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NOTICE OF PROPOSED RULEMAKING

AND PUBLIC HEARINGS

Notice is hereby given that the Delaware River Basin Commission will hold three public hearings in accordance with this notice. On May 25, 1983, a hearing will be held at 3:00 P.M. following the Commission's regular May business meeting, which is open to the public.

An informal pre-meeting conference among the Commissioners and staff will be open for public observation beginning at 11:00 A.M.

The conference, meeting and hearing will be held in the Pennsylvania West Room of the Philadelphia Centre Hotel at 1725 Kennedy Boulevard, Philadelphia, Pennsylvania.

The second hearing will be held on June 2, 1983 in the Goddard Conference Room of the Commission's offices at 25 State Police Drive, West Trenton, New Jersey.

The third hearing will be held on June 3, 1983 in the Banquet Hall of the Karsten Inn on Route 6 in Port Jervis, New York.

Both the June 2 and June 3 hearings will be held from 1:00-5:00 P.M. and will resume at 7:00 P.M.

The subjects of the hearing will be as follows:

I. Amendments to the Comprehensive Plan Relating to Water Quality Standards.

Article 3 of the Commission's Basin Regulations - Water Quality contains the Comprehensive Plan's water quality standards. Within this Article are certain salinity control standards for the Delaware estuary. The Commission is now considering amendments to its Comprehensive Plan and Basin Regulations - Water Quality to revise the salinity control standards. Specifically, it is proposed to:

1. Amend the Comprehensive Plan and subsection 3.30.3-C.12 of the Basin Regulations - Water Quality to read:

   12. Chlorides. Maximum 30-day average concentration of 180 mg/l at River Mile 98.

2. Insert new Subsection 3.30.3-C.14 to read:

   14. Sodium. Maximum 30-day average concentration of 100 mg/l at River Mile 98.

3. Delete Subsection 3.30.4-C.12.

II. Amendments to the Comprehensive Plan Relating to Water Supply Policy.

Article 2 of the Water Code of the Delaware River Basin includes Commission policy relating to the conservation, development and utilization of Basin water projects. The planning and design of facilities and programs are dependent upon critical conditions during periods of drought. As droughts vary in severity, it is common practice to select, for planning and design of water supply facilities and programs, a drought of sufficient severity to assure the provision of dependable water supplies. Although past DRBC practice has been to assume the most severe drought of record, the Comprehensive Plan does not currently specify a drought criterion for planning and design. The Commission is now considering an amendment to the Comprehensive Plan to add a drought criterion, as recommended in the Final Level B Study and by the parties to the 1954 U.S. Supreme Court Decree. It is proposed to:

1. Amend the Comprehensive Plan and Article 2 of the Water Code of the Delaware River Basin by the addition of a new section 2.400 to read as follows:

2.400 Design Streamflow Criteria

2.400.1 Water Supply. The drought of record, which occurred in the period 1961-1967, shall be the basis for determination and planning of dependable water supply.

2.400.2 Salinity Control. The drought of record, which occurred in the period 1961-1967, shall be the basis for planning and development of facilities and programs for control of salinity in the Delaware estuary.

2.400.3 Waste-Assimilative Capacity. (See Section 4.30.7 of Basin Regulations - Water Quality - Administrative Manual - Part III).

III. Amendment to the Comprehensive Plan Relating to Diversions, Releases, and Reservoir Management During Drought.

Diversions of water from the Delaware River Basin to New York City and northeastern New Jersey, as well as downstream releases from the City's upper Basin reservoirs, are controlled by the 1954 amended Decree of the U. S. Supreme Court, except as may be modified during a Commission-declared state of emergency resulting from a drought or catastrophe pursuant to Section 3.3 of the Delaware River Basin Compact. Such a drought emergency has been declared on two occasions, and experience during these emergencies has shown the value of a drought operation formula setting forth diversion rates and streamflow objectives for guidance of reservoir operations. The Commission is now considering an amendment to the Comprehensive

Plan to adopt such a drought operation formula. Specifically, it is proposed to:

1. Amend the Comprehensive Plan and Article 2 of the Water Code of the Delaware River Basin by the addition of new sections 2.5.3 and 2.5.4 to read as follows:

2.5.3 Schedule of Phased Reductions in Diversions, Releases and Flow Objectives During Drought

A. Criteria Defining Conditions

For purposes of water management pursuant to Section 3.3 and Article 10 of the Compact, diversions of water from the Delaware River Basin by the City of New York and State of New Jersey, compensating reservoir releases from the New York City Delaware Basin Reservoirs, reservoir releases from Beltzville Reservoir, Blue Marsh Reservoir, and other reservoirs under the jurisdiction and control of the Commission, and streamflow objectives at the USGS gaging stations located at Montague, New Jersey, and Trenton, New Jersey, shall be governed by a schedule based upon a differentiation between "normal", "drought warning", and "drought" conditions defined by the combined storage in the Cannonsville, Pepacton and Neversink Reservoirs as set forth in Figure 1 entitled "Operation Curves for Cannonsville, Pepacton and Neversink Reservoirs". The division of the drought-warning zone into upper and lower halves shall be defined as a physically equal division, or 20 billions of gallons in each zone.

B. Schedule of Reductions

The schedules of phased reductions set forth in Tables 1 and 2 shall govern (1) the maximum allowable rates of diversion of waters from the Delaware River Basin by the City of New York and State of New Jersey; (2) the minimum compensating releases to be made by the City of New York from its reservoirs in the upper Delaware Basin; and the streamflow objectives at the USGS gaging stations located at Montague, New Jersey and Trenton, New Jersey.

During "drought" conditions as defined by the Figure entitled "Operation Curves for Cannonsville, Pepacton and Neversink Reservoirs", the streamflow objectives at the Montague and Trenton gaging stations shall be established as set forth in Table 2, in accordance with the seven-day average location of the 250 mg/l isochlor (the "salt front") in the Delaware Estuary.

C. Diversion Allowances and Release Requirements

(1) The City of New York may divert waters from the Delaware Basin at a maximum rate equivalent to the quantities set forth in Table 1.

(2) The State of New Jersey may divert waters from the Delaware River Basin, from the Delaware River or its tributaries in New Jersey, at a maximum rate equivalent to the quantities set forth in Table 1.

