitute for
1980 Senate Nos. 1611 and 1613

AN ACT concerning the management of water and the diversion of any surface or ground water anywhere in the State, and revising and repealing parts of the statutory law relating thereto.

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey.*

1. This act shall be known and may be cited as the "Water Supply Management Act."

2. The Legislature finds and declares that the water resources of the State are public assets of the State held in trust for its citizens and are essential to the health, safety, economic welfare, recreational and aesthetic enjoyment, and general welfare, of the people of New Jersey; that ownership of these assets is in the State as trustee of the people; that because some areas within the State do not have enough water to meet their current needs and provide an adequate margin of safety, the water resources of the State and any water brought into the State must be planned for and managed as a common resource from which the requirements of the several regions and localities in the State shall be met; that the present regulatory system for these water resources is ineffective and counter-productive; that it is necessary to insure that within each basin there exists adequate water supplies to accommodate present and future needs; that to ensure an adequate supply and quality of water for citizens of the State, both present and future, and to protect the natural environment of the waterways of the State, it is necessary that the State, through its Department of Environmental Protection, have the power to manage the water supply by adopting a uniform water diversion permit system and fee schedule, a monitoring, inspection and enforcement program, a program to study and manage the State's water resources and plan for emergencies and future water needs, and regulations to manage the waters of the State during water supply and water quality emergencies.

EXPLANATION—Matter enclosed in bold-faced brackets [thus] in the above bill is not enacted and is intended to be omitted in the law.

3. As used in this act:

a. "Commissioner" means the Commissioner of the Department of Environmental Protection or his designated representative;

b. "Consumptive use" means any use of water diverted from surface or ground waters other than a nonconsumptive use as defined in this act;

c. "Department" means the Department of Environmental Protection;

d. "Diversion" means the taking or impoundment of water from a river, stream, lake, pond, aquifer, well, other underground source, or other waterbody, whether or not the water is returned thereto, consumed, made to flow into another stream or basin, or discharged elsewhere;

e. "Nonconsumptive use" means the use of water diverted from surface or ground waters in such a manner that it is returned to the surface or ground water at or near the point from which it was taken without substantial diminution in quantity or substantial impairment of quality;

f. "Person" means any individual, corporation, company, partnership, firm, association, owner or operator of a water supply facility, political subdivision of the State and any state, or interstate agency or Federal agency;

g. "Waters" or "waters of the State" means all surface waters and ground waters in the State.

4. a. Upon a finding by the commissioner that there exists or impends a water supply shortage of a dimension which endangers the public health, safety, or welfare in all or any part of the State, the Governor is authorized to proclaim by executive order a state of water emergency. The Governor may limit the applicability of any state of emergency to specific categories of water supplies or to specific areas of the State in which a shortage exists or impends.

b. The department shall, within 180 days of the effective date of this act, adopt an Emergency Water Supply Allocation Plan as a rule and regulation. This plan shall be utilized as the basis for imposing water usage restrictions during a declared state of water emergency and shall include a priority system for the order in which restrictions would be imposed upon the various categories of water usage.

c. During the duration of a state of water emergency the commissioner, to the extent not in conflict with applicable Federal law or regulation but notwithstanding any State or local law or contractual agreement, shall be empowered to:

(1) Order any person to reduce by a specified amount the use of any water supply; to make use of an alternate water supply where possible; to make emergency interconnections between systems; to transfer water from any public or private system; or to cease the use of any water supply;

(2) Order any person engaged in the distribution of any water supply to reduct or increase by a specified amount or to cease the distribution of that water supply; to distribute a specified amount of water to certain users as specified by the commissioner; or to share any water supply with other distributors thereof;

(3) Establish priorities for the distribution of any water supply;

(4) Adopt rules and regulations as are necessary and proper to carry out the purposes of this section; and

(5) Direct any person engaged in the retail distribution of water to impose and collect a surcharge on the cost of that water as a penalty for the violation of any order to reduce water usage issued pursuant to this subsection. The disposition of all sums collected pursuant to this subsection shall be as provided by law; and

(6) Otherwise implement the Emergency Water Supply Allocation Plan adopted pursuant to subsection b. of this section.

Any order issued by the commissioner pursuant to this subsection shall be based upon fair compensation, reasonable rate relief and just and equitable terms, to be determined after notice and hearing which may occur subsequent to the order and compliance therewith.

d. During the existence of a state of water emergency, the Governor may order the suspension of any laws, rules, regulations, or orders of any department or agency in State Government or within any political subdivision which deal with or affect water and which impede his ability to alleviate or terminate a state of water emergency.

e. Any aggrieved person, upon application to the commissioner, shall be granted a review of whether the continuance of any order issued by the commissioner pursuant to this section is unreasonable in light of then prevailing conditions of emergency.

f. During a state of water emergency the commissioner may require any other department or other agency within State Government to provide information, assistance, resources, and personnel as shall be necessary to discharge his functions and responsibilities under this act, rules and regulations adopted hereunder, or applicable Federal law and regulations.

g. The powers granted to the Governor and the commissioner under this section shall be in addition to and not in limitation of

any emergency powers now or hereafter vested in the Governor, the commissioner, or any other State department or agency pursuant to any other laws; except that, upon declaring a state of energy emergency, the Governor may supersede any other emergency powers.

h. The state of water emergency declared by the Governor pursuant to this section shall remain in effect until the Governor declares by a subsequent executive order that the state of water emergency has terminated.

5. The commissioner shall have the power to adopt, enforce, amend or repeal, pursuant to the "Administrative Procedure Act," P. L. 1968, c. 410 (C:52:14B-1 et seq.) rules and regulations to control, conserve, and manage the water supply of the State and the diversions of that water supply to assure the citizens of the State an adequate supply of water under a variety of conditions and to carry out the intent of this act. These rules and regulations may apply throughout the State or in any region thereof and shall provide for the allocation or the reallocation of the waters of the State in such a manner as to provide an adequate quantity and quality of water for the needs of the citizens of the State in the present and in the future and may include, but shall not be limited to:

a. A permit system to allocate or reallocate any or all of the waters of the State, which system shall provide for the issuance of permits to diverters of more than 100,000 gallons per day of the waters of the State, containing at a minimum the conditions required by this act;

b. Standards and procedures to be followed by diverters to ensure that:

(1) Proper methods are used to divert water;

(2) Only the permitted quantity of water is diverted and that the water is only used for its permitted purpose;

(3) The water quality of the water source is maintained and the water standards for the use of the water are met;

(4) The department is provided with adequate and accurate reports regarding the diversion and use of water;

c. Inspection, monitoring, reporting and enforcement procedures necessary to implement and enforce the provisions of this act;

d. Standards and procedures to be followed to determine the location, extent and quality of the water resources of the State and plan for their future use to meet the needs of the citizens of the State;

e. Standards and procedures to be followed to maintain the minimum water levels and flow necessary to provide adequate water quantity and quality;

f. Standards and procedures governing the maintenance of adequate capacity by, and withdrawal limits for, water purveyors.

6. a. The department in developing the permit system established by this act shall:

(1) Permit privileges previously allowed pursuant to lawful legislative or administrative action, except that the department may, after notice and hearing, limit the exercise of these privileges to the extent currently exercised, subject to contract, or reasonably required for a demonstrated future need. All diversion permits issue by the Water Policy and Supply Council prior to the effective date of this act shall remain in effect until modified by the department pursuant to this act. Persons having or claiming a right to divert more than 100,000 gallons of water per day pursuant to prior legislative or administrative action, including persons previously exempted from the requirement to obtain a permit, shall renew that right by applying for a permit, or water usage certification, as the case may be, within 180 days of the effective date of this act. Thereafter, the conditions of the new permit or certification shall be conclusive evidence of such previously allowed privileges.

(2) Require any person diverting 100,000 or more gallons of water per day for agricultural or horticultural purposes to obtain departmental approval, in consultation with the appropriate county agricultural agent, of a 5 year water usage certification program. This program shall include the right to construct, repair or reconstruct dams or other structures, the right to divert water for irrigation, frost protection, harvesting and other agriculturally-related purposes, and the right to measure the amount of water diverted by means of a log or other appropriate record, and shall be obtained in lieu of any permit which would otherwise be required by this act.

b. Nothing in this act shall prevent the department form including, or require the department to include, the presently non-utilized existing privileges in the new or any future diversion permits issued to the present possessors of these privileges, except as otherwise expressly provided in subsection a. of this section.

7. a. Except as provided by section 6 of this act, no person may divert more than 100,000 gallons per day of any waters of the State or construct any building or structure which may require a diversion

of water unless he obtains a diversion permit. Prior to issuing these permits, the department shall afford the general public with reasonable notice of permit applications, and with the opportunity to be heard thereon at a public hearing held by the department.

b. Every permit issued pursuant to this section and every water usage certification approved pursuant to section 6 of this act shall be renewed by the department upon the expiration thereof, with any conditions deemed appropriate by the department, for the same quantity of water, except that the department may, after notice and hearing, limit that quantity to the amount currently diverted, subject to contract, or reasonably required for a demonstrated future need.

8. Every permit issued pursuant to this act shall include provisions:

a. Fixing the term of the permit;

b. Fixing the maximum allowable diversion, expressed in terms of a daily or monthly diversion;

c. Identifying and limiting the use or uses to which the water may be put;

d. Requiring the diverter to meter the water being diverted and report the amount and quality of the water being diverted;

e. Allowing the department to enter the diverter's facilities or property to inspect and monitor the diversion;

f. Requiring that all water diverted for a nonconsumptive use be returned to a reasonably proximate body of water designated by the department;

g. Allowing the transfer of a permit with the consent of the department, but only for the identical use of the waters by the transferee;

h. Governing the operations and maintenance of the specific facilities, equipment or premises not otherwise established in regulations because of the unique nature of the facilities, equipment or premises;

i. Permitting the department to modify, suspend or terminate the permit, after notice and hearing, for violations of its conditions, this act, regulations adopted or orders issued by the department, and when deemed necessary for the public interest.

9. The Board of Public Utilities shall fix just and reasonable rates for any public water supply system subject to its jurisdiction, as may be necessary for that system to comply with an order issued by the department or the terms and conditions of a permit issued pursuant to this act.

10. Any expenditures necessary to comply with an order or permit issued by the department for construction, improvement, repair or rehabilitation of public water supply systems shall, for the purposes of P. L. 1976, c. 68 (C. 40A:4–45.1 et seq.), be considered as expenditures mandated by State law.

11. The department shall in accordance with a fee schedule adopted by rule and regulation, establish and charge reasonable administrative fees, which fees shall be based upon, and not exceed, the estimated cost of processing, monitoring, administering and enforcing the diversion permits. The department shall deposit the fees in the "Environmental Services Fund" created by P. L. 1975, c. 232 (C. 13:1D–30 et seq.). There shall be annually appropriated an amount equivalent to the amount anticipated to be collected as fees by the department for the administration of the water supply management program.

12. No person supplying or proposing to supply water to any other person shall have the power to condemn lands, water or water privileges for any new or additional source of ground or surface water until that person has first submitted to the department an application for approval to divert the source of the water and the department has approved the application subject to such conditions as it may determine to be necessary to protect the public health and welfare.

13. a. Within 180 days of the effective date of this act, the department shall prepare and adopt the New Jersey Statewide Water Supply Plan, which plan shall be revised and updated at least once every 5 years.

b. The plan shall include, but need not be limited to, the following:

(1) An identification of existing Statewide and regional ground and surface water supply sources, both interstate and intrastate, and the current usage thereof;

(2) Projections of Statewide and regional water supply demand for the duration of the plan;

(3) Recommendations for improvements to existing State water supply facilities, the construction of additional State water supply facilities, and for the interconnection or consolidation of existing water supply systems; and

(4) Recommendations for legislative and administrative actions to provide for the maintenance and protection of watershed areas.

c. Prior to adopting the plan, the department shall:

(1) Prepare and make available to all interested persons a proposed plan;

(2) Conduct public meetings in the several geographic areas of the State on the proposed plan; and

(3) Consider the comments made at these meetings, make any revisions to the proposed plan as it deems necessary, and adopt the plan.

14. a. When the department determines that the developed water supply available to a water purveyor is inadequate to service its users with an adequate supply of water under a variety of conditions, the department may order the water purveyor to develop or acquire, within a reasonable period of time, additional water supplies sufficient to provide that service.

b. The Division of Local Government Services in the Department of Community Affairs shall, when reviewing the annual budget of any municipality, county, or agency thereof which operates a public water supply system, certify that an amount sufficient to cover the cost of any order issued to the municipality, county or agency thereof pursuant to subsection a. of this section is included in that annual budget.

15. The department may:

a. Perform any and all acts and issue such orders as are necessary to carry out the purposes and requirements of this act;

b. Administer and enforce the provisions of this act and rules, regulations and orders promulgated, issued or effective hereunder;

c. Present proper identification and then enter upon any land or water for the purpose of making any investigation, examination or survey contemplated by this act;

d. Subpena and require the attendance of witnesses and the production by them of books and papers pertinent to the investigations and inquiries the department is authorized to make under this act, and examine them and such public records as shall be required in relation thereto;

e. Order the interconnection of public water supply systems, whether in public or private ownership, whenever the department determines that the public interest requires that this interconnection be made, and require the furnishing of water by means of that system to another system, but no order shall be issued before comments have been solicited at a public hearing, notice of which has been published at least 30 days before the hearing, in one newspaper circulating generally in the area served by each involved public water supply system, called for the purpose of soliciting comments on the proposed action;

f. Order any person diverting water to improve or repair its water supply facilities so that water loss is eliminated so far as practicable, safe yield is maintained and the drinking water quality standards adopted pursuant to the "Safe Drinking Water Act," P. L. 1977, c. 224 (C. 58:12A–1 et seq.) are met;

g. Enter into agreements, contracts, or cooperative arrangements under such terms and conditions as the department deems appropriate with other states, other State agencies, Federal agencies, municipalities, counties, educational institutions, investor owned water companies, municipal utilities authorities, or other organizations or persons;

h. Receive financial and technical assistance from the Federal Government and other public or private agencies;

i. Particpate in related programs of the Federal Government, other states, interstate agencies, or other public or private agencies or organizations;

j. Establish adequate fiscal controls and accounting procedures to assure proper disbursement of and accounting for funds appropriated or otherwise provided for the purpose of carrying out the provisions of this act;

k. Delegate those responsibilities and duties to personnel of the department as deemed appropriate for the purpose of administering the requirements of this act;

l. Combine permits issued pursuant to this act with permits issued pursuant to any other act whenever that action would improve the administration of both acts;

m. Evaluate and determine the adequacy of ground and surface water supplies and develop methods to protect aquifer recharge areas.

16. If any person violates any of the provisions of this act or any rule, regulation or order adopted or issued pursuant to the provisions of this act, the department may institute a civil action in a court of competent jurisdiction for injunctive relief to enforce said provisions and to prohibit and prevent that violation and the court may proceed in the action in a summary manner. Any person who violates the provisions of this act or any rule, regulation or order adopted or issued pursuant to this act shall be liable to a civil administrative penalty of not more than $5,000.00 for each offense to be imposed by the department pursuant to standards adopted in regulations; or a civil penalty of not more than $5,000.00 for each offense, to be collected in a civil action by a summary proceeding under "the penalty enforcement law" (N. J. S. 2A:58–1

et seq.) or in any case before a court of competent jurisdiction wherein injunctive relief has been requested. The Superior Court and county district court shall have jurisdiction to enforce the penalty enforcement law. If the violation is of a continuing nature, each day during which it continues shall constitute an additional, separate and distinct offense. The department is authorized to compromise and settle any claim for a penalty under this section in such amount in the discretion of the department as may appear appropriate and equitable under all of the circumstances.

17. All of the powers, duties and functions of the Water Policy and Supply Council are transferred to the Department of Environmental Protection. Whenever the term "Water Policy and Supply Council" occurs or any reference is made thereto in any law, contract or document, administrative or judicial determination, or otherwise, it shall be deemed to mean or refer to the Department of Environmental Protection.

18. a. There is established in the department a Water Supply Advisory Council which shall consist of seven members appointed by the Governor with the advice and consent of the Senate. Each of these members shall be appointed for a term of 3 years, provided that, of the members first appointed by the Governor, three shall serve for terms of 1 year, two shall serve for terms of 2 years, and two shall serve for terms of 3 years. Of these members, one shall be a representative of the agricultural community, one shall be a representative of industrial and commercial water users, one shall be a representative of residential water users, one shall be a representative of investor-owned water companies, one shall be a representative of municipal or county water companies, one shall be a representative of private watershed protection associations and one shall be a representative of the academic community.

b. A majority of the membership of the council shall constitute a quorum for the transaction of council business. Action may be taken and motions and resolutions adopted by the council at any meeting thereof by the affirmative vote of a majority of the full membership of the council.

c. The council shall meet regularly as it may determine, and shall also meet at the call of the commissioner.

d. The council shall appoint a chairman from among its members and such other officers as may be necessary. The council may, within the limits of any funds appropriated or otherwise made available to it for this purpose, appoint such staff or hire such experts as it may require.

e. Members of the council shall serve without compensation, but the council may, within the limits of funds appropriated or otherwise made available for such purposes, reimburse its members for necessary expenses incurred in the discharge of their official duties.

19. The council shall:

a. Advise the department concerning the preparation, adoption and revision of the New Jersey Statewide Water Supply Plan;

b. Advise the department concerning the implementation of the permit program required by this act;

c. Advise the New Jersey Water Supply Authority concerning the construction, maintenance and operation of State water supply facilities and projects; and

d. Advise the department concerning the preparation and implementation of the Emergency Water Supply Allocation Plan.

20. The council may:

a. Review any matter relating to water supply and to transmit such recommendations thereon to the department or to the New Jersey Water Supply Authority as it may deem appropriate;

b. Hold public meetings or hearings within this State on any matter related to water supply; and

c. Call to its assistance and avail itself of the services of such employees of any State, county or municipal department, board, commission or agency as may be required and made available for such purposes.

21. R. S. 58:2–2 is amended to read as follows:

58:2–2. Payment for water diverted as provided in [section] *R. S.* 58:2–1 [of this title] shall be deemed to be a license and its amount shall be fixed by the [State Water Policy Commission] *department* at a rate of not less than $1.00 nor more than $10.00 per million gallons. If at all times an amount equal to the average daily flow for the driest month, as shown by the existing records, or in lieu thereof 175,000 gallons daily for each square mile of unappropriated watershed above the point of diversion, shall be allowed to flow down the stream. The [commission] *department* shall fix the minimum rate and may increase the rate proprotionally as a less amount is allowed to flow down the stream below the point of diversion, due account being taken in fixing said increase both of the duration and amount of the deficiency. The aforesaid 125,000 gallons daily for each square mile of unappropriated watershed shall be additional to the dry-season flow or any part thereof which may be allowed to flow from any appropriated watershed or watersheds above the point of diversion.

Water diverted within the corporate limits of a municipality for manufacturing and fire purposes only and returned without pollution to the stream from which it was taken within said corporate limits shall not be reckoned in making up the aggregate amount diverted.

Any party aggrieved by the action of the [commission] *department* upon filing written complaint on or before March twentieth, shall be heard and permitted to give evidence of the facts, and the sum fixed may be changed, reduced, or cancelled, as the facts may warrant.

22. R. S. 58:2–3 is amended to read as follows:

58:2–3. The [State Water Policy Commission] *department* shall annually certify to the State Comptroller, as soon as practicable after January first, and not later than February fifteenth, the names of all municipalities, corporations or private persons owing money to the State for the diversion of water during the preceding year, with the amounts so due.

The State Comptroller shall promptly notify said municipalities, water companies or persons of their indebtedness to the State, and if said amounts are not paid to the State Treasurer on or before July first of the same year, the State Comptroller shall certify to the Attorney-General for collection the names of the delinquents and the amounts due from each, and the Attorney-General shall take immediate steps to collect the same in the name of the State.

All sums received as herein provided shall be [paid into the General State Fund and the expenses of the administration of this chapter shall be included in the annual appropriations bill] *deposited to the credit of the State and deemed as part of the Environmental Services Fund. The Legislature shall annually appropriate an amount equivalent to the amount anticipated to be collected as sums charged under this section in support of the water management programs.*

23. R. S. 58:2–4 is amended to read as follows:

58:2–4. In the case of the condemnation of subsurface, well or percolating water supplies, there shall be charged by the State a fee of $1.00 per million gallons from that portion of the supply for the acquisition of which the State's right of eminent domain is exercised for all water diverted, which charge shall be certified to the State Comptroller by the [State Water Policy Commission] *department* and its collection shall be enforced in the same manner as hereinbefore in this chapter provided in the case of excess diversion of surface water supplies.

24. R. S. 58:2–5 is amended to read as follows:

58:2–5. Nothing in this chapter shall be construed to confer upon any municipality, corporation or person, any franchise not already possessed by said municipality, corporation or person, but the approval of the [commission] *department* contained in its decision as provided in this chapter, shall constitute the assent of the State to the diversion of water as against the State in accordance with the terms of said decision.

25. Any rules and regulations promulgated pursuant to any statutes repealed by this act shall remain in effect until superseded by rules and regulations promulgated pursuant to this act. However, all such rules and regulations shall be reviewed and revised where necessary by the department within 2 years of the enactment of this act.

26. The following are repealed:
R. S. 58:1–2 through R. S. 58:1–25;
R. S. 58:1–28 through R. S. 57:1–34;
R. S. 58:3–1;
R. S. 58:6–1 through R. S. 58:6–5;
P. L. 1942, c. 24 (C. 58:1–25.1 through 58:1–25.25);
P. L. 1963, c. 181 § 1-14, 16, 17 (C. 58:1–35 through 58:1–50);
P. L. 1947, c. 375 (C. 58:4A–1 through 58:4A–4);
P. L. 1945, c. 22, § 9 (C. 13:1A–9);
P. L. 1948, c. 448, § 100, 101 (C. 13:1B–49 and 13:1B–50).

27. This act shall take effect immediately.

P. L. 1981, CHAPTER 293, *approved October 7, 1981*

Senate Committee Substitute for 1980 Senate No. 1612

AN ACT creating the New Jersey Water Supply Authority, empowering the authority to acquire, finance, construct and operate water systems under certain circumstances, authorizing the issuance of bonds of the authority, and providing for the terms and security thereof.

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey:*

1. This act shall be known and may be cited as the "New Jersey Water Supply Authority Act."

2. The Legislature finds that a State authority should be established to acquire, finance, construct and operate water systems pursuant to the provisions of this act.

3. As used in this act:

a. "Authority" means the New Jersey Water Supply Authority created by this act;

b. "Bonds" means bonds, notes, or other obligations issued or authorized pursuant to this act;

c. "Compensating reservoir" means the structures, facilities and appurtenances for the impounding, transportation and release of water for the replenishment in periods of drought or at other necessary times of all or a part of waters in or bordering the State diverted into a project;

d. "Cost" as applied to a project means the cost of acquisition and construction thereof, the cost of acquisition of lands, rights-of-way, property rights, easements, and interests required by the authority for acquisition and construction, the cost of demolishing or removing any buildings or structures on land so acquired, including the cost of acquiring any lands to which buildings or structures may be moved, the cost of acquiring or constructing and equipping an office of the authority, the cost of machinery, furnishings, and equipment, financing expenses, reserves, interest prior to and during construction and for no more than 6 months after completion of construction, engineering, expenses of research and development

with respect to any project, legal expenses, plans, specifications, surveys, estimates of cost and revenues, working capital, other expenses necessary or incident to determining the feasibility or practicability of acquiring or constructing a project, administrative expense, and such other expense as may be necessary or incident to the acquisition or construction of the project;

e. "Construct" and "construction" means and includes acts of construction, reconstruction, replacement, extension, improvement and betterment of a project;

f. "Department" means the Department of Environmental Protection;

g. "Governmental agency" means any municipality, county, or any agency thereof, the State Government and any instrumentality or subdivision thereof;

h. "Project" means a water system or any part thereof;

i. "Real property" means lands both within or without the State, and improvements thereof or thereon, or any rights or interests therein;

j. "Revenue" means all rents, fees and charges for water sold from, or for the use and services of any project of the authority and payments in respect of any loans or advances made to governmental agencies pursuant to this act;

k. "Service charges" means water service charges established or collected by the authority pursuant to this act;

l. "Water system" means the plants, structures and other real and personal property financed, acquired, constructed or operated or to be financed, acquired, constructed or operated by the authority under this act or additions and improvements thereto, including reservoirs, basins, dams, canals, aqueducts, standpipes, conduits, pipelines, mains, pumping stations, water transmission systems, compensating reservoirs, waterworks or sources of water supply, wells, purification or filtration plants or other plants, equipment and works, connections, rights of flowage or diversion, and other plants, structures, boats, conveyances, and other real and personal property and rights therein, and appurtenances necessary or useful and convenient for the accumulation, supply, treatment or transmission of water.

4. a. There is established in but not of the Department of Environmental Protection a public body corporate and politic, with corporate succession, to be known as the "New Jersey Water Supply Authority." The authority is hereby constituted as an instrumentality of the State exercising public and essential governmental functions.

b. The authority shall consist of the Commissioner of Environmental Protection, who shall be a member ex officio with full voting rights, and six public members appointed by the Governor with the advice and consent of the Senate for terms of 3 years; provided that of the members of the authority first appointed by the Governor, two shall serve for terms of 1 year, two shall serve for terms of 2 years, and two shall serve for terms of 3 years, of whom two shall be recognized experts in the fields of water resource management and distribution, and public finance, respectively. The remaining public members appointed by the Governor shall represent the following: the agricultural community, industrial water users, residential water users and private watershed associations. Each member shall hold office for the term of his appointment and until his successor shall have been appointed and qualified. A member shall be eligible for reappointment. Any vacancy in the membership occurring other than by expiration of term shall be filled in the same manner as the original appointment but for the unexpired term only.

c. Each appointed member may be removed from office by the Governor, for cause, after a public hearing, and may be suspended by the Governor pending the completion of the hearing. Each member before entering upon his duties shall take and subscribe an oath to perform the duties of his office faithfully, impartially and justly to the best of his ability. A record of these oaths shall be filed in the office of the Secretary of State.

d. The chairman, who shall be the chief executive officer of the authority, shall be the Commissioner of Environmental Protection, and the members of the authority shall elect one of their number as vice chairman thereof. The authority shall elect a secretary and a treasurer who need not be members, and the same person may be elected to serve both as secretary and treasurer. The powers of the authority shall be vested in the members thereof in office from time to time and four members of the authority shall constitute a quorum at any meeting thereof. Action may be taken and motions and resolutions adopted by the authority at any meeting thereof by the affirmative vote of at least four members of the authority. No vacancy in the membership of the authority shall impair the right of a quorum of the members to exercise all the powers and perform all the duties of the authority.

e. No resolution or other action of the authority providing for the issuance of bonds or the refunding of bonds shall be adopted or otherwise made effective by the authority without the prior approval, in writing, of the Governor and of the State Treasurer

or the Comptroller of the Treasury. A true copy of the minutes of every meeting of the authority shall be prepared and forthwith delivered to the Governor. No action taken at such meeting by the authority shall have effect until 10 days, exclusive of Saturdays, Sundays and public holidays, after the copy of the minutes has been so delivered. If, in this 10-day period, the Governor returns the copy of the minutes with a veto of any action taken by the authority at that meeting, the action shall be of no effect.

f. Each member and the treasurer of the authority shall execute a bond to be conditioned upon the faithful performance of the duties of the member or treasurer, as the case may be, in a form and amount as may be prescribed by the Comptroller of the Treasury. The bonds shall be filed in the office of the Secretary of State. At all times thereafter the members and treasurer of the authority shall maintain these bonds in full force. The costs of the bonds shall be borne by the authority.

g. The members of the authority shall serve without compensation, but the authority shall reimburse its members for actual expenses necessarily incurred in the discharge of their duties. No officer or employee of the State shall be deemed to have forfeited or shall forfeit his office or employment or any benefits or emoluments thereof by reason of his acceptance of the office of ex officio member of the authority.

h. The Commissioner of Environmental Protection may designate an officer or employee of the department to represent him at meetings of the authority, and the designee may lawfully vote and otherwise act on behalf of the commissioner. The designation shall be in writing delivered to the authority and shall continue in effect until revoked or amended by writing delivered to the authority.

i. The authority may be dissolved by act of the Legislature on condition that the authority has no debts or obligations outstanding or that provision has been made for the payment or retirement of debts or obligations. Upon a dissolution of the authority all property, funds and assets thereof shall be vested in the State.

5. a. All water supply facilities, owned or operated by the State, either now or hereafter, are transferred to the authority. The authority shall operate these facilities pursuant to the statutory authorizations enabling the State to operate and manage the facilities. The Delaware and Raritan Canal Transmission Complex, the Spruce Run-Round Valley Reservoir Complex and all other State-operated facilities now or hereafter authorized to be designed, constructed and operated pursuant to any past or future bond

issues, including the "Water Supply Bond Act of 1981," are specifically included as State water supply facilities.

b. The revenue from all State water supply facilities, the disposition of which is not otherwise expressly provided for by law, is pledged to the authority for the purposes provided herein.

6. a. The authority is hereby empowered to design, initiate, acquire, construct, maintain, repair and operate projects or cause the same to be operated pursuant to a lease, sublease, or agreement with any person or governmental agency, and to issue bonds of the authority to finance these projects, payable from the revenues and other funds of the authority. All projects undertaken by the authority shall conform to the recommendations of the New Jersey Statewide Water Supply Plan.

b. The authority shall be subject to compliance with all State health and environmental protection statutes and regulations and any other statutes and regulations not inconsistent herewith. The authority may, upon the request of a governmental agency, enter into a contract to provide services for any project.

c. The authority shall consult with the Water Supply Advisory Council from time to time prior to final action on any project or undertaking authorized pursuant to this section.

7. Except as otherwise limited by the act, authority shall have power:

a. To sue and be sued.

b. To have an official seal and alter the same at pleasure.

c. To make and alter bylaws for its organization and internal management and for the conduct of its affairs and business.

d. To maintain an office at such place or places within the State as it may determine.

e. To acquire, lease as lessee or lessor, rent, hold, use and dispose of real or personal property for its purposes.

f. To borrow money and to issue its negotiable bonds and to secure the same by a mortgage on its property or any part thereof and otherwise to provide for and secure the payment thereof and to provide for the rights of the holders thereof.

g. To fix and revise from time to time and charge and collect rents, fees and charges for any of the services rendered by the authority, which shall be equitably assessed.

h. To procure insurance against any losses in connection with its property, operations or assets in such amounts and from such insurers as it deems desirable.

i. Subject to any agreement with bondholders to invest moneys of the authority not required for immediate use, including proceeds

from the sale of any bonds, in such obligations, securities and other investments as the authority shall deem prudent.

j. To appoint and employ an executive director and such additional officers who need not be members of the authority and accountants, financial advisors or experts and such other or different officers, agents and employees as it may require and determine their qualifications, terms of office, duties and compensation, all without regard to the provisions of Title 11, Civil Service, of the Revised Statutes, except with respect to those officers and employees of the Water Supply Facilities Element who are transferred to the authority pursuant to section 24 of this act, and these officers and employees shall remain subject to the provisions of that Title.

k. To contract for and to accept any gifts or grants or loans of funds or property or financial or other aid in any form from the United States of America or any agency or instrumentality thereof, or from the State or any agency, instrumentality or political subdivision thereof, or from any other source and to comply, subject to the provisions of this act, with the terms and conditions thereof.

l. To acquire, hold, rent, lease, use and dispose of real or personal property in the exercise of its powers and the performance of its duties under this act.

m. To acquire, subject to the provisions of any other statute, in the name of the authority by purchase or otherwise, on such terms and conditions and in such manner as it may deem proper, except with respect to property owned by the State, by the exercise of the power of eminent domain, any land and other property, which it may determine is reasonably necessary for any of its projects and any and all rights, title and interest in that land and other property, including, providing there is no prudent and feasible alternative, public lands, reservations, highways or parkways, owned by or in which the State or any county, municipality, public corporation, or other political subdivision of the State has any right, title or interest, or parts thereof or rights therein and any fee simple absolute or any lesser interest in private property, and any fee simple absolute in, easements upon or the benefit of restrictions upon, abutting property to preserve and protect the project.

n. To do and perform any acts and things authorized by the act under, through, or by means of its officers, agents or employees or by contracts with any person.

o. To establish and enforce rules and regulations for the use and operation of its projects and the conduct of its activities, and provide for the policing and the security of its projects.

p. To do any and all things necessary or convenient to carry out its purposes in accordance with the powers given and granted in the act.

8. a. Upon the exercise of the power of eminent domain, the compensation to be paid thereunder shall be ascertained and paid in the manner provided in P. L. 1971, c. 361 (C. 20:3–1 et seq.).

b. Whenever the authority shall determine that it is necessary that any public utility facilities such as tracks, pipes, mains, conduits, cables, wires, towers, poles and other equipment and appliances of any public utility, as defined in R. S. 48:2–13, which are now, or hereafter may be, located in, on, along, over or under any project, should be removed from such project, the public utility owning or operating such facilities shall relocate or remove the same in accordance with the order of the authority; provided however, that the cost and expenses of such relocation or removal, including the cost of installing such facilities in a new location or new locations, and the cost of any lands, or any rights or interests in lands, and any other rights acquired to accomplish such relocation or removal, less the cost of any lands or any rights of the public utility paid to the public utility in connection with the relocation or removal of such property, shall be ascertained and paid by the authority as a part of the cost of such project. In case of any such relocation or removal of facilities, as aforesaid, the public utility owning or operating the same, its successors or assigns, may maintain and operate such facilities, with the necessary appurtenances, in the new location, for as long a period, and upon the same terms and conditions, as it had the right to maintain and operate such facilities in their former location.

9. a. The authority is hereby empowered from time to time to issue its bonds in such principal amounts as in the opinion of the authority shall be necessary to provide sufficient funds for any of its corporate purposes, including the payment, funding or refunding of the principal of, or interest or redemption premiums on, any bonds issued by it whether the bonds or interest to be funded or refunded have or have not become due the establishment or increase of such reserves to secure or to pay such bonds or interest thereon and all other costs or expenses of the agency incident to and necessary to carry out its corporate purposes and powers.

b. Except as may be otherwise expressly provided in the act or by the authority, every issue of bonds shall be general obligations payable out of and secured by any revenues or funds of the authority, subject only to any agreements with holders of particular bonds pledging any particular revenues or funds. The authority

may issue such types of bonds as it may determine, including, without limiting the generality of the foregoing bonds as to which the principal and interest are payable (1) exclusively from the revenues and funds derived from or relating to the project or part thereof financed with the proceeds of the bonds; (2) exclusively from the revenues and funds derived from or relating to certain designated projects or parts thereof, whether or not the same are financed in whole or in part from the proceeds of bonds; (3) exclusively from certain designated funds of the authority; or (4) from the revenues and funds of the authority generally. The bonds may be additionally secured by a pledge of any grant, subsidy or contribution from the United States of America or any agency or instrumentality thereof or the State of New Jersey or any agency, instrumentality or political subdivision thereof, or any person, or a pledge of any income or revenues, funds or moneys of the authority from any source whatsoever.

c. Whether or not the bonds are of such form and character as to be negotiable instruments under the terms of Title 12A, Commercial Transactions, New Jersey Statutes, the bonds are hereby made negotiable instruments within the meaning of and for all the purposes of said Title 12A, subject only to the provisions of the bonds for registration.

d. Bonds of the authority shall be authorized by a resolution or resolutions of the authority and may be issued in one or more series and shall bear such date, or dates, mature at such time or times, bear interest at such rate or rates of interest per annum, be in such denomination or denominations, be in such form, either coupon or registered, carry such conversion or registration privileges, have such rank or priority, be executed in such manner, be payable from such sources in such medium of payment at such place or places within or without the State, and be subject to such terms of redemption, with or without premium, as such resolution or resolutions may provide.

e. Bonds of the authority may be sold at public or private sale at such price or prices and in such manner as the authority shall determine. Every bond shall mature and be paid not later than 40 years from the date thereof.

f. Bonds may be issued under the provisions of the act without obtaining the consent of any department, division, commission, board, bureau or agency of the State, and without any other proceeding or the happening of any other conditions or other things than those proceedings, conditions or things which are specifically required by this act.

g. Bonds of the authority issued under the provisions of this act shall not be in any way a debt or liability of the State or of any political subdivision thereof other than the authority and shall not create or constitute any indebtedness, liability or obligation of the State or of the political subdivision or be or constitute a pledge of the faith and credit of the State or of the political subdivision but all such bonds, unless funded or refunded by bonds of the authority, shall be payable solely from revenues or funds pledged or available for their payment as authorized in the act. Each bond shall contain on its face a statement to the effect that the authority is obligated to pay the principal thereof or the interest thereon only from revenues or funds of the authority and that neither the State nor any political subdivision thereof is obligated to pay the principal or interest and that neither the faith and credit nor the taxing power of the State or any political subdivision thereof is pledged to the payment of the principal of or the interest on the bonds.

h. All expenses incurred in carrying out the provisions of the act shall be payable solely from revenues or funds provided or to be provided under the provisions of the act and nothing in this act shall be construed to authorize the authority to incur any indebtedness or liability on behalf of or payable by the State or any political subdivision thereof.

10. In any resolution of the authority empowering or relating to the issuance of any bonds the authority, in order to secure the payment of such bonds and in addition to its other powers, shall have power, by provisions therein which shall constitute covenants by the authority and contracts with the holders of the bonds:

a. To pledge all or any part of its rents, fees, tolls, revenues or receipts to which its right then exists or may thereafter come into existence, and the moneys derived therefrom, and the proceeds of any bonds.

b. To pledge any lease or other agreement or the rents or other revenues thereunder and the proceeds thereof.

c. To mortgage all or any part of its property, real or personal, then owned or thereafter to be acquired.

d. To covenant against pledging all or any part of its rents, fees, tolls, revenues or receipts or its leases or agreements or rents or other revenues thereunder or the proceeds thereof, or against mortgaging all or any part of its real or personal property then owned or thereafter acquired, or against permitting or suffering any lien on any of the foregoing.

e. To covenant with respect to limitations on any right to sell, lease or otherwise dispose of any project or any part thereof or any property of any kind.

f. To covenant as to any bonds to be issued and the limitations thereon and the terms and conditions thereof and as to the custody, application, investment, and disposition of the proceeds thereof.

g. To covenant as to the issuance of additional bonds or as to limitations on the issuance of additional bonds and on the incurring of other debts by it.

h. To covenant as to the payment of the principal of or interest on the bonds, or any other obligations, as to the sources and methods of payment, as to the rank on priority of the bonds with respect to any lien or security or as to the acceleration of the maturity of the bonds.

i. To provide for the replacement of lost, stolen, destroyed or mutilated bonds.

j. To covenant against extending the time for the payment of bonds or interest thereon.

k. To covenant as to the redemption of bonds and privileges of exchange thereof for other bonds of the authority.

l. To covenant as to the rates of toll and other charges to be established and charged, the amount to be raised each year or other period of time by tolls or other revenues and as to the use and disposition to be made thereof.

m. To covenant to create or authorize the creation of special funds or moneys to be held in pledge or otherwise for construction, operating expenses, payment or redemption of bonds, reserves or other purposes and as to the use, investment, and disposition of the moneys held in those funds.

n. To establish the procedure, if any, by which the terms of any contract or covenant with or for the benefit of the holders of bonds may be amended or abrogated, the amount of bonds the holders of which must consent thereto, and the manner in which the consent may be given.

o. To covenant as to the construction, improvement, or maintenance of its real and personal property, the replacement thereof, the insurance to be carried thereon, and the use and disposition of insurance moneys.

p. To provide for the release of property, leases or other agreements, or revenues and receipts from any pledge or mortgage and to reserve rights and powers in, or the right to dispose of, property which is subject to a pledge or mortgage.

q. To provide for the rights and liabilities, powers and duties arising upon the breach of any covenant, condition or obligation and to prescribe the events of default and the terms and conditions upon which any or all of the bonds of the authority shall become or may be declared due and payable before maturity and the terms and conditions upon which any such declaration and its consequences may be waived.

r. To vest in a trustee or trustees within or without the State such property, rights, powers and duties in trust as the authority may determine, including the right to foreclose any mortgage, and to limit the rights, duties and powers of the trustee.

s. To execute all mortgages, bills of sale, conveyances, deeds of trust and other instruments necessary or convenient in the exercise of its powers or in the performance of its covenants or duties.

t. To pay the costs or expenses incident to the enforcement of such bonds or of the provisions of the resolution or of any covenant or agreement of the authority with the holders of its bonds; and

u. To limit the rights of the holders of any bonds to enforce any pledge or covenant securing bonds.

11. Any pledge of revenues, moneys, funds or other property made by the authority shall be valid and binding from the time when the pledge is made. The revenues, moneys, funds or other property so pledged and thereafter received by the authority unless otherwise agreed, shall immediately be subject to the lien of the pledge without any physical delivery thereof or further act, and the lien of the pledge shall be valid and binding as against all parties having claims of any kind in tort, contract or otherwise against the authority, irrespective of whether the parties have notice thereof. Neither the resolution nor any other instrument by which a pledge of revenues, moneys or funds is created need be filed or recorded except in the records of the authority.

12. Neither the members of the authority nor any person executing bonds issued pursuant to this act shall be liable personally on the bonds by reason of the issuance thereof.

13. The authority may establish such reserves, funds or accounts as may be, in its discretion, necessary or desirable to further the accomplishment of the purposes of the authority or to comply with the provisions of any agreement made by or any resolution of the authority.

14. The State of New Jersey pledges to and covenants and agrees with the holders of any bonds issued pursuant to authority of the act that the State will not limit or alter the rights or powers vested in the authority to acquire, construct, maintain, improve, and repair

any project in any way that would jeopardize the interest of such holders, or to perform and fulfill the terms of any agreement made with the holders of the bonds, or to fix, establish, charge and collect such rents, fees, rates or other charges as may be convenient or necessary to produce sufficient revenues to meet all expenses of the authority and fulfill the terms of any agreement made with the holders of the bonds, together with interest thereon, with interest on any unpaid installments of interest, and all costs and expenses in connection with any action or proceedings by or on behalf of such holders, until the bonds, together with interest thereon, are fully met and discharged or provided for.

15. The State and all public officers, governmental units and agencies thereof, all banks, trust companies, savings banks and institutions, building and loan associations, savings and loan associations, investment companies, and other persons carrying on a banking business, all insurance companies, insurance associations and other persons carrying on an insurance business, and all executors, administrators, guardians, trustee and other fiduciaries, may legally invest any sinking funds, moneys or other funds belonging to them or within their control in any bonds issued pursuant to the act, and such bonds shall be authorized security for any and all public deposits.

16. Any governmental entity, notwithstanding any contrary provision of law, except any requiring notice or public hearing, is authorized to lease, lend, grant or convey to the authority at its request upon such terms and conditions as the governing body or other proper utility of such governmental entity may deem reasonable and fair and without the necessity for any advertisement, order of court or other action or formality, other than the ordinance, resolution or regular action thereof, any real property or interest therein which may be necessary or convenient to the effectuation of the purposes of the authority. No property of the State, other than meadowlands, riparian lands or lands underwater and similar lands or interests therein referred to and whose disposition is controlled by the provisions in Title 12, Commerce and Navigation, and Title 13, Conservation and Development, of the Revised Statutes, shall be so granted, leased or conveyed to the authority except upon the approval of the State House Commission and payment to the State of such price therefor as may be fixed by the State House Commission.

17. Every project, when constructed and placed in operation, shall be properly maintained and kept in good condition and repaired by the authority. Every project shall be operated by such

operating employees as the authority may in its discretion employ or pursuant to a contract or lease with a governmental agency or person.

18. Nothing in this act shall be construed to authorize or permit the authority to plan, initiate, acquire, construct, maintain, repair or operate any retail water system or project.

19. The authority may establish and alter rates and charges, and collect rents, fees and charges for water sold from, and for the use of services of any water system project and contract in the manner provided in this section with one or more persons, one or more governmental entities, or any combination thereof, receiving the use or services of any project, and fix the terms, conditions, rents, rates, fees and charges for such use or services.

The contract may provide for acquisition by such person or governmental agency of all or any part of the project for such consideration payable over the period of the contract or otherwise as the authority in its discretion determines to be appropriate, but subject to the provisions of any resolution of the authority authorizing the issuance of bonds or any trust agreement securing the same. Any water supply entity which has the power to construct, operate and maintain water management facilities may enter into a contract or lease with the authority whereby the use or services of any project of the authority will be made available to the entity and pay for the use or services such rents, rates, fees and charges as may be agreed to by the authority and the entity.

Any one or more public or private entity may cooperate with the authority in the acquisition or construction of a project and shall enter into such agreements with the authority as are necessary, with a view to effective cooperative action and safeguarding of the respective interests of the parties thereto, which agreements shall provide for such contributions by the parties thereto in such proportion as may be agreed upon and such other terms as may be mutually satisfactory to the parties including without limitation the authorization of the construction of the project by one of the parties acting as agent for all of the parties and the ownership and control of the project by the authority to the extent necessary or appropriate for purposes of the issuance of bonds by the authority. Any governmental agency may provide such contribution as is required under such agreements by the appropriation of money or, if otherwise authorized by law to issue bonds or levy taxes or assessments and issue bonds in anticipation of the collection thereof, by the issuance of bonds or by the levying of taxes or assessments and the issuance of bonds in anticipation of the collection thereof, and

by the payment of such appropriated money or the proceeds of the bonds to the authority pursuant to such agreements.

20. On or before the last day of February in each year the authority shall make an annual report of its activities for the preceding calendar year to the Governor and to the Legislature. The report shall set forth a complete operating and financial statement covering its operations during the year. The authority shall cause an audit of its books and accounts to be made at least once in each year by certified public accountants and the cost thereof shall be considered an expense of the authority and a copy thereof shall be filed with the Comptroller of the Treasury.

21. All officers, departments, boards, agencies, divisions and commissions of the State are authorized to render such services to the authority as may be within the area of their respective governmental functions as fixed by law, and as may be requested by the authority. The cost and expense of the services shall be met and provided for by the authority. The Attorney General shall serve as counsel to the authority.

22. The authority is hereby authorized to make and enter into contracts and agreements necessary or incidental to the performance of its duties and the execution of its powers. No contract on behalf of the authority shall be entered into for the doing of any work, or for the hiring of equipment or vehicles, where the sum to be expended exceeds the sum of $2,500.00 unless the authority shall first publicly advertise for bids therefor, and shall award the contract to the lowest responsible bidder; but advertising shall not be required where the contract to be entered into is one for the furnishing or performing services of a professional nature or for the supplying of any product or the rendering of any service by a public utility subject to the jurisdiction of the Board of Public Utilities and tariffs and schedules of the charges, made, charged, or exacted by the public utility for any such products to be supplied or services to be rendered are filed with the board. This section shall not prevent the authority from having any work done by its own employees, nor shall it apply to repairs, or to the furnishing of materials, supplies or labor, or the hiring of equipment or vehicles, when the safety or protection of its or other public property or the public convenience require, or the exigency of the authority service will not admit of such advertisement. In such case the authority shall, by resolution, passed by the affirmative vote of a majority of its members, declare the exigency or emergency to exist, and set forth in the resolution the nature thereof and the approximate amount to be expended.

23. a. All projects and other property of the authority is declared to be public property devoted to an essential public and governmental function and purpose and shall be exempt from all taxes and special assessments of the State or any political subdivision thereof; provided, however, that when any part of the project site not occupied or to be occupied by facilities of the project is leased by the authority to another whose property is not exempt and the leasing of which does not make the real estate taxable, the estate created by the lease and the appurtenances thereto shall be listed as the property of the lessee thereof and be assessed and taxed as real estate. All bonds issued pursuant to this act are declared to be issued by a body corporate and public of the State and for an essential public and governmental purpose and these bonds, and the interest thereon and the income therefrom, and all funds, revenues, income and other moneys received or to be received by the authority and pledged or available to pay or secure the payment of the bonds, or interest thereon, shall be exempt from taxation except for transfer, inheritance and estate taxes.

b. Any project constructed, maintained or operated by the authority shall be exempt from compliance with local zoning regulations, but the authority shall wherever practicable adhere to the regulations.

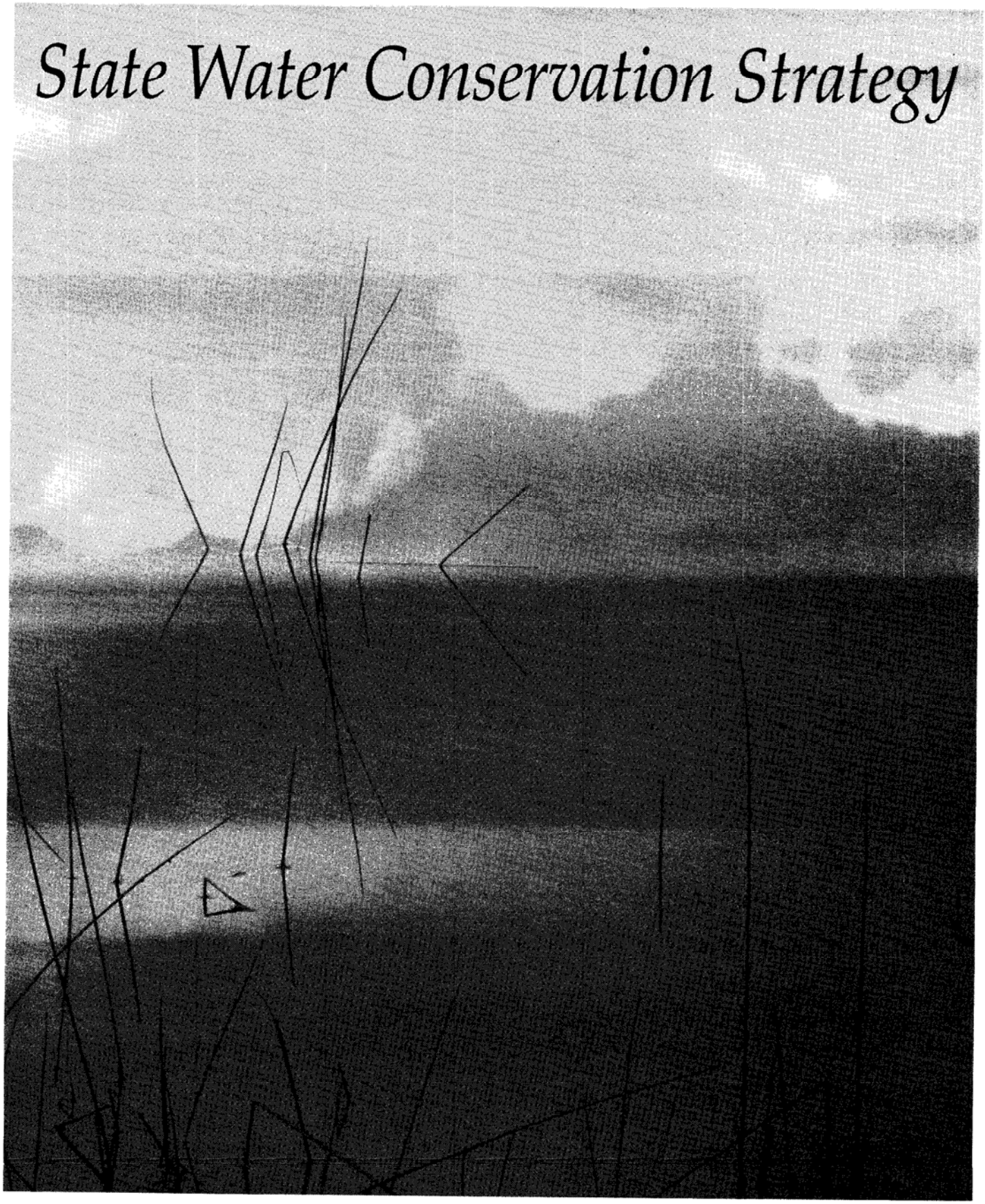
24. The Water Supply Facilities Element in the Division of Water Resources of the Department of Environmental Protection, together with all its functions, powers and duties, is hereby transferred to the authority established pursuant to this act. This act shall not affect the terms of office of, nor the salaries received by, the present officers or employees of the element.

25. The transfer of responsibilities directed by this act shall be made in accordance with the "State Agency Transfer Act," P. L. 1971, c. 375 (C. 52:14D–1 et seq.).

26. This act shall take effect immediately.

APPENDIX B

State Water Conservation Strategy



APPENDIX
B

WATER CONSERVATION STRATEGY:
Issues and Recomendations

Joseph A. Miri, Ph.D.

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
Water Supply Element
CN 426
Trenton, New Jersey 08625-0426

Printed on Recycled Paper

ACKNOWLEDGMENTS

Chapter III, Existing Programs, in this document, represents the work of numerous staff members of the NJDEP Water Supply Element. Louise Slater of the Bureau of Water Allocation prepared drafts of the sections on source and service metering and water system conservation and drought management plan review. Bill Dietze of the Bureau of Safe Drinking Water (BSDW) drafted the section on the unaccounted-for water program. Josephine Craver, also of BSDW, did the draft of the section on the water supply rehabilitation loan program. BSDW staff member Paul Schorr drafted the section on drought response. In addition, the late Steven LaSure of the Water Planning Group in the Office of Environmental Planning prepared a draft of the section on conservation in water supply planning.

APPENDIX B

TABLE OF CONTENTS

I. INTRODUCTION 6

A. The Need For A Water Conservation Policy 6

B. Definitions: A Multitude of Measures 7

II . ISSUES 8

A. The Benefits of Conservation 8
1. Economic 8
2. Environmental 9

B. Trends and Incentives Toward Conservation 10

C. Water System Revenue Loss and Instability 11

D. Impact on Consumers' Water Bills 13

E. Effect of Long Term Conservation on Drought Response 14

F. How Should Conservation Savings Be Allocated? 16

III. EXISTING PROGRAMS 18

A. Source and Service Metering 18

B. Unaccounted-for-Water Program 19

C. Water Supply Rehabilitation Loan Program 20

D. Plumbing Code Revisions 21

E. Conservation in Water Supply Planning 22

F. Public Education 23
1. Water Conservation Landscaping 23
2. Student Materials 25

G. Industrial Water Conservation 26

H. Water System Conservation and Drought Management Plan Review 26

I. Water Utility Rate and Service Regulation 28

J. Energy Conservation and Water Conservation 28

K. Drought Response 29

IV. CONSERVATION MEASURES 30

A. Outdoor Water Use Restrictions 30

B. Accelerated Replacement of Plumbing Fixtures 30
1. Costs and Benefits 31
2. Financial Assistance for Accelerated Replacement of Plumbing Fixtures 34

C. Water Conservation Pricing 34
1. Inclining and Declining Block Rate Structures 35
2. Uniform Rate Structure 36
3. Seasonal Surcharge 37
4. Promoting Conservation Pricing 37

D. Water Audits and Add-on Conservation Devices 38

V. CONCLUSION 40

I. INTRODUCTION

A. The Need For A Water Conservation Policy

Although people are learning more and more about the environment every day, it is still true that most are not terribly conscious of where their water comes from, how much they consume in the various uses to which it is put, what is involved in bringing that water to their finger tips or, for that matter, what happens to it after it is used. The fact that people do not see it until it flows out of the tap has removed water from their everyday awareness and consciousness, or at least did so for many years. Before water was piped into each customer's home or factory and instead had to be drawn in containers of one type or another, there was no need for organized water conservation programs, for its weight and volume provided sufficient reason for not wasting it in and around the home. At a broader level, as our awareness and understanding of the true impact of the use of environmental resources increases, so have the calls to help reduce that impact by reducing our demand for water. And yet, while water conservation enjoys strong support, it remains surrounded by some controversy among water purveyors, engineers and environmentalists.

As this document will show, the Department of Environmental Protection (DEP) has a number of programs which help to conserve our water supplies and has a commendable record in this area. Within the Department, water conservation has been viewed as part of the overall function of water resources management. In this context, these programs address both supply and demand management. Despite this, there has never been a definitive position taken by the Department as a whole regarding conservation in general and on demand management in particular.

While focusing on demand management, this document sets forth the Department's position on water conservation as an identifiable component of its overall programs and examines the policy considerations which should guide the Department's decisions regarding conservation. It seeks to: explain why the Department supports water conservation; outline which types of conservation should be emphasized by the Department in the future; and indicate how conservation should be encouraged, promoted and/or required.

Following this introductory chapter, the various issues surrounding water conservation are explored in Chapter II. In Chapter III, DEP's existing water conservation programs are described. Chapter IV examines four potential conservation initiatives from a policy standpoint, with an emphasis on accelerated installation of conservation plumbing fixtures and conservation pricing. Based on the discussions of existing programs and potential new initiatives, Chapter V, the Conclusion, makes several suggestions to guide future Departmental decisions in developing and implementing water conservation programs in New Jersey.

B. Definitions: A Multitude of Measures

Water conservation can refer to a myriad of individual activities and practices. The American Water Works Association has defined water conservation as "those practices, techniques, and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses." Publications to educate customers, ordinances to limit water use, programs to reduce leakage, plumbing code changes to reduce fixture volume and flows, etc., all come under the rubric of conservation.

The broad array of different measures has increased conservation's appeal, but it has also fostered misunderstanding and sometimes confusion in the public debate over conservation's value and importance. Public deliberations frequently lump these different measures together while the advantages and disadvantages of each are quite different. Supporters and opponents of conservation often confuse each other by failing to make the necessary distinctions among the different types of conservation.

The term water conservation refers broadly to two types of activities: supply management and demand management. Supply management usually refers to measures that improve water system efficiency, such as metering, leakage loss reduction, improved interconnections and inter-system operations coordination. Sometimes improvements in the management and use of the basic sources of water, i.e. aquifers and streams, are included, but this is more properly referred to as source management or watershed management. Supply management attempts to reduce the loss of water from the point of withdrawal to the customer's

service connection.

Demand management refers to measures which reduce demand or increase efficiency of use at the service connection and beyond. Since these measures focus on the customer, the water system has much less control over them and since they may have the short term effect of reducing revenue, water system managers may have ambivalent attitudes toward those measures. To be sure, many demand management measures are more complex than the typical supply management measures and require the involvement and cooperation of not only water purveyors, but also customers, governmental agencies and the general public. In sum, demand management measures are less straight forward and often more controversial.

Even looking solely at water demand management, there are many ways to achieve reductions. Again, public deliberations often lump these different measures together. There is a need for reasoned deliberation and wise choice because our future environmental and financial well being will be significantly influenced by the water conservation programs and activities we choose to implement. For this reason, this document seeks, among other things, to advance public deliberation over, and discussion of, conservation by distinguishing among the different types of demand management and examining them individually from a policy standpoint.

A condensed version of this document is contained in the text of the Statewide Water Supply Plan in Chapter 7. This appendix discusses several supply management measures, but places more emphasis on demand management. For example, reuse of wastewater and regional operation of water systems are not addressed here but are covered in the text of the Plan.

II . ISSUES

A. The Benefits of Conservation

1. Economic

The long run economic benefits of water conservation derive from the fact that reduced demand enables a system to either postpone or reduce the

size of projected new or expanded water and wastewater facilities. The short run economic benefits are the reduced pumping and treatment costs. One water system in Ohio found that the equivalent capital cost of water conservation to be less than 10% of the cost for reservoir storage. Another system in Washington State estimated annual savings of $1.98 million by implementing an accelerated plumbing fixture installation program with a one-time cost of $2.4 million.

Ignoring the potential for conservation in planning for water supply facilities would simply mean raising rates to a level which will pay for the plant and equipment necessary to meet the highest estimated demand. However, the financial savings from conservation can be realized if water conservation measures are evaluated when facilities are planned. If a practical and realistic program of water conservation to bring about a long term reduction in demand is evaluated and found to be achievable, its implementation can significantly reduce the outlay for the typical facility options. While they may not provide direct economic benefit to the water system owners or managers, similar benefits also accrue to wastewater systems serving customers in the water supply service area.

2. Environmental

Despite their attractiveness, the economic benefits are not the only reason for implementing water conservation. Reductions in water demand can bring about substantial environmental benefits. First, postponement of construction of facilities means less disruption of the existing natural environment. Moreover, reduced drafts from streams can mean improved water quality from the increased flows. To the extent that the wastewater is discharged to another river basin or to the ocean, reduced withdrawals can improve streamflow and aquifer levels in the source watershed. Reduced ground water withdrawals can improve base streamflow and aquifer levels. Also, reductions in ground water withdrawal make the zone of contribution for the well smaller, reducing potential for contamination from surrounding land uses, and for wetlands impacts. Finally, reductions in draft means water quality problems such as those caused by chlorine residuals from drinking water treatment are diminished and the problems related to sludge disposal are lessened.

B. Trends and Incentives Toward Conservation

There are many trends occurring in water supply and wastewater which have the effect of encouraging water conservation and even reuse of water. One incentive toward reducing water supply demand is the increasing costs of treating raw water to meet safe drinking water standards. As water customers demand higher levels of protection against various health risks, the treatment component of the cost of providing water increases. The high cost of treating wastewater is another incentive toward conservation. In the past, the impact on the environment of poor wastewater treatment was not universally recognized. With this recognition comes an acknowledgment that improved wastewater treatment to preserve surface and ground water quality will be expensive.

Another area where costs will increase is water supply development itself. As easily developable, good quality water sources in close proximity to demand centers are used up, less attractive, more distant sources must be utilized. These are usually more expensive on a per gallon basis.

These economic incentives not only encourage conservation, but they also increase the attractiveness of reuse as an alternative to new water supply. In a given situation, when the cost of development, transmission, treatment and distribution of water to customers, combined with the treatment and disposal of wastewater, exceeds the costs of reused water and its treatment and disposal, reuse will be attractive.

Still another trend which helps bring about water conservation is the trend toward energy conservation. As a result of the still relatively high cost of energy and our country's increasing dependence on foreign sources of petroleum, there are strong incentives toward energy conservation. Water users therefore not only save money by reducing the amount of water they purchase, but also by reducing the amount of energy needed to heat a significant portion of that water. Since most electric power generation evaporates large amounts of water, reduction in energy demand can also result in a reduction in water use by the power companies.

C. Water System Revenue Loss and Instability

Water supply systems, especially those which draw on surface waters, are capital intensive endeavors. There is a high ratio of plant and equipment costs to operation and maintenance costs incurred in providing water to customers. When long term water conservation programs are implemented, people use less water and water sales fall. While this is happening, however, the bulk of the cost of providing water to customers does not decrease in the short term. For reasons discussed elsewhere, water rates (the price per unit volume of water) must be raised or water system revenues will fall. As a result of this scenario, some water purveyors fear conservation's impact on demand and oppose water conservation programs.

Just as significant as the downward pressure on sales and revenue exerted by conservation, is the revenue instability it can create. Especially when several conservation measures are instituted at the same time, it is difficult to predict the actual impact on customer demand until a study can evaluate the different measures. This may make it necessary to adjust water rates more frequently than normal.

The problem of revenue instability can be aggravated if a system adopts rates based too heavily on usage charges (those which vary according to the amount of water used) and very little on fixed charges (those which are the same regardless of the amount of water used.). The larger the fixed or minimum charge is, the less incentive there is for conservation. However, when too great a portion of the charge for water is based on usage, instability in revenue tends to increase because residential and commercial usage fluctuates with precipitation and other factors. The ultimate in revenue stability is provided by the flat rate, under which the same total amount of money is paid regardless of the quantity used. Flat rates completely remove any economic incentive to conserve, however. While flat rates are not very common in New Jersey, a portion of virtually all systems' rates consist of a fixed or minimum charge, which varies little or none at all with the quantity used.

The revenue impact of demand can vary significantly with the type of water system. For example, ground water systems are typically less capital intensive than surface water systems since impoundment, transmission and treatment facilities usually are not extensive. Operation and maintenance constitute a larger proportion of overall water production costs. For such systems, reduction in demand provides greater relative economic rewards than for the more capital

intensive surface water systems.

A number of water systems operating in New Jersey purchase raw water from other systems and treat and distribute it on a retail basis. Still other systems purchase treated or finished drinking water and merely distribute it retail. Operation and maintenance make up an even larger proportion of overall production costs for these systems and the negative revenue effect of reductions in demand are almost eliminated unless perhaps some of the purchased water is purchased on a use-or-lose basis (e.g. a fixed price contract for a specified flow).

As discussed under Section IV.B., Conservation Pricing, there are numerous factors which must be considered in setting rates. In balancing various factors, one of the advantages of gradual, long term conservation vs. drought-response conservation is the fact that gradual reductions in unit volume water sales or a reduction in the rate of growth in unit volume water sales can easily be accommodated in the rate setting process so as to minimize the negative financial impacts on water systems. While there are some who feel that the state should not be concerned with the impact on a purveyor's financial condition, the financial viability and well being of the water systems in the state cannot be ignored by the state's utility rate regulators. The balancing of revenue stability and the need for conservation, among other factors, is the responsibility of the utility rate regulatory body.

While the gradual, as opposed to rapid, implementation of long term water conservation programs can be helpful in reducing revenue instability, a water system may not always have the flexibility to wait a long period to significantly reduce demand. There are other means to do this. One method to reduce the impact of conservation-induced revenue instability is to create a revenue stabilization account similar to those used in the electric power industry. With the agreement of the utility regulators, a small, temporary surcharge is imposed and the revenues are set aside. While the program is in effect, the water purveyor can draw from the surplus revenues if necessary so that frequent rate adjustments are not required. After the on-going conservation program is established and water demand is stabilized at its new level, water rates can be adjusted and the revenue stabilization account can be closed.

Once the on-going conservation program has been established, the economic benefits of reduced demand, which should be reflected in lower unit costs compared to those costs if conservation had not been utilized, will become apparent.

D. Impact on Consumers' Water Bills

One of the concerns expressed by customers is that if they use less water, purveyors will have to raise rates and water bills will be higher. This is attributed to the fact that providing water to customers is capital intensive and a large proportion of overall costs are fixed (see discussion of revenue loss and instability, above). Thus, when a drop in water use occurs for any reason, these fixed costs must be distributed over a smaller number of units of water sold. This results in higher volume unit prices when rate relief is sought.

In theory, if demand decreases, the cost of providing water should be reduced because operation and maintenance costs decrease due to smaller variable costs (for less chemicals and energy). Despite this, there have been many cases where water conservation implemented in response to droughts resulted in higher water bills as well as higher water unit costs. In reality, the fixed charge and variable charge portions of the typical customer's bill are probably not broken down in precisely the same proportion as the fixed capital and variable operation and maintenance costs are incurred by the purveyor. Therefore, a drop in water use may reduce revenue to a greater extent than the purveyor's variable operation and maintenance costs are reduced by delivering less water to its customers. It is also possible that rate relief following a drought induced decrease in demand has included rate increases attributable to factors other than demand reduction, such as the added costs for emergency water supplies as part of drought response, or the effects of inflation. It is difficult for the typical residential/commercial customer to identify these other factors. Therefore, it is often thought that using less water is a "bad deal", aside from the environmental benefits of water conservation, which are perceived primarily as societal rather than individual.

Even when the overall bill is not higher, if the rate increase results in a higher volume unit cost, the water consumer may still interpret this as a bad deal. From the standpoint of the individual, however, the actual significance of an increase in unit prices should be closely examined. The specific question which must be asked by the consumer is: "Do I necessarily receive a greater benefit when I receive more water rather than less?"

For the typical residential or commercial customer, the answer is no. For

virtually all residential users and the bulk of commercial users, there is an optimal amount of water to satisfy the need. Obtaining more water than this provides very little, if any, benefit. If one can flush away waste with 1.6 gallons of water, rather than 5 or 3.5 gallons, should a modest increase in the cost per gallon be a deterrent? Most water customers are purchasing water service to accomplish specific tasks, not building up a store of a commodity like wheat or gold for which the unit price is significant.

It should also be noted that when cost reductions are achieved with regard to wastewater treatment, most consumers will not usually associate the savings with water conservation. Finally, consumers usually will compare new costs to existing costs rather than to the higher rates caused by new capital expenditures for water supply or wastewater facilities. In the long run, what is most relevant for the customer is that with conservation, the unit cost of water will be lower than it would have been without conservation, because he or she is not paying for the unnecessary facilities and the avoided operation and maintenance.

E. Effect of Long Term Conservation on Drought Response

Another concern over the impact of water conservation relates to the loss or diminution of that portion of a system's demand which be can readily eliminated when a drought occurs. In the past, when a drought emergency was declared, the typical response included temporary restrictions on outdoor water use and a crash program of system and service leakage loss reduction. For growing and/or expanding systems, once the drought passed, demand essentially would return to normal and then resume its rise.

Where the prime limiting factor on the water available to a system is the amount of water remaining in its surface water impoundments and/or flowing in a stream, the proportion of total demand which can readily be eliminated will decrease if on-going, long term reductions in demand have occurred since the previous drought. This scenario is predicated, of course, on the allocation of long term water conservation savings to the growth in the number and/or per capita demand of customers served by the system. (See section II.F., below.)

This concern has led some to oppose the replacement of 3.5 or 5 gallons per flush toilets with 1.6 gallon units because when a drought occurs, a smaller number of people will be able to install toilet dams in response to

a drought. Carried to its extreme, this argument would promote wasting water and construction of new supply facilities so that there would be more demand to be cut in a drought!

Such an argument can hardly be the keystone of an effective overall water conservation policy for our State. First, long term conservation will help reduce the frequency and severity of drought emergencies, since demand during both normal and drought times will be lower than it would have been without long term conservation. Second, the ramifications of long term conservation's impact on discretionary demand are mitigated for ground water systems, where immediate water availability is not usually as severe a limiting factor as it is for surface water systems. Third, the concern over conservation's impact doesn't apply to surface systems in which demand is equal to or more than that which can be supplied in a drought (i.e. the system's safe yield). In these cases, it is imperative that expendable water demand be reduced as quickly as possible in order to forestall a water shortage when a drought occurs. Rather than promoting water waste by using more than is needed, long term conservation should be pursued while at the same time steps should be taken to adjust the systems' drought response to compensate for the decrease in that portion of overall demand which is highly discretionary and easily cut.

The concern over the decrease in "expendable" water use caused by long term conservation is in reality a manifestation at the macro level of the same concern expressed by individual water users who have already reduced water use prior to a drought emergency. They are often justified when they claim that it should not be assumed that they would be able to reduce water in response to an emergency to the same extent as a user which had not implemented any conservation prior to the emergency. Just as it makes sense to give credit to individual water customers or take into consideration previous demand reduction when drought requirements are implemented, so it makes sense to modify system-wide drought response after long term conservation has reduced demand.

Analyses should be conducted to determine what changes should be made in surface water systems' drought response and drought management as a result of long term water conservation's reduction in the demand for water which people can do without under drought conditions. The results of such analyses should also help in determining how planning for system expansion is affected by on-going conservation.

The studies may very well show that an effective response to this potential problem is to design long term conservation programs which, while seeking to eliminate the wasting of water, avoid the complete elimination of the discretionary water use component of overall demand. Short term drought response conservation measures can then be focused on discretionary demand, i.e. car washing and lawn watering, at the onset of a drought emergency. This does not mean, however, that on-going water conservation measures cannot be applied to outdoor use. Conservation landscaping practices, such as replacing high water using plants with drought tolerant plant materials, will decrease long-term water demand without interferring with drought response measures such as banning lawn watering and car washing. In fact, such practices will make it easier for residential customers to comply with the typical drought restrictions on outdoor use without damage to costly, water-dependent landscaping.

F. How Should Conservation Savings Be Allocated?

In New Jersey, the question of what should happen to water which is saved when conservation has been successful has not as yet resulted in specific instances of serious controversy. While this is an important public policy question, and the general debate over conservation has touched on this issue, no real conflicts have developed. This is not because the proponents of different objectives have reached agreement on what should happen to the saved water, but rather because the use of the water is following the course of least resistance, i.e., it becomes available for and is eventually used by new growth and development in the service area.

When actual per capita water demand is permanently reduced, the most likely result is that the life of the water supply and wastewater facilities is extended. The water remains in the stream, reservoir or aquifer until it is used by growth in demand. This is not insignificant environmentally, since the same amount of growth has resulted in less environmental stress than would be the case without conservation. If the service area is experiencing growth or it is expanded to include new customers, the most likely scenario is that the existing facilities will be able to serve the additional customers longer before yield and capacity limits are reached. The disposition of the saved water is the same, however, whether the service area is expanded to serve new customers or there is growth within the service area. Unless there is careful planning, extensive negotiation among conflicting interests and overt governmental

intervention, the saved water will most likely be applied to future growth, whenever it occurs.

There may be special cases where it would be desirable to use conservation savings for something other than new growth. For example, where the reduced demand is permanent and easily identifiable and where serious water quality conditions exist which could be significantly alleviated by higher low flows, it may be desirable and possible to avoid constructing facilities or if facilities are constructed to use some of the saved water to make releases from the reservoir to augment stream flow, rather than use all of it for additional customers. Since the water saved from installation of 1.6 gallons per flush toilets in new developments should be relatively easy to identify and in view of the fact that federal requirements will mandate further flow reductions in plumbing fixture codes in the future, there may be opportunities to at least test this option on a temporary basis.

A number of difficult issues surround any effort to purposefully allocate conservation savings to something other than new growth. For example, should the benefits of the saved water go to those customers or service areas which reduced their demand or to those areas which have the most water supply or water quality problems? It may not be possible to identify the precise geographic source of the reduced demand and it may not be practical to insure that the benefits accrue specifically to those so identified. If reduced demand is allocated to extend the life of existing water supply and wastewater facilities rather than to a permanent increase in minimum streamflows, the service area whose demand is reduced receives all the benefits of the reduced demand. However, if the saved water from a surface water system is allocated to a permanent increase in minimum required streamflows, the beneficiaries may be the downstream communities rather than the area where the demand was reduced. These issues increase the difficulty of opting for permanent increases in streamflow.

Although state-level regulatory authority must be brought to bear in instances where conservation savings are to be reserved for instream purposes, input from the hydrologic regions involved must be taken into account in what will most likely be case-by-case evaluations of the advantages and disadvantages of such a reservation.

III. EXISTING PROGRAMS

Water conservation has been an integral and balanced component of New Jersey's overall water supply, planning and management programs for over a decade. Because most of these conservation oriented activities have been in operation for some time, many people may not be aware of them. Presented below are brief summaries of the major aspects of these programs, with recommendations for improvement.

A. Source and Service Metering

The metering of water sources is often taken for granted. However, source metering is the prime requisite in any water supply management program. Without source metering there could be no accounting of diversion amounts, no unaccounted-for water program, no way of evaluating leak detection and repair programs, and no way to quantify withdrawals from threatened aquifers.

State regulations require the calibration of source meters. Proof that each meter has been calibrated within the past five years is required with the submittal of all water allocation permit applications. Quarterly reporting of monthly diversions from individual sources is required by most Water Allocation permits. The information is entered in the Bureau of Water Allocation database and is available for a number of applications. Applicants who fail to report diversions are notified of their obligation. Failure to respond is handled by enforcement action.

Just as source metering is the prime requisite for water supply management, metering of service connections and charging rates based at least in part on meter readings constitute the foundation of efficient water use. If you don't know how much water you are using or if you pay the same total amount (flat rate) regardless of how much water you use, there will be virtually no incentive to conserve. Service metering has been a requirement in New Jersey since the 1950's.

Although there has been resistance to installing service meters in some of the smaller systems (approximately 2% of all systems), the value of metering as a water conservation tool cannot be disputed. A recent example: the Borough of Netcong no longer has a peak demand problem in summer. The installation of service meters impressed residents with

the necessity of paying for all the water they use, so they use less. Estimates of demand reduction achieved by service metering range from 20 to 40%.