OPERATION CURVES FOR
CANNONSVILLE, PEPACTON AND NEVERSINK RESERVOIRS

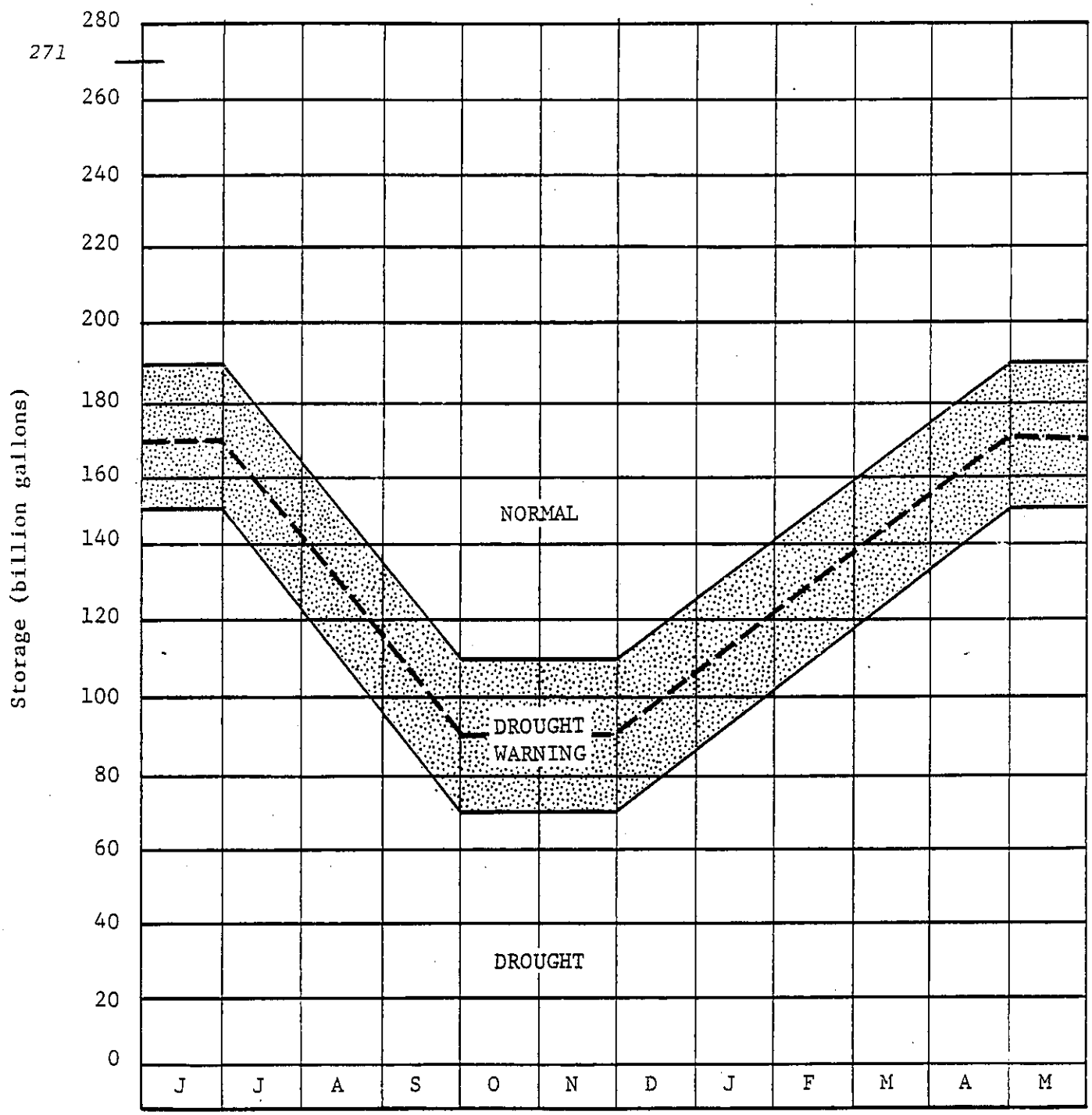


FIGURE 1

TABLE 1

Interstate Operation Formula for Reductions
In Diversions, Releases, and Flow Objectives
During Periods of Drought

NYC Storage Condition	NYC Div. mgd	NJ Div. mgd	Montague Flow Objective cfs	Trenton Flow Objective cfs
Normal	800	100	1750	3000
Upper Half-- Drought Warning	680	85	1655	2700
Lower Half-- Drought Warning	560	70	1550	2700
Drought	520	65	1100-1650*	2500-2900*
Severe Drought (to be negotiated based on conditions)				

*Varies with time of year and location of salt front as shown on Table 2.

TABLE 2

Flow Objectives for Salinity Control
During Drought Periods

Seven-day Average Location of "Salt Front," River-mile*	Flow Objective, Cubic Feet Per Second At:					
	Montague, N.J.			Trenton, N.J.		
	Dec-Apr	May-Aug	Sept-Nov	Dec-Apr	May-Aug	Sept-Nov
Upstream of R.M. 92.5	1600	1650	1650	2700	2900	2900
Between R.M. 87.0 and R.M. 92.5	1350	1600	1500	2700	2700	2700
Between R.M. 82.9 and R.M. 87.0	1350	1600	1500	2500	2500	2500
Downstream of R.M. 82.9	1100	1100	1100	2500	2500	2500

*Measured in statute miles along the navigation channel from the mouth of Delaware Bay.

(3) The City of New York shall release water from one or more of its storage reservoirs in the upper Delaware Basin in such quantities designed to maintain the minimum basic rates of flow at the USGS gaging station located at Montague, New Jersey, as set forth in Tables 1 and 2.

D. Computation of Diversions

(1) Diversions by the City of New York during "normal" conditions as defined by Figure 1, shall be computed as provided in Section III.A.4. of the Amended Decree of the U. S. Supreme Court in New Jersey v. New York, 347 U.S. 995 (1954). At no time during a twelve-month period of the Water Year, commencing June 1, shall the aggregate total quantity diverted by the City of New York, divided by the number of days elapsed since the preceding May 31, exceed the maximum permitted rate of diversion.

(2) Diversions by the State of New Jersey during "normal" periods as defined by Figure 1 shall be computed as provided in Section V.3 of the amended Decree of the U.S. Supreme Court in New Jersey v. New York, 347 U.S. 995 (1954). The total diversion by the State of New Jersey shall not exceed an average of 100 mgd in any calendar year. During the months of July, August, September, and October of any year, diversions by the State of New Jersey shall not exceed 100 mgd as a monthly average, and not more than 120 million gallons in any day shall be withdrawn.

(3) Diversions by the City of New York and State of New Jersey set forth in Table 1 during "drought warning" and "drought" conditions as defined by Figure 1 shall be computed as a daily running average, commencing on the day such drought warning or drought operations become effective, as provided in subsection E of this Section. If the allowable diversion for any condition period following entry into drought warning operations is not fully used, the unused portion may not be credited or used during subsequent periods.

(4) Upon return to normal condition operations, following a period of drought warning or drought operations, diversions by the City of New York and State of New Jersey shall be computed as averages commencing upon the date of return to normal operations.

E. Effective Period for Drought Operating Schedule

(1) The schedule of diversion, release and streamflow objectives for "drought warning" operations as provided in Subsection B shall go into effect automatically whenever the combined storage in the New York City Delaware Basin

Reservoirs declines below the drought warning line defined in Figure 1, and remains below that line for five consecutive days.

(2) The schedule of diversions, releases and streamflow objectives for "drought" operations as provided in Subsection B shall go into effect immediately whenever the combined storage in the New York City Delaware Basin Reservoirs declines below the drought line defined in Figure 1, and remains below that line for five consecutive days.

(3) When the combined storage in the New York City Delaware Basin Reservoirs (including the projected water runoff equivalent of actual snow and ice within the watersheds tributary to the reservoirs) reaches a level 15 billion gallons above the drought warning line as defined in Figure 1, and remains above that level for five consecutive days, the drought warning and drought operations schedules set forth in Subsection B shall automatically terminate, and normal operations shall be resumed as provided in the Amended Decree of the U. S. Supreme Court in New Jersey v. New York, 347 U.S. 995 (1954).

(4) Pursuant to Section 3.3(a) of the Compact, the Parties to the U. S. Supreme Court Decree in New Jersey v. New York, 347 U.S. 995 (1954), have given their unanimous consent to adoption and implementation by the Commission of the drought operation schedules provided in this section. The Parties have agreed that the drought operation formula will go into effect automatically, and be binding on parties for not less than 180 days following the triggering of drought warning operations, unless terminated automatically by improved storage conditions as provided in Subsection E.3. During the 180-day period following triggering of drought warning operations, authorized representatives of the City of New York, States of Delaware, New Jersey, and New York, and Commonwealth of Pennsylvania, as parties to the U. S. Supreme Court Decree, shall convene no less frequently than once each month to review current conditions, and they may extend, modify, or extend as modified the schedules provided in this section. If no unanimous agreement as to a continuing drought operation formula is reached within the 180-day period, all Parties shall be released from the terms of the formula and schedules and may pursue their rights and obligations under the Delaware River Basin Compact and the U. S. Supreme Court Decree.

2.5.4 Drought Emergency Actions

A. Criteria Defining Conditions

For purposes of water management pursuant to Section 3.3 and Article 10 of the Compact, the determination of drought warning and drought conditions shall be based upon the combined storage in the Cannonsville, Pepacton and Neversink Reservoirs, in accordance with Figure 1, entitled "Operation Curves for Cannonsville, Pepacton and Neversink Reservoirs". The division of the drought-warning zone into upper and lower halves shall be defined as a physically equal division, or 20 billions of gallons in each zone.