Service metering is so fundamental that it should be universal in New Jersey. Those systems which have not yet installed meters and have not received some form of exemption should do so by July 1, 1996 or be referred for priority enforcement action.

B. Unaccounted-for-Water Program

Under the Water Supply Management Act Rules (N.J.A.C. 7:19-6 et seq.), the DEP is responsible for an annual enumeration of water purveyors with unaccounted-for water in excess of 15% of the purveyor's plant-delivered water. For each purveyor size class, the Department must determine the percentage of purveyors, not to be greater than 35% of the purveyors in each class, that have the highest proportion of unaccounted-for water. These purveyors are determined to be provisionally delinquent and are notified as to their status.

Each provisionally delinquent purveyor is allowed one year in which to take appropriate corrective action. The Program seeks corrective actions such as the elimination of leaks and establishment of a program of regular system surveillance, maintenance and rehabilitation. Also, the purveyor is asked to submit a schedule to the Department for further corrective action. After reviewing the material submitted by the purveyor, if the DEP determines that the purveyor's percentage of unaccounted-for water has reached the median percentage for all purveyors of that class, the provisionally delinquent status of the purveyor will be terminated. Unless the provisional status is terminated or the purveyor submits a schedule for corrective action which is approved by the Department, an order will be issued by the Department requiring the purveyor to eliminate all undue losses within the system in accordance with a specified compliance schedule.

An examination of the records of this program for 1991, the most recent year in which records have been completed, reveals the following information. Of all the Class 3 purveyors (those serving a population of greater than 50,000 people), 8 out of 25, or 32%, had unaccounted-for water greater than 15% of their plant delivered water. For this class of purveyor, the arithmetic mean was 13.52 % unaccounted for water with the median purveyor being at 11%. Of the Class 2 purveyors (those

serving populations of between 10,001 and 50,000 people), 31 out of 110 purveyors, or 28%, had unaccounted-for water greater than 15% of their plant delivered water. The arithmetic mean for unaccounted-for water for Class 2 purveyors was 13% with the median purveyor in this class having 12% unaccounted for water.

There is some evidence that the Unaccounted-for Water Program, in conjunction with the Water Supply Rehabilitation Loan Program (See Section III.C. below), has been effective in helping to reduce water system leakage losses. A compilation of the totals of water withdrawn, used, delivered, sold and accounted for by purveyor class would increase the effectiveness of this program and could be used to prioritize the Department's efforts in reducing unaccounted for water by purveyors.

C. Water Supply Rehabilitation Loan Program

When leakage losses are attributable to aging and deteriorating transmission and distribution lines, the DEP's Water Supply Rehabilitation Loan Program provides low interest loans for the refurbishing and restoration of these facilities. This program helps a water system reduce its leakage losses when it cannot afford to repay the needed funds at current market interest rates.

The Water Supply Rehabilitation Loan Program provides loans of up to $3 million to municipalities and public purveyors to rehabilitate their existing water supply distribution systems. These improvements include water main replacement, storage tank rehabilitation, and cleaning and lining of water mains. One hundred fifteen loans totalling $86 million have been provided. Potential reduction in leakage is an important factor in the Department's consideration of the overall effectiveness of the project and its priority ranking. Priority points are assigned based on the amount of water saved per day for each project. Many other factors are also taken in account: age and size of existing system, interconnections with neighboring water systems, improvement of water quality and fire flows, etc. For the loans which have been made thus far, the average reduction in leakage is approximately 4% of total demand.

Leakage loss reduction programs have been successful in the Camden Metropolitan Area, due at least in part to the DEP's Unaccounted-for Water Reduction Program and the Water Supply Rehabilitation Loan Program, which have helped a number of systems to reduce leakage losses by providing low interest loans to refurbish older systems. In the

Area, water systems serving over 10,000 people reduced their unaccounted-for water from 19.3% to 16% during the 1989-93 period. Thus far, the size of this reduction is consistent with projected savings for the year 2020 from supply management measures identified in the Camden Area Water Supply Study. (See Section III.E. Conservation in Water Supply Planning.)

D. Plumbing Code Revisions

Responsibility for administration of the plumbing code in New Jersey rests with the Department of Community Affairs (DCA) as part of the Uniform Construction Code. The DEP has always supported plumbing fixture code amendments when proposed changes in the fixtures reduce the amount of water used and the new fixtures provide the same original function. In 1978, the DEP recommended that plumbing fixture specifications be amended to require water closets using 3.5 gallons as opposed to the 5 to 7.5 gallon products then in use. Working with DCA, the Department initiated the process to effect this change and the 3.5 gallon water closet become a requirement later that year.

In the mid-1980's the Water Conservation Advisory Committee of the Delaware River Basin Commission (DRBC) began exploring ways to promote greater consistency among the basin states in their policies and regulations regarding plumbing fixtures and to explore technological advances in the development and performance testing of water closets and other fixtures. The New Jersey Commissioner on the DRBC strongly supported the adoption by the DRBC and New Jersey of plumbing code regulations which promoted conservation. The Commission subsequently adopted plumbing fixture specifications requiring that water conserving products be used in new construction and replacement installations. These regulations covered water closets (3.5 gallon per flush) urinals, showerheads, kitchen faucets and lavatory faucets. Since the State already had water conservation plumbing fixture requirements in place, the Commission's action required no further action in New Jersey. (Several jurisdictions in the basin, however, including the state of Pennsylvania, were not in compliance and initiated efforts to conform to the DRBC regulations.)

In 1988, the Commission revised its plumbing fixture regulations to require water closets using 1.6 gallons of water per flush by 1991. Working with the Department of Community Affairs, the DEP recommended that DCA evaluate the 1.6 gallon water closet to determine

if it should be used in New Jersey. This evaluation was made and with the support of the DEP and DRBC, DCA revised the State's plumbing subcode through regulations which took effect on July 1, 1991.

The National Energy Policy Act of 1992 prohibited the manufacture for residential use of water closets using more than 1.6 gallons after January 1, 1994. While this statute greatly reduced state prerogatives in setting specifications for indoor water use fixtures and appliances, there will be other opportunities to incorporate sound technological improvements in residential water use such as in automatic lawn sprinkling systems. When products using less water are made available which effectively perform the same functions as the original products, they should be incorporated into New Jersey's relevant codes as quickly as possible.

Leakage loss reduction and plumbing fixture code changes which reduce water use are structural, as opposed to behavioral, water conservation measures. The difference between these two types of measures is discussed below in Sections IV.B. Accelerated Replacement of Plumbing Fixtures, and Chapter V, Conclusion.

E. Conservation in Water Supply Planning

Water conservation must be an integral part of water supply planning rather than an after thought or a stop-gap measure. Since the mid 1980's, all regional water supply planning studies conducted by DEP have explicitly considered water conservation as an option for meeting part of the projected water demands.

The Camden Metropolitan Area Water Supply Feasibility Study showed that 65 mgd of maximum day additional supply would be needed by the year 2020. Supply management type conservation measures, such as leakage loss reduction, would save an estimated 11 mgd according to the study. Demand management measures could save an additional 15 mgd. Combined conservation savings would therefore amount to about 26 mgd or 21% of total projected water use. The Atlantic County Water Supply Study found that: "Implementation of water conservation, including leak reduction, can significantly reduce water contamination." Revised demand projections showed that a reduction of about 18 percent could be achieved through water conservation, constituting a reduction in projected average day demand for the year 2040 from about 48 mgd to 39 mgd. Finally, the Eastern Raritan Basin Water Supply Study

estimated that the installation of the 1.6 gallon per flush water closets in all new construction and renovation, as required by recent plumbing code changes, will reduce average per capita demand from 150 gallons per capita per day (gpcd) to 131 gpcd by the year 2040. These regional studies are evaluated and implemented by water purveyors when they seek access to water supply sources in order to establish or expand their water systems.

The accuracy of future projections of water supply demand in New Jersey would be increased if better data were available from water systems as to the composition of existing water demand. The patterns of residential, commercial and industrial water demand and use are significantly different and water systems should be required to provide a breakdown of use in these categories or in similar categories such as residential vs. non-residential or large user versus small user. The availability of this data also has benefits for drought response and long range conservation planning. This information, which should be reported in an appropriately consistent format, could be obtained through the review of water system conservation and drought response plans. (See also Sections H. Water System Conservation and Drought Management Plan Review, and V. Conclusion, below.)

F. Public Education

1. Water Conservation Landscaping

A major focus of water conservation public education and awareness programs is on outdoor use. There are several reasons for this. First and most important, virtually all outdoor water use is concentrated in the warmer months and the impoundment and/or pumping, transmission, treatment and distribution capacity needed to provide the peak summer demand is not utilized for most of the year. This is not an efficient use of plant and equipment.

Second, a significant portion of outdoor water use is lost through evaporation. Unlike indoor residential use, almost all of which finds its way back to streams and aquifers via sewers or septic systems to be used again, as much as 90% of water used outdoors is lost to the atmosphere. This means that not only is expensive storage capacity being depleted, but that downstream users cannot benefit from any reuse. Third, a large part of outdoor water use is discretionary and as such is susceptible to

over-use or wastage if the user is not informed about efficient methods. Fourth and finally, reduced landscape irrigation will have beneficial water quality impacts, since the runoff contributes to non-point source pollution.

For these reasons, DEP embarked on a program of informing and educating the public as to how they can save water in planning and maintaining their landscapes. In cooperation with Rutgers University, a manual entitled "Landscaping for Water Conservation: A Guide for New Jersey" was developed; low water using demonstration landscapes were planted in New Brunswick, Clementon, Cape May and Millburn; and video tapes and other materials were produced. DEP concluded that if the attractiveness and relatively low maintenance aspects of water conservation landscaping could be demonstrated in a practical way, the landscape and nursery "industry," as well as the general public, would be much more likely to be aware of water conservation landscaping and utilize it.

Another outdoor water conservation project in which DEP has participated in is the collection and dissemination of weather data for the calculation of evapotranspiration rates for various crops. This enables irrigators to regulate the timing and duration of their water applications and optimize water use. The project which is being conducted by the South Jersey Resource Conservation and Development Council, consists of an integrated network of 11 weather stations in southern New Jersey. Six additional stations are proposed. DEP has provided partial financial support for this project.

Over the long term, increasing public exposure to water conservation landscaping will significantly reduce outdoor demand from what it would otherwise be. In order to reach greater numbers of people interested in saving water outdoors, increased effort should be extended to reach them through nurseries, retail garden centers and landscape contractors, all of whom can help customers make intelligent choices on plant selection and water use practices.

One significant factor in determining the water and fertilizer needs of plants is soil composition. While this can easily be improved when landscaping plants are installed, turf soil areas are costly to improve. Greater attention should be paid to soil composition when properties are developed, since a relatively small expenditure of money in soil improvement could pay huge dividends over the life of the parcel in lower water and fertilizer costs and reduced non-point source pollution from

the turf's runoff. The all-too-common practice of placing little or no top soil on residential or commercial development lots causes years of increased harm to the environment and to the purchaser's pocketbook. The DEP should develop public education and demonstration programs to educate developers, homebuyers and local officials on the economic and environmental benefits of good turf soil composition.

An approach toward reducing outdoor demand which has not been explored in New Jersey is to give the private sector increased responsibility for conservation education and awareness. Thus far in New Jersey, DEP has taken the lead in efforts to provide efficient residential and commercial water use on the landscape as summarized above. These programs should be expanded and updated. In order to better leverage its staff and financial support in this area, however, it should form a partnership with the landscaping and gardening community, water utilities, the educational community and water users to promote the wise use of water. Such a group, which would be a not-for-profit organization, could utilize both public and private sector funds to promote sound outdoor water use practices. Organizations such as this as have been created in Georgia, Florida and just recently in New York. The Georgia and Florida organizations have been quite successful in developing and publishing educational materials, providing technical assistance to communities and small purveyors on emergency water restriction ordinances, and training members of the landscaping community in water conservation.

2. Student Materials

The other area of emphasis in DEP's conservation education programs have been the development of school curriculum materials. These efforts are based on recognition of the fact that awareness of where water supplies originate and what is involved in bringing that water to the tap in potable condition will make students more likely to appreciate its value and less likely to waste or misuse water as adults. In addition to the typical posters and brochures, a set of curriculum materials for kindergarten through sixth grade was developed, published and distributed. Later, a student workbook providing water awareness and conservation was produced.

More recently, with the completion of the Plan of Action for Environmental Education in New Jersey and establishment of the Environmental Education Network, the development of curriculum

materials for water awareness will be placed in the broader context of overall environmental awareness among students and adults. The pervasiveness of water in the environment insures that water conservation will have an important place in environmental education as the Action Plan is implemented.

G. Industrial Water Conservation

While residential water use is relatively uniform in nature and in the amounts typically used, industrial water use differs with each type of industry and sometimes at each plant within the same industry. This makes it difficult to apply general water conservation measures to specific sites except for measures such as leakage control. As a result, DEP has focused its industrial water conservation efforts toward conservation technology transfer and reviewing water conservation plans submitted as a condition of self-supplied water allocation permits. Evaluation of industrial water conservation plans is staff intensive because of use and process variations.

New Jersey has relied heavily on the Delaware River Basin Commission's Water Conservation Advisory Committee to develop industrial water conservation technology transfer sessions. These technology transfer sessions have documented the economic benefits of water conservation to industrial water users and have been quite well received. In the pulp and paper industry, the Curtis Paper Company explained how it reduced its water use from 0.8 mgd to 0.2 mgd over a five-year period (from 40,000 gallons to 7,000 - 8,000 gallons per ton of product). The program yielded significant economic benefits as well, including effluent reduction, savings in pulp and elimination of settling ponds. The program paid for itself in three months. In the chemicals and pharmaceuticals industry, water saving programs including retrofitting and water audits were described, which in one facility resulted in no increase in water consumed while the facility underwent a one-third increase in size over a ten-year period. Based on the success of these sessions, New Jersey should embark on a long term technology transfer program for selected industries and classes of commercial users.

H. Water System Conservation and Drought Management Plan Review

As a condition of water allocation permits issued by the DEP to water utilities and large volume self-supplied users, the permittee is required to

adopt and implement a Water Conservation and Drought Management Plan for the area served. (Consolidation of a conservation plan and drought response plan into one submittal was the result of the water allocation regulation revision of March, 1995.) The timing of plan submittal and updates, which must cover actions taken pursuant to the plan, are set at the time of the issuance of the permit and vary with the nature of the diverison and/or the permittee's compliance record. Those plans must cover: 1) water system data on sources, connections, interconnections, etc; 2) analysis of water use, covering demand projections, per capita use and peak demands; 3) unaccounted-for water reduction activities, including leak detection and repair, distribution system improvements, etc., and calculation of unaccounted-for water and an estimated of the water saved; 4) public education and awareness; and 5) drought response planning. Also, as part of the plan, N.J.A.C. 7:19-6.5(a)4 requires that water systems have rates which provide an incentive for water conservation. (See Sec. IV.C., Water Conservation Pricing.) The required components are slightly different when applied to self-supplied permit holders. When an increase in water allocation is requested, the applicant's conservation program is reviewed to help verify the need for the increase.

A primary goal of the program is to check progress in conservation efforts by comparing data reported over a period of years. This can be done for individual permittees or regions of the State by comparing per capita use, taking into account customer make-up and other factors.

There are several areas of potential improvement for the review of conservation program plans. In order for water systems to better integrate water conservation into their water supply planning, the conservation program plans should be required with the completed water allocation application. (This recommendation has been implemented as part of the water allocation regulation revision of March, 1995.) Moreover, a specific estimate should be included in the plan of the portion of projected water demands which are expected to be satisfied through water conservation. Water systems should be asked for more specific data on the breakdown of current water use, including residential, commercial and industrial components. As indicated above (See Section E. Conservation in Water Supply Planning), the availability of this data has benefits for long range water supply planning, including conservation and drought response. Finally, greater staff resources should be devoted to evaluating water system usage data and assessing the effectiveness of the conservation programs and greater visibility should be accorded the overall conservation plan review function.

I. Water Utility Rate and Service Regulation

The Board of Public Utilities (BPU) has jurisdiction over investor-owned water supply systems and those governmentally-owned systems which serve customers outside their boundaries. Water rates charged by other county and municipal utilities are not regulated by the BPU. Regulation of water system rates and services by the Board has helped to promote efficient use of water in New Jersey. Within its jurisdiction, the BPU has by and large eliminated the use of declining block rates, which discourage conservation by charging less per unit as usage increases. Through the rate regulation function, the Board is also actively engaged in fostering purveyor water conservation education programs, service metering of all customers, unaccounted-for-water programs, as well as improved system technical and financial management.

J. Energy Conservation and Water Conservation

Another water conservation benefit of BPU activities is its energy utility rate and service regulation. As part of the response to federal and state regulations enacted in the years following the energy crisis of the 1970's, gas and electric utilities in New Jersey carry out several conservation programs. The costs of these programs, after approval of the BPU, are recoverable by the utility as an expense.

These programs became more popular with the utilities as a result of regulations adopted in 1991 allowing a utility to treat its investments in energy conservation equipment as part of its rate base, the assets on which the utility may earn a rate of return. This meant that the cost of providing customers with energy conservation equipment resulting in measurable energy savings would be treated in a manner similar to investment in plant and equipment on which a profit is earned (See also Section IV. B.2).

The BPU should evaluate allowing water utilities to treat the cost of providing water saving plumbing fixtures and other conservation equipment to customers as investments on which a rate of return may be earned. Such a policy has been utilized in the electric utility industry and while the opportunities in water supply may not be as extensive, it should prove attractive to certain water systems.

K. Drought Response

Short term, rather than long term conservation is the focus in a drought. New Jersey's procedures for responding to water supply shortages are set forth in the Emergency Water Supply Allocation Plan Regulations N.J.A.C. 7:19-10 et seq. and the Water Emergency Surcharge Schedule Regulations, N.J.A.C. 7:19-1 et seq. Under N.J.A.C. l9-13, if a dry spell lasts through the Drought Warning period, a Drought Emergency would be declared by the Governor, upon the recommendation of the DEP Commissioner.

The first three phases of drought emergency tighten restrictions on different classes of users and adjustable uses: outdoor uses (Phase I), indoor uses (Phase II-rationing), and industrial and commercial use curtailment (Phase III). The fourth Phase (Phase IV) is when the emergency has become a disaster and water quality cannot be guaranteed. In the droughts of 1980-82 and 1985, the Emergency reached Phase II. Although water rationing surcharges have been imposed for relatively short periods, outdoor water use restrictions are the initial mandatory limitations on water use in an emergency. These restrictions focus on the more discretionary component of overall water demand.

Concurrently with demand management, actions are typically taken in drought periods to conserve storage and utilize alternate sources of water. These include alteration of instream minimum passing flows and transfers of water from one water system to another. As rainfall occurs and storage levels rise, there is a transition from emergency to normal conditions. Until such time as reservoir storage is beyond doubt, the typical emergency is not terminated.

New Jersey's drought response program has worked successfully in several drought and drought warning periods. However, the severity of the water shortages could be reduced if more effective demand and supply measures could be implemented in the Drought Warning period. We therefore recommend that the Department consider amending the Water Supply Allocation Plan Regulations to allow the Commissioner to order a reduction in minimum passing flow requirements pending a public hearing, so that the 45 days or so hearing notice and comment period does not delay remedial action. This change could forestall or lower the severity of a drought. In addition, surface water system drought management plans should contain rule curves which identify thresholds for the system's drought response actions. (The latter

recommendation has been implemented in the water allocation regulation revision of March, 1995.)

IV. CONSERVATION MEASURES

This chapter examines four water conservation initiatives: regulation of outdoor water use; accelerated installation of conservation plumbing fixtures; conservation pricing; and water audits and installation of add-on conservation devices.

A. Outdoor Water Use Restrictions

Since outdoor water use is in good portion discretionary and conditions exist which can contribute to overuse and waste, communities attempting to reduce demand have sought to impose use restrictions on lawn and garden irrigation and car washing, usually through local ordinances. Depending on the specific objective to be accomplished through the demand reduction, these restrictions can take the form of an outright ban, an odd-even day ban, or a limit on the hours of certain uses. At the outset of and during droughts, all three measures can successfully reduce peak day demands.

Communities wishing to reduce demand during normal periods may find that while the odd-even day ban may reduce peak day usage, there is less certainty that it will reduce average daily usage during summer because some customers may not want to skip an opportunity to water and be required to wait until the fourth day to water again. If the peak day is not the primary concern (as it might be if, for example, distribution or treatment capacity is the limiting factor on delivery), an outright ban or limits on hours will probably be more effective in reducing overall summer usage.

There have been cases in New Jersey (e.g. Wall Twp. in the 1970's) of voluntary or "soft" use restrictions also being effective in reducing peak day demands and average daily usage. This is additional evidence that public education can be effective in reducing outdoor water use.

B. Accelerated Replacement of Plumbing Fixtures

When plumbing codes are amended to require more efficient fixtures, the total savings from the new products take many years to be realized.

First, a transition period, normally six months or a year, is usually written into the amendments to provide for sale of existing products already manufactured. Second, and more important, the new products are required to be used only in new construction and where existing fixtures are replaced.

One option available to regions or systems seeking to curtail demand is to attempt to accelerate the use of the new fixture by providing incentives to install the products, such as rebates or low interest loans. The North Wales Water Authority in Pennsylvania has a rebate program to accelerate the installation of the 1.6 gallon per flush water closet in its service area. Similar programs have been implemented to promote the conduct of water audits and the installation of low flow showerheads as well as other conservation devices.

1. Costs and Benefits

In addition to the environmental benefits of reductions in water demand (See Section II.A.2), the financial pay back period of accelerated installation of water conserving products can be evaluated. The North Wales Water Authority concluded that providing incentives for accelerated installation of water saving toilets would produce long term benefits outweighing the costs.

The 1995 Statewide Water Supply Plan evaluated the water savings possible through the change over to 1.6 gpf toilets and low flow showerheads using 2.5 gallons per minute (gpm). According to the 1995 Plan consultants, the 1.6 gpf toilets would result in an 18.4% reduction in indoor residential water use. In the Cape May Regional Water Resources Planning Area (RWRPA), for example, where commercial water use patterns are similar to residential patterns and there is little industrial usage, this would amount to about 4.1 mgd in water savings. If showerheads were replaced with 2.5 gpm fixtures, a 13% reduction in indoor residential water use would be achieved. In the Cape May RWRPA, this would amount to about 2.9 mgd, for a total possible savings of 31.4% or about 6.9 mgd compared to total indoor use of 22.2 mgd.

The 1995 Plan consultants made an assumption that there would be a 75% achievement rate in the change over to the newer products over the next 20 to 40 years. If the changeover to the newer fixtures were accelerated as part of an organized program over a 2 or 3-year period, these savings could be realized much more quickly. Since the quantity

saved given above reflects 31.4% of total indoor use rather than of indoor residential use only, the 6.9 mgd is probably a reasonable quantity achievable under an organized program, which would be able to do better than 75% installation rate.

In addition to the water savings, cost savings to customers would also be realized from reduced water, sewer and energy charges. While the revenue of the water and sewer utilities would be reduced, the effects of these reductions would be offset by the following factors: reduced O & M costs; longer life of capital facilities; and implementation of retrofit over an extended period (i.e. 3 years) rather than immediately.

If we can make some rough assumptions about the number of fixtures which need to be replaced, we can calculate a rough cost per mgd of water saved resulting from installation of the newer fixtures. This type of demand side analysis can be performed when a feasibility study is being conducted in a planning area that is experiencing deficit conditions or during the development of a specific watershed-based management plan. If it is assumed that there is an average of 2.5 people per dwelling unit and 2 toilets and 2 showerheads per unit, a population of about 95,000 would have about 38,000 dwelling units. This translates to approximately 76,000 toilets and 76,000 showerheads. For the water closets, this amounts to about $2,800,000 per mgd saved; for the showerheads this comes to about $396,000 per mgd saved. For New Jersey in general, even the $2.8 million per mgd for the 1.6 gpf water closet compares favorably with the cost of developing new surface supplies, which must include impoundment and or intake, transmission and treatment costs. Moreover, the $150 cost of toilet replacement is extremely conservative, since bulk purchase of products and services through an organized program could result in a cost of $100 or even less.

From the standpoint of the customer, we can estimate the annual savings in the cost of water from the 2.5 gpm showerhead which would be realized by a family of four, given an average of one 7-minute shower per person per day. Assuming that the existing showerheads consume from 3.5 to 5 gallons per minute and the retail cost of water ranges from $1.50 per thousand gallons to $3.00 per thousand gallons, a reduction of 1 to 2.5 gpm can be achieved and the annual savings realized are as shown in the table below:

Flow Rate of Original Showerhead	Water Use Reduction From 2.5 gpm Showerheads	Annual Savings in Cost of Water at Various Prices Per 1000 Gallons		
		$1.50	$2.00	$3.00
5.0 gpm	2.5 gpm	$38.33	$51.10	$76.65
4.5 gpm	2.0 gpm	$30.66	$40.88	$61.32
4.0 gpm	1.5 gpm	$23.00	$30.66	$45.99
3.5 gpm	1.0 gpm	$15.33	$20.44	$30.66

Energy and sewer cost savings would be in addition to these savings and if the showers taken are longer than 7 minutes, the overall savings would be even greater.

Likewise, if we make some assumptions about per capita indoor use, we can roughly calculate the savings in retail water costs for a family resulting from a changeover from a 3.5 gallon-per-flush toilet to a 1.6 gallon-per-flush toilet. Assuming four flushes per person per day, a family of four would save 30.4 gallons per day (gpd) or about 11,000 gallons per year. The annual savings on water charges would be about $17 at a price of $1.50, $22 at $2.00 and $33 at $3.00. For many families in pre-1980 homes in which the toilets have not been replaced, the savings are more dramatic, since these older fixtures used 5 or more gallons per flush. With the 5 gpf fixtures, the family of four would save 54.4 gpd or about 20,000 gallons per year. The annual savings on water changes would be about $30 at a price of $1.50, $40 at $2.00 and $60 at $3.00. Sewer cost savings would be in addition to these savings.

Aside from these savings, there are other significant advantages of accelerated installation of more efficient plumbing fixtures from a policy standpoint. First, it is a structural water conservation measure, requiring no action by the water user. Once the product is installed, it will provide the savings regardless of the predisposition toward conservation of the user. (See further discussion in Section V. Conclusion.) In addition, plumbing fixture changes reduce non-discretionary demand for water, as opposed to the largely discretionary usage which takes place outdoors. These measures therefore do not reduce the cushion which is available for reduction during drought emergencies (See Section II E.) Finally, when evaluating water supply options, it must be remembered that the absolute number of remaining new supply sources, either ground or surface, is decreasing, not increasing.

2. Financial Assistance for Accelerated Replacement of Plumbing Fixtures

In view of the above, the DEP should give strong consideration to low or no interest loans to water systems so that existing showerheads could be replaced with 2.5 gpm or less fixtures and existing water closets could be replaced with 1.6 gallon water closets. Such a program would be voluntary for the water system and would be targeted to areas experiencing water supply problems. Such a program would complement the existing water supply system rehabilitation loan program and should provide flexibility for either direct installation of the fixtures by the purveyor or its contractor or for rebates for installation by the customer. For the time being, such a program would have to be limited to governmentally-owned water systems since the 1981 Water Supply Bond Fund is the only immediately available source of funds to make the loans, but other sources of funds should be considered which would allow investor-owned involvement in such a program.

If the Board of Public Utilities would allow regulated water utilities to treat water saving fixtures and other water conservation equipment as part of their rate base, as it has done for power generation utilities and as recommended in Section III. J., above, the accelerated installation of water conservation fixtures and devices would receive additional stimulus.

C. Water Conservation Pricing

The effort to encourage water conservation through water rates is a manifestation of the widespread perception that: 1) the rates charged for water by most water systems do not reflect its true cost, in view of external environmental and social costs associated with its production and use and 2) the structure of rates as distinct from their level may encourage the use of more water than is needed or even optimal for a task or purpose.

The elasticity of demand for water is the change in the quantity purchased brought about by a change in price. It is given as the ratio of the percentage change in the quantity demanded to the percentage change in price. There have been numerous studies on price elasticity of water demand and while it is difficult to generalize, recent analysis of a large number of studies indicates that for the eastern United States, long term elasticity for single family residential water demand ranges from -.5 to -.6 and the annual average for the nation as a whole ranges from -.2 to

-.4. This means that for each 1% rise in the cost of water, demand will decrease by .2% to .4%. Individual categories of commercial and institutional water demand also show an average elasticity range of -.2 to -.4. The demand for some residential uses of water is more elastic than others. Most indoor residential uses, drinking, cooking and bathing, represent a basic need or necessity and, therefore, this demand is less elastic. Most outdoor uses such as lawn and landscape watering, car washing, and recreation are more discretionary and this demand is more elastic.

Of course, there are certain prerequisites for pricing to have any influence at all on quantity used. Meters must be installed, operating and read reasonably often. In addition, at least a portion of the water charges imposed must be based on the quantity used. Meters are necessary not only for pricing to have any influence on demand, but without them, there would be little customer awareness of how much water is being used. This means that even an attempt to use less water in response to something other than rates, i.e. environmental concern or an anti-waste attitude, could not be measured by the customer. Basing at least part of the water charge on quantity helps provide customer awareness of the usage level and thereby provides an incentive for conservation. Cost savings to water customers is an important incentive toward conservation. Savings on energy and sewer charges provide additional conservation incentives.

As discussed below, the inclining block rate, uniform rate and/or seasonal rate would be considered conservation rate structures, while the flat rate and the declining block are not.

1. Inclining and Declining Block Rate Structures

There is considerable disagreement over the impact and value of inclining vs. declining block rates. Proponents of the declining block rate argue that as water production increases, the unit cost drops and so charging less per unit for larger quantities of water only reflects the utility's development, treatment and distribution cost. Opponents argue, among other things, that if the real or true cost of water, including the "externalities," were charged, this would not be the case. Without getting into a detailed discussion of the validity of both claims, suffice it to say that declining block rates give the wrong signal to water users about the value of water and its place in the environment. A great deal of the impact on demand of these two rate structures depends on the size and

number of the blocks. A very large first block, for example, can negate the expected impact on demand, regardless whether it is higher or lower than the second block.

An increasing block would cause larger users to subsidize smaller users. Since a larger portion of a smaller user's demand is relatively inelastic, an inclining block structure can be expected, all things being equal, to have a comparatively greater impact on discretionary rather than non-discretionary water use. While the inclining block rate does send a "good" signal, the difficulty in pin-pointing the effects of this rate structure, as opposed to rate level, would suggest that from an equity standpoint, its use be considered when specific demand reduction objectives are being sought by the utility, rather than a general reduction in demand.

It is neither possible nor desirable to determine a single, "true" price for water, since so many different factors can affect the cost of providing it to customers. Moreover, it is just as important to send the proper signal to customers through the structure of water rates as it is to depend on high water rates to reduce demand. Simply raising the price for water to reduce demand without being mindful of the demand elasticifies is not as constructive as using the pricing structure to accomplish specific conservation objectives, progress toward which should be measured.

2. Uniform Rate Structure

The potential disadvantages of the inclining and declining block rate structures are obviously avoided if a uniform rate is adopted. The uniform rate retains the same unit volume price regardless of the quantity used. (Usually, there is a minimum charge to each customer to recover the system's fixed costs.) Not only does the uniform rate send a good signal in that there is no incentive to use more than is desired just because the unit price is lower, but there is also equity in treating all users in the same class in the same manner.

Another advantage of the uniform rate is that its simplicity is useful if the utility is considering a seasonal surcharge. If the seasonal surcharge is superimposed over numerous blocks, the complexity can blur the signals which the utility is attempting to give the customers through the rate structure.

3. Seasonal Surcharge

In most systems, water usage increases in summer. (In the typical community, this is caused by extensive outside use of water, but in resort areas, the increase in population due to the tourist influx means that the increase demand has a large indoor use component). In order to supply this additional demand, extra plant capacity is needed which would not be necessary during the rest of the year. This means that customers using the same amounts of water throughout the year are subsidizing users that contribute to the high summer demands.

In these instances, a surcharge can be applied during the summer months which takes into account the seasonal differences in capacity costs. The surcharge can be imposed as a winter-summer rate or as an alternative seasonal rate. Under the winter-summer rate, the surcharge is applied to consumption above the average winter use. The alternative seasonal rate is simply a higher rate that is charged for all water consumed during the summer. Although it is somewhat easier to administer, the alternative seasonal rate is less desirable from a conservation standpoint. First, it does not discriminate between excess use in summer and the more normal usage rates during the rest of the year, because the higher rate is paid regardless of the amount used. Second, and because of this, it does not discriminate between the non-discretionary and discretionary components of total water usage.

To the extent that seasonal surcharges increase the sensitivity of water system revenue to precipitation and temperature, which can greatly influence outdoor water use in the summer, the surcharge and the underlying basic rate should be set so as to guard against severe revenue instability. (See discussion above in Section II. C. Water System Revenue Loss and Instability.)

4. Promoting Conservation Pricing

The BPU has virtually eliminated the declining block rate and has replaced it with a uniform rate in most cases. Similar trends are taking place among the non-rate regulated water systems, but there are a number which retain the declining block structure. These systems should review their rate structure to determine if the declining block structure makes as much sense today as when it was first adopted. Unless there are highly compelling reasons for the non-conserving rates, they should be eliminated.

The Delaware River Basin Commission requires that a water system without a conservation rate structure which applies for a new or expanded allocation totaling 1.0 mgd or more must examine the feasibility of implementing a conservation rate structure before the Commission may issue the allocation permit.

Since a large percentage of purveyor supplied water is sold through unregulated systems, the impact of BPU's policies are somewhat limited, particularly in the areas of pricing and overall financial planning and management. In the area of rate structure, DEP could take some actions to help promote conservation. For example, water systems without conservation rate structures in place as required by N.J.A.C. 7:19-6.5(a)4, should be ineligible to receive public water financing, including financial assistance for accelerated installation of conservation plumbing fixtures. In addition, where demand/supply problems exist, as delineated by the NJSWSP or other studies, systems requesting new or expanded water allocations should not be issued allocation permits if such systems are not in compliance with N.J.A.C. 7:19-6.5(a)4, unless they agree to bring their rates into compliance within a specified time period to be fixed by NJDEP. A similar policy should be applied regardless of location, whenever a new or expanded allocation request would result in a proposed withdrawal equal to or exceeding 1.0 mgd.

D. Water Audits and Add-on Conservation Devices

An alternative to replacement of a plumbing fixture, which can be expensive in some cases, is a program of installing "add-on" water conservation devices which reduce the water used by the fixtures. There are three types of products for reducing water used by water closets. Volume displacement devices usually are plastic bags filled with water or bottles weighed down with gravel. Toilet tank dams retain water in the tank when the toilet is flushed. Variable flush devices allow the user to vary the amount of water used per flush. Showerhead flow restrictors are also available. They are inserted in the supply line just upstream of the showerhead and reduce the amount of water flowing through it.

Of these devices, the simplest is the volume displacement device. It can be used in most toilets, is easily installed and usually does not require adjustment or maintenance. While it may produce lower savings (0.5 to 1 gallons) than the other products, its other attributes make it the most likely to be installed by the water customer in a volunteer retrofit

program. Toilet tank dams save more water (1.5 gallons) and are relatively easy to install, but do require periodic adjustment to retain their position in the tank. Variable flush devices are the most difficult to install, but they have been shown to be effective in saving water. Difficulty of installation has prevented them from being installed on a large scale.

While the add-on conservation devices do not provide the same level of water demand reduction as replacement of water closets or showerheads, the cost and inconvenience is so much lower that a community seeking to reduce demand by a moderate amount in a short time should consider a voluntary program in which the add-on devices are distributed in a kit free of charge to the customer or for a small fee. The kit should contain information on how to install the devices and check for and repair leaking toilets and taps. Such programs have been successfully implemented, without significant negative revenue effects, by a number of governmentally-owned and investor-owned water systems whose systems were approaching either their safe yield, maximum treatment or transmission capacity or other limiting factors. Of course, as water closets and showerheads are replaced with the 1.6 gpf and 2.5 gpm products, the need for add-on devices will diminish.

A residential water audit is an inspection of the dwelling unit's water system and fixtures to determine their efficiency and make recommendations for improvements. Typically, repair of toilet and faucet leaks and installation of add-on retrofit devices are suggested. The recommendations are implemented on the spot, at a subsequent visit or by the homeowner.

A recent study done in Marin County, California showed that when the audits are done in homes that show higher than normal consumption, the cost of the audit can be recouped by the consumer in about two years. The savings to the utility are, of course, not as attractive on a system-wide basis. This indicates that audits can be an efficient means of reducing demand, but that subsidization by the utility or by other public entities may be less appropriate than for other conservation measures. A good substitute for water audits may be educational efforts to promote public awareness of domestic leaks and encourage their repair.

V. CONCLUSION

The analyses set forth in this document shows that the broad advantages of water conservation outweigh the disadvantages. The DEP should reaffirm its support for the concept of water conservation as an effective and efficient alternative in water resources planning and management. A primary issue is the approach to be taken toward implementation of conservation. It is usually assumed that water conservation is a concept that must be implemented through government regulatory mechanisms. Indeed, there have been calls from some quarters for mandatory swift and dramatic reductions in water customers' usage through direct regulation. While such means are needed to change water user behavior during drought episodes, it would be difficult to maintain such reduced demand levels permanently without extensive hardship. The experience in recent instances of state and locally imposed outdoor water use restrictions attests to the lack of popularity of such measures and the need for uniform and consistent enforcement efforts throughout the affected area in order to maintain proper levels of compliance even on a temporary basis.