B. Drought Emergency Declaration

It is the policy of the Commission that a drought emergency will be declared for purposes of imposing mandatory in-basin conservation measures and other appropriate actions whenever combined storage in the New York City Delaware Basin Reservoirs falls into the drought zone for five consecutive days as defined in Figure 1. Termination of a drought emergency will be considered by the Commission whenever combined storage in the New York City Delaware Basin Reservoirs reaches a level 40 billion gallons above the drought warning line as defined in Figure 1 and remains above that line for 30 consecutive days. The drought emergency will be terminated by the Commission whenever the combined storage in the New York City Delaware Basin Reservoirs reaches 40 billion gallons above the drought warning line defined in Figure 1 and remains above that line for 60 consecutive days, unless the Commission unanimously agrees to extend the emergency.

C. Effect of Policy

This policy is not intended to extend, impair, or conflict with the Commission's authority under the Compact to declare or terminate a drought emergency or water-shortage emergency in the Basin, or subregion thereof, in other instances as conditions may require.

IV. Amendment to the Comprehensive Plan Relating to Water Conservation Policy.

Article 2 of the Water Code of the Delaware River Basin includes Commission policy relating to the conservation of water. Current policy focuses on total water use throughout the Basin, emphasizing the importance of overall reduction and maximum efficiency of use. While conservation measures can provide significant benefits at any time, conservation during drought periods is especially critical. The distinction between depletive water uses (i.e., uses which permanently remove water from the Basin by evaporation, exportation and other routes) and water which is used, treated and returned to a watercourse is essential because of flow-salinity relationships in the Delaware Estuary and the need to maintain minimum fresh water flows during drought. The Commission is now considering an amendment to the Comprehensive Plan to add policy relating to depletive use reduction during drought, as recommended in the Final Level B Study Report and by the parties to the 1954 U. S. Supreme Court Decree. It is proposed to:

1. Amend the Comprehensive Plan and Article 2 of the Water Code of the Delaware River Basin by the addition of new Section 2.1.4 to read as follows:

2.1.4 Depletive Use Reduction During Drought. It shall be the policy of the Commission that conservation measures in the Basin designed for implementation during drought periods shall be based upon the objective of reducing overall depletive use of fresh water by 15 percent.

V. Application for Approval of the Following Project Pursuant to Section 3.8 of the Delaware River Basin Compact.

New York State Department of Environmental Conservation (D-77-20 CP REVISED). A program to continue on a permanent basis, as conditioned, augmented conservation releases from the New York City Delaware River Basin Reservoirs. The purpose of the program, in effect since 1977 on an experimental basis, is to augment low streamflows below the Cannonsville, Pepacton and Neversink Reservoirs to protect and enhance the recreational use of waters affected by such releases. The proposed release levels are identical to the schedules contained in Rules and Regulations of the New York State Department of Environmental Conservation (Amended Part 671, Reservoir Releases Regulations: Cannonsville, Pepacton, and Neversink Reservoir adopted May 2, 1980). The release levels have been consented to by the City of New York in reliance upon mutual commitments made by the State and City of New York (Stipulation of Discontinuance in The City of New York vs. The State of New York Department of Environmental Conservation, Index No. 5840-80).

Explanatory material relating to these proposed amendments to the Comprehensive Plan may be examined at the Commission's offices. Persons wishing to testify at these hearings are requested to notify the Secretary in advance. Written testimony submitted to the Secretary by June 15, 1983 will be included in the hearing record.

Susan M. Weisman, Secretary
April 22, 1983

Position Paper on
Proposed Amendment to Comprehensive Plan
Regarding the Augmented Conservation Release
Program at the Three Upper-Basin New York City Reservoirs

Table 1 of the attached draft Docket No. D-77-20 CP (REVISED) shows the program of augmented conservation releases from the New York City Delaware River Basin Reservoirs that has been in effect since 1977 on an experimental basis. The purpose of the program is to augment low streamflows below the Cannonsville, Pepacton and Neversink Reservoirs to protect and enhance the recreational use of waters affected by such releases. Preliminary research findings and comments from fishermen and recreationists indicate that the effect of the program has been beneficial and should be continued on a permanent basis (with the constraints provided in Part D of the Docket).

The proposed augmented conservation release levels are identical to the schedules contained in Rules and Regulations of the New York State Department of Environmental Conservation (Amended Part 671, Reservoir Releases Regulations: Cannonsville, Pepacton, and Neversink Reservoirs, adopted May 2, 1980). The release levels have been consented to by the City of New York in reliance upon mutual commitments made by the State and City of New York (Stipulation of Discontinuance in The City of New York vs. The State of New York Department of Environmental Conservation, Index No. 5840-80).

Several comments were made during the public meetings and public review process of the "good faith negotiations" that appear to merit future study and consideration by the State and City of New York as follows:

(1) intermediate water conservation flow levels should prevail during drought alerts and drought warnings;

(2) the thermal stress relief augmented releases should be available under all storage conditions; and

(3) the return to augmented conservation release levels following a drought would not be made until the combined storage in the three reservoirs reaches 25 billion gallons above the drought warning level and remains above that level for 15 consecutive days. This period was felt to be excessive for reinstituting the augmented conservation releases.

The New York State Department of Environmental Conservation and the New York City Department of Environmental Protection should review the above comments, the regulation and the consent order and should submit any appropriate revisions to the program to the DRBC for further consideration and possible action.

DRAFT

DOCKET NO. D-77-20 CP (REVISED)

DELAWARE RIVER BASIN COMMISSION

MODIFICATION TO THE RELEASE SCHEDULES FROM
CANNONSVILLE, PEPACTON, AND NEVERSINK RESERVOIRS
DELAWARE AND SULLIVAN COUNTIES, NEW YORK

Proceedings

The New York State Department of Environmental Conservation (NYDEC) adopted regulations in 1977 to modify the schedule of conservation releases from Cannonsville, Pepacton, and Neversink Reservoirs. The regulations provided for the new schedule of releases to be tried on a limited experimental basis.

The Delaware River Basin Commission (DRBC) approved the experimental release program on May 25, 1977, by Docket decision D-77-20 and extended that approval through May 31, 1983, by Resolution 82-7. Docket decision D-77-20 also directed the parties to the 1954 Decree to develop criteria defining the onset and stages of drought emergencies.

NYDEC proposes to amend the experimental regulations by removing the automatic termination date, deleting the relationship to the "excess quantity" as established by the U.S. Supreme Court Decree (347 U.S. 995 1954) and limiting releases according to a reservoir storage curve in time of drought warning and drought.

Preliminary research findings and comments from fishermen and recreationists indicate that the program has had a beneficial effect. The DRBC held a hearing on May 28, 1980, on the amended release regulations and a proposal that the Commission's approval of the schedule of augmented releases be made permanent.

Reservoir Release Program

A. New Conservation Releases

In place of the previous New York City schedule of conservation releases, a new conservation release schedule on a year-round basis has been tried as an experimental program and is proposed to be continued on a permanent basis. Under this schedule, the minimum releases from Cannonsville, Pepacton, and Neversink Reservoirs will be as follows:

	April 1 - June 14 Aug. 16 - Oct. 31	June 15 - Aug. 15	Nov. 1 - March 31
Neversink	45 cfs*	45 cfs	25 cfs
Pepacton	70	70	50
Cannonsville	45	325	33
	160 cfs	440 cfs	108 cfs

*cubic feet per second

These total conservation releases break down as follows:

TABLE 1

Reservoir and Operative Dates	Column 1 Basic Conservation Release	+	Column 2 Proposed Augmented Conservation Release	=	Column 3 Total New Conservation Release
Neversink					
4/1 - 4/7	5 cfs		40 cfs		45 cfs
4/8 - 10/31	15		30		45
11/1 - 3/31	5		20		25
Pepacton					
4/1 - 4/7	6		64		70
4/8 - 10/31	19		51		70
11/1 - 3/31	6		44		50
Cannonsville					
4/1 - 4/15	8		37		45
4/16 - 6/14	23		22		45
6/15 - 8/15	23		302		325
8/16 - 10/31	23		22		45
11/1 - 11/30	23		10		33
12/1 - 3/31	8		25		33

B. Basic Montague Release

At all times, New York City would be required to make such releases as directed by the River Master designed to maintain a minimum basic flow of 1750 cfs at the Montague gaging station, or the excess release rate during the seasonal period, as already required by the Decree.

C. Special Thermal Stress Releases

Special releases may be made from one or more of the reservoirs in order to relieve thermal stress conditions which pose a threat to fisheries. The total volume of such release shall not exceed 6,000 cfs-days from all reservoirs. Thermal releases, with a one-day lead time, would be made whenever the maximum water temperature in designated downstream areas as determined from measurements at Callicoon, Harvard, Woodbourne, or Hale Eddy is projected to exceed a maximum of 75°F, or a 72°F daily average. If the 6,000 cfs-days reserve is not used by October 31 of any year it will not be used thereafter. No releases for relieving thermal stress would be required from November 1 to April 30 of any year. Releases for purposes of relieving thermal stress shall be at the direction of NYDEC.

D. Drought Warning and Drought Conditions

The augmented conservation release will be reduced to the basic conservation release (shown in Table 1) during drought warning and drought periods as defined by the attached reservoir storage curves marked "Operation Curves for Cannonsville, Pepacton, and Neversink Reservoirs" except that when the Delaware River Master directs releases according to the provisions in the 1954 U.S. Supreme Court Decree, New York City shall make such releases from Cannonsville, Pepacton, and Neversink Reservoirs as are necessary and sufficient to maintain the constant minimum flows specified in "A" above on the West Branch Delaware River, East Branch Delaware River, and the Neversink River, and provided that the total amount of water released from the three reservoirs does not exceed the amount directed by the Delaware River Master. If the amount of directed releases by the River Master is not sufficient to maintain the augmented releases from all three reservoirs, the releases from each reservoir will be determined at the discretion of NYDEC and New York City -- Department of Environmental Protection (NYC - DEP).

Conservation releases shall be returned to normal augmented levels following a drought. Return to normal augmented levels shall not be made unless and until combined storage in the three reservoirs reaches 25 billion gallons above the drought warning level, as shown by the "Operation Curves for Cannonsville, Pepacton, and Neversink Reservoirs" and remains at or above that level for 15 consecutive days.

Findings

The NYDEC's Amended Part 671 Regulations entitled, Reservoir Release Regulations: Cannonsville, Pepacton, and Neversink Reservoirs adopted May 2, 1980, are generally consistent with this proposed action.

The Monitoring and Evaluation Program during the experimental reservoir release period has been reported in two performance reports by NYDEC: one for the year July 1, 1977, through June 20, 1978, and a second for the July 1, 1978, through December 31, 1979 period. These evaluations indicate that the conservation release program has been very effective and beneficial and should be continued. The report includes an estimate that an additional 52,500 -- 65,500 angler-trips annually could result from the release program. The economic value of these additional angler trips could range from $1,650,000 to $2,066,000 annually.

The project does not conflict with nor adversely affect the Comprehensive Plan. It provides beneficial use of the water resources and does not adversely influence the present or future use and development of water resources of the Basin.

Decision

I. The project, as described above, with modifications specified hereinafter, is hereby added to the Comprehensive Plan.

II. The project is approved pursuant to Section 3.8 of the Compact, subject to the following conditions:

a. Approval is subject to all conditions imposed by NYDEC.

b. Monthly summaries of reservoir operations submitted by NYC-DEP to NYDEC shall also be submitted to the DRBC.

c. Detailed operational records of each reservoir, maintained by both the City and State Reservoir Release Managers, shall be available to the DRBC upon request.

d. The provisions of the reservoir release program approved herein shall not be applicable to any action taken by NYC-DEP or NYDEC with regard to the operation of the Cannonsville, Pepacton, or Neversink reservoirs in any emergency situation where there is a threat to the continued existence or safe operation of the dams or tunnels or to any appurtenant structures or to the public health or safety. Any emergency action shall continue only for such time as is necessary to avert the threat and is subject to the approval of the Executive Director of the DRBC.

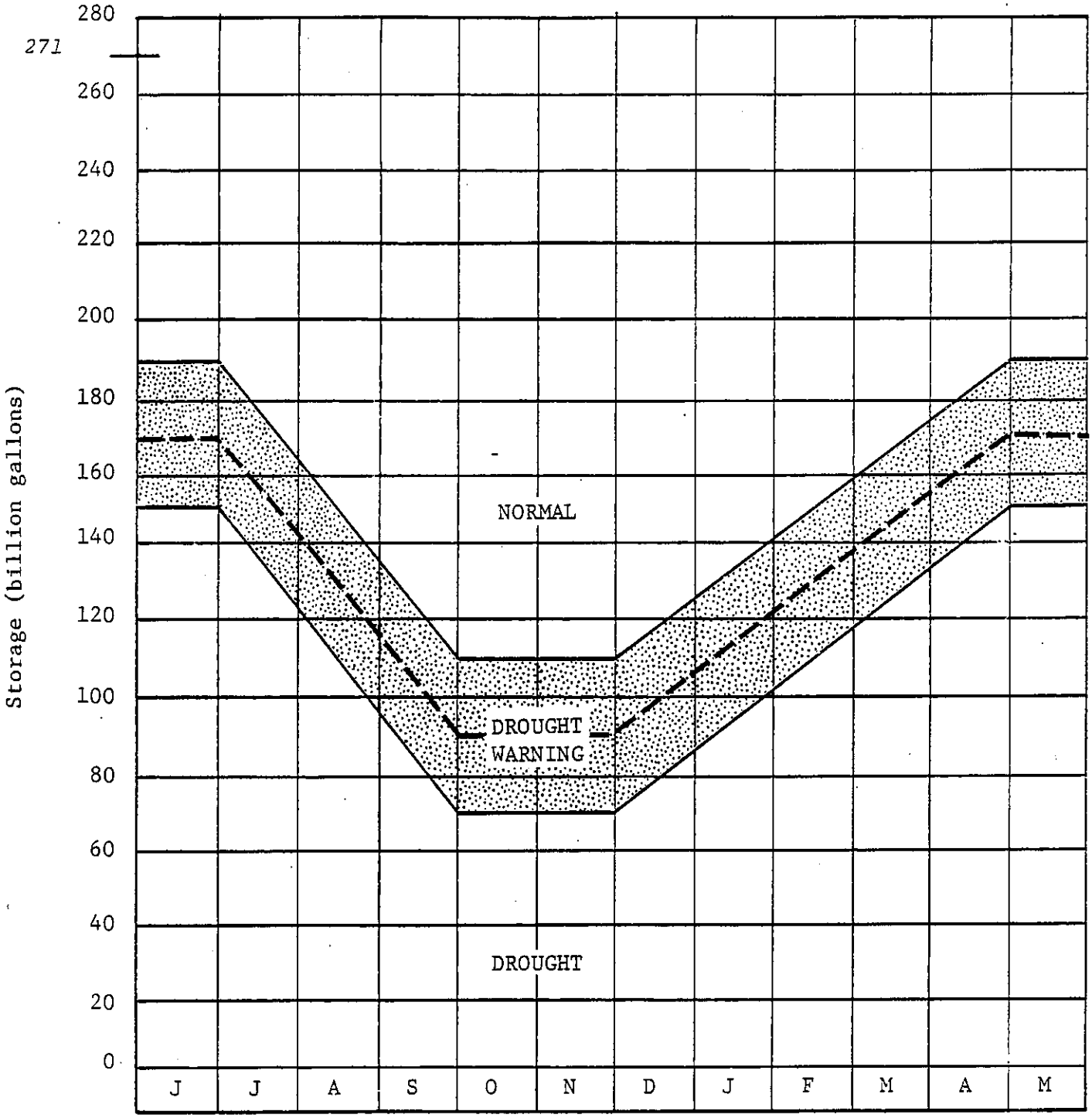
e. Increases in the augmented conservation release levels may not be made except in accordance with the allowances provided for in the Stipulation of Discontinuance in The City of New York vs. the State of New York Department of Environmental Conservation, Index No. 5840-80, and shall be subject to approval by the DRBC.

f. Releases under emergency conditions. The Commission retains its power under Section 3.3(a) and Article 10 of the Compact to declare a drought emergency after consultation with the River Master, in order to conserve the waters in the Delaware River and its tributaries in the reservoirs of the Upper Delaware River Basin, in order to protect water supply, health, and safety of the residents of the Delaware River Basin and its service area. The River Master retains all of his powers under the Decree including the powers under Article VII, B.1 of the 1954 Decree to conserve the waters in the river, its tributaries, and in reservoirs owned by the City of New York, or in reservoirs developed by other parties to the Decree after 1954.