DEP should favor non-regulatory and incentive-based means to bring about reductions in water demand. There are two basic reasons for this policy. First, in an open and free society, we are predisposed to non-coercive behavior changes rather than those mandated by statute or regulations. Secondly, as a practical matter, water customers will be much more likely to follow the desired behavior and reduce demand on a sustained basis if they are informed as to its overall benefits to them and to society as a whole.

In the long run, public education can be an effective substitute for regulations. Recognizing this, the DEP has emphasized public education for conservation, focusing on water awareness in the school curriculum and promoting conservation landscaping among adults. (See Section III.F. Public Education). These programs should be expanded. The DEP should update and broaden its school curriculum materials on water conservation, coordinating its activities to complement and further the goals of the Environmental Education Plan of Action.

Likewise, the DEP should continue and strengthen its education programs for water conservation landscaping particularly in research and demonstration. In particular, greater efforts need to be made in reaching the landscaping and nursery professionals more effectively and

also in support of research and demonstration to not only reduce turf area but also improve efficiency of turf irrigation.

There are other approaches to water demand reduction which do not require direct regulation of water customers' behavior. An important criteria in evaluating these approaches is whether the conservation measure is structural or behavioral. At one end of the continuum is a plumbing fixture change which reduces water demand without any change in user behavior and at the other end is a user's decision to turn the water off while soaping up in the shower, an action which reduces water demand solely as a result of a change in user behavior. Behavioral changes, while they can be induced by regulatory constraints or stimuli, usually involve a decision or choice by the water user. On the other hand, once a 1.6 gpf water closet is installed in accordance with the plumbing code, there is little if any choice left to the water customer regarding its use.

Structural conservation measures are more reliable and certain than behavioral measures. Due to this greater certainty and reliability, structural measures should be favored by the DEP over regulatory behavioral measures, other things being equal. In view of this, when future technological advances are made in fixtures and equipment so that less water is used and equivalent performance is provided, code changes should be made expeditously.

A policy favoring structural over behavioral conservation measures should not be used to preclude attempts to reduce demand by effecting behavior. It merely recognizes that human behavior is usually not as reliable as the operation of physical objects. No matter how much emphasis we may decide to put on structural water conservation, there will be effective opportunities to influence behavior such as through incentives and education and they should be utilized in the overall DEP strategy for water conservation. The recommendations made above in Section IV on pricing are examples of incentive-based measures to promote conservation directed at both the purveyor and the customer. Such a policy also favors accelerated installation of the 1.6 gpf toilet and the 2.5 gpm showerhead.

Structural water conservation measures can also be helpful in reducing wasting of water which the customer often cannot control. One such situation is the automatic activation of lawn sprinkler systems during periods of rainfall. Such systems could be required to have moisture sensors so that they would not be activated when rain has provided

sufficient water for the turf. The NJDEP should consider requesting that DCA amend the applicable construction subcodes to provide for such a requirement.

It is evident from the analyses presented in the body of this document that neither water conservation nor the narrower concept of demand reduction should be perceived as a monolithic concept, but rather as a bundle of different measures, practices and activities, each with its own advantages and disadvantages. In addition, there is great variation in water supply and water quality conditions across New Jersey, due in part to its varied topography and geology. Both ground and surface water systems provide water service in the state. Among the ground water systems, sources include both sand and gravel aquifers as well as fractured rock aquifers. Ground and surface waters also have significantly different levels of quality, often requiring different levels of treatment, which will affect rates and rate structures. Given the variety of conservation measures and supply scenarios, uniform application of a single set of conservation measures over the entire State is difficult. The State should therefore allow regional and local entities to design and develop their own conservation programs tailored to their areas.

One source of information which would improve the ability to select the optimum mix of conservation measures for a given region, as well as aid in system expansion planning is improved data on the components of system demand. It was learned in the effort to prepare the 1995 Statewide Water Supply Plan that many water systems do not have reliable, detailed breakdowns of residential, commercial and industrial demand. Since the nature and pattern of industrial demand differs dramatically from residential and commercial, better data on the makeup of system demand will not only improve the ability to forecast the increases in demand, but also improve drought response planning, especially the estimation of demand reduction achievable from different types of conservation measures.

The policy of regionalized conservation management should guide both the existing water system conservation and drought plan review program as well as any future financial support provided by the state for conservation. In evaluating a water conservation plan, the state should be most interested in whether or not it addresses the particular supply and demand issues that exist in that system. Likewise, financial support for conservation should be provided first to areas where deficit or system constraints problems are most serious, the proposed measures directly address these problems, and local support for conservation is greatest.

Areas with projected future deficits would receive second priority.

Conservation measures designed to meet regional and local issues will be implemented much more effectively than uniform measures applied throughout the state and they will be even more effective and more enthusiastically accepted if they are developed and designed by representatives of the regions and localities.

Where there is regional and local interest in water conservation, the DEP should encourage that interest by offering planning assistance in developing and designing a water conservation program and providing financial support for plan implementation, such as low or no interest loans for the installation of low flow plumbing fixtures. A conservation policy which focuses on the different water supply conditions in various parts of the State must be based on careful identification of those areas which could benefit substantially from conservation. The 1995 Statewide Water Supply Plan reviewed water supply conditions in the 23 Regional Water Resources Planning Areas (RWRPA) into which the State was divided. Those RWRPA's which have significant water supply problems should be subjected to a detailed analyses to determine if they should be considered potential beneficiaries of water conservation and if so, the conservation funding and other assistance from the DEP herein recommended should be utilized in these priority areas.

Moreover, in areas where these detailed analyses indicate source and/or supply problems exist, the DEP's existing conservation related programs should be coordinated and focused on utilizing the benefits of demand and supply management. The following are examples of such coordination which should be undertaken in these areas:

1. The compliance schedules for systems under the unaccounted-for water and leakage loss reduction program should be accelerated.

2. Large, self-supplied water users should be required to perform water audits once every five years or when new or expanded allocation permit applications are submitted, whichever is more frequent.

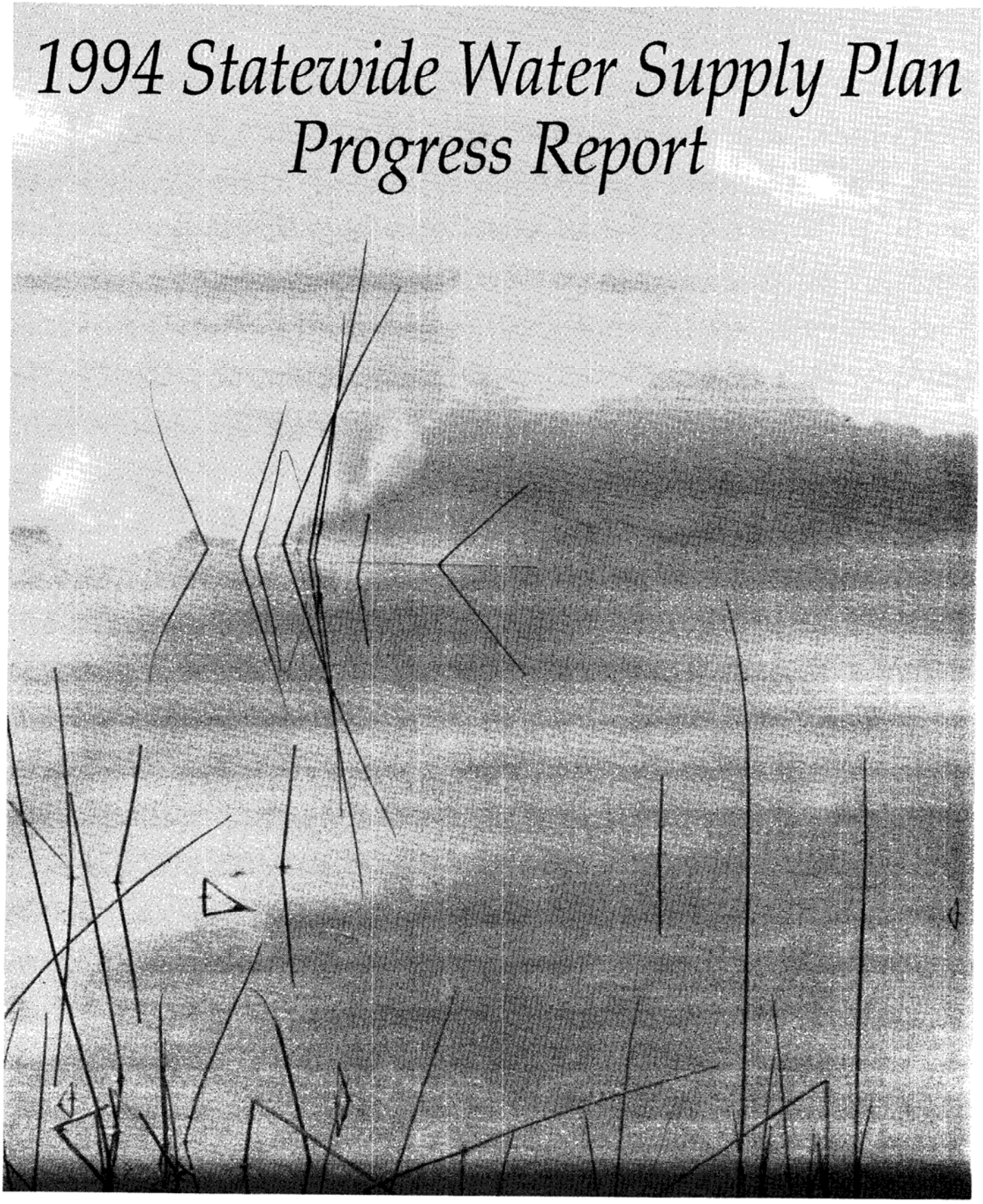
3. Plumbing fixture code enforcement should be monitored through the water system conservation plan review program. This should be coordinated with the Department of Community Affairs.

In a water-rich state such as New Jersey, it should not be the business of the DEP to preclude, as a part of its on-going conservation programs, a

water customer's opportunity to enjoy a healthy lawn. On the other hand, it should be the Department's business to provide the wherewithal and the incentives to communities and water systems for implementation of practical demand reduction measures. It should also be DEP's business to adopt structural changes in water use because they are cost effective and bring about minimal disruption of water user behavior. In this way, the Department can be assured of achieving reductions in water use which are both substantial and lasting and therefore truly protective of the environment.

APPENDIX C

1994 Statewide Water Supply Plan Progress Report



New Jersey
Statewide Water Supply Plan

1994
PROGRESS REPORT

New Jersey Department of Environmental Protection
Office of Environmental Planning
Bureau of Water Planning
CN 418
Trenton, NJ 08625-0418

March

1995

Printed on recycled paper

STATE OF NEW JERSEY
Christine Todd Whitman, *Governor*

Department of Environmental Protection
Robert C. Shinn, Jr., *Commissioner*

Policy and Planning
Lewis Nagy, *Assistant Commissioner*

Office of Environmental Planning
Martin A. Bierbaum, *Administrator*

New Jersey
Department of Environmental Protection

The mission of the New Jersey Department of Environmental Protection is to conserve, protect, enhance, restore and manage our environment for present and future generations. We strive to prevent pollution; ensure the efficient use of safe, environmentally sound and reliable energy resources; provide opportunities for recreation and enjoyment of natural and historical resources; and promote a healthy and sustainable ecosystem.

ACKNOWLEDGMENTS

Bob Canace, Acting Section Chief
NJ Geological Survey

Kimberly A. Cenno, Principal Geologist
Office of Environmental Planning

Robert Kecskes, Section Chief
Office of Environmental Planning

Rick Kropp, Bureau Chief
Water Supply Element

Joseph J. Mattle, Environmental Engineer
Office of Environmental Planning

Joseph A. Miri, Chief
Water Supply Element

Steve Nieswand, Administrator
Water Supply Element

Terri Romagna, Supervising Geologist
Office of Environmental Planning

Phil Royer, Section Chief
Water Supply Element

Daniel J. Van Abs, Ph.D., Assistant Administrator
Office of Environmental Planning

Nicholas P. Zripko, Principal Planner
Office of Environmental Planning

For further information, please write:

New Jersey Department of Environmental Protection
Office of Environmental Planning
Bureau of Water Planning
CN 418
Trenton, NJ 08625-0418

TABLE OF CONTENTS

ACKNOWLEDGMENTS 1

INTRODUCTION 5

MAJOR CAPITAL CONSTRUCTION PROJECTS 6

MAJOR PROJECTS 6
A. DELAWARE AND RARITAN CANAL IMPROVEMENTS 6
B. WANAQUE SOUTH PROJECT INCLUDING MONKSVILLE RESERVOIR 6
C. MANASQUAN RESERVOIR 7
D. F.E. WALTER RESERVOIR MODIFICATION 7
E. MERRILL CREEK RESERVOIR 9
F. TRI-COUNTY WATER SUPPLY PROJECT 9
G. WATER SUPPLY FOR SOUTH RIVER AREA 9

WATER RESOURCES EVALUATIONS 10

FEASIBILITY STUDIES 10
A. SOUTH RIVER BASIN AREA 10
B. CAMDEN METROPOLITAN AREA 11
C. EASTERN RARITAN BASIN AREA 11
D. MANASQUAN RIVER WATER SUPPLY FEASIBILITY STUDY 12
E. GROWTH AREAS FEASIBILITY STUDY 12
F. CAPE MAY COUNTY REGIONAL AREA 13
G. EVALUATION OF CONTAMINATED WELLFIELDS & ALTERNATE SUPPLIES 14
H. ESTUARY IMPACT FEASIBILITY STUDY 14
I. PASSAIC-HACKENSACK WATER SUPPLY BASIN FEASIBILITY STUDY 14
J. ATLANTIC COUNTY REGIONAL AREA 15
K. DELAWARE RIVER FLOW AUGMENTATION FEASIBILITY STUDY 15
L. OCEAN COUNTY FEASIBILITY STUDY 16
M. BURIED VALLEY FEASIBILITY STUDY 16
N. NORTHWEST MERCER COUNTY FEASIBILITY STUDY 16
O. CONSOLIDATIONS AND EXTENSIONS OF SERVICE 16
P. HUDSON MAIN STEM PROJECT 17
GROUND WATER STUDIES 17
A. VINCETOWN/MOUNT LAUREL-WENONAH AQUIFER GROUND WATER STUDY 17
B. RAMAPO VALLEY-FILL AQUIFER STUDY 17

C. South River Study 18
D. Atlantic County Ground Water Study 19
E. Cooperative Map: Statewide Map of Geological Formations 19
F. Buried Valley Ground Water Study (Central Passaic Region) 20
G. Lamington Ground Water Study 21
H. Northwest Mercer Ground Water Study 21
I. Rockaway Ground Water Study 22
J. Germany Flats Ground Water Study 22
K. Aquifer Recharge Mapping Program 23
L. Camden Metropolitan Area Ground Water Study 23
M. Confined Coastal Plain Ground Water Study 24
Regional Water Resources Evaluations 24
A. Cape May Aquifer Recharge Evaluation 24
B. Wetlands Impact Study 25
C. Lamington Buried Valley Aquifer Evaluation 25
D. Rockaway River Watershed Evaluation 26
E. Cedar Creek/Forked River/Sloop Creek Evaluation 27
F. Great Egg Harbor River Watershed Evaluation 27
G. Metedeconk/Toms/Tuckahoe River Watersheds Evaluation 27
H. Upper and Lower Maurice River Watershed Evaluation 27
I. Mullica River Watershed Evaluation 28
J. Salem and Cohansey River Watersheds Evaluation 28

WATERSHED AND AQUIFER PROTECTION 29

Well Head Protection 29
A. Delineation of Interim Well Head Protection Areas 29
B. County/Regional Demonstration Projects & Competitive Grant Programs 30
C. County/Local Outreach Programs 30
D. Finalized Well Head Protection Area Demonstration Projects 31
Demonstration Projects/Other Studies 31
A. Ocean County Project for Maintenance of Stormwater Basins 31
B. Mercer County Nonpoint Source Pollution Control Project 32
C. Watershed Buffers 32
D. Middlesex County Aquifer Protection 33
E. Sussex County Septic System Management 33

STATE AND REGIONAL WATER SUPPLY PLANNING 34

Water Conservation 34
A. Cape May County Water Conservation Program 34
B. General Water Conservation Program 34
Water Management Planning 35
A. Completion of Water Resources Geographic Information System 35
B. USGS Matching Funds for Water Management Planning 36
C. Regional Water Supply Infrastructure 36
Statewide Water Supply Plan Revision 36

SPECIAL WATER TREATMENT STUDY 37

PURVEYOR INFRASTRUCTURE LOAN PROGRAMS 38

WATER SUPPLY INFRASTRUCTURE REHABILITATION 38
INTERCONNECTION TESTING AND IMPROVEMENTS 38
POLLUTED WELLFIELDS AND INADEQUATE SMALL SYSTEMS 39
A. LOANS FOR CONSTRUCTION OF WATER SUPPLY FACILITIES TO REPLACE WELLS 39

1994 STATEWIDE WATER SUPPLY PLAN PROGRESS REPORT

INTRODUCTION

The New Jersey Water Supply Bond Fund (Bond Fund), established in 1981, provided $350 million for the implementaton of projects and programs recommended by the New Jersey Statewide Water Supply Plan (SWSP). The original SWSP was completed in 1981 and adopted in 1982 and is the State's major water supply planning document.

The State's role in water supply planning, carried out by the New Jersey Department of Environmental Protection (Department), includes implementing the water allocation system, regulating drinking water quality protection, data gathering, and planning to meet future needs. On the basis of projected water demand information and feasibility studies, the State has sponsored major capital projects intended to meet comprehensive water supply needs.

The Bond Fund of $350 million is used by the State for projects and management initiatives as provided in the SWSP Action Program, a component of the SWSP that specifies the intended uses of the bond funds. The first Action Program was in the original SWSP document. In order to reflect changing conditions, the SWSP, including the Action Program, were reviewed and modified by the Updates of 1983, 1985, 1987, 1988, 1991 and 1993.

A status report on the SWSP projects and management initiatives are given here. The SWSP Action Program appears at the back of this report and also in the 1993 Update. This report is current as of July 1993 and is expected to be revised periodically. Please note, projects and management initiatives recommended in the 1995 New Jersey Statewide Water Supply Plan currently being revised are not contained here in this document.

For a better understanding of the following initiatives contained in this document, please keep in mind that ground water studies often lead to regional water resources evaluations which can then lead to feasibility studies (if necessary) and then finally to capital construction projects (if necessary).

MAJOR CAPITAL CONSTRUCTION PROJECTS

Major Projects

A. Delaware and Raritan Canal Improvements

The Legislature provided a $20.5 million Bond Fund loan in 1985 to the New Jersey Water Supply Authority to dredge 32 miles of the 60-mile waterway and rebuild certain canal facilities, in order to restore its capacity to transport 100 million gallons per day (MGD) of Delaware River water to Central New Jersey. The 100 MGD diversion (with reductions during drought) from the Delaware River was granted under a 1954 Supreme Court Decree as partial compensation to New Jersey for the diversion by New York of 800 MGD into its three upper Delaware Basin reservoirs, located near the headwaters. The Delaware and Raritan Canal provides an important supply to New Jersey, but it was so sediment-filled by the early 1980's that it could not supply more than half of its allotment. Integrated management of the Delaware River diversion and the Raritan Basin supply offer the possibility of optimal use for both sources, to meet the expanding future water supply needs of Central New Jersey. The project was completed in 1985.

B. Wanaque South Project including Monksville Reservoir

The Wanaque South Project, including Monksville Reservoir, was completed by the North Jersey District Water Supply Commission (NJDWSC) and the Hackensack Water Company in 1987. The SWSP Action Program allocated and the Legislature appropriated $50 million from the Bond Fund, of which $42 million was actually borrowed by NJDWSC. Hackensack Water Company's share was privately funded and backed by $101 million of State Economic Development Authority bonds. (Only public entities are eligible for loans from the Water Supply Bond Fund). This $143 million joint public-private project is the cornerstone for insuring adequate water supply in Northeastern New Jersey beyond the year 2000, based on the drought of record.

The project increased the safe yield of the two systems by 79 MGD and offsets the water supply deficit for that region, as shown in the studies sponsored by the Department under the SWSP. The project increased the existing Ramapo Pumping Station's capacity to 150 MGD (pumping high-flow water to the Wanaque Reservoir), constructed the 250 MGD Wanaque South Pumping Station, and added the eleven-mile Wanaque South Force Main as well as the seven billion gallon Monksville Reservoir. The new Force Main takes water from the Passaic and Pompton Rivers and connects the Wanaque South and Ramapo Pumping Stations with the existing Wanaque Reservoir. It also interconnects with the Passaic Valley Water Commission and Hackensack Water Company's Pompton Lakes Pumping Station. The pipeline interconnects with the supply systems of the five largest water supply systems in the State.

C. Manasquan Reservoir

The Legislature appropriated a $72 million Bond Fund loan to the New Jersey Water Supply Authority to build the Manasquan Reservoir, for which the dedication was held in September 1990. The reservoir holds about four billion gallons. Water is withdrawn from the Manasquan River during periods of high flow. This project can provide a safe yield of 30 MGD to the Monmouth and Northern Ocean County region. Approximately half of the safe yield has been contracted for by purveyors and municipalities in Monmouth County and Northern Ocean County.

This region was designated as Water Supply Critical Area No. 1 because of the depletion of aquifers and the threat of salt water intrusion. The Water Supply Critical Area program requires purveyors with stressed ground water supplies to find alternate sources. The Manasquan Reservoir was developed to provide surface water for conjunctive use with existing ground water supplies.

D. F.E. Walter Reservoir Modification

New Jersey, Pennsylvania, and Delaware, the three lower basin member states of the Delaware River Basin Commission (DRBC), in keeping with the 1983 DRBC "Good Faith Agreement," are committed to sponsorship of additional storage for flow augmentation in the Delaware River mainstem. The F.E. Walter Reservoir modification project, at a cost of approximately $138 million (1992 estimate), will provide additional water for releases into the Lehigh River which flows into the Delaware River at Easton, Pennsylvania. The flood control improvement and the recreational component of the project, to be funded by the federal government and Pennsylvania, are estimated to cost approximately $31 million. This 23 billion gallon source of water supply will provide flow for new consumptive uses in the Delaware Basin and also help to prevent contamination of the Potomac-Raritan-

Magothy (PRM) aquifer system by saline intrusion in the estuary during times of low flow. Because of the extensive pumping from the aquifer system over many years in New Jersey, water has infiltrated into the PRM from the Delaware River mainstem. The "Good Faith Agreement" is a commitment to feasible, cooperative solutions to water supply problems including: the threat of saltwater intrusion in the PRM; the need for water supply for future growth in consumptive use; and other problems that were identified in DRBC's Level B Study.

In order to directly support this project, New Jersey and Pennsylvania have agreed to provide $10 million each of State financing upfront and Delaware will provide about $800,000. DRBC will be the non-federal sponsor of the modification of the F.E. Walter Reservoir, which is a U.S. Army Corps of Engineers (ACOE) project. The current cost-sharing formula used by ACOE for water supply projects requires the non-federal sponsor to repay the federal government during the period of construction. DRBC proposes to pay the interest and principal as well as maintenance costs with money collected through a comprehensive user fee system. The contributions of $20.8 million at the outset from the three down-basin states will reduce the bond financing costs as well as reduce the total amount of the debt which DRBC will need to incur.

This project has been delayed because DRBC cannot institute a user fee system involving holders of water allocation permits that could legally withdraw water in existence prior to 1961 (when the DRBC Compact was enacted) unless the U.S. Congress amends Section 15.1 (b) of the Compact. Legislation for this amendment has been introduced into Congress, but there has been opposition from some major user groups to the proposed fees. The commitment of the State of New Jersey and the other two down-basin states to providing State money for the F.E. Walter Reservoir modification shows their official support of this flow augmentation project, which is of vital importance to the region's future water supply.

The 1982 SWSP Action Program included items labeled "Delaware low flow augmentation" in the original SWSP and also in the 1983, 1985, and 1987 Updates. These items were included both as a proposed feasibility study and as capital projects under "Expenditures to be undertaken by others". They include the F.E. Walter Project as discussed above and also the proposed expansion of the Prompton Reservoir that will not be undertaken in the immediate future. In 1988, the SWSP Action Program was amended to allocate a Bond Fund loan of $10 million specifically for the F.E. Walter Reservoir modification. Before making the allocation from the Bond Fund, the Department prepared a feasibility and financing report, based in part on the ACOE reports on project design and feasibility. An additional $500,000 has been allocated to cover the Department's costs related to New Jersey's participation in Delaware River flow augmentation, flow maintenance, and other DRBC water resource issues.

E. Merrill Creek Reservoir

The major electric utility companies of the Delaware River Basin, as part of DRBC's 1983 "Good Faith Agreement," formed the Merrill Creek Owners Group (MCOG). The Merrill Creek Reservoir, located in Warren County, New Jersey, was built by MCOG at a cost of $217 million. The yield from this project is 200 cubic feet per second for a period of 115 days. Whenever the flow at Trenton is below the equivalent of 3,000 cfs and the basin is in Drought Warning, MCOG is required to make releases from Merrill Creek to compensate for consumptive uses of water in electric power generation. This arrangement ensures that the electric power companies, a vital industry and a large consumer of water, will be able to maintain operations in times of low flow. DRBC also has the right to order releases from Merrill Creek for other needs under conditions specified in the DRBC Comprehensive Plan. The Merrill Creek Reservoir was identified in the Action Program as a privately funded action, requiring no State bond funds. The reservoir was completed in 1988.

F. Tri-County Water Supply Project

The New Jersey American Water Company (Western Division) is in the process of constructing a $167 million water treatment plant on the Delaware River in Cinnaminson and a 40 mile regional pipeline that will bring drinking water supplies to several municipalities and other users in Burlington, Camden and Gloucester counties. These supplies are necessary to reduce the region's reliance on the Potomac-Raritan-Magothy (PRM) aquifer system for which the State has mandated an average reduction of 22 percent in use, based on 1983 pumpage, due to the threat of saltwater intrusion caused by overuse. This project is totally funded by New Jersey American; completion is anticipated by late 1995 or early 1996.

G. Water Supply for South River Area

The Middlesex Water Company has completed its $40 million Raritan River water treatment plant improvements and regional pipeline to eastern Middlesex and northern Monmouth counties in order to meet State mandated reductions in water withdrawals to that region's aquifers due to saltwater intrusion as well as to meet future demand. The project was funded by the water company.

WATER RESOURCES EVALUATIONS

Feasibility Studies

A. South River Basin Area

The South River Basin feasibility study was initiated to analyze the alternative methods for providing water supply for this area of Middlesex and Monmouth counties that are located in Water Supply Critical Area No. 1. The area is largely dependent on ground water supplies that have become increasingly threatened by salt water intrusion. Alternative sources of supply (primarily surface water) were identified as needed to compensate for reductions in ground water withdrawals as well as to meet the demands of future growth. The study divided the region into five subareas, and identified those towns that could meet future demands themselves or through interconnections and those towns that need a new regional water supply. Existing and potential sources of supply, including the Raritan River, Delaware & Raritan Canal, South River, and Manasquan Reservoir, were analyzed. The study was completed in early 1987.

The water supply deficits to be met in the South River Area were estimated at 42 MGD by the year 2010 and 60 MGD by the year 2040. The study included six different scenarios for solving the problem and gave costs per million gallons for each scenario. Each solution involved whether a new filtration plant or an expansion of an existing one and also a regional pipeline. An expansion of Middlesex Water Company's filtration plant and a regional water supply pipeline were included in several of the alternatives presented in the feasibility study. The Department reviewed the recommendations of the study and concurred that Middlesex Water Company's infrastructure should be expanded to meet the need described above. The Company proceeded with the expansion of treatment and distribution capacity. East Brunswick Water Authority has also expanded its distribution system in order to provide surface water supplies to portions of the study area.

B. Camden Metropolitan Area

This study was undertaken because of the ground water level decline in the PRM aquifer that provides the bulk of water supplies for the region. The consulting firm studied the feasibility of new sources of supply including a new intake on the New Jersey side of the Delaware River, developing new sources in the Cohansey Sands aquifers, drilling new wells in the unstressed portions of the PRM aquifer, or transporting surface water from the City of Philadelphia. The consultant's recommendation was for a new intake on the New Jersey side of the river, called the Tri-County Water Supply Project. This project is being financed and carried out by the New Jersey - American Water Works Company and is expected to be completed by 1995 or 1996 at a cost of approximately $170 million.

The Camden Area was included in Water Supply Critical Area No. 2, so designated because of the depletion of the PRM and includes Burlington and Gloucester counties. The new surface water intake will enable surface water to be used to supplement ground water from stressed aquifers. The Camden Metropolitan Area feasibility study included a conservation strategy that could save as much as 10 MGD by the year 2000.

C. Eastern Raritan Basin Area

The Eastern Raritan Basin Water Supply Feasibility Study was completed in March 1992. The main objective of the feasibility study was to plan for additional water supplies as demand increased in the study area. This was accomplished by: 1) estimating future demand, 2) evaluating the engineering, financial, environmental and institutional feasibility of individual water resource projects capable of meeting new demand, and 3) evaluating alternative programs and combining the individual projects found to be feasible.

The study concluded that the Kingston Quarry was the most cost-effective water supply facility that could meet future water demands in the study area. This project is a viable option only if certain institutional matters can be resolved with the quarry owner, Trap Rock Industries, Inc. These matters include the legal terms of turning the site over to the State, guaranteeing a schedule for State acquisition, and providing the necessary reservoir storage volume at the required time of transference. Due to these institutional issues, the study recommended that the Confluence Pumping Station project be built and operational for when demand exceeds water availability in the study area.

Since the completion of the study, the Department has used updated population and demand predictions from the upcoming 1995 SWSP to develop an implementation plan for the study area. The implementation plan has estimated that additional storage may be required approximately as early as the year 2039 for the study area, a significantly later time than the study anticipated. This is dependent on predicted growth trends in and around the basin, ground water availability, and other various factors that may alter the study area's demand and availability. In addition, the implementation plan recommends that if the Department cannot obtain the project of first choice (Kingston Quarry), it should proceed with the implementation of the next most cost-effective water supply augmentation facility, the Confluence Pumping Station. The New Jersey Water Supply Authority was identified as the most appropriate project sponsor.

D. Manasquan River Water Supply Feasibility Study

The Manasquan Reservoir System Project was completed and began operation in 1990. Approximately one half of the safe yield of the project is currently contracted for by local purveyors. Further investigation of the conjunctive use potential for this project has been put off at this time. The restoration of the major aquifer system due to the Water Supply Critical Area No. 1 cutback in well withdrawals is continuing.

E. Growth Areas Feasibility Study

Approximately $49,000 from the appropriation for this study was used to evaluate the effects of land use changes on the base flows of the Raritan River. The purpose of this evaluation was to determine if there was a negative effect on the safe yield of the Raritan System that includes the Spruce Run and Round Valley Reservoirs, the Delaware and Raritan Canal and pumping stations associated with these supply sources. The study concluded that there have not been any adverse effects and that urbanization has not reduced the base flow of this watershed.

Appropriations were also used to complete a regional water resource evaluation in the Salem/Gloucester County Area. This evaluation provides a comprehensive inventory of the surface water and surficial ground water systems in this region.

F. Cape May County Regional Area

The Department initiated a comprehensive investigation of all of Cape May County's water resources in 1989. This project was initiated because the Department's coastal chloride monitoring network and other documentation indicated that saltwater was advancing into southern Cape May County's regional ground water systems. Saltwater intrusion has affected the major aquifers in southern Cape May County as a result of over-pumpage. The Cohansey aquifer is the most significantly affected water supply source in this area. A comprehensive investigative report of the water resources of Cape May County is currently being prepared by the USGS. The objectives of this report are to present data on surface water flow, hydrostratigraphy, water use, ground water flow, water quality and water budget and to determine the relation and impact of each of these components with respect to the water resources. A water budget for both the shallow aquifer system and the deep aquifer system is discussed for predevelopment and for the present. The investigation is concluding that withdrawals from the Cohansey aquifer in southern Cape May County are affecting its long-term ability to renew itself, and that alternative supplies are needed to maintain the integrity of this water supply.

Documents prepared by the Department regarding the Cape May County regional area includes: "Population Projections 1990 -- 2040," "Hazardous Waste Sites Inventory Report" and "Saltwater Intrusion and Proactive Water Supply Planning in Cape May County, New Jersey." Two reports were also prepared by the U.S. Army Corps of Engineers in conjunction with a consulting firm: "Cape May Desalination Study Final Report" and a "Barrier Island Interconnection Study." The USGS has published "Ground-Water Hydrology and Simulation of Saltwater Encroachment, Shallow Aquifer System of Southern Cape May County, New Jersey" and is working on "Analysis of Saltwater Intrusion in the Atlantic City 800-Foot Sand Toward Public Supply Wells in Cape May County, New Jersey." Also published by the U.S.Geological Survey was a paper entitled, "Saltwater Intrusion into Fresh Ground-Water Supplies, Southern Cape May County, New Jersey, 1890-1991." The Department is working with Cape May County officials to develop a well managed and coordinated water resource development plan to protect and extend the County's ground water supply.

G. Evaluation of Contaminated Wellfields & Alternate Supplies

A number of consultants were used to evaluate various contaminated wellfields project sites during fiscal years 1985 to 1989. Seventeen studies were completed for areas contaminated with mercury, volatile organic chemicals and nitrates. The funds expended totaled $1.5 million. The solutions to the problems were then implemented to resolve the existing contamination problem and provide potable drinking water to the affected residents.

H. Estuary Impact Feasibility Study

This project was undertaken to evaluate the limitations to water supply development in the Metedeconk and Toms River basins. The downstream reach of this river system is susceptible to encroachment of saline estuarine waters during low flow conditions. Ground and surface water withdrawals and other aspects of development may exacerbate this condition. The project has placed special emphasis on the interaction of ground and surface water hydrologic systems. Changes in the magnitude and distribution of streamflow induced by surface and ground water withdrawals and the attendant saltwater encroachment is being evaluated. Surface and ground water data collection efforts have been completed. Coordinated ground and surface water models are being developed. The ground water model is being used to estimate seasonal low base flow; these results will be applied to a surface water model to evaluate saltwater encroachment.

I. Passaic-Hackensack Water Supply Basin Feasibility Study

A feasibility study is being undertaken by Department staff using a model to optimize the Passaic-Hackensack basin surface water sources. A watershed model will be developed which will evaluate the availability of water from the existing reservoir systems in both basins. The model will allow the Department to simulate transfers of water between systems and to evaluate changes in the system operations. This would include changes to passing flow requirements, reservoir storage and runoff feeding the reservoirs. Drought conditions and other recurrent hydrologic events can be replicated to assess the performance of the existing system of reservoirs and potential changes to those systems, such as interbasin transfers of water or reductions in demands due to emergency water conservation requirements.

By improving the ability to replicate droughts, the model will be a intregal tool for evaluating and optimizing response to water supply drought warnings and emergencies. It will also allow for improved coordination among the various

purveyors of Passaic-Hackensack basin water during drought and in planning for future demands. Finally, the Department anticipates using the model as part of its wastewater management and watershed management planning efforts in the area.

J. Atlantic County Regional Area

The Department is drafting an implementation plan for the Atlantic County regional area based upon a ground water investigation completed by the U.S. Geological Survey, a feasibility study completed by an engineering consultant, and the findings of several ground water investigations relevant to this region. While the initial focus of the original investigation was on the immediate Atlantic City vicinity, it is now concluded that the area must be viewed in a larger regional context. As such, the implementation plan will address both the Atlantic City area and the regional water resources that are interconnected with it. The tentative findings of the plan are that regional withdrawals from the Atlantic City 800-foot sand aquifer is exceeding its long-term capability to renew itself and that intermediary steps taken in the near future would allow the resource to be sustainable to meet the water supply needs of future generations. However, no impacts on existing wells are expected in the near future, nor is saltwater intrusion a critical issue in the near term, except perhaps near outcrop areas west of Atlantic City. However, surface water and Cohansey aquifer withdrawals may be causing streamflow depletion and that further analysis is required. Lastly, human effects on water quality could potentially reduce the number of available alternative water supplies in the future.

The plan will propose that: 1) new wells and substantial increases in allocations for existing wells should be discouraged in areas where saltwater intrusion would be significantly accelerated; 2) the monitoring well network should be expanded so that saltwater intrusion and streamflow depletion can be continuously assessed and steps taken to proactively preempt intolerable effects; and 3) a watershed management plan be developed that addresses the many interrelated activities that ultimately affect the water resources of the southeastern portion of the coast.

K. Delaware River Flow Augmentation Feasibility Study

The funding has been set aside for this study, which may not be necessary if the previously discussed F.E. Walter Reservoir Modification Project is implemented.

L. Ocean County Feasibility Study

Ocean County has been one of the fastest growing counties in the State. A feasibility study will be needed to ensure water supplies for future growth. This study will not be started until the Estuary Impact Feasibility Study and the Confined Coastal Plain Ground Water Study, discussed in this document, are completed. This study could also be linked to the Manasquan River Water Supply Feasibility Study previously mentioned. Funds are appropriated for this study.

M. Buried Valley Feasibility Study

The buried valley aquifer system, a water supply for the Central Passaic River Basin area (and also for other regions) is experiencing pressures from development. Well depletion and ground water interference are especially serious in Essex and Morris Counties. Supplies will be needed in the Central Passaic Basin area to meet the new demands and also to replace water losses due to ground water contamination resulting from septic systems, industrial discharges, and spills. Geological studies are in progress. In the future, a study might be needed in order to analyze yields, relate them to future expected demand and assess options if necessary.

N. Northwest Mercer County Feasibility Study

The results of the Northwest Mercer Ground Water Study demonstrated that local water supply concerns could be addressed through appropriate wellfield management and exploration for additional sources of ground water in the region. This feasibility study was not undertaken. Funds were appropriated but will not be used for this purpose.