BY THE COMMISSION:

ADOPTED:

OPERATION CURVES FOR
CANNONSVILLE, PEPACTON AND NEVERSINK RESERVOIRS



Position Paper on
Proposed Amendments to Comprehensive Plan
to Adopt a Drought Operation Formula for the New York
City Reservoir System and to Identify Drought Emergency Criteria

The provisions of the Supreme Court Decree of 1954 giving New York City (NYC) the right to divert up to 800 mgd of water from the Delaware River Basin while requiring it to maintain a flow of 1750 cfs at Montague were based on the most extreme drought experienced up to that time, that of the 1930's. Various reservoir model computer simulation studies have shown that the simultaneous 800 mgd diversion to NYC and the maintenance of 1750 cfs at Montague would not be attainable under the 1961-67 drought experience which was a more extreme drought than that of the 1930's. To meet the Decree requirements would result in the emptying of the NYC Delaware reservoir system in mid-drought; clearly a situation that could not practically be permitted since about half of the NYC public water supply and a major portion of main stem lowflow augmentation capability depends on the Delaware Basin reservoirs.

A solution to such a problem would be the construction of additional storage which would provide a larger buffer to lessen the probability of emptying the system during the drought of record. Although future enlargement of Cannonsville Reservoir is proposed, that volume of additional storage would not be nearly sufficient to meet the existing Decree requirements. Another alternative would be to reduce the diversion and flow objectives during times of drought so that the use of remaining storage can be extended, although with some compromise to the extent of salt intrusion in the estuary and reductions in New York City water supplies. Such a change in the diversions and flow objectives could not be done without consent from all parties to the Supreme Court Decree of 1954 except during a declared drought emergency when action by the DRBC is authorized.

The Level B Study and Good Faith Agreement both recommended temporarily modifying the Decree operating criteria during drought warnings and drought conditions as well as the flow objectives of the Delaware River at Trenton. The Good Faith-recommended drought operation formula was generally applied during the 1980-81 drought experience. The parties believe it represents a compromise between the needs of New York City and northeastern New Jersey for water supply, and the needs of the lower Basin to maintain minimum fresh-water flows in the river and into the estuary in order to protect water uses and quality in that region. The capability of the reservoir system to meet these revised reservoir operating criteria and reduced flow regimes was tested by computer modeling. The drought of record, which occurred in the 1960's, was used to formulate the flow regime used in the models.

The combined maximum usable storage for water supply in the three NYC reservoirs totals 271 billion gallons. While it is normal for this water volume to vary throughout the year when demand exceeds the natural inflow, with normal rainfall occurring during the year, the depleted storage will be replenished. However, during extended periods of below normal precipitation, the reservoirs will exhibit a downward trend in storage from year to year and the possibility exists that the water

supply storage can be entirely depleted. During the 1980-81 drought, the NYC supply dwindled down to critical supply conditions until they were reversed by February 1981 rains.

The intent of this proposed recommendation is to establish consensus in advance as to what constitutes drought conditions warranting emergency action. The criteria will be useful to water users and the general public, as well as to water management officials of the parties.

Combined storage of the three New York City reservoirs comprises about 90 percent of the total available storage in the Basin, and for that reason is accepted by the parties as a sound criterion for determining a basinwide drought emergency. The Commission may, as circumstances warrant, declare a drought emergency for sub-regions of the Basin based upon different criteria.

Authority to declare a drought or other water supply emergency is contained in Section 10.4 of the Compact. Under such declaration the Commission may control the amount of water withdrawn from surface or ground water sources for any purpose, and may regulate the operation of public and private reservoirs in the Basin. Section 3.3 of the Compact contains special provisions relating to diversions and releases under the Supreme Court Decree during a drought or catastrophe.

In order to maximize the storage of water in the three Delaware system-NYC reservoirs while going into a drought, simultaneous reductions in the NYC diversions and flow objectives at Montague and Trenton were proposed by the Good Faith negotiators. These reduced criteria would be imposed when the combined NYC storage fell below certain seasonal criteria.

Figure 1 shows the combined operation curves for Cannonsville, Pepacton and Neversink Reservoirs under normal conditions. At intervals of 20 billion gallons below the normal storage curve, a two-part drought warning curve is superimposed and defined as the upper and lower half of drought warning. Below the drought warning curve is the drought area which signifies that the storage is so low that stringent conservation measures and reduced releases have to be made in order to extend the remaining water supply.

The reductions of diversions and flow objectives that would be triggered by a lowering of storage levels are given in Table 1. The formula for such reductions is based upon a differentiation between "normal," "upper and lower half drought warning" and "drought." When the storage levels go into drought condition, the Montague and Trenton flow objectives are correlated to the location of the 7-day average of 250 mg/l isochlor in the estuary as defined in Table 2.

The last operating criteria for the NYC system as shown in Table 1 is that for "severe drought", which will be determined based upon conditions at the time. It is obvious as a result of the simulated drought model investigation that a further lowering of the NYC storage would result in a more severe water shortage. A larger cutback schedule would be required in order to avoid emptying the remaining storage. Alternative measures would be necessary to supply water to the public in the event of such a catastrophic drought.