O. Consolidations and Extensions of Service

A number of small water companies in New Jersey lack efficient and effective management and have allowed their systems to fall into disrepair. Many of these systems are probably not economically viable because of their age. It is not always clear, however, what steps must be taken to improve their situation. In many cases, engineering and management studies are needed to establish what improvements must be made to an individual system and the cost of the necessary improvements. These analyses would provide a sound basis for a judgment as to

whether a system should be taken over, as provided under The Small Water Company Takeover Act, and what the conditions should be.

Thus far, the Department has chosen not to fund such studies, preferring to allow economic forces and negotiations to operate in these situations.

P. Hudson Main Stem Project

Funds have not been appropriated for this project. The need to increase water supplies for the Northeast portion of New Jersey will be better defined by the Passaic-Hackensack Water Supply Basin Feasibility Study previously discussed. Once the water supplies from the Passaic and Hackensack systems are fully utilized, the Hudson River becomes the next logical supply source for the region. Discussions with New York State are continuing; if New Jersey was to access fresh water from the river, it would have to be from locations within New York.

Ground Water Studies

A. Vincetown/Mount Laurel-Wenonah Aquifer Ground Water Study

Designation of a Water Supply Critical Area for the Potomac-Raritan-Magothy aquifer system in the vicinity of the city of Camden, in Burlington, Camden and Gloucester counties, increased the demand for water supply from adjacent aquifers. The Mount Laurel-Wenonah aquifer is one such aquifer. In 1988, the USGS conducted a study to 1) estimate the potential future withdrawals from this aquifer, and 2) evaluate the potential hydrogeologic effects of these withdrawals on the aquifer. A series of model simulations was made using an existing model developed under the USGS RASA (Regional Aquifer System Analysis) Program. The results indicated that expected demands would induce excessive drawdown (100 to 220 feet). Because sparse hydrologic information about this aquifer is available, additional data collection and model refinement was determined to be necessary, particularly in Salem County.

B. Ramapo Valley-Fill Aquifer Study

This investigation was undertaken to determine the potential of glacial valley-fill aquifers to augment streamflow during severe drought. The study included an assessment of the geohydrology of the Ramapo River basin above Pompton Lake, including the thickness, distribution and hydrologic characteristics of the glacial valley-fill sediments, water quality and the development of a numerical ground-

water model. The geologic framework of the study area is documented in the New Jersey Geological Survey report, "Bedrock topography and profiles of valley-fill deposits in the Ramapo River valley, New Jersey." The hydrology of the valley-fill aquifer system, including ground water levels, hydraulic characteristics of the valley-fill sediments, ground water flow, stream discharge characteristics and ground and surface water quality are documented in the U.S. Geological Survey report, "Geohydrology of, and simulation of ground-water flow in, the valley-fill deposits in the Ramapo River valley, New Jersey." The USGS ground water flow model addresses the semi-confined part of the aquifer in Mahwah, New Jersey. The modeling results conclude that even under confined conditions additional pumpage from the valley-fill aquifer would cause significant stream depletion. Thus, augmentation of streamflow during drought from these and similar valley-fill aquifers may not be a viable water-management strategy during drought.

C. South River Study

The South River ground water study encompasses the portions of Monmouth County and portion of Middlesex County within the New Jersey Coastal Plain. The area of interest corresponds to the portion of Water Supply Critical Area No. 1 within which large-scale ground water withdrawals have historically taken place. Saltwater intrusion into the PRM aquifer system has been documented in the Raritan Bay area. An investigation of the geohydrology of the area was undertaken to assess the future potential for saltwater intrusion, based on anticipated water-use patterns and Critical Area restrictions.

The geologic framework of the area was evaluated and the results incorporated into a numerical ground water flow model. Ground water withdrawals were evaluated and aquifer tests performed to establish the hydrologic characteristics of the aquifer system. Ground water quality data were collected and evaluated to further assess the flow system and the effects of saltwater intrusion.

Several reports were produced by the USGS which document the study, including: "Ground-water withdrawals from coastal plain aquifers for public supply and self-supplied industrial use in Middlesex and Monmouth Counties, New Jersey, 1901-85;" "Aquifer-test analysis of the upper aquifer of the Potomac-Raritan-Magothy aquifer system, Union Beach Borough, Monmouth County, New Jersey;" "Hydraulic properties of the middle and upper aquifers of the Potomac-Raritan-Magothy aquifer system in the northern coastal plain of New Jersey," "Hydrogeology, simulation of regional ground-water flow, and saltwater intrusion, Potomac-Raritan-Magothy aquifer system, northern coastal plain of New Jersey;" "Water-quality data for the Potomac-Raritan-Magothy aquifer system in the northern coastal plain of New Jersey;" "Lead and cadmium contamination associated with

saltwater intrusion in a coastal ground water basin of central New Jersey;" and "Confining unit effects on water quality in the New Jersey Coastal Plain."

D. Atlantic County Ground Water Study

The Atlantic City 800-sand aquifer is a major source of ground water for the Atlantic barrier island communities in Ocean and Atlantic County and an important alternate source to the Cohansey aquifer in Cape May County. Increased demands for water supply in these coastal counties over several decades and saltwater intrusion into the Cohansey aquifer in Cape May County have caused a greater demand on the 800-foot sand aquifer. Chloride levels in the aquifer have increased in a few locations, prompting a concern over the future water supply viability of the aquifer to serve high-growth coastal areas.

The study characterized the hydrogeology of the Atlantic City 800-foot sand aquifer, including location of inland recharge areas, the aquifer's relationship to the water table aquifer, and the geology and water quality offshore in downdip sections of the aquifer that are the suspected source of saltwater. Geologic boring and monitor wells were installed 5 miles off the coast of Atlantic City in an unprecedented investigation of the seaward extent of the aquifer.

Ground water levels and water quality data were collected and published in "Water Levels in the Principal Aquifers of Atlantic County and Vicinity," "Records of Selected Wells in Atlantic County, New Jersey," and "Records of Wells, Exploratory Boreholes and Ground-Water Quality in Atlantic County and Vicinity," by the New Jersey and U.S. Geological Surveys. A numerical ground water flow model was developed and used to simulate the Atlantic City 800-sand aquifer system's response to current and future water-use scenarios. The study concluded that the composition of the aquifer offshore inhibits the inland movement of saltwater and that, even under high growth scenarios, the aquifer should remain a viable source of water well beyond the 50-year planning horizon. The final project report, "Ground-Water Resources of the Atlantic City Region, New Jersey," by the U.S. Geological Survey is currently in progress and scheduled for publication in 1995.

E. Cooperative Map: Statewide Map of Geological Formations

This project involved the production of a new state geologic map for New Jersey, based on collection of new geologic data and the use of modern mapping concepts. Five of the six geologic maps (scale 1:100,000) are compiled and awaiting publication by the U.S. Geological Survey, or are in the review process. The sixth map, the central surficial sheet, is currently being compiled and will be ready for review in early 1995.

The geologic data collected and compiled under this project are primarily being used to define the distribution and physical properties of the aquifers and confining units in New Jersey, and have been an integral part of the ground water studies and regional water resource evaluations. Additional applications include the definition of the hydrogeologic framework for all of the characterization of aquifer properties for aquifer recharge and well head protection.

A deep corehole (ACGS #4) was drilled in Atlantic County and provided key stratigraphic reference sections for a better delineation of the Piney Point, Kirkwood and Cohansey aquifers.

F. Buried Valley Ground Water Study (Central Passaic Region)

Ground water depletion and interference between major wellfields necessitated this investigation of the hydrogeology and water resource potential of the Buried Valley aquifer system in western Essex and eastern Morris Counties. The study involved the a delineation of bedrock and valley-fill aquifers and confining units, the compilation of historic pumpage and water level data, and the development and the implementation of a computerized ground water flow model for the central Passaic River Basin.

Compilation of geologic and hydrologic data has been completed. A report by the New Jersey Geological Survey, "Ground-water-withdrawal and water-level data for the central Passaic River basin, New Jersey, 1898-1990," has been published. A joint U.S. Geological Survey - Department report on water quality in the study area, "Ground-water quality in the central part of the Passaic River Basin, northeastern New Jersey," is also available. A report documenting the hydrogeologic conditions in the study area is currently in review, but all data from the report are available for public distribution. A computerized ground water flow model has been developed and used to evaluate requests for ground water diversions. Documentation of ground water modeling in the study area was first published in the NJGS report, "Simulated drawdowns, 1972-1995, in the Pleistocene buried-valley aquifers in southwestern Essex and Southeastern Morris Counties New Jersey." Results of the current modeling effort are contained in a report in progress, planned for completion in 1995.

G. Lamington Ground Water Study

This study investigated the water resources of the glacial valley-fill and carbonate bedrock aquifers in the upper South Branch Raritan River watershed and the Lamington (Black) River watershed. The thickness and extent of valley-fill and bedrock aquifers and confining units were mapped by the New Jersey Geological Survey, and will be documented in a report currently in progress. The U.S. Geological Survey investigated ground water levels, ground water flow, stream-aquifer interactions, and water quality. USGS developed a numerical ground water flow model for the study area, which was used to simulate current conditions and undertake several future water-use scenarios. The results of hydrologic data collection and the ground water model will be documented in a single report by the USGS to be published in early 1995. The model was used to simulate a proposed large ground water diversion by the Morris County Municipal Utilities Authority in the Flanders area. The model concluded that the diversion could have impacts on streamflow in Drakes Brook, the discharge area for the aquifer. As a result, a monitoring strategy was put in place to determine any impacts attributable to the diversion.

H. Northwest Mercer Ground Water Study

This study was initiated as a result of suspected interference with domestic wells in Hopewell Township by public supply wells in Pennington Borough. The purpose of the study was to investigate the hydraulics of the fractured rock aquifer in the region, the Passaic Formation, and determine if well interference was taking place. The geohydrology of the region was investigated by the New Jersey Geological Survey. An aquifer-stress test was undertaken for the Pennington wellfield. Results of the investigation are documented in the NJGS report, "Well interference and evidence of fracture flow in the Passaic Formation near Pennington, Mercer County, New Jersey," that concluded that well interference was partly controlled by structures in the bedrock aquifer. Recommendations were made for wellfield management to avoid future problems with well interference. A water budget for the Stony Brook watershed was completed as part of the investigation; a report is in progress and will be published in 1995.

I. Rockaway Ground Water Study

The water resources of the upper Rockaway River watershed above Boonton Reservoir were investigated in this study. The Rockaway River is hydraulically connected to the glacial valley-fill aquifer in the region and receives ground water seepage to maintain its flow during dry periods. Streamflow in the Rockaway River flows to the Boonton Reservoir, which has a court ordered minimum passing flow of 7 million gallons per day. Significant increases in ground water withdrawals are projected for the Rockaway Basin. The possibility of streamflow depletion as a result of increased ground water withdrawals, in combination with wastewater discharge downstream of the Boonton Reservoir, has warranted concern for maintaining the passing flow requirement and the safe yield of the reservoir.

Information on the geohydrology of the glacial valley-fill aquifer was compiled and documented in a report by the New Jersey Geological Survey, "Hydrogeologic framework of the middle and lower Rockaway River basin, Morris County, New Jersey." The United States Geological Survey-Water Resources Division studied the hydrology of the region, including characteristics of ground and surface water, ground water/surface water interaction, and water quality; their findings are documented in, "Hydrologic conditions in the upper Rockaway River basin, New Jersey, 1984-1986." Geologic and hydrologic data were used in the development of a numerical ground water flow model by the USGS. The model was used to simulate current and future ground water use in the glacial valley-fill aquifer, including impacts on baseflow in the Rockaway River of increases in ground water pumpage. A final report on the ground water modeling analyses and simulation of alternative water supply scenarios will be published by mid-1995.

J. Germany Flats Ground Water Study

The Germany Flats ground water study encompasses glacial and fractured bedrock aquifers of a buried valley in Sussex County. The region continues to experience significant growth and communities have looked to these aquifers for new sources of supply. Major goals of the project are to investigate the ground water resources of the valley and develop a numerical ground water flow model to simulate the ground water system. The model will be used to assess the impacts of the proposed increases in ground water withdrawals, including reductions in streamflow.

Interim products include draft maps of ground water elevations and flow directions, identification and mapping of aquifers, quantification of aquifer hydraulic characteristics, a database of ground and surface water elevations and stream baseflows, and results of ground water quality sampling. Work on the ground water

flow model is in progress. Data collected during the study has assisted local communities in exploring for additional water supplies and addressing local well head protection projects, as well as assessing other water resource issues.

K. Aquifer Recharge Mapping Program

The goals of this program are to (1) develop a methodology to map ground water recharge areas that can be applied by interested parties in New Jersey, and (2) link the ground water mapping methodology with hydrogeologic data to produce aquifer recharge maps. The first goal has been attained with the publication of a New Jersey Geological Survey report, "A method for evaluating ground-water recharge areas in New Jersey." Work is underway on the second goal: an aquifer recharge map of Middlesex County is currently in draft form and is scheduled for completion in early 1995. It is anticipated that aquifer recharge maps of individual counties will be produced at a rate of 1 to 2 per year, depending on size and complexity. Local participation by county planning agencies would enhance progress in producing additional maps.

L. Camden Metropolitan Area Ground Water Study

The Camden Area was included in State regulations designating Water Supply Critical Area No. 2, which was established due to the Department's concern over declining water levels in the heavily used PRM aquifer system, and the resulting potential for saltwater intrusion. The study involved a definition of the geohydrologic framework of the PRM system, collection of water-level and water quality data, and the development of a numerical ground water model addressing the PRM system and overlying Englishtown and Mount Laurel-Wenonah aquifers. Since the Delaware River is a significant source of recharge to the PRM, the interaction between the river and the aquifer system was a significant component of the investigation. Ground water model changes in water level were simulated using the model for scenarios involving increased usage of PRM based on growth and usage that would occur as a result of restrictions mandated by Water Supply Critical Area regulations. The model showed that imposition of restrictions would halt historical downward trends in water levels, that water level recovery would begin to take place, and that water levels would eventually stabilize at acceptable levels. The study showed that saltwater intrusion along the southern portion of the aquifer in Gloucester and Camden Counties from the Delaware River was of most concern.

A report documenting the data collected under the study and the results of the ground water modeling scenarios are currently in progress and will be published in 1995.

M. Confined Coastal Plain Ground Water Study

State regulation establishing Water Supply Critical Areas 1 and 2 in the New Jersey Coastal Plain have restricted water supply options for many southern New Jersey communities. These regulations along with water supply needs created by growth in southern counties have caused public and private purveyors to seek additional water supply from these aquifers outside the Water Supply Critical Areas and from other confined aquifers. This study addresses the regional impact on water levels and the potential for saltwater intrusion in confined aquifers in areas where data are lacking, and will provide information on the water supply capabilities and water quality considerations for confined aquifers being exploited as alternatives to critical aquifers. Stratigraphic data will be collected to correlate deep aquifers statewide and up to 11 new observation wells will be added to monitor for saltwater intrusion and long-term water level trends. The study is scheduled to begin in July of 1995 and last two years.

The PRM investigation is part of an investigation of confined aquifers in the New Jersey Coastal Plain designed to obtain stratigraphic information in key areas where limited data exists on the properties, thickness, and distribution of the formations (Potomac, Raritan, Magothy) which constitute the largest confined aquifer system in New Jersey. The investigation involves the collection of data through existing wells that have been extensively cored. A 2000 foot corehole will be drilled in Bass River State Park in New Gretna during the Spring of 1995. This corehole will help clarify poorly understood deep subsurface relationships in the upper and middle PRM aquifer system, in addition to other confined aquifers above the PRM system. Data from the New Gretna corehole will be correlated with core data collected from the PRM in Aberdeen, Brick Township, Buena Borough, Cherry Hill, Dover Township, and Voorhees Township, to develop a regional framework that will be used to generate subsurface aquifer maps. This information will aid greatly in assessing the potential for movement of saltwater in deep portions of the aquifer to major pumping centers in Water Supply Critical Areas 1 and 2.

Regional Water Resources Evaluations

A. Cape May Aquifer Recharge Evaluation

A 1990 unpublished Open File Report by the USGS entitled "Saltwater Intrusion and Artificial Recharge of Selected Aquifers, Cape May County, New Jersey 1989" focuses on saltwater intrusion and artificial recharge of the County's aquifers. The following aquifers: Rio Grande water-bearing zone, Atlantic City 800-foot sand

aquifer, Piney Point aquifer and the Kirkwood-Cohansey aquifer of northern Cape May County were part of this study that was funded by the USGS, the Army Corps of Engineers and the Department. The report presents findings on artificial recharge via ground water injection within Cape May County and will be evaluated with other alternatives as a future water supply option in the southern portion of the County.

B. Wetlands Impact Study

Increasing demands for water supply development particularly in water table aquifers has warranted concern for the effects of ground water withdrawals on freshwater wetlands. Sensitive ecosystems develop throughout New Jersey where the depth-to-water is small and ground water discharge is persistent. Water table declines and reduced ground water discharge from depletive withdrawals may have adverse effects on these ecologies. During the period 1990-1994 a cooperative investigation was undertaken by the USGS and the Department. The objectives of the investigation were to: 1) characterize natural hydrologic fluctuations in and near these areas to provide a baseline for future monitoring and interpretations, 2) provide guidelines for the development of water table aquifers that minimize adverse effects, and 3) provide methods for evaluation of appropriate well siting. Two representative sites in wetland areas have been instrumented with closely placed piezometers near the wetland area; ambient hydrologic data have been collected. A ground water flow model of the Rancocas Basin has been developed and used to demonstrate well siting guidelines. Procedures for conducting and analyzing aquifer tests for well siting have been developed.

C. Lamington Buried Valley Aquifer Evaluation

The valley-fill and carbonate-rock aquifer near Long Valley on the Lamington River is an important source of ground water in southwestern Morris and northeastern Hunterdon Counties. During 1987-1990 a cooperative investigation was undertaken by the USGS and the Department. The objective of the investigation was to address concerns about the adequacy of the stream-aquifer system to supply the increasing water demands expected in coming years. As part of the investigation, the area's geology was assessed. Streamflow data were collected at several stations. Ground water levels were collected and potentiometric maps constructed for the water table and confined aquifers. Ground water samples were collected to assess water quality. This information was used to construct a ground water flow model that was used to evaluate the ground water flow system and the factors that limit water supply availability. The effects of recent and anticipated withdrawals on base flow water levels and the overall water budget was estimated. Ground water levels were predicted to decline up to 28 feet but not interfere with

two existing public supply wells. Drakes Brook in the South Branch Raritan River was estimated to be most sensitive to withdrawals and decline in flow by as much as 26 percent.

D. Rockaway River Watershed Evaluation

The Rockaway Valley Quartenary Aquifer was designated a "sole-source aquifer" by the Federal Environmental Protection Agency (EPA) in 1984. This aquifer is part of the regional buried valley aquifer system. The Rockaway River is hydraulically connected to the aquifer and derives its base flow from ground water seepage. Streamflow in the Rockaway River flows to, and supplies the Jersey City Reservoir. The Jersey City Reservoir has a court-ordered minimum passing flow of 7 million gallons per day. Significant increases in ground water withdrawals are projected for the area. The possibility of streamflow depletion as a result of ground water withdrawals has warranted concern for the reservoir and maintenance of the passing flow requirement. Significant geologic, surface water and ground water data were collected during the project. A ground water flow model was developed. Model results and analysis of streamflow records indicate that increased withdrawals by the year 2000 may result in streamflow entering the reservoir to fall below the passing flow requirement for about 5 percent of the time if the 1960's drought was to recur.

Department/USGS Surficial Aquifer Program

The Surficial Aquifer Program is being jointly funded by the USGS and the Department. The Statewide Water Supply Plan has adopted a watershed based approach to water supply planning. The State has been divided into a series of 23 Regional Water Resources Planning Areas that generally correspond to the large surface water drainage watersheds in the state. Little information has been gathered and analyzed to characterize the water table aquifers in these areas. The Surficial Aquifer Program is a systematic reconnaissance investigation of the surficial (water table) aquifer in each of these basins.

The objective of the investigation is to gather existing and selected new data on the geology, water table configuration, ground water quality, surface water quantity and quality and the overall water budget (including water use). The information is interpreted in basic map tables and graphical depiction for ease of understanding, and published in an atlas (plate-report) format. An investigation is conducted in a basin for a period of approximately 18 months. When warranted, the information in these studies is used for more comprehensive investigations including ground/surface water modeling. The following watersheds have, or will be, evaluated as part of this program:

E. Cedar Creek/Forked River/Sloop Creek Evaluation

The intended purpose of this investigation was to examine the water table aquifer and ground water-surface water interaction in the study area. The water table aquifer was delineated. Plans for collection of hydrologic data included acquiring ground water levels, stream flow data, and water quality data. A water budget would be developed for the individual watersheds. The study was postponed, but its need will be reassessed during the development of the SWSP.

F. Great Egg Harbor River Watershed Evaluation

The watershed is 346 square miles in area. Water levels measured in 142 wells and 82 stream sites were used to construct a water table map. Observed seasonal water table fluctuations usually range 1 to 5 feet. One continuous stream gaging station and 11 low flow partial-record stations were analyzed. Average annual precipitation was about 45 inches; evapotranspiration was approximately 28 inches. Consumptive water use in 1987 was nearly 2.5 billion gallons (1.2 for public and domestic supply, 1.2 for irrigation and 0.12 for industry and mining). Ground water recharge was estimated at 18 inches.

G. Metedeconk/Toms/Tuckahoe River Watersheds Evaluation

The watershed is 330 square miles in area. Water levels measured in 83 wells were used to construct a water table map. Observed seasonal water table fluctuations usually range from 1 to 5 feet. One continuous stream gaging station and 11 low flow partial-record stations were analyzed. Average annual precipitation was about 45 inches; evapotranspiration was approximately 28 inches. Consumptive water use in 1987 was 7 billion gallons (5.9 from ground water and 1.1 from surface). Ground water recharge was estimated at 15 inches for the Metedeconk River Basin and 19 inches for the Toms River Basin.

H. Upper and Lower Maurice River Watershed Evaluation

The watershed is 240 square miles in area. Water levels measured in 91 wells and 90 stream sites were used to construct a water table map. Observed seasonal water table fluctuations usually range from 1 to 3 feet. Three continuous stream gaging stations and 12 low flow partial-record stations were analyzed. Average annual precipitation was about 45 inches; evapotranspiration was approximately 25 inches. Consumptive water use in 1987 was nearly 1.86 billion gallons (0.91 for public and domestic supply, 0.91 for irrigation and 0.03 for industry). Ground water recharge was estimated at 19 inches.

I. Mullica River Watershed Evaluation

The watershed is 569 square miles in area. Water levels measured in 197 wells and 156 stream sites were used to construct a water table map. Observed seasonal water table fluctuations usually range from 2 to 3 feet. Three continuous stream gaging stations and 17 low flow partial-record stations were analyzed. Average annual precipitation was 45 inches; evapotranspiration was 28 inches. Consumptive water use in 1989 was 3.3 billion gallons (0.53 for public and domestic supply, 2.8 for irrigation and 0.2 for industry and mining). Ground water recharge was estimated at 19 inches.

J. Salem and Cohansey River Watersheds Evaluation

The watersheds total 358 square miles in area. Water levels measured in 124 wells and 175 stream sites were used to construct a water table map. Observed seasonal water table fluctuations usually range from 2 to 9 feet. Four continuous stream gaging stations and 10 low flow partial-record stations were analyzed. Average annual precipitation was 43 inches; evapotranspiration was 30 inches. Consumptive water use in 1990 was 1.5 billion gallons (0.44 for public and domestic supply, 0.42 for irrigation, 0.43 for industry and 0.23 for power generation). Ground water recharge was estimated at 13 inches.

WATERSHED AND AQUIFER PROTECTION

Well Head Protection

A. Delineation of Interim Well Head Protection Areas

The 1986 Federal Safe Drinking Water Act Amendments (Section 1428) require that all states develop a Well Head Protection Program to target areas for special protection of both public community (PCWS) and public noncommunity (PNCWS) water supply wells. For this reason, the State of New Jersey submitted to the EPA for approval and subsequently adopted the New Jersey Well Head Protection Program Plan (December 1991). The purpose of the Well Head Protection Program (WHPP) is to minimize the risks posed to these wells from pollutant discharges to ground water. The special protection for these areas is focused within a delineated geographic area called a Well Head Protection Area (WHPA).

A WHPA can be defined as the zone of an aquifer that contributes water to a well over a specified time interval. In this area ground water pollution, if it occurs, may pose a significant threat to the well. The delineation of a WHPA on a map is a representation of the actual, three-dimensional aquifer volume from which the well draws water. The delineation of a WHPA combines this risk based "time of travel" with the properties of the well and the hydrogeologic characteristics of the surrounding aquifer. The Department is proposing that each WHPA be divided into three sequential tiers, so that existing and potential pollutant sources may be regulated in a different way depending upon their proximity to the well head. The Department will be performing an interim delineation utilizing a simple ground water flow method, at a minimum for all existing and new public community water supply wells. However, interested parties are encouraged to perform delineation's at an advanced level for Department review based upon their own needs or concerns for both PCWS and PNCWS wells. Currently, regulations are being developed by which the WHPAs will be delineated. The WHPA delineation project is a multi-year project. Delineation's completed by the Department will be prepared and adopted on a geographic (aquifer-county) basis. The NJ Geological Survey is delineating WHPA's using Water Supply Bond funds appropriated in 1992.

All relevant regulatory programs of the Department will utilize the WHPAs developed utilizing these delineation regulations. Management plans and regulations of these programs will be changed over time, where necessary, to implement the WHPP plan. Local governments and other land use regulators will be encouraged likewise to use these delineation's for their decision-making processes and to refine the delineation's using more advanced methods. It is the Department's intent that the WHPAs certified pursuant to these regulations be the sole WHPAs used by all public entities for management purposes.

B. County/Regional Demonstration Projects & Competitive Grant Programs

In order to facilitate program involvement by local agencies and obtain information on particular facets involved in developing a Well Head Protection Program for New Jersey, the Department and EPA provided opportunity for local grants to perform demonstration projects. EPA provided a series of competitive grants within Region II that were awarded to 6 municipalities. These grants were aimed at the development of program components for both public community and noncommunity wells. These components included advanced delineation's of public community wells, siting of new wells, the managment of public noncommunity wells and the development of public outreach programs.

The Department provided through Section 205j Pass through funds the opportunity for two successful county demonstration projects. Ocean County was awarded project funds to locate and delineate WHPAs for five public community wells, identify potential and existing pollution sources within these areas and develop a management program for the protection of these areas. Cape May County focused their demonstration project on the delineation and managment of WHPAs for domestic well clusters. The county's work in delineating the areas and management steps will assist the state in expanding its current program.

C. County/Local Outreach Programs

Public participation and outreach are essential components to the WHPP. Effort has focused on training through the Rutgers Continuing Education Program in technical issues, WHPA delineation's and best management practices, and program development and management techniques for local and county government officials. Department staff assisted outreach efforts by attending meetings and workshops sponsored through a variety of organizations and agencies to discuss program aspects. The Rutgers Ground Water Management Assistance Center has conducted studies on local needs and has served assistance in local outreach efforts by providing technical and non-technical expertise on questions from local groups.

D. Finalized Well Head Protection Area Demonstration Projects

The Department has entered into a cooperative project with the U.S. Geological Survey to establish methods to delineate highly accurate WHPA's using existing regional ground water models. As part of the project, the USGS will develop a technical guidance manual for use by any interested parties. Finally, the Department is using $350,000 in Water Supply Bond funds to support six regional WHP projects. These projects will begin in 1995. These demonstration projects will encompass similar components to the EPA grants, however, will be regionally based. The primary focus of these projects will be to demonstrate management of WHPAs and the development of a WHPP on a regional scale.

Demonstration Projects/Other Studies

A. Ocean County Project for Maintenance of Stormwater Basins

Stormwater management facilities are intended to mitigate the adverse hydrologic impacts of land development and protect downstream areas from flooding, erosion and sometimes water quality degradation. With a Bond Fund appropriation, the Department sponsored a stormwater management demonstration project, conducted by the Ocean County Planning and Engineering Departments. The study included on-site field evaluations of 51 stormwater management sites in six counties, including detention, retention, infiltration and regional basins. It also included questionnaires to design engineers, a survey of maintenance problems, and an inventory of storm water regulations, including maintenance requirements. The results were published by the Department in 1989 in the "Ocean County Stormwater Management Demonstration Study Report."

The study led to production of the "Stormwater Management Facilities Maintenance Manual" by the Department in 1989. The manual includes: Ownership and Maintenance Responsibility; Planning and Design Guidelines; Construction Inspection; Maintenance Equipment and Procedures; Regulatory Aspects; Cost Data and Financing Techniques. The manual is designed to be applicable to stormwater management in the entire state that includes a variety of geologic conditions.

B. Mercer County Nonpoint Source Pollution Control Project

The Mercer County project was intended to be a demonstration project for the control of nonpoint source pollution. It was started in 1987, the year when Congress passed the Clean Water Act that required states to develop a nonpoint source pollution control program. The Mercer County project was discontinued because the County was unable to complete the designated tasks due to staffing difficulties.

C. Watershed Buffers

Under Bond Fund sponsorship, a 1988 study entitled "Watershed Management Strategies for New Jersey" was prepared by the Department of Environmental Resources of Cook College, Rutgers, The State University of New Jersey. The report included the following: 1) need for watershed management; 2) watershed management in other states; 3) water supply/water quality sensitive lands; 4) best management practices, including urban/suburban and rural; 5) buffer strips; 6) dual-purpose detention basins; 7) stormwater districts; 8) on-site wastewater management entities.

This report was cited in another report published by the Department entitled, "Evaluation and Recommendations Concerning Buffer Zones Around Public Water Supply Reservoirs" (December 1989). This latter report was mandated under Public Law 1988, Chapter 163. In this report, the Department recommended that the Legislature promulgate enabling legislation requiring the adoption of regulations establishing buffer zones for all watersheds associated with water supply reservoirs, tributaries and intakes.

Various bills have been introduced in the Legislature to establish watershed buffers or expressly authorize the Department to promulgate regulations establishing such buffers. In the meantime, the Department is moving forward in developing components of a Statewide Watershed Management Program, including watershed-based planning, permitting, nonpoint source control and stormwater management. Watershed buffer zones, once authorized, would be incorporated into this Statewide Program as another element or tool of watershed management.

D. Middlesex County Aquifer Protection

The Middlesex County Planning Board is in the process of completing their final report on the Middlesex County Aquifer Recharge Protection Demonstration Project. This project, which has a large Geographic Information System (GIS) component, focuses on the delineation of WHPAs and aquifer recharge areas in the county and identification of pollution sources that may impact these areas. Maps have been generated on a municipal basis. The Planning Board is utilizing the information from this report in an ongoing process to assist local agencies in making land use decisions for the protection of ground water. As a separate aspect of this project, a set of best management practices was developed by a consultant for Department and Middlesex County consideration.

E. Sussex County Septic System Management

Sussex County was awarded a grant by the Department to demonstrate the potential application of septic system management techniques. A consulting firm was contracted by the County to prepare a manual on maintaining septic systems. The document produced in conjunction with the Sussex County Planning Department and the Department is titled, "A Manual for Managing Septic Systems." The manual provides information on proper homeowner day to day operation of septic systems and guidance to local entities for periodic inspections, public education and potential institutional and financial arrangements. The procedures developed in the manual were based on actual experiences in Sussex County as the result of four pilot demonstration projects. The Department will use the manual to promote best management practices for the mitigation of septic system pollution through out the State.

STATE AND REGIONAL WATER SUPPLY PLANNING

Water Conservation

A. Cape May County Water Conservation Program

The objectives of this initiative are to: 1) identify the major water users/uses that characteristically demonstrate a potential for water savings; 2) identify the most cost effective and practical water conservation technique(s) for the water users; 3) implement the selected water conservation techniques; 4) monitor the water savings effectiveness and progress prior to implementation; 5) develop a manual, which can be used by other counties, to reduce water use. The proposed long range goal is to reduce county-wide water consumption by 15 percent, with special emphasis placed on the barrier islands and southern Cape May County. All 16 municipalities will be targeted for outreach and education to reduce water consumption throughout the County.

B. General Water Conservation Program

The Department is committed to an active water conservation program to be implemented by purveyors, local governments, households, commercial enterprises, recreational facilities, farmers and the State itself.

The Water Conservation Program has included review of purveyor conservation plans, a series of training conferences on water conservation, a grade school curriculum project, a study and widely distributed guide titled "Landscaping for Water Conservation," and a low-water use landscaping demonstration project. An extensive array of technical and nontechnical literature has been widely distributed. More recently, efforts have been made to reach specific target audiences such as landscape contractors and nursery operators who can educate their customers regarding water conservation landscaping.

The staff of the Water Conservation Program participated in the Delaware River Basin Commission's development of regulations on source metering, individual

metering, low-water use plumbing fixtures, leak detection and repair and conservation pricing.

Bond Fund sponsorship of conservation studies, as part of feasibility studies for specific regions including the Camden Metropolitan Area, Atlantic County, Eastern Raritan Basin, South River Basin and Cape May County, is included in the allocation for feasibility studies. The studies are varied in scope; some are done by consultants and some are prepared by Department staff. These regional conservation studies have the potential for providing basic water conservation strategies that can reduce water demand and postpone for one or more decades the necessity of building new water supply withdrawal, storage, and treatment facilities as well as wastewater treatment facilities.

As part of the Revision to the Statewide Water Supply Plan, a water conservation strategy has been prepared to guide future state conservation efforts.

Water Management Planning

A. Completion of Water Resources Geographic Information System

The Department's Geographic Information System (GIS) provides the capability of storing and comparing various water-resource data sets. Current coverage's include information on over half the bedrock and surficial aquifers in the state, detailed maps of glacial valley-fill and coastal plain aquifers, and locations of over public community supply wells collected in the field using global positioning systems. The GIS will be used to map Well Head Protection Areas (WHPA) for all of the state's public community supply wells; WHPAs for Atlantic County are currently on the system. Aquifer recharge areas mapped using the methodology developed by the New Jersey Geological Survey (NJGS) will be maintained on the system. Middlesex County is currently in the process of being mapped and placed on the GIS. A database containing hydrologic characteristics, including transmissivity, hydraulic conductivity and porosity, is maintained by NJGS, and the locations of all data points are compiled on the GIS. The location of abandoned mines is currently compiled. Radon samples, sinkholes and other environmentally significant information are in the process of being compiled on GIS. The capabilities of the system permit ready comparison of data sets. For example, the location of known ground water contamination sites can be compared to the location of public community supply wells and their Well Head Protection Areas. Bond Funds have been allocated for further development of water related GIS information.

B. USGS Matching Funds for Water Management Planning

In 1991, an update to the original 1982 SWSP was adopted to provide up to $500,000 for the purpose of developing ambient water data through the USGS/Department cooperative ambient water monitoring program for fiscal year 1991 only. Prior to that year, funding for this purpose had been provided from the general State revenues. Since FY 1991, funding has been provided from permit fee accounts from the various regulatory programs that make predominant use of the data base. As mentioned in the 1991 Update, these data are critical components of a continuous monitoring program that supports the development of water supply and water quality models and analyses, which in turn support the regulatory decisions of the Department. The monitoring program for FY 1991 was completed and the results published as part of the USGS Water Resources Data series. The USGS provided matching funds for the monitoring program.

C. Regional Water Supply Infrastructure

The Department intends to analyze the nature and extent of problems dealing with the interrelationships among local planning, local water supply and infrastructure, and local development. A set of alternative solutions to these problems would be developed to provide guidance to decision makers who must provide appropriate coordination and oversight in the development of new water supply infrastructure. A study would be undertaken of uniform management and financial standards for all public and private water supply systems. The Action Program has $500,000 allocated for these initiatives, but the Department has decided to postpone the work for the time being. However, a portion of the funding may be used to help support a major study by the Office of State Planning and the NJ Department of Transportation, "Land Use, Infrastructure and the Environment," that has similar goals and could assist the Department.

Statewide Water Supply Plan Revision

Since the original SWSP was published in 1982, there have been several Updates of the SWSP prepared by Department staff. With the passage of time, more extensive revision of the SWSP became necessary. The first major revision of the SWSP has been undertaken for this purpose and was accomplished in part through contract with outside consultants.

The revised plan focuses on those water supply projects and management initiatives needed during the period 1990 to 2040. It has more emphasis on ground water resources than the original plan, which focused more on surface water sources. The new plan looks at the potential of ground water resources for supply, ground water

resource vulnerability, and the need for a protective strategy for aquifer systems and water supply watersheds.

The overall plan for the revision was to inventory the available supply, project the demands for the 50-year period, and calculate any deficits. Analyses of financial and institutional impacts were conducted and environmental impacts identified for the recommended alternatives. The conclusions and recommendations of the revision will undergo public review throughout the process. The revision is scheduled for completion in 1995.

Special Water Treatment Study

The Department used the Bond Fund to sponsor the Special Water Treatment Study to investigate methods of treatment to remove the new classes of pollutants being found in drinking water, some of which are carcinogenic. The study was intended to assist purveyors in keeping abreast of new techniques for removing organic and inorganic contaminants. Of particular concern were smaller purveyors who do not have large technical and engineering resources, but who must meet the requirements of the Safe Drinking Water Act of 1984. Specific recommendations for dealing with trihalomethanes and nonvolatile organic chemicals were provided for those relying on surface water supplies. Information was also made available for private well owners on home treatment for removal of organic pollutants from ground water.

PURVEYOR INFRASTRUCTURE LOAN PROGRAMS

Water Supply Infrastructure Rehabilitation

The original 1982 SWSP and the accompanying Action Program placed a high priority on rehabilitation of inadequate and deteriorating water supply transmission and distribution facilities, interconnection improvements, and an evaluation of contaminated wellfield and alternative supplies. A loan program provides assistance to local water supply systems and includes a repayment period of ten years, with twenty years granted in hardship cases including all contaminated wellfield loans. The Department provides extensive financial and engineering review to ensure that the funded projects are adequate for there intended purposes.