OPERATION CURVES FOR
CANNONSVILLE, PEPACTON AND NEVERSINK RESERVOIRS

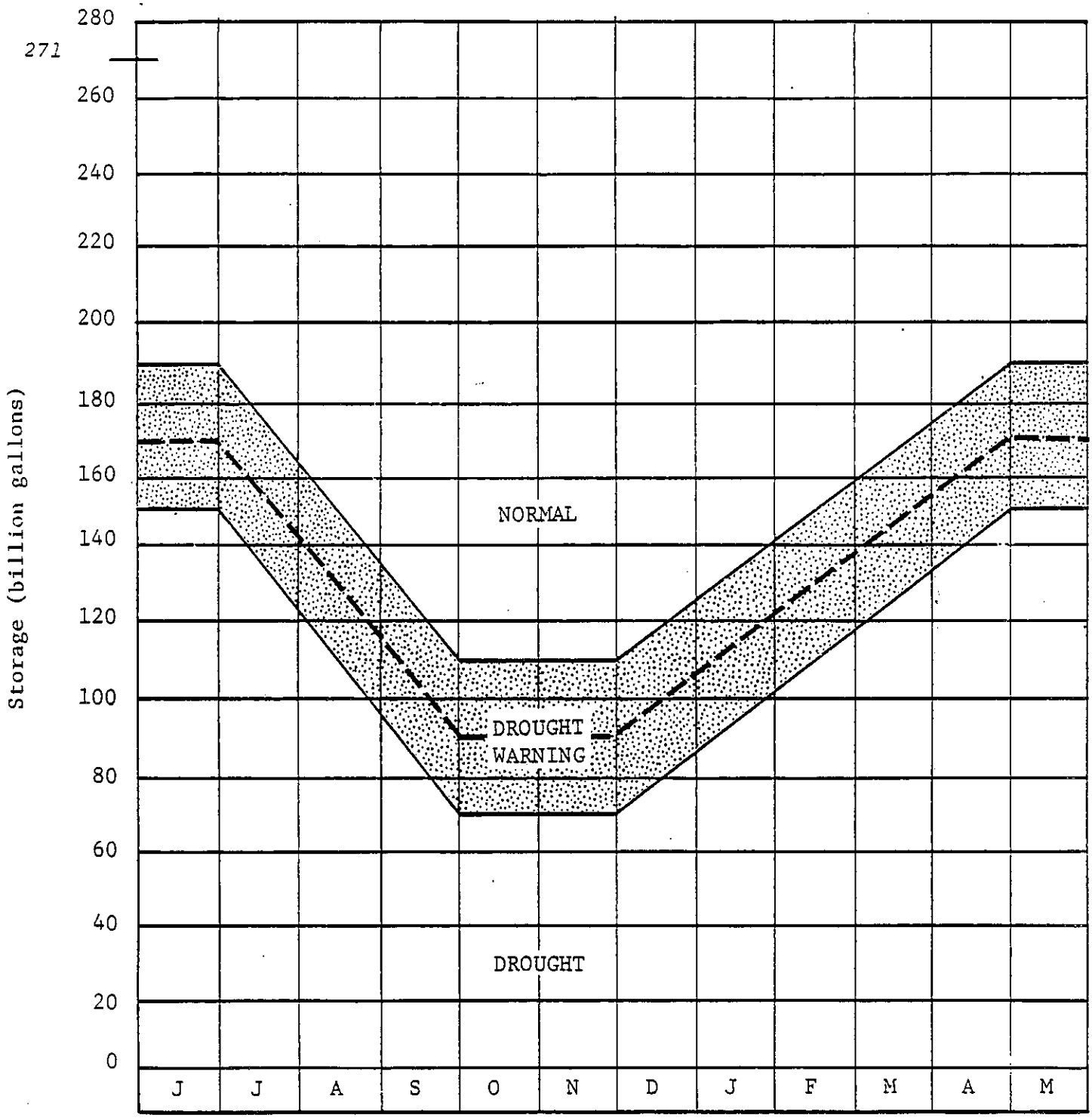


FIGURE 1

Termination of the proposed drought operation formula involves a criterion (15 billion gallons for five days) different from that proposed for terminating a drought emergency (40 billion gallons for 30 days). In the former instance, the action required is largely automatic and can be executed quickly. It can be easily reversed if storage conditions worsen and dip into the drought warning. A larger margin of certainty is proposed in the latter instance because public conservation controls and drought awareness programs take time to organize and cannot be turned on and off quickly.

TABLE 1

Interstate Operation Formula for Reductions
In Diversions, Releases, and Flow Objectives
During Periods of Drought

NYC Storage Condition	NYC Div. mgd	NJ Div. mgd	Montague Flow Objective cfs	Trenton Flow Objective cfs
Normal	800	100	1750	3000
Upper Half-- Drought Warning	680	85	1655	2700
Lower Half-- Drought Warning	560	70	1550	2700
Drought	520	65	1100-1650*	2500-2900*
Severe Drought (to be negotiated based on conditions)				

*Varies with time of year and location of salt front as shown on Table 2.

TABLE 2

Flow Objectives for Salinity Control
During Drought Periods

Seven-day Average Location of "Salt Front," River-mile*	Flow Objective, Cubic Feet Per Second At: Montague, N.J.			Trenton, N.J.		
	Dec-Apr	May-Aug	Sept-Nov	Dec-Apr	May-Aug	Sept-Nov
Upstream of R.M. 92.5	1600	1650	1650	2700	2900	2900
Between R.M. 87.0 and R.M. 92.5	1350	1600	1500	2700	2700	2700
Between R.M. 82.9 and R.M. 87.0	1350	1600	1500	2500	2500	2500
Downstream of R.M. 82.9	1100	1100	1100	2500	2500	2500

*Measured in statute miles along the navigation channel from the mouth of Delaware Bay.

Position Paper on
Proposed Amendment to Comprehensive Plan
Regarding the Use of the Design Drought for
Determination and Planning of Dependable Water Supply

Water supply management systems must be designed to provide reliable and adequate supplies to meet essential health, safety and economic needs during droughts as well as normal times. In water planning, water supply capacities, yields, and management actions must be calculated against and targeted to a drought of specific intensity or severity. The more severe the design drought the greater the margin of safety. Where a reasonably long period of hydrologic record is available (approximately 80 years in the Delaware River Basin), use of the drought of record is considered reasonable and appropriate for determination and planning of dependable water supply.

In the Delaware River Basin, the drought of record occurred during the period 1961-1967. The 1960s drought has been estimated to have a recurrence interval of several hundred years in the upper Basin and about 100 years for the lower Basin.

It is proposed to amend the Comprehensive Plan by adding the following section establishing the intensity of drought to be used in planning for dependable water supply in the Basin:

> "Design Drought. The drought of record, which occurred in the period 1961-1967 shall be the basis for determination and planning of dependable Basin water supply."

In adopting this planning criteria, DRBC does not assume that all uses will be satisfied during extreme droughts. Rather, the management plans adopted (including conservation efforts, emergency cutbacks in use, and water resources development efforts) must be geared to meet essential needs, protect health and safety, and avoid economic hardships, during such drought of record conditions.

Further, it should be noted that in the future, a drought more severe than drought of record may (and most likely will) occur. Thus, plans should include some margin of safety to allow for more critical conditions, and provide for actions if needed to address such emergencies.

Position Paper on Proposed Amendment
to Comprehensive Plan (Water Quality Standards)
Revised Salinity Objective for
Delaware Estuary

Introduction

Concern for the salinity levels in the Delaware estuary has a long history. A half-century ago, the needs of instream fisheries and water-using industries and municipalities along the estuary were the subjects of intense debates during the litigation over the right of New York City to divert water from the upper Delaware River Basin. This court test, known as the first Delaware River diversion case, was settled by the U. S. Supreme Court in New Jersey v. New York, 283 U.S. 805 (1931); the court decreed that although the City could store water during periods of high streamflow and divert some of it out of the Delaware Basin, this right was conditioned upon the City's provision of downstream releases to augment the natural streamflow during periods of low flow in the Delaware River. This low-flow augmentation was required to protect the general quality of water in the river and estuary, especially the latter and especially with respect to salinity. It should be noted, however, that despite the 1931 decree, diversions did not in fact begin until 1953.

The 1931 decree of the Supreme Court was amended in 1954 following several years of negotiations among the Basin States and the City of New York. The amended decree permitted the City to increase its average rate of diversion from 440 mgd to 800 mgd, but this increased diversion was conditioned upon increased downstream releases during low-flow periods for water-quality and salinity control (New Jersey v. New York, 347 U.S. 995 (1954).

Before New York City constructed its Delaware system reservoirs, unacceptably high salinities had already forced the City of Chester, which had long used the river as its water source, to abandon the Delaware River in 1951 and switch to a source in the Susquehanna River Basin.

The need to control salinity in the estuary figured prominently in the Federally sponsored comprehensive study of the Delaware River Basin in the late 1950s and early 1960s. That study, as reported in House Document 522,* resulted in recommendations for greatly increased streamflow augmentation for estuarine salinity control and other purposes.

The Delaware River Basin Compact was adopted by the Basin States and the Federal Government in late 1961, and early in the existence of the Delaware River Basin Commission (DRBC), the region suffered its most severe drought of record. A significant adverse impact of this drought was record high salinity levels in the Delaware estuary. Emergency measures were taken by the Commission and cooperating agencies, including privately owned hydroelectric power companies, to regulate streamflows for salinity control

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*87th Congress, 2d Session, U. S. Govt. Printing Office, Washington, D. C., 11 volumes (1962)

in the estuary. In order to conserve water needed for salinity control and supply, depletive uses of water, including out-of-Basin diversions, were cut back. In spite of these emergency measures, however, salinity levels at some industrial water intakes were unacceptably high, and these industries were forced to shut off their estuary-water pumps and to switch to more expensive alternative supplies of process water. However, the Philadelphia water intake at Torresdale in the upper tidal reach (river-mile 110.4) was not impacted during the drought of the 1960s, nor was the DRBC chloride standard for Zone 2 (above river-mile 108.4)--a maximum 15-day average chloride concentration of 50 mg/l--violated.

The experience of the drought of the 1960s led the Commission to adopt salinity-control objectives when it adopted water quality standards for the estuary in 1967. These standards are still included in the Commission's Comprehensive Plan. More recent experience and studies have shown the need to revise the salinity objectives for the Delaware estuary. It is the purpose of this paper to review the development of proposed new salinity objectives for the estuary, objectives that would take into account current and projected conditions not entirely foreseen in 1967, when the current salinity standards were adopted.