These loans, for which $100 million has been appropriated (out of $120 million allocated) from the Bond Fund, are for the rehabilitation of antiquated or poorly functioning transmission and distribution facilities used by publicly owned potable water systems, such as pipelines, storage tanks, pumping stations, and hydrants. The projects are intended to reduce water leakage and to enable the systems to function more efficiently. As of mid-1994, the Department has committed $72,702,347 of loans under this program.

Interconnection Testing and Improvements

Interconnections between potable water systems provide backup supplies in case of water main breaks, well contamination, equipment failure or any other supply emergency. The Legislature has appropriated $8,068,000 (out of $15 million allocated) from the Bond Fund for interconnection testing and improvement loans. A major goal of this program is to increase the ability to continue service during a drought. As of mid-1994, the Department has committed $275,000 of loans under this program.

Polluted Wellfields and Inadequate Small Systems

A. Loans for Construction of Water Supply Facilities to Replace Wells

Bond Fund loans are made to provide water supplies in circumstances where a publicly-owned purveyor's wells or clusters of individual wells have become contaminated. These projects are intended to provide for both emergencies and for long-term supplies. The Legislature has appropriated $25 million (out of $25 million allocated in the Action Program) for this program. As of mid-1994, the Department had committed $22,003,148 of loans under this program to the following: Edgewater Park Township, Upper Deerfield Township, Delanco Township, Winslow Township, Hawthorne Borough, South Orange Township, Garfield City, Ho-Ho-Kus Borough, Clinton Township, Ramsey Borough, Stafford Township MUA, Wharton Borough, Berkeley MUA, Lacey Township MUA, Livingston Township, Waldwick Borough, Rockaway Borough, Ridgewood Village, and Oakland Borough.

1993 NJ STATEWIDE WATER SUPPLY PLAN ACTION PROGRAM
(in millions of dollars)

PROJECTS/PROGRAMS	1981 Water Supply Bond		Commitment From Other Funding Sources
	Allocated	Appropriated	
MAJOR CAPITAL CONSTRUCTION PROJECTS			
1. Delaware and Raritan Canal Improvements (a)	20.55	20.55	
2. Wanaque South including Monksville Reservoir (b)	42.0	50.0	101.0
3. Manasquan Reservoir (c)	72.0	72.0	
4. F.E. Walter Reservoir Modification (d)	10.5	0	114.0
5. Merrill Creek Reservoir (e)			217.0
6. Tri-County Water Supply Project (f)			170.0
7. Water Supply for South River Area (f,g)			40.0
WATER RESOURCES EVALUATIONS			
8. Feasibility Studies (h)	20.0	15.731	0.42
9. Ground Water Studies (i)	19.65	18.35	3.9
10. Regional Water Resources Evaluations (j)	9.0	3.1	
WATERSHED AND AQUIFER PROTECTION			
11. Well Head Protection (k)	3.0	1.7	
12. Demonstration Projects and Other Studies	8.0	2.3	
STATE AND REGIONAL WATER SUPPLY PLANNING			
13. Water Conservation	1.6	1.125	
14. Water Management Planning	2.0	0.95	
15. Master Plan Revision (l)	1.75	1.75	
16. Special Water Treatment Study	0.6	0.6	
PURVEYOR INFRASTRUCTURE LOAN PROGRAMS			
17. Water Supply Infrastructure Rehabilitation	120.0	100.691	
18. Interconnection Testing and Improvements	15.0	8.068	
19. Polluted Well fields and Inadequate Small Systems	25.0	25.0	
20. Miscellaneous Appropriation		8.0	

1981 WATER SUPPLY BOND AMOUNT:	$350,000,000
AMOUNT APPROPRIATED:	$323,760,515
AMOUNT EXPENDED/OBLIGATED AS OF 3/31/93:	$242,122,975
REPAID LOANS AS OF 3/31/93:	$62,289,535

FOOTNOTES:

(a) This project was completed in 1985.

(b) A line item appropriation of $8 million was approved in the FY92 budget by the Legislature to fund other categories.

(c) This project was completed in 1990.

(d) The US. Army Corps of Engineers will develop water supply storage in the F.E.Walter Reservoir, with the Delaware River Basin Commission (DRBC) serving as the non-federal sponsor and the three lower basin states financing the expansion through water charges. A $10 million loan from the 1981 Bond Fund will contribute to financing the capital cost of this project. There is also needed $500,000 for administrative costs for New Jersey's participation in this and other aspects of the "Good Faith" agreement, from the 1981 Bond Fund. The $10 million loan will be repaid through DRBC water charges. The Pompton Reservoir Modification Project (estimated cost: approximately $59 million) is being held in abeyance.

(e) The Merrill Creek Reservoir Project was constructed by the Merrill Creek Owners Group and completed in 1989.

(f) These projects will be funded by local water purveyors.

(g) An interim portion of this project has been completed.

(h) Feasibility studies include but are not limited to: Northwest Mercer County Regional Area (Hopewell-Pennington Regional Area); Cape May County Regional Area; Buried Valley Aquifer Systems; Evaluation of contaminated well fields and alternate supplies; South River Basin Area (complete); Camden Metropolitan Area (complete); Atlantic County Regional Area (complete); Ocean County Regional Area; consolidations and extensions of service; Low Flow Augmentation of Delaware River (one study complete); Eastern Raritan Basin Area (complete); Hudson main stem; Environmental study of effect of water supply withdrawals on estuaries. Because of special problems, the State may also undertake exploratory analyses and studies. A small portion of these funds may be used to match US. Army Corps of Engineers Planning Assistance Program (ACOEPAP) monies. To date, funding in the amount of $420,000 has been committed by the ACOEPAP.

(i) Ground water studies include but are not limited to: Vincentown Aquifer; Mount Laurel-Wenonah Aquifer; Germany Flats Buried Valley Aquifer; and the Buried Valley Aquifer Systems. Includes hard rock and offshore drilling. The cost estimate includes monitoring network coverage. To date, funding in the amount of $8.2 million has been committed to the USGS Cooperative Agreement Program.

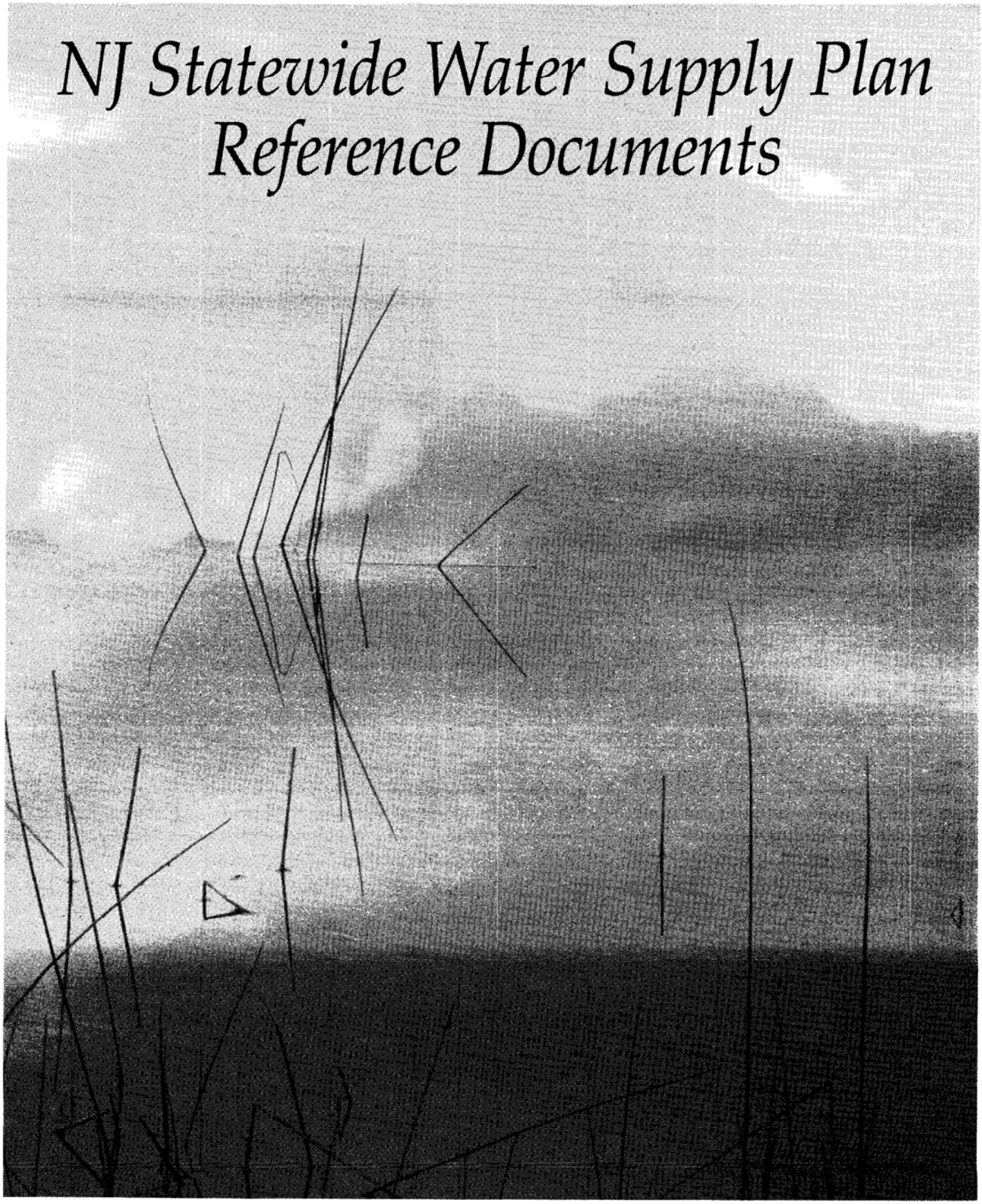
(j) Previously named "County Shallow Aquifer Plans." A small portion of these funds may be used to match ACOEPAP monies.

(k) Previously named "Wellhead and Aquifer Protection."

(l) Required by law (P.L. 1981, c. 261).

APPENDIX D

NJ Statewide Water Supply Plan Reference Documents



APPENDIX D

New Jersey Statewide Water Supply Plan Reference Documents

Task 2 Report: Water Supply Baseline Data Development and Analyses. Prepared for the NJ Statewide Water Supply Plan, by CH2MHill, Metcalf & Eddy and NJ First, November 1992.

Task 3 Report: Development and Projection of Water Demands and Comparison to Net Available Water. Prepared for the NJ Statewide Water Supply Plan, by CH2MHill, Metcalf & Eddy and NJ First, May 1993.

Task 4 Report: Preliminary Development of Water Supply Initiatives. Prepared for the NJ Statewide Water Supply Plan, by CH2MHill, Metcalf & Eddy and NJ First, July 1993.

Task 5 Report: Institutional, Financial and Environmental Impact Analyses. Prepared for the NJ Statewide Water Supply Plan, by CH2MHill, Metcalf & Eddy and NJ First, April 1994.

Task 6A Report: Watershed and Aquifer Protection Program Progress Report. Prepared for the NJ Statewide Water Supply Plan, by CH2MHill, Metcalf & Eddy and NJ First, February 1990.

Final Water Supply Database Hardcopy. Prepared for the NJ Statewide Water Supply Plan, by CH2MHill, Metcalf & Eddy and NJ First, August 1994.

Depletive Water Use Project for Regional Water Resource Planning Areas of New Jersey. NJ Department of Environmental Protection, Office of Land and Water Planning, July 1994.

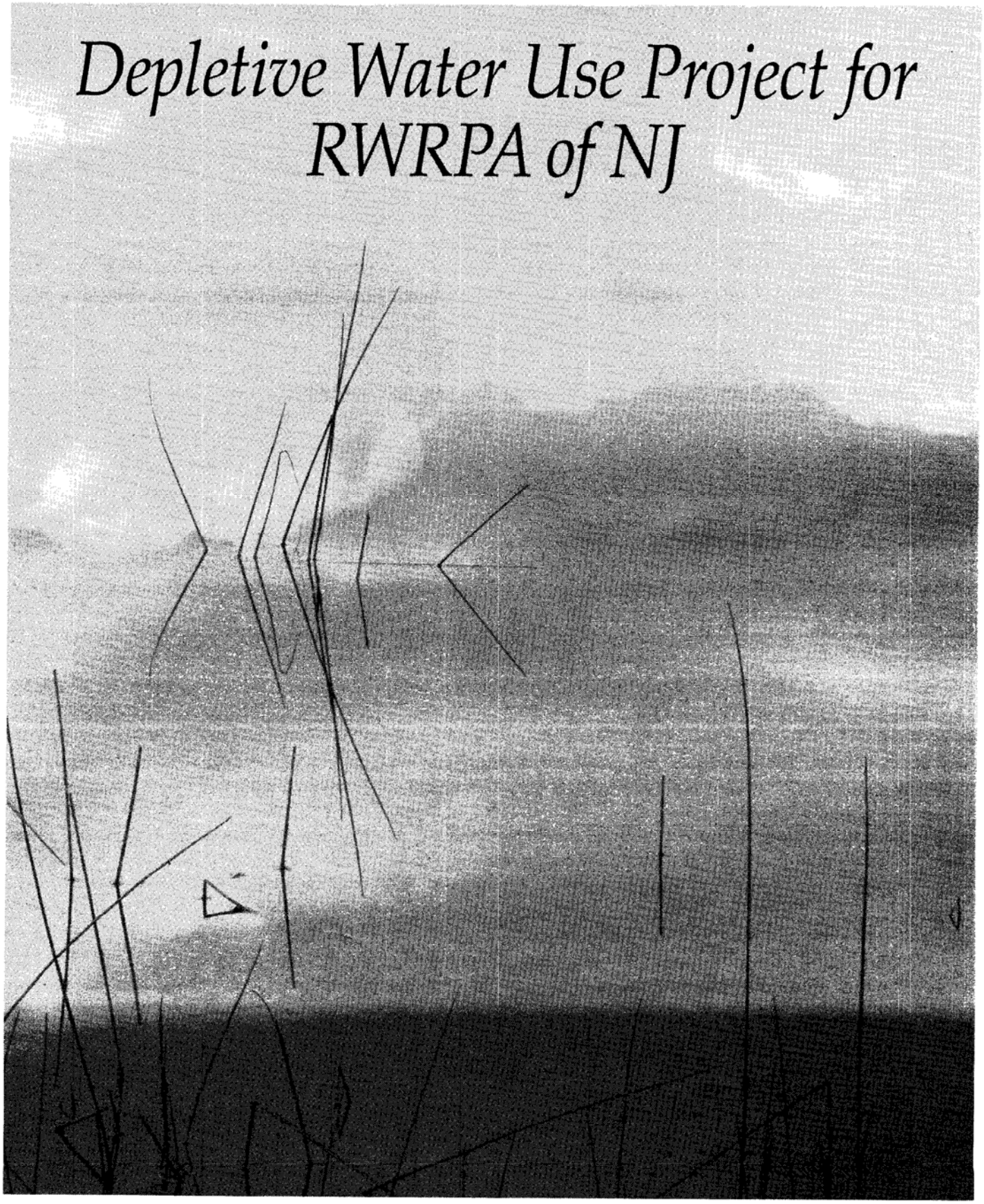
NJ Statewide Water Supply Plan Updates. NJ Department of Environmental Protection, 1983, 1985, 1987, 1988, 1991, 1993, and 1994.

The NJ Statewide Water Supply Master Plan. NJ Department of Environmental Protection, Division of Water Resources, Trenton, NJ, April 1982.

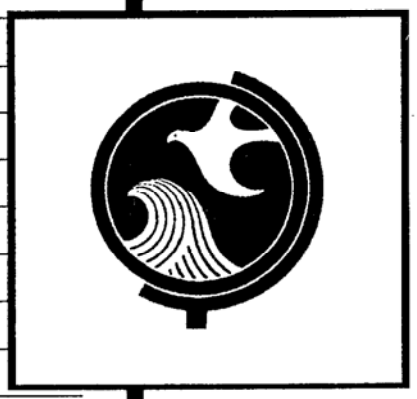
NJ Well Head Protection Program Plan. NJ Department of Environmental Protection, Trenton, NJ, December 1991.

Note: For a complete listing of reference documents utilized, please refer to Appendix G in the "Task 5 Report: Institutional, Financial and Environmental Impact Analyses" document mentioned above.

APPENDIX E



Depletive Water Use Project for RWRPA of NJ



DEPLETIVE WATER USE PROJECT FOR REGIONAL WATER RESOURCE PLANNING AREAS OF NEW JERSEY

State of New Jersey

Department of Environmental Protection

Environmental Regulation

July 1994

Depletive Water Use Project for Regional Water Resource Planning Areas of New Jersey

by

Nicholas P. Zripko, *Principal Planner*
Office of Land and Water Planning

and

Asghar Hasan, *Supervising Environmental Engineer*
Water Supply Element

New Jersey Department of Environmental Protection
Office of Land and Water Planning
CN 423
Trenton, NJ 08625-0423

JULY 1994

Printed on recycled paper

STATE OF NEW JERSEY
Christie Todd Whitman, *Governor*

Department of Environmental Protection
Robert C. Shinn, Jr., *Commissioner*

Environmental Regulation
John R. Weingart, *Assistant Commissioner*

Office of Land and Water Planning
Martin A. Bierbaum, *Administrator*

New Jersey
Department of Environmental Protection

The mission of the New Jersey Department of Environmental Protection is to conserve, protect, enhance, restore and manage our environment for present and future generations. We strive to prevent pollution; ensure the efficient use of safe, environmentally sound and reliable energy resources; provide opportunities for recreation and enjoyment of natural and historical resources; and promote a healthy and sustainable ecosystem.

ACKNOWLEDGMENTS

Nicholas P. Zripko, Principal Planner
Office of Land and Water Planning
Author; Data Management, Collection and Analysis; Research; Technical Assistance; Graphics

Asghar Hasan, Supervising Environmental Engineer
Water Supply Element
Author; Data Collection and Analysis; Research; Technical Assistance

Robert Kecskes, Section Chief
Office of Land and Water Planning
Project Guidance; Technical Assistance

Daniel J. Van Abs, Ph.D., Assistant Administrator
Office of Land and Water Planning
Project Guidance; Technical Assistance

Kimberly A. Cenno, Senior Geologist
Office of Land and Water Planning
Data Collection and Review

Joseph J. Mattle, Environmental Engineer
Office of Land and Water Planning
Data Review; Graphics

Richard Clawges, Physical Scientist
U.S. Geological Survey
Data Collection

John S. Malleck, Manager
Office of Land and Water Planning
Report Layout

For further information, please write:

New Jersey Department of Environmental Protection
Office of Land and Water Planning
CN 423
Trenton, NJ 08625-0423

TABLE OF CONTENTS

Depletive Water Use Project For Regional Water Resource Planning Areas in New Jersey

ABSTRACT vi

CHAPTER ONE 1

BACKGROUND 1
Why Depletive Water Use is Important *1*
Statement of the Problem *2*
Depletive Use and the MA7CD10 ..... *4*
Depletive Use and the Clean Water Act *5*
Who Should Use This Report *6*
Statewide Water Supply Plan (SWSP) *10*

CHAPTER TWO 12

SCOPE/OBJECTIVES/METHODOLOGY 12
Study and Geographic Area Breakdown *12*
Analysis to Determine Depletive Water Use *14*
Diversion Types Utilized *17*

CHAPTER THREE 19

SPREADSHEET DEVELOPMENT 19
Format Requirements *19*
Explanation of Spreadsheet Fields/Records *19*
Figure 6 - Schematic of Table 7 (Scenario OB - Transfer) *32*
Supplemental Databases Developed *33*

CHAPTER FOUR 34

SENSITIVITY ANALYSIS 34
Problems with the Data (Quality Control) *34*
Uncertainties with the Assumptions *35*

CHAPTER FIVE 36

SPREADSHEET IMPROVEMENTS AND RECOMMENDATIONS 36
Refinements to Existing Fields *36*
Additions of New Fields *37*

CHAPTER SIX 39

RESULTS AND CONCLUSIONS 39
RWRPA by RWRPA Depletive Use Outcomes *39*
Impacts of Depletive Use / Future Steps *40*

APPENDICES

APPENDIX A Depletive Water Use Spreadsheet A-1

APPENDIX B Municipalities Served By Purveyors With Associated Waste Water Treatment Plants B-1

APPENDIX C County/Municipality Coding List for New Jersey C-1

APPENDIX D Surface/Ground Water Coding List for New Jersey D-1

APPENDIX E Municipality Names With RWRPA And County/ Municipality Codes E-1

APPENDIX F Surface Water Diversion Purveyors With Municipalities Served F-1

TABLES

TABLE 1 SUMMARY OF RWRPA INFORMATION 8
TABLE 2 NAMES AND NUMBERS OF THE 23 REGIONAL WATER RESOURCE PLANNING AREAS (RWRPAS) 15
TABLE 3 NAMES AND NUMBERS OF DEPLETIVE WATER USE FIELDS 19
TABLE 4 SPECIFIC DISCHARGE LOCATION CODES 26
TABLE 5 SCENARIO: WAIS (WITHIN RWRPA IN-STREAM) 28
TABLE 6 SCENARIO: WAOS (WITHIN RWRPA ON-SITE) 29
TABLE 7 SCENARIO: OB (OCEAN/BAY) 30
TABLE 8 SCENARIO: OB - TRANSFER (OCEAN/BAY) 31
TABLE 9 IMPACTS OF DEPLETIVE WATER USE ON REGIONAL WATER SUPPLIES 42

FIGURES

FIGURE 1 - MAP OF WATERSHED DRAINAGE BASINS IN NEW JERSEY 13
FIGURE 2 - MAP OF 23 REGIONAL WATER RESOURCES PLANNING AREAS (RWRPAS) 16
FIGURE 3 - RWRPA WATER FLOW MODEL 18
FIGURE 4 - MAP OF NEW JERSEY PHYSIOGRAPHIC PROVINCES 21
FIGURE 5 - SCHEMATIC SCENARIO OF DISCHARGE CODES 27
FIGURE 6 - SCHEMATIC OF TABLE 7 (SCENARIO OB - TRANSFER) 32

ABSTRACT

Depletive water use, also referred by others as out-of-basin transfers and wastewater and water exportations, has become a significant issue in New Jersey over the last several years as competition for water has increased. Simply defined as surface or ground water withdrawn from a selected watershed or water resource and discharged in another, depletive water use results in a reduction in fresh water discharge to the watershed from which the water was originally withdrawn. If significant, depletive water use could reduce stream base flow and thereby lower reservoir safe yield and the capacity of a waterway to assimilate wastes. Significant depletive water use could also result in saltwater intrusion in aquifers and estuaries, and it can place stresses on fresh water-dependent ecosystems.

Depletive water use, as defined within this report and subsequent spreadsheet analysis, is simply the amount of surface or ground water withdrawn from a selected geographic area that is then used for water supply and disposed of in such a way that it can no longer be utilized again in that particular geographic area. As an example, depletive ground water withdrawals (diversions that do not return used water or treated wastewater to the same aquifer or to surface water above water supply intakes in the same area) intercept natural discharge and reduce the quantities of water for maintaining the base flow of streams and lakes, maintaining wetlands and retarding saltwater intrusion.

In recognition of the potential problems associated with depletive water use, the Statewide Water Supply Plan (SWSP), the first revision to the New Jersey Statewide Water Supply Master Plan, inventoried these uses in each of the 23 Regional Water Resource Planning Areas (RWRPA, essentially large watersheds) that were evaluated for water supply needs. It concluded that almost one-half of the water supply is used depletively; this generally is in the form of water that is withdrawn from the various RWRPAs, used for water supply, converted to waste water and subsequently discharged after treatment to tidal reaches. In some RWRPAs, almost 100 percent of the water is used depletively.

This report represents a "broad brush" inventory of depletive water uses in the state and can serve as an initial guide for where these forms of use may result in the above impacts. It should be used by all involved in water supply and waste water planning and management. After discussing how to use the report, it concludes that a policy is needed to manage depletive water uses in New Jersey as well as other future initiatives to better define the impacts associated with this phenomenon.

CHAPTER ONE

Background

Why Depletive Water Use is Important

The importance of depletive water uses has become an increasingly important water supply topic in New Jersey over the last several years. A depletive water use is, simply speaking, a ground or surface water withdrawal that is used but once in a specific geographic area. Examples include water that is diverted from a river and piped to a city in an adjacent watershed where it is used for potable supply, or water that is withdrawn from wells, used in nearby communities and transported to the ocean after wastewater treatment. When this type of use is small, in comparison to the amount of water available from the overall supply, depletive water use is not a problem. When depletive water uses are large, however, fresh water discharge to streams and out of aquifer systems can be reduced to a point where reservoirs may no longer provide the water they were capable of delivering, streams may not possess adequate assimilative capacity for pollutant loadings, aquifers may be impaired by saltwater, and ecosystems could be stressed. Each of these phenomena serve to limit the state's water supplies. Also, the water may be simply unavailable for re-use in any location.

Based on this potential, the Department of Environmental Protection (Department) evaluated the magnitude of depletive water uses in the state as a component of the first revision to the New Jersey Statewide Water Supply Master Plan. The evaluation concluded that, of the 2279 million gallons/day (MGD) of actual diversions of surface and ground water supplies, 749 MGD are used depletively. One must note, of the 2279 MGD of actual diversions, 940 MGD is for industrial water use for once-through systems, and does not greatly affect the surface water flow. Therefore, approximately 56 percent of the remaining combined surface and ground water (2279 - 940 = 1339) use is depletive. Wastewater reuse may play a greater future role in meeting the state's water supply needs and ensuring that there is adequate freshwater to prevent the undesirable effects cited above. It is anticipated that this report, as well as future updates, will be utilized to help in shape New Jersey's strategic objectives of maintaining and protecting water quality and water quantity. As a direct result of this report, the Department is in the process of developing a depletive water

use policy, especially regarding the interbasin transfer of water and wastewater.

Statement of the Problem

Depletive water use is of particular importance in New Jersey with respect to water supply, water quality and ecosystem management. Presently, approximately 10 percent of runoff and recharge now enters the manmade "plumbing system" consisting of a water delivery / wastewater collection and treatment infrastructure and is depletively discharged into the state's tidal waters. This large-scale transfer of water can result in reduced yield of reservoir systems, loss of stream assimilative capacity and impairment to freshwater-dependent ecosystems. This figure ranges from 0 to 43 among the various watersheds of the state.

Water Supply - During periods of low precipitation, when there is little or no surface water runoff, the only natural contribution to stream flow is that discharged from ground water systems. As depletive ground water withdrawals from the upper most aquifers increase in a particular area, the amount of ground water discharge is reduced and results in reduced stream flow. Recent geohydrologic investigations* conducted in New Jersey are concluding that in some cases reductions in stream flow discharge can be proportional to the ground water withdrawal (e.g., one-to-one ratio). Thus, ground water withdrawals may affect stream flow in the same manner as surface water withdrawals, under particular geological conditions.

This phenomenon can have serious water supply implications. If significant depletive ground water withdrawals have recently been developed upstream of a surface water intake that serves a large population, that intake may be required to "prematurely" cease pumping and turn to its storage reservoir or alternative water supply. If the stream in question is regulated by minimum passing flow requirements, not only will the intake have to cease operations earlier, but reservoir releases may need to be made sooner than anticipated in order to meet these passing flows. Thus, depletive water use can reduce the safe yield of reservoirs.

---

* "Steady-State Simulation of Ground Water Flow in the Rockaway River Buried Valley," USGS; "Ground Water Flow in the Surficial Aquifers of the Toms River and Metedeconk River Basins, NJ," USGS; and, "Hydrogeology of the Ground Water Flow in a Valley-Fill and Carbonate-Rock Aquifer System near Long Valley in the NJ Highlands," USGS.

Safe yield is defined as the amount of water that a river or reservoir system can continuously provide if the drought of record were repeated. An example of safe yield impacts is the encroachment into a surface water supply watershed of a regional sewerage collection system that discharges the wastewater into tidal waters. If local ground water is to be pumped into the homes served by this collection system there is a strong likelihood that the yield of the watershed may be affected. If depletive uses have occurred over the decades above a surface water supply, it may be necessary to re-evaluate that supply's yield.

The yield of surface water supplies can also be reduced by the abandonment of sewage discharges upstream of surface water supply intakes. The historical stream discharge period of record, especially those stream discharges during low flow periods, and available system storage serve as the basis for establishing the yield of surface water supplies. If sewage discharges made up a component of the stream discharge record, cessation of those discharges would require that the record be reformulated so as to reflect lower stream flows. Yield would need to be reduced. On the other hand, yield can be increased if new sewage discharges occur after the yield has been defined and the water supply that serves that sewage system originates in another watershed.

Depletive water use can also reduce the amount of available ground water. Ground water discharge is equal to ground water recharge, over the long term. It is ground water discharge that maintains stream flow during low precipitation periods, retards saltwater from intruding into aquifers and estuaries, maintains lake levels and wetlands. If wells intercept substantial amounts of ground water flowing toward these features, they will be affected, and could be impaired. As such, ground water availability can be generically evaluated by comparing ground water recharge against depletive water use.

Water Quality - Since depletive water use can reduce stream flow and the quantity of available ground water, water quality may be a concern. As a result of the same hydrologic dynamics discussed above, significant depletive ground water withdrawals upstream of a municipal or industrial sewage treatment plant can cause that facility to violate water quality standards, even if the facility is discharging in accordance with its permit conditions. Effluent limitations

for sewage treatment plant discharges are also based on the historical stream discharge record (i.e., water quality standards downstream of the discharge will be maintained during low flow). Further, nonpoint pollution impacts can be increased through reduced dilution in the state's water resources, including ground water systems. For the latter, water level declines in conjunction with increased waste inputs reducing the natural "flushing" effect in aquifers as water passes through these systems.

Ecosystems - Depletive water uses upstream, or in the same vicinity, of freshwater-dependent ecosystems can have implications on these resources. Studies of rivers in the Northeastern United States experiencing reduced stream flow as a result of depletive uses showed a consistent pattern of degraded fish communities. The most critical factors influencing fish communities are food, water quality, physical habitat, flow regime, biotic interaction, and temperature.* Reductions in water quantity by depletive uses affects each of these directly or indirectly. Ground water withdrawals that are depletive cause increases in the fluctuations of the water table. This can affect freshwater ecosystems at the surface by reducing access to water by the root systems of native vegetation. Adverse impact to the environmentally-sensitive riparian habitat are possible. Quantifying the effects of reduced flow on ecosystems, however, is proving to be a complicated process. The Department has initiated investigative research in this regard.

Depletive Use and the MA7CD10

From a regulatory perspective, low stream flow, or base flow (the ground water contribution to a stream), serves as the primary criterion for managing New Jersey's water resources. The most common stream discharge employed for this purpose is the MA7CD10, or the seven consecutive days of lowest flow that may be expected to occur once during a ten-year interval. This statistical stream flow event essentially represents stream discharge during periods of relatively severe low precipitation. The historical record in some cases goes back to 1897.

The Department is heavily dependent on the MA7CD10. This value is useful in determining the locations for water

* Bain, Mark B., "Instream Flow and the Integrity of Fish Communities in Streams and Rivers," New York Cooperative Fish and Wildlife Research Unit, Cornell University, NY, 1993 (Pg. 1).

supply intakes and the amount of water available for storage, and for sewage treatment outfalls. It is also used to indicate the occurrence of stream flows less than those required for water supplies in the absence of reservoirs, or stream discharges insufficient to assimilate wastewater discharges. Most major water supply and wastewater control facilities are designed based on the MA7CD10.

Since MA7CD10 is the most critical low flow from a water supply and water quality perspective, it is critical that this design flow be accurate. As implied above, however, depletive uses reduce stream flow, especially low flow. Thus, the MA7CD10 is subject to question if the effects of depletive uses are not factored into its formulation.

If depletive water uses remained constant throughout the historical period of (stream discharge) record, these uses would not be of concern since their impacts on stream flow are incorporated into the record. For example, if depletive water uses occurred during the last decade of a record that goes back five or six decades, the stream flow reduction caused by these activities would be "diluted" by the length of the record. Therefore, the MA7CD10 should be reformulated to take into consideration this occurrence.

The opposite effect takes place when sewage was recently imported into a watershed during the latter portion of a five or six decade period of record. Again, the MA7CD10 should be reformulated to reflect this occurrence. It should be noted that the MA7CD10 is often extrapolated for use in watersheds that do not have a stream discharge period of record from watersheds that do.

Depletive Use and the Clean Water Act

Efforts to achieve the laudable "fishable and swimmable" goals of the Federal Clean Water Act and the State's Clean Water Enforcement Act have inadvertently contributed to increased depletive uses in New Jersey and may increase these uses in the future as treatment provisions become more stringent. Smaller treatment plants that previously discharged to freshwater portions of the state have been abandoned and tied into regional sewage treatment plants that discharge into tidal waters in order to escape higher costs. Other plants have abandoned their discharges in small streams for the advantage of the increased dilution of larger rivers. Industries and electrical power generating facilities that previously employed once-through cooling

practices now utilize highly evaporative cooling towers to meet stream thermal standards. Consequently, stream flow reductions caused indirectly by these well-intentioned Acts may actually compromise their very goals.

It is essential that the goals of these Acts be better "synchronized" with the goals of the Water Supply Management Act and other applicable statutes, since depletive use affects the sustainability of the state's water and ecological resources. As depletive use increases, so does the future need to increase reservoir storage or to seek alternative water supplies. Alternative supplies will undoubtedly be much more costly in light of the fact that almost all of the state's conventional supplies have already been developed as well as the fact that several of the major regional aquifer systems in New Jersey are in over-draft. As such, when a municipality is deciding if it should participate in a depletive wastewater operation, it should simultaneously consider the secondary costs of alternative water supplies. In this regard, future policy may be necessary as the Department's watershed approach evolves.

Who Should Use This Report

This report should be used by public and private scientists, water managers and engineers responsible for developing water supply and wastewater analysis and plans, local, county and state officials that are involved in land use planning, water quality planners and natural resource managers. Examples on how the report should be used are provided below.

Water Supply - Those involved in developing water supplies or in the regulation of water allocations will find this report useful in estimating the availability of water as well as the development of strategies for its long-term use. **Table 1**, on page 8 describes surface and ground water availability for each of the 23 water supply planning areas in the state and compares these amounts to the water depletively withdrawn from these resources. One must note, ground water availability is not thoroughly quantified; consequently, these values should be used only for planning purposes as estimates. In any case, the report will allow those involved to broadly determine if there is any potential water supply conflicts with respect to depletive use.

For example, Table 1 indicates that several coastal planning areas may be experiencing ground water supply deficits.

Since these are planning estimates, it should not be assumed there is no available ground water; rather, particular supplies in the area may be adequate. Water purveyors are thus encouraged to discuss their plans early in the planning process with the Department for developing future water supplies in these areas.

Table 1 illustrates that the planning areas characterized with the largest percentages of total depletive water use are the Metedeconk River, Navesink/Swimming River, South River, Toms River, Atlantic Coastal, and Manasquan and Raritan Rivers. However, caution must be exercised when interpreting Table 1 since there are various factors that can mask the impacts, or non-impacts, of depletive water use.

First, depletive water use has to be compared to overall water availability of the source; the percentage of depletive use could be high when compared to the diversion(s), but if the diversion(s) represents a small percentage of the source availability there may be no problem. Second, the location of the depletive use may be a critical factor; what appears to be a minor percentage of depletive use could actually represent a major water supply problem. For example, depletive uses above surface water supply intakes or near the saltwater/freshwater interface can have critical impacts on supplies. Third, the location of the discharge of the depletively used supply is very important. Planning Areas 14 and 17, which are Critical Water Supply Areas, show very minor amounts of depletive use. This is because Table 1 considers discharges within planning areas non-depletive. These discharges are to the Delaware River, such that depletion of ground water supplies is masked by treated wastewater inputs to the river system.