Current standards

Currently there are several standards for chlorides and total dissolved solids (equivalent to salinity in seawater solutions) in the tidal Delaware River, each applying to a specific location or reach of the river. The chloride standards, adopted by the DRBC in 1967, are as follows:

Zone	River miles	Chloride standard
2	133.4-108.4	Maximum 15-day average concentration: 50 mg/l
3	108.4-95.0	Maximum instantaneous concentration: 200 mg/l
4	95.0-78.8	Maximum instantaneous concentration: 250 mg/l at river-mile 92.47 (mouth of Schuylkill River)

Ionic ratios.--The current water quality standards for the Delaware estuary do not include an objective for sodium concentration. However, in seawater dilutions, the ratio of sodium ions to chloride ions remains constant, so that where sea salts dominate the other dissolved solids, the sodium concentration equivalent to a given chloride concentration can be determined by application of the known ratio of sodium ions to the chloride ions in seawater--0.556.

Zone 2.--The current chloride standard for Zone 2 is a maximum 15-day average concentration of 50 mg/l. It should be noted that in the waters of Zone 2, which is generally above the limits of sea-salt penetration, the ionic ratios are different from, and less constant than, those of seawater. Thus, for chloride concentrations of 50 mg/l or less, there are no measurable sea salts present, and the ionic ratio for seawater

cannot be applied to the chloride concentration to determine the equivalent sodium level.

Zone 3.--The current chloride standard for Zone 3 is a maximum instantaneous concentration of 200 mg/l. In the tidal Delaware River, a chloride concentration of 200 mg/l is a definite indication of the presence of sea salts in quantities that dominate the non-ocean salts in the mixture of fresh water and seawater. Thus, at this level of chlorides, the seawater ionic ratios are reasonably valid, and the sodium/chloride ratio of 0.556 can be used to estimate the sodium concentration:

$$Na = 0.556\ Cl = 0.556 \times 200\ mg/l$$
$$= 111\ mg/l.$$

If this standard could be met at the seaward boundary of Zone 3 (river-mile 95.0), the up-estuary chloride and sodium concentrations throughout Zone 3 would be less than 200 mg/l and 111 mg/l, respectively.

Zone 4.--The current chloride standard at river-mile 92.47, in Zone 4 at the mouth of the Schuylkill River, is an instantaneous maximum concentration of 250 mg/l. This is equivalent to a sodium concentration of 138 mg/l, and to a salinity of 0.450 parts per thousand (ppt).

Zones 5 and 6.--The salinity of the estuary in Zones 5 and 6, which reach from river-mile 78.8 to the mouth of Delaware Bay, is highly variable over space and time, and is controlled largely by natural forces and events not subject to more than minor influence by man. Consequently, the DRBC has not established a salinity standard for this 79-mile reach of estuarine waters. Nevertheless salinity levels are important to many industries along the shores of the estuary, which take water from the estuary, either directly as surface water or via wells that are recharged in part by the estuary. In the case of public water supplies, none below Philadelphia is taken directly from the estuary, but several tap aquifers that are threatened by intrusion of brackish or saline waters from the estuary.

The oyster industry in Delaware Bay is dependent on a range of salinities that is neither too low nor too high. Oysters cannot long survive in waters where the salinity remains below 5 parts per thousand (ppt). Adult oysters tolerate full-strength seawater (salinity of 34 ppt or more), but young oysters are preyed upon by oyster drills in salinities of 15 ppt or greater. The 15-ppt isohaline, often called the "drill line," serves as a barrier to the oyster drills. Consequently, natural oyster beds above the drill line serve as a protected nursery area in which oysters can be allowed to set and grow until their shells are thick enough to resist the oyster drills, after which they can be transplanted in the saltier waters of more seaward areas of the bay.

Although the DRBC has not incorporated any Zone-5 or Zone-6 salinity standard or objective in the Comprehensive Plan, the Zone-4 salinity standard of 250 mg/l has provided a measure of protection for the lower estuary; if salinity is limited at any given point along the estuary, the salinity throughout most of the estuary is concomitantly limited. That is, salinities throughout the estuary rise or fall together. Thus, if the

chloride concentration at the mouth of the Schuylkill River (river-mile 92.47) is held to 250 mg/l, the salinities over the natural oyster beds in upper Delaware Bay will tend to remain below some higher but undetermined limit of chlorinity (or salinity). Similarly, the mile 92.47 standard, if it could be met, would also provide some protection for the industrial and public water supplies threatened by sea salts along the estuary in Zone 5. However, because of frequently very high salinities in the lower reach of Zone 5, it is not practical to control salinity in this reach to the extent necessary to provide potable water from the tidal river.

1967 Standards.--When the current salinity standards for the estuary were adopted in 1967, they reflected the system of proposed flow-regulation reservoirs that had been part of the Comprehensive Plan since 1962. Implementation of these authorized projects would have made it possible to meet the 1967 standards under conditions projected to the early 21st century or longer. The existing standards cannot be met today with a repetition of the drought of the nineteen-sixties and, in fact, were not met during that drought. Those standards were a goal predicated upon a large increase in useable storage as would have been provided by the Tocks Island project. With the shelving of the Tocks Island and Trexler Reservoir projects, it became necessary to review the Comprehensive Plan, including the standards for salinity control in the estuary. This led to a comprehensive study by the DRBC staff (the Level B Study) and a parallel effort by representatives of the parties to the 1954 amended decree of the U. S. Supreme Court (known as the "Good-Faith Negotiators"). Concurrently, the DRBC staff and consultants conducted studies of salinity intrusion in the Delaware estuary as related to regulated flows in the Delaware River. During roughly the same period, the Philadelphia District Office of the Corps of Engineers, U. S. Army, carried out a Congressionally authorized study of salinity intrusion in the Delaware estuary. All of these efforts were coordinated by frequent contacts and meetings of the agencies involved. Findings of each group were made available to the others as they were developed, so that the final conclusions and recommendations of each group reflected consideration of the findings of the other studies.

DRBC salinity studies

The DRBC staff and consultants began in 1977 to develop a deterministic mathematical model that would simulate salinity distribution along the axis of the Delaware estuary for assumed conditions of streamflow regulation, depletive water use, and sea level. The model has been used to predict salinity levels in the year 2000, based on the following assumptions:

1. The basic hydrology of the drought of the 1960s (from May 1961 through December 1966) would recur, except as modified by assumed conditions of reservoir operations and depletive use. The year-2000 hydrology would correspond to that of 1965, the driest year of record.

2. Sea level at the mouth of Delaware Bay would continue to rise until the year 2000 at the average rate observed during the past several decades.

3. New York City reservoirs (Pepacton, Cannonsville, and Neversink) would be operated to provide a specified minimum flow in the Delaware River at Montague, N.J. The regulated Montague flow objective would vary according to a rule curve showing the combined volume of water stored in New York City's three Delaware Basin reservoirs. The Montague objective would be 1,750 cfs or less. It was assumed that the requirement for excess releases, specified in the 1954 amended decree of the Supreme Court, would expire before the year 2000.

4. Diversions to New York City and to northeastern New Jersey authorized by the 1954 amended decree would be reduced during periods of drought or near drought to conserve water in storage.

5. In addition to the major diversions to New York City and northeastern New Jersey, net depletive uses from the Delaware River above Trenton would increase during the 35-year period from 1965 to the year 2000, as projected for purposes of the Level B Study.

6. Depletive use of water from the portions of the Basin below Trenton would be as projected for purposes of DRBC's Level B Study. The salinity-increasing effect of depletive use diminishes from location to location in the seaward direction, and becomes negligible for depletive-use locations in lower Delaware Bay.

7. When necessary to provide the river flow to be tested, proposed reservoirs were assumed to be built and operated to provide the desired test flows at Trenton. For the highest summer flow tested (3,475 cfs), it was assumed that the river flow would be regulated in part by a ground-water pumping system, as it was not possible to provide that test flow with the assumed surface reservoirs alone.

8. Blue Marsh Reservoir would be operated to maximize the low flow of the Schulykill River at Philadelphia.

The salinity model was used to test the long-term (15-month) salinity response to a wide range of levels of flow regulation, represented by the average flow at Trenton for the four-month period from 1 June through 30 September. However, in order to provide realistic streamflows, the regulated flows were simulated with a reservoir hydrology model developed by the U. S. Army Corps of Engineers (HEC-3) for the entire drought period from 31 May 1961 until early 1967. Flows were diminished by storage during high-flow months and augmented as necessary during low-flow months to meet the target flows to be tested. The 15-month salinity simulations were for various levels of flow regulation represented by four-month average low flows ranging from 2,000 cfs to 3,475 cfs for the period June through September.