Table 1
Summary of RWRPA Information
ALL VALUES ARE IN MILLION GALLONS PER DAY (MGD)

RWRPA NUMBER	RWRPA NAME	TOTAL RECHARGE	AVAILABLE GROUND WATER	SURFACE WATER YIELDS	TOTAL AVAILABLE WATER	INTER-BASIN TRANSFER (-)OUT (+)IN	NET AVAILABLE WATER	1990 PLANNING AREA DEMAND			1990 (+) SURPLUS (-) DEFICIT	2010 TOTAL DEMAND	2010 (+) SURPLUS (-) DEFICIT	2040 TOTAL DEMAND	2040 (+) SURPLUS (-) DEFICIT	DEPLETIVE WATER USE	
								SURFACE	GROUND	TOTAL						SURFACE	GROUND
1	Middle Delaware River	100.3	20.1	0.0	20.1	-1.1	19.0	0.0	13.6	13.6	5.4	14.2	4.8	15.2	3.8	0.1	0.2
2	Flat Brook	50.5	10.1	0.0	10.1	0.0	10.1	0.0	0.1	0.1	10.0	0.2	9.9	0.3	9.8	0.0	0.0
3	Walkill/Pequest River	430.7	86.1	2.4	88.5	2.8	91.3	5.5	16.8	22.3	69.0	28.3	63.0	35.7	55.6	0.0	1.8
4	Upper Passaic Pompton/ Ramapo Rivers	471.0	94.3	406.2	500.5	-261.0	219.5	19.3	72.3	91.6	127.9	98.5	121.0	109.1	110.4	249.9	20.2
5	Lower Passaic/ Rahway Rivers	235.8	47.2	8.9	56.1	306.8	362.9	326.1	45.8	371.9	-9.0	355.5	7.4	343.1	19.8	17.0	22.7
6	Hackensack River	108.7	21.7	74.0	95.7	51.2	146.9	147.7	7.2	154.9	-7.9	162.8	-15.8	170.4	-23.5	2.6	0.0
7	Pohatcong River	48.9	9.8	0.0	9.8	0.9	10.7	0.9	2.7	3.6	7.1	4.0	6.7	4.5	6.2	0.0	0.3
8	Musconetcong River	134.1	26.8	0.0	26.8	1.8	28.6	1.8	4.0	5.8	22.8	6.7	21.9	8.1	20.5	0.0	1.8
9	Trenton Delaware Tributaries	87.6	17.6	66.0	83.6	-66.7	16.9	0.4	2.1	2.5	14.4	3.1	13.8	3.8	13.1	0.0	0.0
10	Raritan River	554.0	110.5	160.0	270.5	-57.3	213.2	63.4	54.2	117.7	95.5	141.2	71.9	164.2	49.0	133.6	24.6
11	South River	124.3	24.7	8.0	32.7	23.8	56.5	33.7	50.1	83.7	-27.2	98.4	-41.9	116.7	-60.3	0.8	34.0
12	Navesink/Swimming Rivers	185.3	31.6	32.6	64.2	11.6	75.8	42.5	19.8	62.3	13.5	62.4	13.4	61.6	14.2	29.6	20.4
13	Manasquan River	73.7	9.1	30.0	39.1	-13.0	26.1	1.9	10.8	12.8	13.3	15.2	10.9	18.0	8.1	0.2	6.8
14	Rancocas Creek	539.8	82.6	52.2	134.8	1.5	136.3	56.1	44.7	100.8	35.5	120.1	16.3	135.4	0.9	9.7	2.9
15	Metedeconk River	111.3	11.2	0.0	11.2	0.2	11.4	1.4	13.7	15.0	-3.6	19.0	-7.6	25.6	-14.2	1.2	13.9
16	Toms River	200.0	20.0	0.0	20.0	1.9	21.9	10.0	28.1	38.2	-16.2	48.7	-26.8	62.4	-40.4	7.9	15.4
17	Camden Delaware Tributaries	217.0	36.8	0.0	36.8	11.7	48.5	13.4	105.0	118.4	-69.8	128.1	-79.6	142.0	-93.5	0.4	2.8
18	Mullica River	634.5	63.5	9.3	72.8	1.1	73.9	39.6	90.1	129.7	-55.8	157.9	-84.0	160.7	-86.8	20.9	49.1
19	Atlantic Coastal	249.6	25.0	0.0	25.0	0.3	25.3	0.3	11.9	12.2	13.1	18.1	7.2	27.2	-1.9	0.0	7.8
20	Salem River	296.2	40.3	3.0	43.3	0.0	43.3	16.7	14.2	30.9	12.4	34.2	9.1	35.4	7.9	12.8	9.9
21	Maurice River	540.4	54.0	0.0	54.0	0.0	54.0	2.2	60.3	62.5	-8.5	71.8	-17.8	76.8	-22.8	1.1	10.3
22	Great Egg Harbor River	311.4	31.1	0.0	31.1	0.6	31.7	1.5	19.5	20.9	10.8	26.4	5.3	30.3	1.4	0.4	3.9
23	Cape May Coastal	289.8	29.0	0.0	29.0	2.8	31.8	3.1	24.6	27.7	4.1	32.6	-0.8	39.0	-7.2	0.2	10.9
	TOTAL	5994.9	903.1	852.6	1755.7	-0.0	1755.7	787.6	711.5	1499.1	256.6	1647.3	108.4	1785.6	-29.9	488.5	259.6

FOOTNOTES:

Total Recharge - estimated long-term, average recharge to aquifers.
Available Ground Water - estimated percentage (10%-20%) of total ground water recharge available for water supply below planning threshold.
Surface Water Yields - amount surface water continuously available throughout a repetition of drought of record.
Total Available Water - sum of available ground water and surface water yields.
Interbasin Transfer - 1990 net amount of water entering or leaving planning area through purveyor interconnections.
Net Available Water - sum of total available water plus/minus interbasin transfers.
1990 Planning Area Demand - estimated water demand; 2010 and 2040 total demand follow two and four columns to the right. Also, numbers do not reflect industrial once-through water usage.
1990 Surplus/Deficit - estimated amount of water available for future water supply; 2010 and 2040 surplus/deficit follow two and four columns to the right.
1990 Depletive Use - estimated amount of water withdrawn, used for supply, and disposed of where no longer available again for area in question.

(Data based on years of record from 1986 to 1988)

Wastewater/Water Quality - This report may be beneficial to those who develop wastewater effluent limitations and wastewater management plans. For instance, if a new sewage treatment plant is proposed in a planning area with significant depletive shallow aquifer withdrawals upstream of the proposed discharge, the Department may suggest to the applicant to verify that historical low streamflows have not decreased as a result of the withdrawals. In the event that the withdrawals are relatively recent, but low flow has been estimated using a long period of (stream discharge) record, low flows may need to be reformulated to reflect reduced streamflow so the discharge will not violate water quality standards. Also, if officials who operate an existing treatment plant upstream of a potable surface water intake/reservoir system are considering tying into a regional plant, they should consult with the Department to determine if their wastewater discharge makes up a portion of the safe yield of the reservoir system. An additional example would be a proposed sewerage collection system upstream of an intake or a trout production stream. If the wastewater is proposed to be conveyed out of the planning area, and the origin of the water is from the local aquifer, unacceptable baseflow reductions may result.

Where surface water is subject to the effects of substantial ground water withdrawals from a shallow aquifer, streamflow may be reduced and consequently more greatly impaired by nonpoint sources of pollution than if the withdrawals were not so significant. Thus, those involved in evaluating waterways impaired by these forms of pollution may want to consider prioritizing those planning areas that are characterized by numerous nonpoint source activities and major depletive uses. Those involved in ground water quality could also find this report useful. The problem associated with shallow aquifers experiencing substantial depletive uses are compounded by extensive ground water contamination. Planning areas that are characterized by both phenomena may deserve additional priority due to coupled effects of both.

Land Use - Officials who are responsible for land use planning and zoning may find this report helpful in determining if the area under their purview should be sewered or remain on septic systems. If present land uses utilize highly depletive forms of wastewater management, resulting in potential

deficits, possibly the future land use could be served by a non-depletive wastewater management mode such as water withdrawals from the shallow aquifer and wastewater discharge to the surface water where stream baseflow reductions are anticipated (so as to "compensate" for the reduction). Or, future land use can be designated to be served by local wells and septic systems, under the purview of an on-site management program to ensure that water quality standards are maintained.

Natural Resources - Since many natural ecological resources in the state are freshwater-dependent, this report may be of interest to biologists, wildlife experts, conservationists, environmental associations, professional and recreational fishermen, and natural resource regulators.

Statewide Water Supply Plan (SWSP)

The Department is nearing completion of the first major revision to the original Statewide Water Supply Master Plan (SWSMP). The original SWSMP was adopted and then distributed in May 1982. It was the first comprehensive statewide plan to examine all aspects of water supply management in a context of extensive public and intergovernmental participation.

The Statewide Water Supply Plan (SWSP) is the basic planning tool of the Department for managing New Jersey's water supply resources. It describes the steps the Department intends to take now and in the immediate future to meet water supply planning and management goals.

The goal of the SWSP is to provide a framework for sound water supply planning, to clearly identify responsibilities, needs and resource capability, and to develop the tools essential to meet those responsibilities.

Preparation, adoption and periodic revision or update of the SWSP are required by the Water Supply Management Act of 1981. The Act states that the SWSP shall be revised and updated at least once every five years. There is no requirement that the recommendations suggested by the SWSP be implemented, but any project which would be supported by the 1981 Water Supply Bond Fund must be included in the SWSP.

In response to the above mentioned guidelines, periodic updates of the plan have also been issued since 1982. These particular updates appeared in 1983, 1985, 1987, 1988, 1991 and 1993. These updates addressed specific elements of the plan, incorporating new information as available. These updates provide only minor adjustments to the structure of the SWSP, though significant projects have been added. The updates also maintain the effectiveness of the SWSP, by keeping the plan relatively current and accurate as situations and technologies change.

The SWSP recognized that depletive water withdrawals are an important consideration in determining the true availability of combined water supplies. Water should be recycled near the point of withdrawal to truly be non-depletive. The discharges below any possible water supply intake in a specified geographic area are, for all intents and purposes, depletive to that particular area. However, if such discharges are made to a stream within that area, it is not considered depletive. If these discharges are made to an outside area's stream, they are considered depletive to the area of origin but available for reuse to the outside area. There existed a need to define a threshold above which withdrawals may cause unacceptable impacts. An index consisting of the ratio of ground water recharge to ground water depletive use was developed as an indicator of the stress on the ground water system within the SWSP revision process.

CHAPTER TWO

Scope/Objectives/Methodology

Study and Geographic Area Breakdown

The SWSP looked at water supply planning of ground and surface water resources in a different context from that in the original SWSMP. Instead of utilizing, for the most part, political boundaries for water supply planning as was done in the original SWSMP, the revision focused on the element in which it is seeking to plan for, namely the water source. In addition, the Department wanted a finer level of understanding for water supply planning and chose a breakdown for the state consisting of a greater number of regions in order to accomplish this task. The original SWSMP consisted of 6 regions as opposed to the SWSP which contains 23 regions.

In order to effectively manage and plan for utilization of ground and surface water supplies, the hydrologic unit must be considered. These units were chosen in order to determine if specific undesirable impacts may be realized within them as a result of the cumulative effects of depletive ground and surface water diversions. These hydrologic units are referred to as Regional Water Resource Planning Areas (RWRPAs). New Jersey has been divided up into 23 RWRPAs. The actual boundaries of these RWRPAs follow the boundaries of major watersheds in the state. Underlying shallow and confined aquifers are also included within the RWRPAs. The boundaries of these major watersheds are shown in **Figure 1**, on page 13.

The selection of the RWRPAs was discussed by planning staff with the New Jersey Geological Survey as well as the United States Geological Survey. The following steps were used for identification of base water sources which formed the final RWRPA boundaries:

- started with the watershed drainage basin map of New Jersey;
- looked at the availability and status of stream gauging stations which were important to confirm recharge estimates previously developed;
- considered existing studies that focused on some of the basins;

New Jersey Watersheds

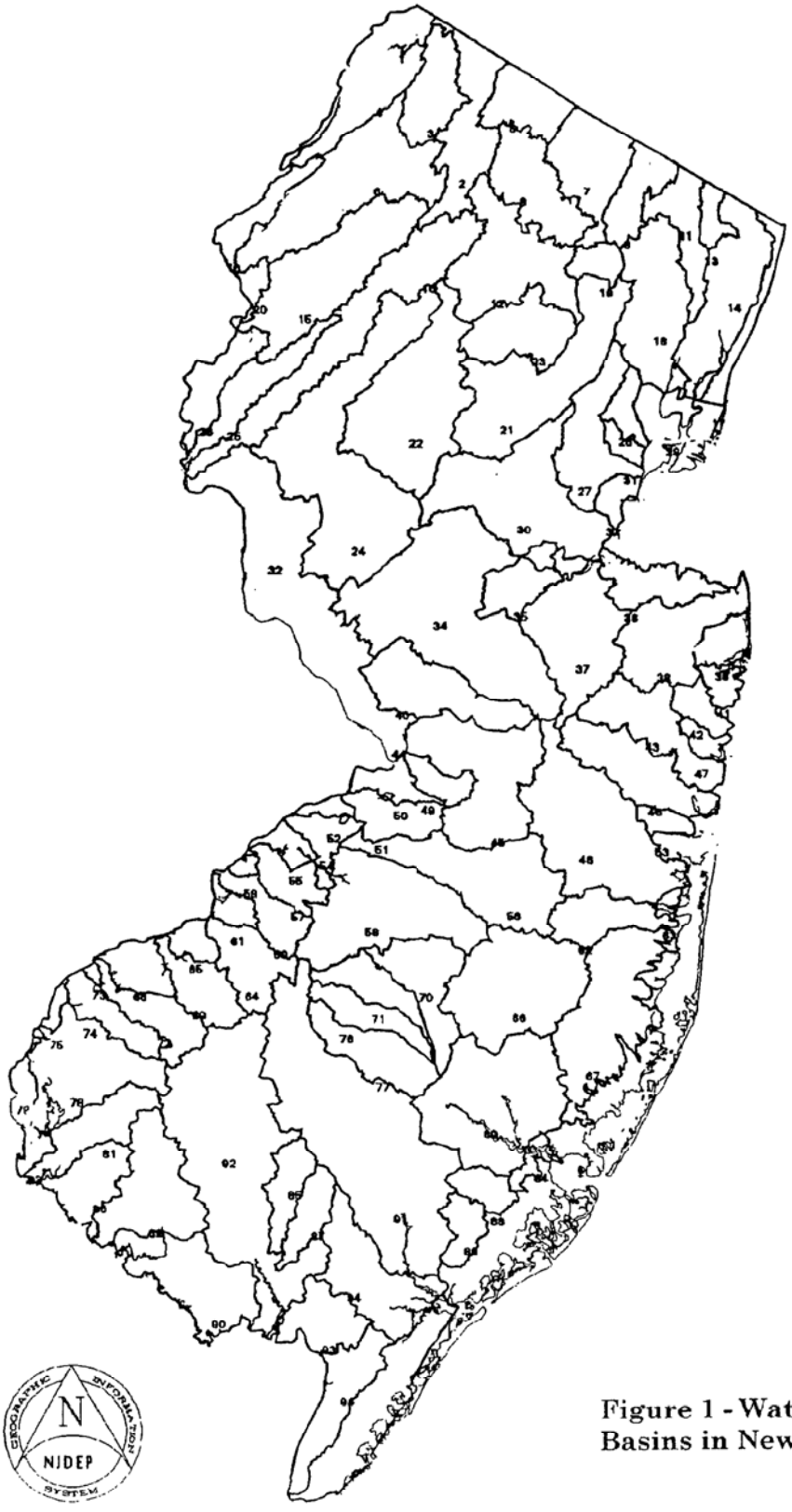


Figure 1 - Watershed Drainage Basins in New Jersey

- considered receiving water bodies for drainage from the basins, recognizing the need to assess the impact on receiving bodies, such as the Atlantic estuaries, of water use upstream;
- compared the drainage basin map to the geological map of the state to potentially use geology as a criteria for subdividing the basins; however, using drainage basins as an assessment criteria will facilitate the development of water budgets from which recharge estimates can later be refined;
- considered existing and planned regional water resources investigations such as the shallow aquifer studies; and
- considered population centers.

In order to facilitate ease in discussing and listing information and for developing the Depletive Water Use database, the RWRPAs were given numbers from 1 to 23 starting at the most northwestern portion of New Jersey (Sussex County) to the most southern portion (Cape May County). The selected boundaries of the RWRPAs are shown in **Figure 2**, on page 16, **Table 2**, on page 15 lists the associated names and numbers of the RWRPAs for easy reference.

Analysis to Determine Depletive Water Use

The Bureau of Water Supply Planning and Policy (BWSPP), now located within the Office of Land and Water Planning (OLWP), conducted a six month analysis to develop a database for depletive water use. The database essentially illustrates where surface and ground waters are withdrawn, where they are utilized, and where they are ultimately discharged. The specific formulation of the depletive water use database is discussed in Chapter 3 of this report. The database was used to evaluate the extent of depletive use in the various RWRPAs and also to determine whether a reduction in these depletive uses can potentially extend New Jersey's water supplies.

Specifically, depletive surface and ground water withdrawals for each individual water diversion having either a water allocation permit or agricultural certification were determined by analyzing the connection between surface and ground water withdrawals and the discharge of wastewater effluent. For example, where ground water is withdrawn from an aquifer and subsequently recharged to the same aquifer, the withdrawal is NOT considered depletive. Any

discharges to streams upstream of water supply intakes in a RWRPA are NOT considered depletive to that RWRPA. Any discharges downstream of water supply intakes, but well within the RWRPA, are depletive with respect to the existing surface water supply but NOT with respect to the overall RWRPA. All other discharges, such as a discharge that is exported to another RWRPA or offshore (ocean/bay) are considered depletive to the RWRPA. A depletive surface water use is one where a surface water withdrawal occurs and is not returned within the RWRPA. In addition, professional judgment was used for any borderline case discharges, depending on how close (location) a discharge was with respect to the RWRPA boundary.

Table 2
Names and Numbers of the 23 Regional Water Resource Planning Areas (RWRPAs)

RWRPA NUMBER	NAME
1	Middle Delaware River
2	Flat Brook
3	Walkill/Pequest Rivers/Paulins Kill
4	Upper Passaic River and Tributaries
5	Lower Passaic/Rahway Rivers
6	Hackensack River
7	Pohatcong River
8	Musconetcong River
9	Trenton Delaware Tributaries
10	Raritan River
11	South River
12	Navesink/Swimming River
13	Manasquan River
14	Rancocas River
15	Metedconk River
16	Toms River
17	Camden Delaware Tributaries
18	Mullica River
19	Atlantic Coastal
20	Salem River
21	Maurice River
22	Great Egg Harbor River
23	Cape May Coastal

REGIONAL WATER RESOURCES PLANNING AREAS (RWRPAs)

NAMES AND NUMBERS OF THE 23 REGIONAL WATER RESOURCE PLANNING AREAS (RWRPAs)	
RWRPA #	NAME
1	Middle Delaware River
2	Flat Brook
3	Walkill/Pequest Rivers/Paulins Kill
4	Upper Passaic River and Tributaries
5	Lower Passaic/Rahway Rivers
6	Hackensack River
7	Pohatcong River
8	Musconetcong River
9	Trenton Delaware Tributaries
10	Raritan River
11	South River
12	Navesink/Swimming Rivers
13	Manasquan River
14	Rancocas River
15	Metedeconk River
16	Toms River
17	Camden Delaware Tributaries
18	Mullica River
19	Atlantic Coastal
20	Salem River
21	Maurice River
22	Great Egg Harbor River
23	Cape May Coastal

SOURCE: NJDEP

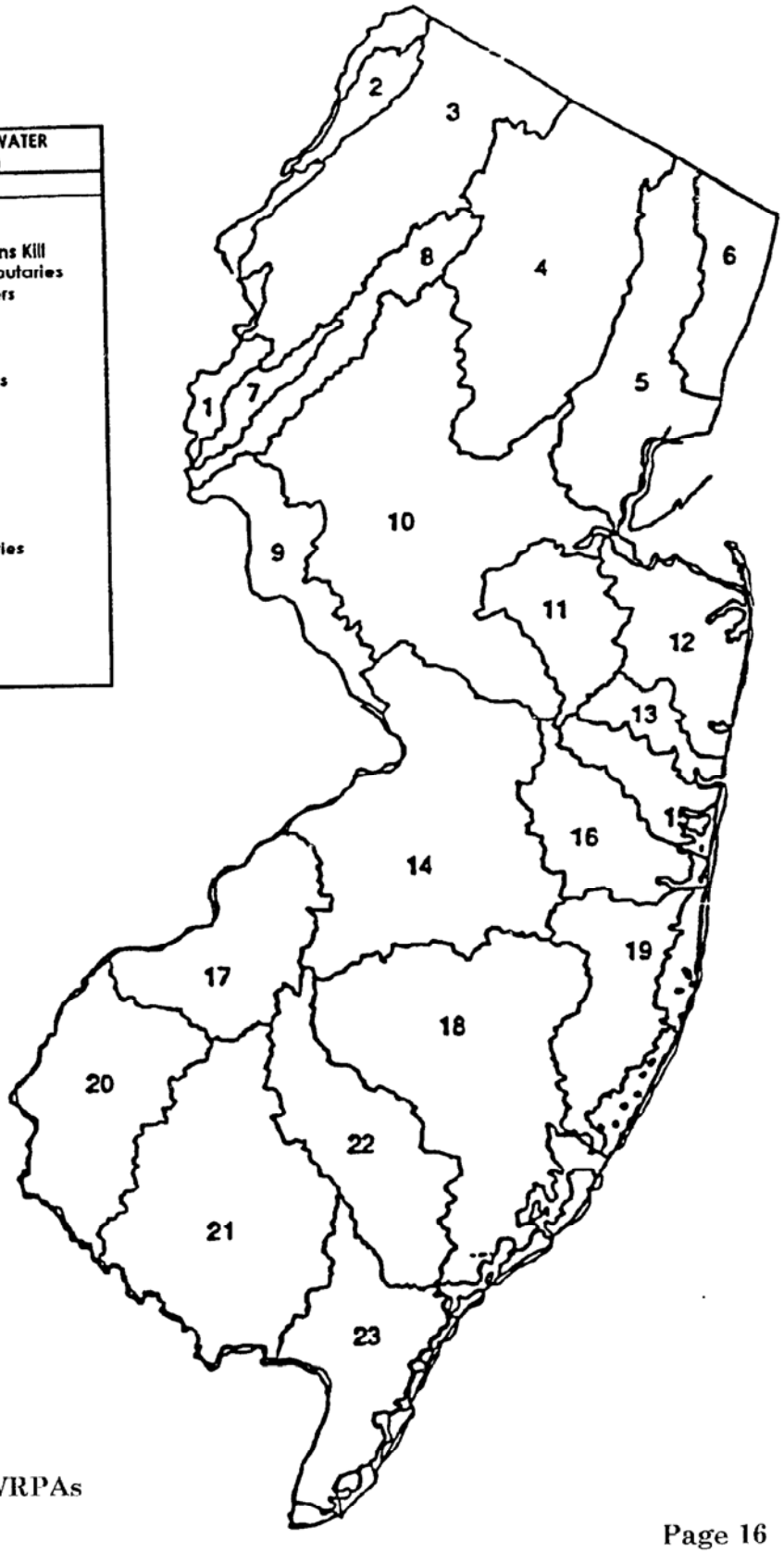


Figure 2 - Map of the 23 RWRPAs

It should be noted that additional water may be available when sewage treatment plants discharge to streams in other planning areas. Additional water may also be available when sewage treatment plants discharge to streams in the same RWRPA when the stream where the discharge is located does not have surface water intakes on it, or significant depletive ground water withdrawals within the basin. The safe yield of these streams is related to the quantity of the discharge, but water quality must be a factor. For a schematic representation of surface and ground water system flows, refer to **Figure 3** - RWRPA Water Flow Model found on page 18.

Diversion Types Utilized

The Depletive Water Use database utilized records of surface and ground water diversions which were obtained from the Department's Bureau of Water Allocation. These diversions included public and investor-owned water purveyors, industrial users and agricultural users which utilize surface waters and unconfined and confined ground water aquifers. Specifically, all diversions which comprise the Depletive Water Use database either had Water Allocation Permits allowing withdrawals of 100,000 gallons per day (gpd) or more, or were agricultural users who have Agricultural Certifications for withdrawals of 100,000 gpd or more. A detailed explanation of diversions and other database fields is addressed in Chapter 3.

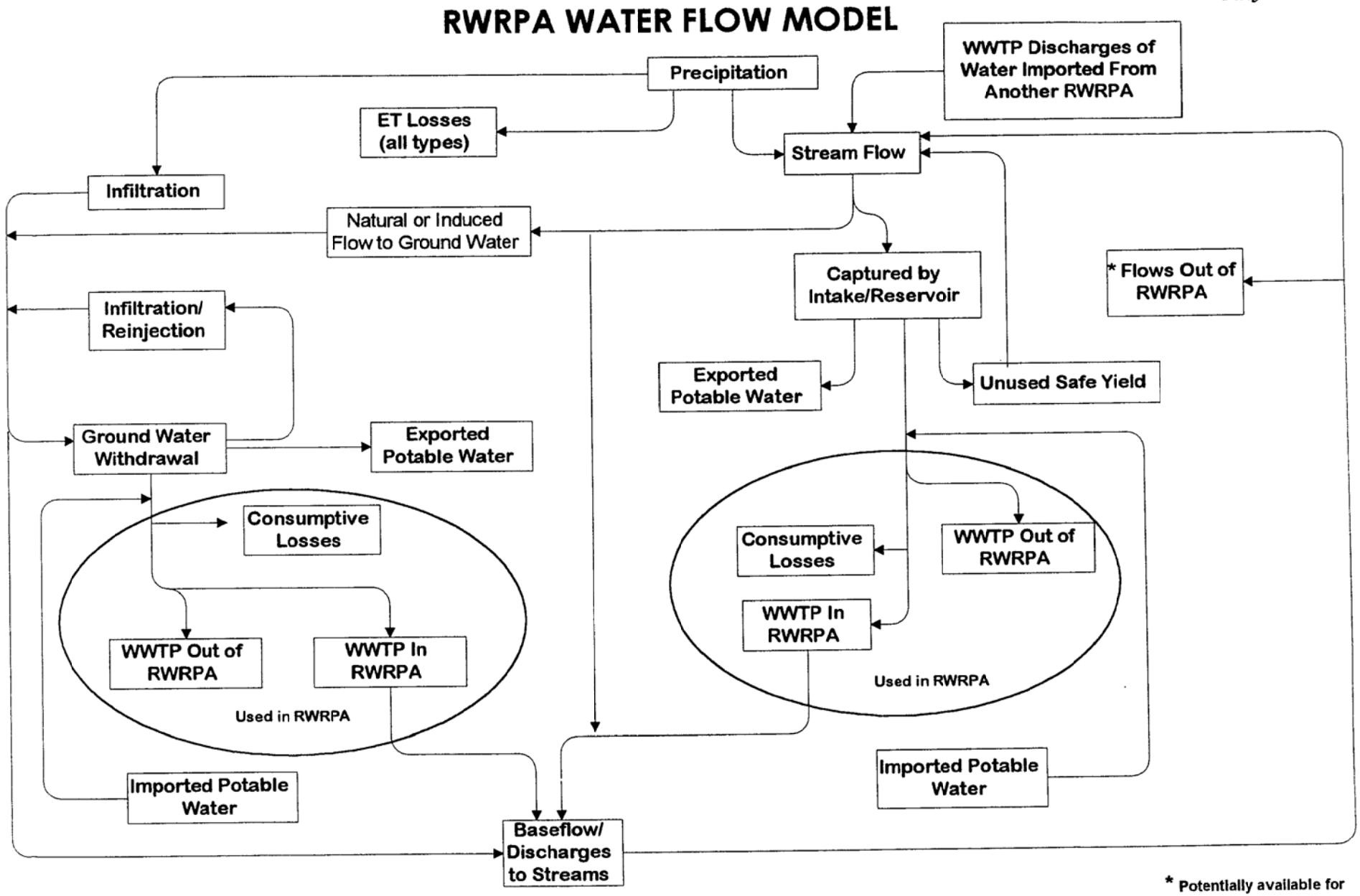


Figure 3 - RWRPA Water Flow Model

CHAPTER THREE

Spreadsheet Development

Format Requirements

The three basic parameters essential in evaluating the depletive water use are 1) the water withdrawal/ diversion, 2) the area serviced by this withdrawal (utilization area), and 3) the location where the water is discharged after use. These three parameters when used together resulted in a quantifiable evaluation of depletive water use in New Jersey.

A spreadsheet was developed to quantify depletive water use statewide. The software utilized to develop and analyze the Depletive Water Use spreadsheet was Lotus 1-2-3 version 3.1+. Various fields for the spreadsheet were developed to establish a continuity of data input relating to the three basic parameters and thereby evaluating the depletive water use, as explained below.

Explanation of Spreadsheet Fields/Records

The following explanation of spreadsheet fields and data records is divided into three categories which follow the three basic parameters as noted above, 1) Water Withdrawal, 2) Utilization Area, and 3) Discharge Location. The fields discussed below refer to the Depletive Water Use spreadsheet in Appendix A. Table 3 is a listing of the field names and numbers used.

Table 3
Names and Numbers of Depletive Water Use Fields

FIELD NUMBER	FIELD NAME
1	Water Allocation Permit Number
2	Surface or Ground Water Diversion
3	Source Diversion
4	Province
5	Category and Type of Diversion
6	Diversion Location
7	Regional Water Resource Planning Area Number
8	Actual Average Annual Withdrawal
9	NJ Pollutant Discharge Elimination System Permit
10	Wastewater Treatment Plant
11	Discharge Receiving Water
12	Actual Average Annual WWTP Discharge
13	Discharge Location
14	Specific Discharge Location
15	Total Depletive Water Use

Water Withdrawal

In order to develop the information presented in Fields #1 through #8, baseline data were obtained from the Bureau of Water Allocation (BWA), Water Supply Element. In addition, extensive calculations and placements of withdrawals in the various field categories were necessary in order to fulfill the requirements of the Depletive Water Use analysis.

Field #1: (*Water Allocation Permit Number*) This field shows the BWA permit number for a ground or surface water diversion.

Field #2: (*Surface or Ground Water Diversion*) This field shows the name of the water purveyor, industrial withdrawal or agricultural withdrawal diverting water from either ground or surface water which relates directly to the previous Field #1.

Field #3: (*Source Diversion*) This field shows the corresponding surface or ground water diversion code from the BWA. This represents the source of the withdrawal; an aquifer in the case of ground water withdrawal and a river basin or sub-basin in the case of surface water withdrawal. Due to the large number of codes used in this field, they are not shown here in the text. However, these codes are listed in Appendix D.

Field #4: (*Province*) This field lists the physiographic province code where the diversion is located. The state of New Jersey is divided into four basic physiographic provinces, namely Coastal, Piedmont, Highlands and Valley & Ridge. These provinces were further sub-divided into seven areas as noted below:

PROVINCE	CODE
Valley and Ridge	VAR
Highlands	HLD
Glaciated Piedmont	PGL
Unglaciated Piedmont	PUG
Inner Coastal Plain	ICP
Northern Outer Coastal Plain	NOC
Outer Coastal Plain	OCP

For a visual picture of these physiographic provinces, refer to the map of **Figure 4**, on page 21.

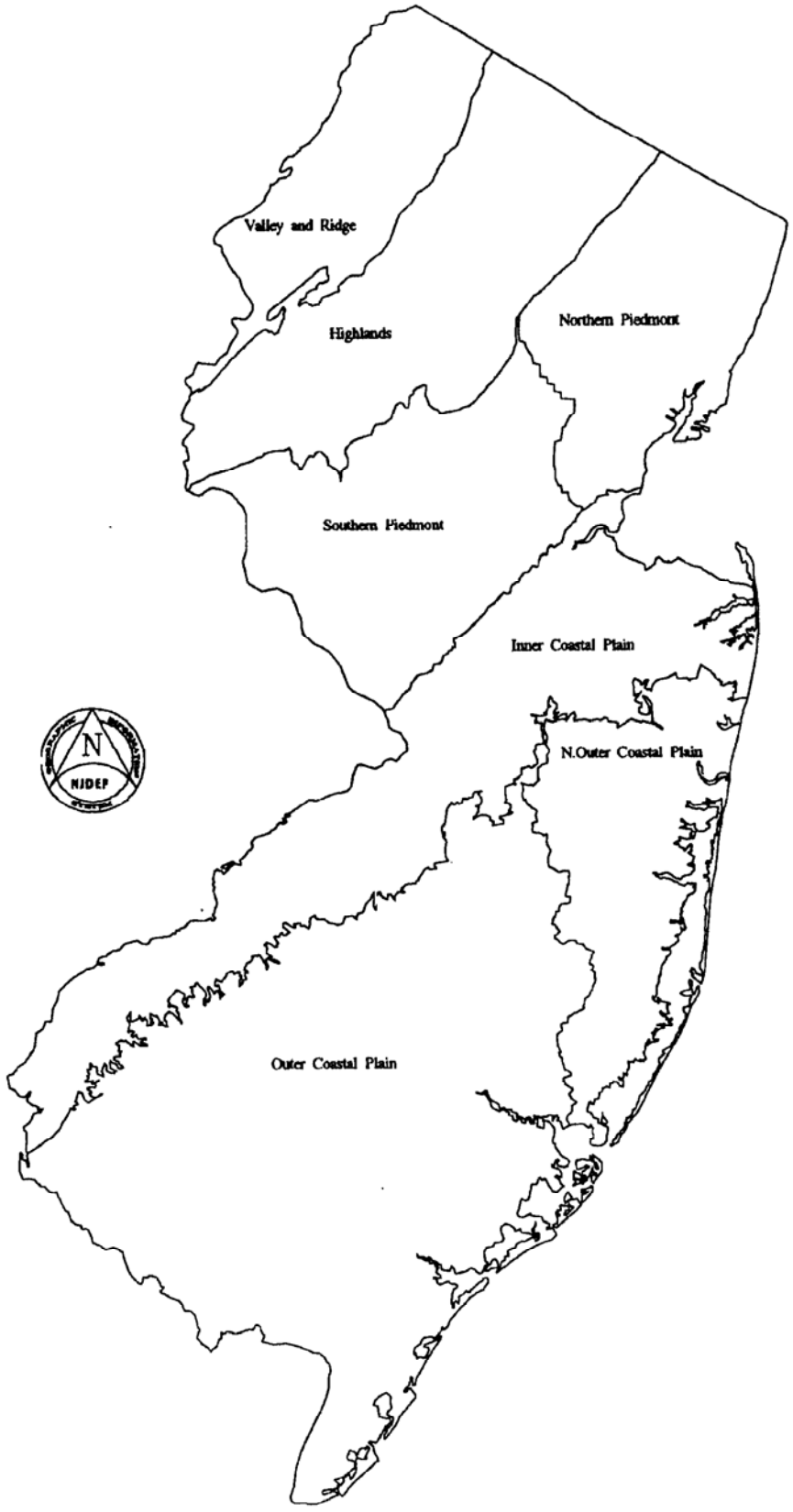


Figure 4 - New Jersey Physiographic Provinces

Field #5: (*Category and Type of Diversion*) This field identifies the type of use of ground or surface water. Specifically, the notations utilized for this field are:

CODE	USE TYPE
PS	surface water diversion for potable supply
IS	surface water diversion for private/industrial use
AS	surface water diversion for agricultural use
PG	ground water diversion from unconfined aquifer by public water supply system
PGC	ground water diversion from confined aquifer by public water supply system
IG	ground water diversion for private/industrial use
AG	ground water diversion for agricultural use

Field #6: (*Diversion Location*) This field lists the location of each diversion by a four digit county/municipality code as utilized by the BWA. The first two digits represent the county code and the last two digits represent the municipality code. The counties are coded using odd numbers starting with "01" in alphabetical order. For example, "01" symbolizes Atlantic County and "03" symbolizes Bergen County. The municipalities on the other hand are coded in alphabetical order for each county beginning with number "01" and following consecutive numbering thereafter. The code "0104" represents Atlantic County, Buena Boro.

Due to the large number of codes which represent this field, they are not shown here in the text. However, these codes are listed in Appendix C. (The Department is developing a more accurate data base for some of these diversion locations, which will be stored in a Geographic Information System.)

Field #7: (*Regional Water Resource Planning Area Number*) This field shows the RWRPA where the diversion is located. New Jersey is divided into 23 RWRPA's, which basically follow the boundaries of the major watersheds of the state. For a visual picture of these major watersheds refer to **Figure 1 - Map of Watershed Drainage Basins in New Jersey** on page 13. **Table 2**, on page 15 lists the names and corre-

sponding numbers of all 23 RWRPA's. **Figure 2**, on page 16 shows the mapped version of the 23 RWRPA's.

Field #8: (*Actual Average Annual Withdrawal*) This field gives the average annual water diversion in million gallons per day (MGD) for each withdrawal listed in the Depletive Water Use spreadsheet. A three year average annual diversion for the period of 1986 to 1988 was used. These years of record were selected for a few reasons. First, these particular years of record provided a diversified hydrologic scenario of events with wet and dry years. Also, baseline data necessary to complete the Depletive Water Use analysis were readily available. Last, this time period closely fit with the SWSP revision's efforts to look at the long range planning horizon of 1990 to 2040.

The amount of water diverted by individual source was used in the Depletive Water Use spreadsheet. For example, if an allocation withdrawal had two sources of supply, one from ground water and one from surface water, these supplies were separated and categorized as explained in Field #5. If a water supply system had wells in unconfined and confined aquifers, these wells were separated and identified as "PG" and "PGC" respectively. In addition, withdrawal amounts from wells were further broken down by specific aquifer formations or surface water sub-basins as indicated in Field #3 above.

It should be noted, when a water purveyor services more than one municipality and these municipalities do not discharge their wastewater to the same treatment plant, the quantity of water withdrawn by this water purveyor was broken down according to the wastewater treatment plant/discharge location (Field #13). The diversion source name (Field #2) and the water allocation permit number (Field #1) for each withdrawal to these municipalities, however, was listed with the original diversion source name (Field #2). This particular situation generally occurred for purveyors with surface water withdrawals who have a large service area comprising a multitude of municipalities and extending to more than one RWRPA. These systems are also interconnected with other water systems, transferring water to such systems on a retail or wholesale basis.

Utilization Area

Due to the large number of municipalities involved in the utilization area of purveyor surface water supply systems, this field was not shown on the Depletive Water Use spreadsheet. However, a separate spreadsheet was prepared, Appendix F, listing the municipalities and the associated water purveyors supplying water to these municipalities. Also shown in Appendix F, Surface Water Diversion Purveyors with Municipalities Served, are the names and the corresponding NJPDES permit numbers of the wastewater treatment plants to which these municipalities discharge their wastewater after use.

Discharge Location

In order to develop the information shown in Field #9 through #14, baseline data were obtained from the Wastewater Facilities Regulation Program, the Municipal Wastewater Assistance Element, the Water Supply Element and the Office of Regulatory Policy (now called the Office of Land and Water Planning.) In addition, certain files from the above mentioned Elements required further research and data extraction in order to fulfill the requirements of the Depletive Water Use analysis.

Field #9: (*New Jersey Pollutant Discharge Elimination System Permit Number*) This field lists the permit numbers with the associated wastewater treatment plants shown in Field #10.

Field #10: (*Wastewater Treatment Plant*) This field shows the name of the wastewater treatment plant (WWTP) receiving the wastewater from the various utilization areas as discussed above, which are supplied by the surface or ground water diversions listed in Field #2.

Field #11: (*Discharge Receiving Water*) This field lists the body of water which receives the wastewater effluent discharge from the WWTP listed in Field #10. The various bodies of water included in this field are: rivers, streams, brooks, creeks, bays, ponds, oceans, ditches, lakes and ground water.

Field #12: (*Actual Average Annual WWTP Discharge*) This field shows the effluent discharge amounts from the WWTP averaged for annual discharge in MGD for the time period 1986 through 1988, which corresponds to the same time period utilized for water withdrawal data in Field #8. As can be seen from the Depletive Water Use spreadsheet in Appendix A, a WWTP name in Field # 10 can appear several times, but the total discharge amount for that particular WWTP is only listed once in Field #12.

Field #13: (*Discharge Location*) this field lists the location of each WWTP discharge by the same four digit county /municipality code utilized by the BWA. (see discussion for Field #6).

Field #14: (*Specific Discharge Location*) this field is separated into two sub-fields. The first sub-field indicates the discharge location relative to whether the withdrawal is depletive or not and also if it is being discharged within the RWRPA. When the discharge was being made to another RWRPA, the second sub-field lists that RWRPA. If no entry was made into this sub-field, then the discharge was being made within the same RWRPA. The discharge codes used and an explanation of their meaning are listed in **Table 4** on page 26.

Table 4
Specific Discharge Location Codes

Discharge Code	Interpretation
WAIS	***Within RWRPA In-stream***: The discharge is to the streams within the RWRPA. The water is assumed to be available for reuse and therefore non-depletive in nature.
WAOS	***Within RWRPA On-site***: The discharge is on-site within the RWRPA. Examples of such discharge are agricultural use, discharges to the septic system and land disposal. In the case of agricultural use, it was assumed that 50% of the water withdrawal was depletive. (More realistic assumptions will be made at a later date using crop-specific information). All other withdrawals had no depletive water use.
OAS	***Outside RWRPA to Stream***: The discharge is to streams outside the RWRPA. The water in this category is depletive to the source RWRPA but may be available to the outside RWRPA in the form of a transfer.
OB	*Ocean/Bay*: The discharge is to the ocean or the bay. This water was assumed to be totally depletive. If the discharge was out of one RWRPA to another and then went to the ocean or bay, then the RWRPA to which the water was transferred to was also shown. The discharge was then depletive to both of the RWRPA's, care being taken that there was no double-counting of water.

Since these four codes in essence explicitly define the depletive water use analysis, these scenarios are also schematically shown in **Figure 5** on page 27.

One typical example of each scenario, showing various inputs into the Depletive Water Use spreadsheet to evaluate depletive water in Field #15 is presented in the following Tables 4 to 7.

Field #15: (*Total Depletive Water Use*) This field shows the depletive water for each withdrawal from Field #2 in MGD. The actual withdrawal quantity (Field #8) was assumed to be totally depletive, when such a depletion was occurring, except in the case of agricultural water use when it was assumed to be only 50% depletive.

Figure 5 - Schematic Scenario of Discharge Codes

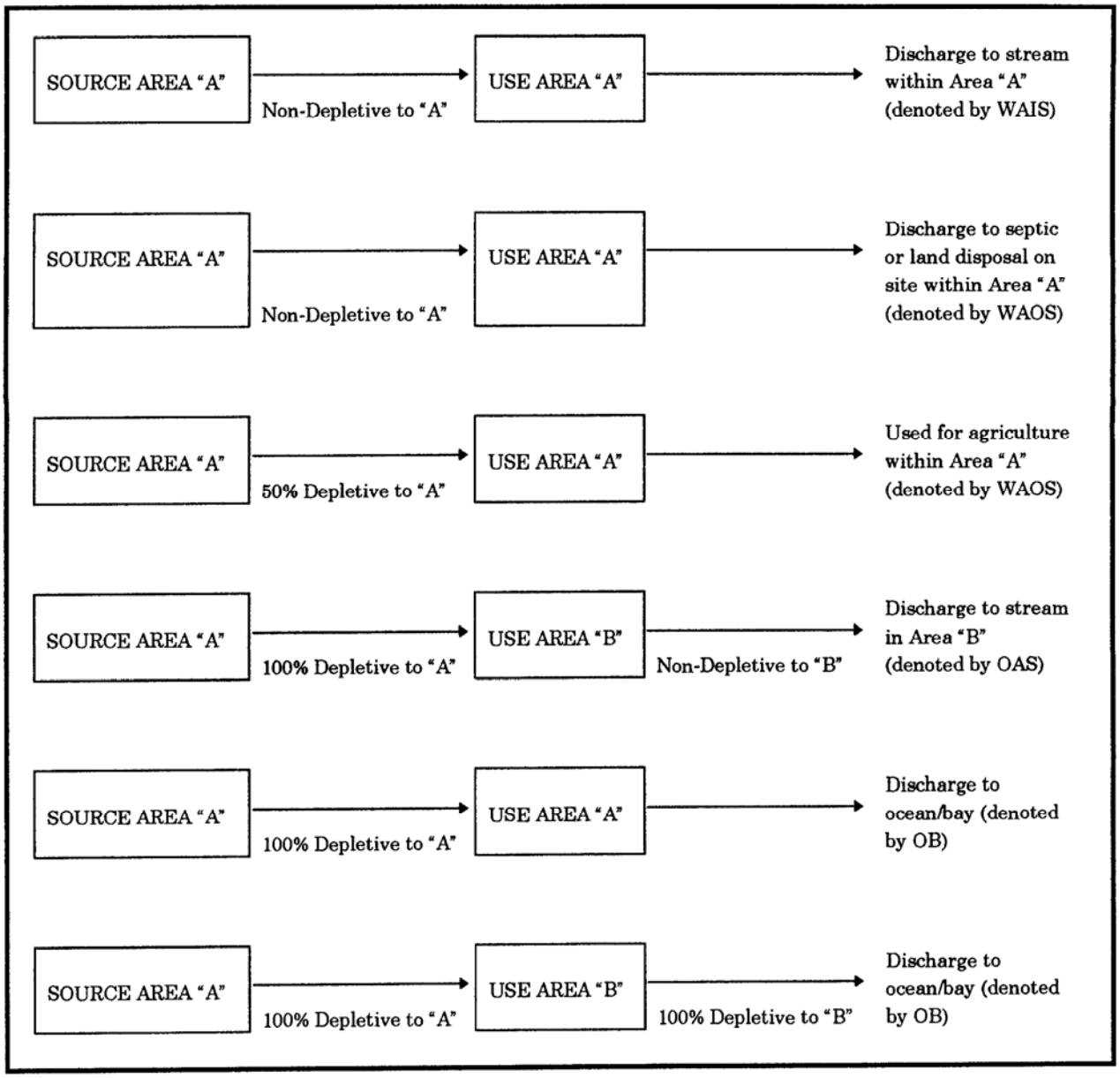


Table 5
Scenario: WAIS (Within RWRPA In-Stream)

Field #1	= Water Allocation Permit #	= 5099		
Field #2	= Surface or Ground Water Diversion	= Passaic Valley Water Commission		
Field #3	= Source Diversion	= SPPAS	= Passaic River	
Field #4	= Province	= PGL	= Glaciated Piedmont	
Field #5	= Category & Type of Diversion	= PS	= Surface water diversion for potable supply	
Field #6	= Diversion Location	= 3105	= Passaic County/ Little Falls Twp.	
Field #7	= RWRPA #	= 4	= Upper Passaic River and Tributaries	
Field #8	= Actual Average Annual Withdrawal	= 0.613 mgd		
Field #9	= NJPDES Permit #	= NJ0029386		
Field #10	= Wastewater Treatment Plant	= Two Bridges STP		
Field #11	= Discharge Receiving Water	= Pompton River		
Field #12	= Actual Average Annual WWTP Discharge	= 3.49 mgd (shown elsewhere)		
Field #13	= Discharge Location	= 2716	= Morris County/ Lincoln Park Boro	
Field #14	= Specific Discharge Location	= WAIS	= within RWRPA in-stream RWRPA Where Discharge is Being Made	= No entry (same as Field #7)
Field #15	= Total Depletive Water Use	= 0 mgd		

The Passaic Valley Water Commission supplies water to the utilization area of Lincoln Park Boro which is located in RWRPA 4. Lincoln Park treats its wastewater through the Two Bridges STP which is located in Morris County/Lincoln Park Boro within RWRPA 4, and the effluent is discharged to the Pompton River. Therefore, this particular withdrawal has a depletive water use of 0 mgd.

Table 6
Scenario: WAOS (Within RWRPA On-Site)

Field #1	=	Water Allocation Permit #	=	2262P				
Field #2	=	Surface or Ground Water Diversion	=	Upper Montclair Country Club				
Field #3	=	Source Diversion	=	GTRB	=	Brunswick Formation		
Field #4	=	Province	=	PGL	=	Glaciated Piedmont		
Field #5	=	Category & Type of Diversion	=	AG	=	Agricultural Ground Water		
Field #6	=	Diversion Location	=	1302	=	Essex County/ Bloomfield Town		
Field #7	=	RWRPA #	=	5	=	Lower Passaic/ Rahway Rivers		
Field #8	=	Actual Average Annual Withdrawal	=	0.086 mgd				
Field #9	=	NJPDES Permit #	=	N/A				
Field #10	=	Wastewater Treatment Plant	=	N/A				
Field #11	=	Discharge Receiving Water	=	N/A				
Field #12	=	Actual Average Annual WWTP Discharge	=	N/A				
Field #13	=	Discharge Location	=	1302	=	Essex County/ Bloomfield Town		
Field #14	=	Specific Discharge Location	=	WAOS	=	within RWRPA on-site RWRPA Where Discharge is Being Made	= 5 =	Lower Passaic/ Rahway Rivers
Field #15	=	Total Depletive Water Use	=	0.043 mgd				

The withdrawal diversion is used for agricultural use within RWRPA 5 in Bloomfield, Essex County. We assumed that half of the total diversion amount (Field #8) was depletive, while the other half of the diversion was assumed to have returned to the source RWRPA surface and ground water systems as non-depletive.

Table 7
Scenario: OB (Ocean/Bay)

Field #1	= Water Allocation Permit #	= 5099				
Field #2	= Surface or Ground Water Diversion	= Passaic Valley Water Commission				
Field #3	= Source Diversion	= SPPAS	= Passaic River			
Field #4	= Province	= PGL	= Glaciated Piedmont			
Field #5	= Category & Type of Diversion	= PS	= Surface Water Diversion for potable supply			
Field #6	= Diversion Location	= 3105	= Passaic County/ Little Falls Twp.			
Field #7	= RWRPA #	= 4	= Upper Passaic River and Tributaries			
Field #8	= Actual Average Annual Withdrawal	= 1.556 mgd				
Field #9	= NJPDES Permit #	= NJ0021016				
Field #10	= Wastewater Treatment Plant	= Passaic Valley STP				
Field #11	= Discharge Receiving Water	= Upper New York Bay				
Field #12	= Actual Average Annual WWTP Discharge	= 225.914 mgd (This is the total effluent discharge of WWTP)				
Field #13	= Discharge Location	= 1314	= Essex County/ Newark City			
Field #14	= Specific Discharge Location	= OB	= Ocean/Bay RWRPA Where Discharge is Being Made	= 5	= Lower Passaic/ Rahway Rivers	
Field #15	= Total Depletive Water Use	= 1.556 mgd				

The Passaic Valley Water Commission supplies water to the utilization area of Fair Lawn Boro which is outside RWRPA 4, the withdrawal location. Fair Lawn Boro (RWRPA 5) discharges its wastewater through the Passaic Valley STP to the Upper New York Bay. Therefore, the depletive water use for this particular withdrawal is 1.556 mgd.

Table 8
Scenario: OB - Transfer (Ocean/Bay)

(Transfer of water between two major purveyor systems within the same RWRPA)

Field #1	=	Water Allocation Permit #	=	5099						
Field #2	=	Surface or Ground Water Diversion	=	Passaic Valley Water Commis-sion						
Field #3	=	Source Diversion	=	SPPAS	=	Passaic River				
Field #4	=	Province	=	PGL	=	Glaciated Piedmont				
Field #5	=	Category & Type of Diversion	=	PS	=	Surface Water Diver-sion for potable supply				
Field #6	=	Diversion Location	=	3105	=	Passaic County/Little Falls Twp.				
Field #7	=	RWRPA #	=	4	=	Upper Passaic River and Tributaries				
Field #8	=	Actual Average Annual Withdrawal	=	20.465 mgd						
Field #9	=	NJPDES Permit #	=	NJ0021016						
Field #10	=	Wastewater Treat-ment Plant	=	Passaic Valley SC						
Field #11	=	Discharge Receiving Water	=	Upper New York Bay						
Field #12	=	Actual Average Annual WWTP Discharge	=	225.914 mgd (This is the total effluent discharge of WWTP which in-cludes other municipalities)						
Field #13	=	Discharge Location	=	1314	=	Essex County/Newark City				
Field #14	=	Specific Discharge Location	=	OB	=	Ocean/Bay RWRPA Where Discharge is Being Made	=	5	=	Lower Passaic/ Rahway Rivers
Field #15	=	Total Depletive Water Use	=	20.465 mgd						

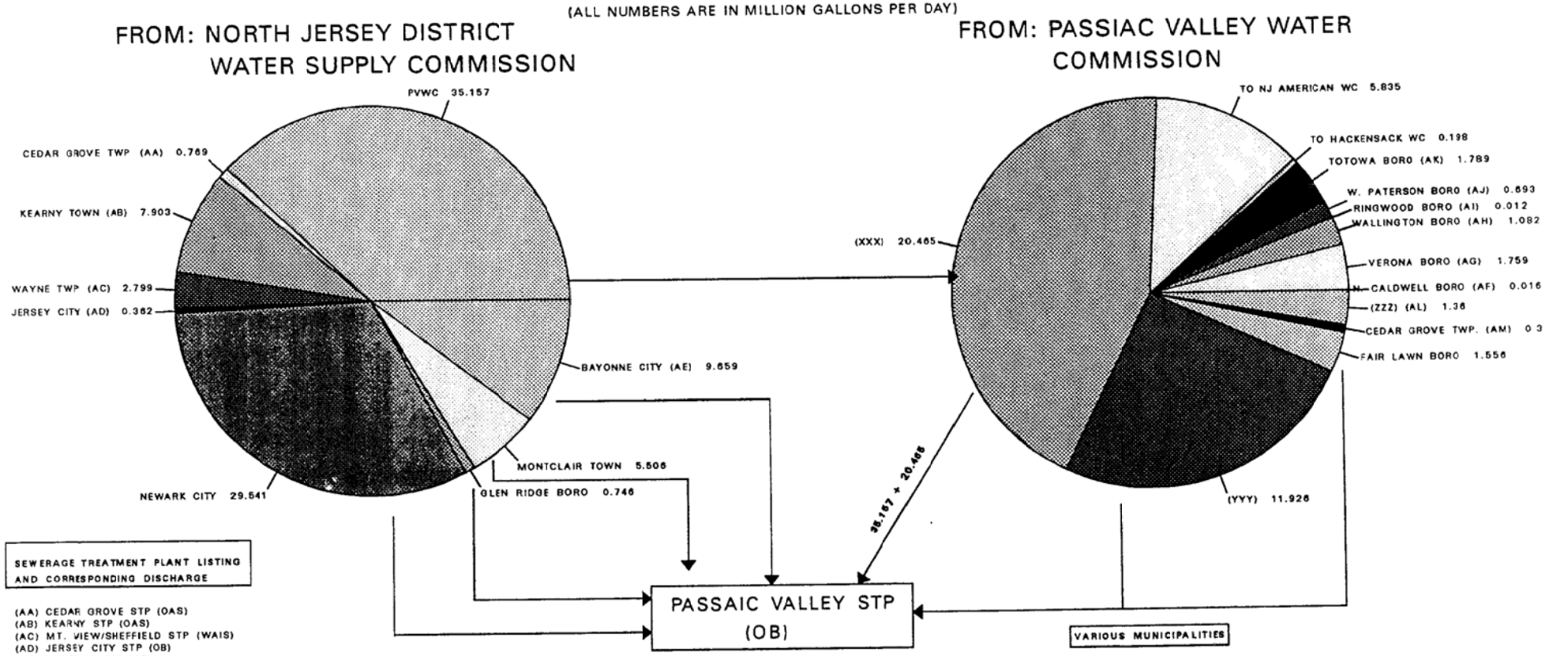
The Passaic Valley Water Commission (PVWC) is one of the partners of the North Jersey District Water Supply Commission (NJDWSC). In addition to 46.991 mgd of their own supply from the Passaic River, PVWC also received 35.157 mgd from the NJDWSC as a partnership share for Passaic/Clifton/Paterson, totaling a supply of 82.148 mgd. The 35.157 mgd supply from NJDWSC, whose source is located in RWRPA #4 was assumed as depletive to RWRPA #4 and discharging to the Passaic Valley SC after use by Passaic/Clifton/Paterson. The PVWC also sold water to other municipalities amounting to 26.526 mgd including 5.835 mgd to NJ American WC and 0.198 mgd to Hackensack WC and supplementing supplies to Passaic City, Clifton City, Paterson City, Prospect Park and West Paterson. The additional supplemental amount of 20.465 mgd (82.148 - 35.157 - 26.526) after use by the above five municipalities was treated by the Passaic Valley SC located in Newark City, Essex County and the effluent was discharged to Upper New York Bay. Therefore, the depletive water use for this withdrawal was 20.465 mgd. Since this is a typical case of depletive use involving two major purveyor water systems, this example is also schematically presented on Figure 6, page 32. There were other sales from PVWC which also fall into scenario "OB", and which are depletive to RWRPA #4. These are shown in Figure 6. These dischargers, coded as "OB" and supplied by PVWC are: Nutley, Lodi, Harrison, Elmwood Park, North Arlington, Garfield, Haledon, Hawthorne and Fair Lawn. All of these municipalities discharge their wastewater to Passaic Valley SC.

FIGURE 6

SCHEMATIC OF TABLE #7

SOURCES IN RWRPA #4

(ALL NUMBERS ARE IN MILLION GALLONS PER DAY)



SEWERAGE TREATMENT PLANT LISTING AND CORRESPONDING DISCHARGE

(AA) CEDAR GROVE STP (OAS)
(AB) KEARNY STP (OAS)
(AC) MT. VIEW/SHEFFIELD STP (WAIS)
(AD) JERSEY CITY STP (OB)
(AE) BAYONNE STP (OB)
(AF) CALDWELL STP (WAIS)
(AG) VERONA STP (OAS)
(AH) WOOD-RIDGE STP (OAS)
(AI) WANNAQUE REG. STP (OAS)
(AJ) WEST PATERSON STP (OAS)
(AK) RIVERVIEW DR. STP (OAS)
(AL) TWO BRIDGES STP (WAIS)
(AM) CEDAR GROVE STP (OAS)

(XXX) PASSAIC CITY, CLIFTON CITY, PATERSON CITY, PROSPECT PARK BORO, AND PART OF WEST PATERSON.

(YYY) NUTLEY TOWN (2.644), LODI BORO (2.148), HARRISON TOWN (2.010), ELMWOOD PARK BORO (1.870), NORTH ARLINGTON BORO (1.706), GARFIELD BORO (1.377), HALEDON BORO (0.158), HAWTHORNE BORO (0.013).

(ZZZ) BLOOMINGDALE BORO (0.461), FAIRFIELD BORO (0.286), LINCOLN PARK BORO (0.613).

SOURCE: NJDEP, Office of Land and Water Planning

Municipalities Served by Purveyors with Associated WWTPs (Appendix B):

Supplemental Databases Developed

This database lists all municipalities in the state by name and county/municipality four digit code sorted alphabetically first by county and then within each of the counties, alphabetically by municipality. The corresponding water purveyor names with their number of service connections are also listed for each municipality. In addition, the wastewater treatment plant name and associated NJPDES permit number is linked with each municipality listed in the database. If the municipality or part of the municipality is served by onsite disposal systems, then the word "SEPTICS" appears in the field called "WWTP". In some instances, a few municipalities are served by both a WWTP and septics and listed accordingly. Lastly, the RWRPA location of each municipality is also shown on the database.

The Lotus 1-2-3 version 3.1 software utilized to develop all the supplemental databases listed here is capable of sorting the fields a number of different ways to provide the user with the best possible structure in order to perform a specific task as well as provide a useful reference listing for water supply planning analyses.

Municipality Names with RWRPA and County / Municipality Codes (Appendix E):

This database lists the 567 municipality names sorted alphabetically with their corresponding RWRPA location as well as the four digit county/municipality code.

Surface Water Diversion Purveyors with Municipalities Served (Appendix F):

The final supplemental database shows the source location from which surface water from water purveyor diversions are withdrawn, what municipalities utilize the water and then where the water is discharged. The overall format of this database is very similar to Appendix A, the Depletive Water Use spreadsheet except for the following:

Appendix F includes the utilization area which lists all the municipalities that use the source withdrawal water; Appendix A does not. Appendix F does not contain the field for discharge receiving waters, Appendix A provides these results.

CHAPTER FOUR

Sensitivity Analysis

Problems with the Data (Quality Control)

The effluent flows from a large number of wastewater treatment plants operated by small industrial dischargers were not accurately reported to the Wastewater Facilities Regulation Program of the Department. Efforts were made to go through individual paper files of those systems to re-calculate the effluent discharge amount. The accuracy of the data was improved after careful analysis and re-calculation of the discharge amounts in the paper files. Since most of these industrial discharges were made by smaller industries, the overall impact on the resultant quantitative discharge was not critical. However, the corrections to these data were important to the accuracy of the Depletive Water Use spreadsheet as a whole.

Data from those public wastewater treatment plants which were receiving wastewater flows from the areas supplied by potable water supply systems, however, were found to be reliable and accurate. These quantities were large in comparison to those of smaller industrial discharges and thereby the overall reliability of the results was good.

The Wastewater Facilities Regulation Program is aware of the inaccuracy in the data reported by the industrial dischargers during the 1986-1988 period database. A more reliable reporting of the data is currently taking place. An update of the Depletive Water Use spreadsheet is recommended for a number of reasons. When the spreadsheet is updated by the OLWP's Water Planning Group, more accurate data will be available on industrial dischargers. An update of the spreadsheet is further necessary due to the fact that since the period of 1986-1988 (which was the study period for this report) changes have taken place in the service areas of a few major wastewater treatment facilities. For example, Camden County MUA has included other municipalities into their service area who previously had their own WWTP facilities and will continue to expand in the future. Similarly, the Middlesex County STP has also included other municipalities into their service area. The utilization areas of potable water purveyors are also expanding.

Uncertainties with the Assumptions

There is one major uncertainty in the basic assumption in the agricultural depletive use amounts. It is assumed that 50% of the water withdrawal is depletive for all withdrawals categorized as agricultural use. This may not hold true for certain agricultural uses, such as the cranberry crop, which could be the dominant crop in certain RWRPAs. In the absence of reliable information at the time of compilation, and the fact that the remaining agricultural use of water is for other purposes, the assumption of 50% depletive loss was accepted as an average figure for water supply planning purposes (but not for actual management purposes). Further analysis with respect to agricultural water use is warranted, especially the water use for the cranberry crop, which is non-depletive in nature and predominantly occurs in planning area 18.

The New Jersey Department of Agriculture through the services of the USGS has been conducting a study entitled "Estimated Demand for Agricultural Water for Irrigation Use in New Jersey". However, during the development of the Depletive Water Use spreadsheet, the above mentioned report was not available. The results of this study for the update of the Depletive Water Use spreadsheet should be analyzed and incorporated into the analysis. Further clarification can be made using land use/land cover data for agricultural land uses (from NJDEPE's Geographic Information System) and estimates of irrigated acreage from various agricultural agencies.

The water under discharge code "OB" in field #14 of the Depletive Water Use spreadsheet was assumed to be 100% depletive. If a raw or treated water (from water purveyor diversions) transfer took place from one RWRPA to another and then was discharged to the ocean or bay, this discharge was also considered 100% depletive. This particular assumption was applied to both surface and ground water withdrawals and did not consider the fact that had there been no transfer or withdrawals of surface waters, the flows from the streams would have eventually been discharged to the ocean or bay anyway. Since this basically represents all of the surface water depletive use, this category of the depletive use should be further investigated and a true depletive loss should be quantified. From a viewpoint of the total depletive water use analysis, however, the assumption of surface water being discharged directly to the ocean or bay is acceptable.

CHAPTER FIVE

Spreadsheet Improvements and Recommendations

Refinements to Existing Fields

With regard to the Depletive Water Use spreadsheet found in Appendix A, the second field named **"Surface or Ground Water Diversion"** currently contains public and investor-owned purveyor, industrial and agricultural withdrawal data for surface waters, unconfined ground water and confined ground water. This field should also include residential self-supplied private domestic well data for each municipality in the state, as a certain level of depletion occurs even when septic systems are used. A small percentage of residential, self-supplied systems may discharge to WWTP's.

This modification could be an addition to the existing "Surface and Ground Water Diversion" field by including a code for this type of diversion within the fourth field named "Category and Type Diversion". However, data regarding actual diversion source and withdrawal amount does not exist for residential self-supplied private domestic wells. Therefore, it may be best to include data on residential wells on a separate table or spreadsheet. This particular change could be accomplished by utilizing the SWSP revision water balance model database outputs from Tasks 2 and 3. Information such as the number of residential wells indicated by the 1990 census by municipality, per capita usage rates and sewer service areas exist in these and other databases, would assist in the development of residential domestic well data by municipality.

The last field in the Depletive Water Use database **"Total Depletive Water Use"** should be modified the following way:

Divide this particular field into two new fields to show depletive water use as being either 1) direct sewage or 2) raw/treated water from water purveyor diversion transfers from adjacent RWRPA's. This could further be broken down to sub-watersheds so that any level of aggregation is possible. This could be accomplished by using the detailed water purveyor breakdowns for surface and ground water (from the baseline BWA files) which were developed for construction of the Depletive Water Use spreadsheets. In addition, database

outputs from Tasks 2 and 3 could also be utilized to assist in this effort.

Withdrawal and Discharge Locations could be improved from the current municipal code to an accurate field location. When combined with other GIS information, automated identification of depletive uses will be possible with respect to RWRPA, individual water source, municipality or county.

Additions of New Fields

"Total Number of Wells"; this new field should be added to the Depletive Water Use spreadsheet in order to show the total number of wells for each water allocation withdrawal. This task could be accomplished by utilizing existing data from the BWA baseline files previously provided. The current arrangement shows the total water allocation withdrawal, which could be from one well or several wells.

"Withdrawal Rank Order (Upstream to Downstream)"; this new field could actually show three different pieces of information within one field. The following six digit coding system could be used:

- first and second digits would indicate the RWRPA location of the withdrawals;
- third and fourth digits would indicate the sub-basin each withdrawal is located within each RWRPA;
- fifth and sixth digits would indicate the specific order of each withdrawal from upstream to downstream within the sub-basin of the RWRPA.

This could be accomplished by using a listing which was prepared during the development of the Depletive Water Use spreadsheet which shows RWRPA's 1 to 23 with the municipalities ranked from upstream to downstream. This particular listing needs to be quality checked for accuracy and also does not contain sub-basin breakdowns for the RWRPA's.

"Total Consumptive Water Use"; this new field could show how consumptive the various withdrawals are as well as the categories of withdrawals (industrial, agricultural, residential, etc.). This can be calculated for water supply planning purposes from the existing fields in the spreadsheet, namely the Actual Average Annual Withdrawal and the Actual Average Annual WWTP Discharge amounts.

"**Water Utilization Area**"; this information does exist as a separate spreadsheet only for surface water purveyors in Appendix F. This new field could show the actual municipality or municipalities that a withdrawal serves for the remaining withdrawals not covered in Appendix F. For example, a water purveyor with a withdrawal from an unconfined aquifer provides water to three different municipalities in one county. This information is critical in determining and linking where water supplies originate, where they are used and then ultimately where they are discharged. This new field can be developed using BWA quarterly reports and staff report files, Water Quality Planning files which contain wastewater treatment plant information and Areawide Water Quality Management Plan reports, and the information collected during the development of the Depletive Water Use spreadsheet.

CHAPTER SIX

Results and Conclusions

RWRPA by RWRPA Depletive Use Outcomes

The impacts of depletive water use on regional and statewide water supplies are summarized in **Table 9** found on page 42. This table shows the actual diversions (in MGD), depletive water (in MGD), and depletive water as a percent of diversion for both surface and ground water uses.

The net depletive water use for each RWRPA is computed as the total depletive water minus the water which the area received as discharged water (OAS) from outside its own RWRPA. This water which was categorized as "OAS" however, was assumed to be equal to the diverted water from the source RWRPA.

The discharge made to the outside RWRPA under the "OAS" category, however, is a discharge from a WWTP, which could in reality be less than the diverted amount due to system losses and consumptive uses in the RWRPA of origin. In certain cases, this could be even higher than the diverted amount, where the stormwater is being discharged through a WWTP. This discharge could also be affected by to infiltration/inflow.

The results of the study are tabulated in Table 9. These results are presented below:

- Total statewide permitted diversion of surface water was about 1645 mgd, averaged for 1986-1988;
- Total statewide permitted diversion of ground water was about 635 mgd, averaged for 1986-1988;
- Total depletive use of surface water was about 489 mgd, whereas that of ground water was 260 mgd;
- Surface water depletive use was 29.7% of total surface water diversion with all the industrial withdrawals considered and 70.2% if the industries using water as once-through systems are omitted;
- Ground water depletive use was 40.9% of total ground water diversion with all the industrial withdrawals

considered and 41.3% if the industries using water as once-through systems are omitted;

- Total surface water that was depletive to one RWRPA but was available to the stream in another RWRPA for reuse was about 33 mgd. The same scenario from ground water discharged to surface water and available as surface water for reuse was about 22 mgd. The total "OAS" water was therefore 55 mgd. This quantity, however, was taken as the diverted water in the RWRPA, and could be less than the amount shown, due to being discharged as effluent to the stream as mentioned earlier.

A cursory examination of diversion versus the effluent discharge from WWTPs shows that 20% of diverted water is lost due to system losses and consumptive use. This means that the "OAS" amount when reduced by 20% will give about 44 mgd as "OAS" depletive water available for reuse. The depletive surface water when reduced by total OAS water gives 434 (489 - 55) mgd as net depletive water, which reduces the surface depletive loss in percent of diversion to 26.4% instead of 29.7% when all of the industries are considered and 61.1% instead of 70.2% if the industries using water as once-through systems are omitted. Table 9 was developed using Lotus 1-2-3 version 3.1+ software.

Impacts of Depletive Use / Future Steps

The Depletive Water Use analysis can be utilized to assess the impacts of current and proposed depletive withdrawals on the state's various water supply systems. This analysis in combination with the ongoing Statewide Water Supply Plan revision employs the methodology of an inflow/outflow model in each of the 23 RWRPAs. The outflow component is important in that reductions in that fraction can result in stream depletion and saltwater migration. Reductions are caused by the out-of-basin transfers of surface or ground water, either through water purveyor raw/treated diversion transfers or water withdrawals that are converted to sewage and treated /discharged to an adjacent RWRPA, which are all considered depletive.

The above mentioned assessment for depletive use has been prepared roughly for each of the 23 RWRPAs. In the future, the assessment should be expanded to evaluate depletive withdrawals above potable water supply intakes so as to estimate the impact on safe yield. Once completed, depletive

uses proposed in the Water Quality Management Plan (WQMP) amendments could be assessed in these cases. In addition, similar evaluations could be made of WQMP amendments that would result in depletive ground water withdrawals near the saltwater/freshwater interface in aquifers vulnerable to saltwater intrusion so as to insure that WWTP projects would not compromise the integrity of regional water supplies. While the expanded database is being compiled for reservoir streams and existing and potential wells near the aquifer salt front, depletive use thresholds should be developed with the assistance of the NJGS and USGS to insure that hydrological assumptions are sound and non-conjectural.

With the above analysis in place, water supply quantity and quality would be integrated with respect to insuring that depletive WWTP projects do not deplete reservoir streams or accelerate saltwater intrusion in regional water supply aquifer systems.

In addition, the above approach could be expanded to take into consideration regional freshwater-dependent natural resources that are vulnerable to depletive losses. Among the resources that the approach would methodically evaluate would be trout production/maintenance streams, non-degradation streams (Category 1), shellfish and other environmentally-sensitive streams and sub-basins where high value wetlands are areally extensive. The various resources could be ranked with respect to their vulnerability to depletive freshwater loss and their sensitivity to changes in water quality.

The secondary and cumulative impacts to water supplies and natural resources could be minimized if depletive sewering could be reduced. Also, the approach could be used to flag streams and rivers that have dischargers on them and where low flow may be reduced by upstream depletive use. The approach for water supplies and natural resources as discussed above may prove to be helpful in maintaining parallel plans at both the local and regional scales. If fully adopted, the Department would be aware well in advance where future depletive and/or non-depletive sewering could be appropriately located. If the Department knew where these

Table 9
Impacts of Depletive Water Use on Regional Water Supplies

RWRPA	TOTAL AVAILABLE WATER	ACTUAL DIVERSION (MGD)		DEPLETIVE WATER (MGD)		DEPLETIVE WATER AS % OF DIVERSION		OAS DEPLETIVE WATER (MGD)		NET DEPLETIVE [-] NET GAIN [+] (MGD)	
		SURFACE	GROUND	SURFACE	GROUND	SURFACE	GROUND	SURFACE	GROUND	SURFACE	GROUND
1	20.1	19.063	12.751	0.135	0.219	0.7%	1.7%	0.000	0.294	-0.135	0.075
2	10.1	0.000	0.000	0.000	0.000	0.0%	0.0%	0.000	0.000	0.000	0.000
3	88.5	9.815	9.674	0.075	1.804	0.8%	18.6%	0.135	0.219	0.060	-1.585
4	500.5	268.096	68.122	249.905	20.163	93.2%	29.6%	23.238	3.822	-226.667	-16.341
5	56.1	30.605	41.206	17.015	22.713	55.6%	55.1%	0.000	0.574	-17.015	-22.139
6	95.7	96.481	3.929	2.586	0.066	2.7%	1.7%	8.100	0.574	5.514	0.508
7	9.8	78.464	1.995	0.000	0.294	0.0%	14.7%	0.651	1.586	0.651	1.292
8	26.8	0.000	4.255	0.000	1.846	0.0%	43.4%	0.000	1.587	0.000	-0.259
9	83.6	103.639	6.442	0.031	0.055	0.0%	0.9%	0.000	0.000	-0.031	-0.055
10	270.5	152.137	41.023	133.580	24.642	87.8%	60.1%	0.835	6.766	-132.745	-17.876
11	32.7	0.902	43.308	0.814	34.005	90.2%	78.5%	0.000	0.000	-0.814	-34.005
12	64.2	30.947	22.493	29.563	20.437	95.5%	90.9%	0.000	0.347	-29.563	-20.090
13	39.1	0.366	6.932	0.185	6.758	50.5%	97.5%	0.000	0.000	-0.185	-6.758
14	134.8	646.949	36.355	9.724	2.890	1.5%	7.9%	0.371	2.382	-9.353	-0.508
15	11.2	1.163	13.927	1.153	13.927	99.1%	100.0%	0.000	0.000	-1.153	-13.927
16	20.0	8.104	22.485	7.891	15.415	97.4%	68.6%	0.000	0.000	-7.891	-15.415
17	36.8	73.999	104.056	0.372	2.801	0.5%	2.7%	0.000	2.980	-0.372	0.179
18	72.8	38.498	85.982	20.944	49.113	54.4%	57.1%	0.000	0.494	-20.944	-48.619
19	25.0	0.032	7.579	0.016	7.563	50.0%	99.8%	0.000	0.000	-0.016	-7.563
20	43.3	16.697	12.230	12.841	9.883	76.9%	80.8%	0.000	0.000	-12.841	-9.883
21	54.0	67.387	53.690	1.103	10.292	1.6%	19.2%	0.000	0.000	-1.103	-10.292
22	31.1	0.825	17.287	0.415	3.875	50.3%	22.4%	0.000	0.000	-0.415	-3.875
23	29.0	0.353	18.873	0.177	10.879	50.1%	57.6%	0.000	0.000	-0.177	-10.879
TOTAL	**1755.7**	**1644.522**	**634.594**	**488.525**	**259.640**	**29.7%**	**40.9%**	**33.330**	**21.625**	**-455.195**	**-238.015**
<MINUS> *Industrial. Use		948.300	5.810	0.000	0.000	xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx
TOTAL		**696.222**	**628.784**	**488.525**	**259.640**	**70.2%**	**41.3%**	**22.302**	**23.756**	**-466.223**	**-235.884**

*** Denotes industries using water for once-through system, and those not affecting the flow of the surface water streams.**

activities would take place, ultimate point and non-point source loadings could be estimated and subsequently apportioned for the various municipalities comprising the RWRPA.

For example, since reservoir and environmentally-sensitive streams (trout production, shellfish areas, etc.) should not be impaired by significant depletive uses, sewering in these areas would be harmful unless this infrastructure was of a non-depletive nature or replacement water was transported into the basin from an adjacent basin. Therefore, development in these areas would be limited to non-depletive private well/septic systems under this scenario.

The benefits derived from the discharge of ground water withdrawals as wastewater should also be considered. Such discharges made above a surface water intake could provide added flows to the streams during drought or low flow conditions and also a variety of other benefits. For example, in the Delaware Basin, current wastewater discharges made below the last surface water intake provide salinity control, navigation flows and waste assimilation.

Many of the issues outlined here require a sound and easily updatable database. In addition, the analyses that would be required necessitate a visual ability to present the information. The format necessary to accomplish this would be, in addition to any database/spreadsheet development, a mapped format utilizing the existing GIS which resides within the Department. With these two pieces of information available, the Department would be able to comprehensively evaluate and proactively plan for current and future water supplies for the state of New Jersey.