Salinity versus fresh-water flow.--For purposes of salinity control, the Delaware estuary is considered to include the tidal Delaware River and Delaware Bay from the head of tide at Trenton to the mouth of the bay between Cape May, N.J., and Cape Henlopen, Del. The salinity of the estuary varies from that of fresh water in the upper reach of the tidal river to that of seawater at the mouth of Delaware Bay. The salinity at a given location varies with tidal phase and the amount of fresh-water inflow from the Delaware River as measured at Trenton and from seaward tributaries. At a given location and time, the salinity level is dependent upon the antecedent fresh-water inflow over a period of several months. Model simulations have shown that the effects of antecedent flow changes on salinity do not persist for as long as 15 months. For this reason, the 15-month simulations can be accepted as adequate to reflect antecedent flows.

A large number of simulations (in excess of 100) were carried out to determine the relationship between the flow of the Delaware River at Trenton, as regulated by various combinations of assumed surface reservoirs and ground-water pumping schemes, and the salinity distribution in the estuary. The salinity levels for specific points in the estuary were analyzed and compared with various water-quality criteria for water uses along various parts of the estuary.

Critical location.--Four principal impacts of salinity were studied. These included (1) the impact on oysters, (2) the corrosive effect on industrial and municipal facilities located in the estuary, (3) the effect on the P-R-M aquifer and (4) the effect on the Torresdale intake of the City of Philadelphia. Early in the salinity study it was concluded that the Potomac-Raritan-Magothy aquifer system was threatened by salinity intrusion from the Delaware estuary in the Camden area. The reach of the tidal river above river-mile 98 is believed to have a good hydraulic connection with the P-R-M aquifer system. Consequently, the salinity of the estuary at and above mile 98 is a factor controlling the salinity of water supplies taken from the P-R-M system near or above mile 98.

Various pumping tests and ground-water modeling studies since the early 1950s have shown that for wells in the Camden area upwards of 50 percent of the water pumped comes from the Delaware estuary, indicating a good hydraulic connection between the aquifers tapped by these wells and the tidal Delaware River. This confirms geological evidence from wells and test borings indicating unconsolidated, highly permeable materials that make up the P-R-M aquifer system along the estuary above mile 98.

Water quality data from wells in the Camden area showed elevated chlorides following the drought of the 1960s, when the salinity of the estuary opposite Camden was abnormally high. The available evidence is more than adequate to conclude that the quality of water from Camden area wells is influenced by the quality of water in the nearby estuary. Thus, excessive salinity in the estuary above mile 98 would mean increased salinity levels in Camden area well waters.

Salinity control is needed not only for protection of Camden wells. Although mile 98 is a good salinity control point for protection of Camden area wells, it can also serve as a control point for protection of

other water users either up-estuary or seaward of Camden; the salinities throughout the estuary rise or fall together in response to reductions or increases in fresh-water inflow, so that flow augmentation to limit salinity at mile 98 also limits salinity at industrial intakes at Burlington, N.J., Chester, Pa., or Wilmington, Del. In summary, although the Camden area ground waters are a major concern, neither the need for salinity control in the estuary nor the location of the salinity-control monitoring point is dependent only upon the threat of salt-water contamination of Camden area ground waters.

Critical sodium concentration.--The concern about salinity in potable water supplies taken from the Delaware estuary centers upon sodium, a major constituent among the elements found in sea water. Sodium in foods has long been widely accepted among medical doctors and other health professionals as undesirable for the significant proportion of the general population susceptible to hypertension and other diseases. More recently, drinking water has come to be recognized as a potentially significant source of sodium in human diets. For example, medical doctors Braun and Florin (1963)* of the New Jersey Health Department warned that doctors who recommend restricted sodium intake for patients may not realize how much sodium can be ingested with drinking water. Probably more important, however, are the many persons susceptible to diseases related to sodium intake who are not under the care of physicians. Available evidence indicates that sodium intake should be minimized for a large proportion of the general population.

The State of New Jersey has adopted a standard for sodium in drinking water. The standard is a maximum instantaneous sodium concentration of 50 mg/l. Wells in the P-R-M aquifer system that are near the Delaware estuary at or near mile 98 produce a mixture of estuary water with water from other sources. The natural background sodium level in the Camden area is 10 mg/l or less. It is conservatively assumed that before mixing with recharge water from the estuary, the ground water has a sodium concentration of 10 mg/l.

With respect to ground-water protection, the tolerable level of salinity or chlorinity of the river water in the recharge area is dependent upon the degree of dilution of the river water by water from less saline sources before reaching the wells tapping the aquifer. Available evidence indicates that the background sodium concentration of the aquifer is 10 mg/l or less, and that wells near the river in Camden receive approximately 55 percent of their recharge from the tidal Delaware River. Based on these values, it is calculated that the mixture of estuary and aquifer waters in a well would have a sodium concentration not exceeding 50 mg/l if the sodium concentration in the estuary at the recharge area did not exceed 83 mg/l. This estuary sodium concentration corresponds to an estuary chloride

* Braun, P., and A.A. Florin, 1963. Drinking Water and Congestive Heart Failure. Sodium Concentration of Selected New Jersey Water Supplies. Journal of the Medical Society of New Jersey, Vol. 60, pp. 504-509. (In 1963, Dr. Florin was coordinator, Heart and Circulatory Disease Program, N.J. Health Dept.)

concentration of 150 mg/l. This is a rough approximation of the tolerable chloride concentration for the Delaware estuary at river-mile 98. Refinement of this estimate would require better information on the proportion of well recharge coming from the estuary, as well as on the background sodium levels in the aquifer near mile 98.

Level B Study

For purposes of DRBC's Level B Study, the mathematical salinity model was used extensively to determine the chlorinities that could be sustained at river-mile 98 for various levels of flow regulation, as provided by various assumed combinations of existing and proposed surface reservoirs. Also, the model outputs were used to determine the augmented low flows required to meet various river chloride objectives at mile 98 (see table 13 of Level B report, p. 39-40). These chloride objectives ranged from a low of 121 mg/l to a high of 220 mg/l. Alternative sets of assumptions were made regarding the cutbacks in water exports and depletive use that would be required during drought or near-drought conditions. From these alternative assumptions were derived a series of alternative objectives for flow augmentation at Trenton. These augmentation objectives ranged from only 50 cfs to a maximum of 1,450 cfs, taking into account a proposed reduction of 15 percent in the Level-B projected depletive use in the year 2000.

The preferred plan presented in the Level B report called for a maximum 30-day chloride concentration of 121 mg/l at river-mile 98. This would require a flow augmentation of 750 cfs at Trenton. The Level B report called for four surface reservoir projects to provide this flow agumentation:

1. Prompton Reservoir modification
2. Francis E. Walter Reservoir modification
3. Merrill Creek Reservoir
4. Hackettstown Reservoir

Good-Faith Recommendations

In July 1982, representatives of the parties to the 1954 decree of the U. S. Supreme Court, known as the "Good-Faith" negotiators, presented draft recommendations to the DRBC on measures to deal with projected water shortages. Between the time of completion of the Level B report in May 1981 and the presentation of the Good-Faith recommendations, the Hackettstown project was found to be infeasible by its sponsor, the State of New Jersey. This led the negotiators to recommend a slightly higher salinity standard for the estuary. They called for a compromise between two of the alternatives presented in the Level B report. These alternatives were the Level B preferred plan salinity objective--a maximum 30-day average chloride concentration of 121 mg/l at river-mile 98, and the next most stringent alternative presented in the Level B report--180 mg/l. The Good-Faith compromise recommendation was for an ultimate objective of a maximum 30-day average chlorinity of 150 mg/l at mile 98, with a corresponding sodium concentration of 83 mg/l. Meeting this objective would require water-use

conservation measures as recommended in the Level B report, and would require new flow augmentation capacity in the form of new or modified reservoirs. The Good-Faith negotiators called for modifications at Prompton and Francis E. Walter Reservoirs, and construction of the proposed Merrill Creek Reservoir project, if feasible, to provide the low-flow augmentation needed to repel salinity in the estuary and meet the proposed ultimate standards for chlorides and sodium.

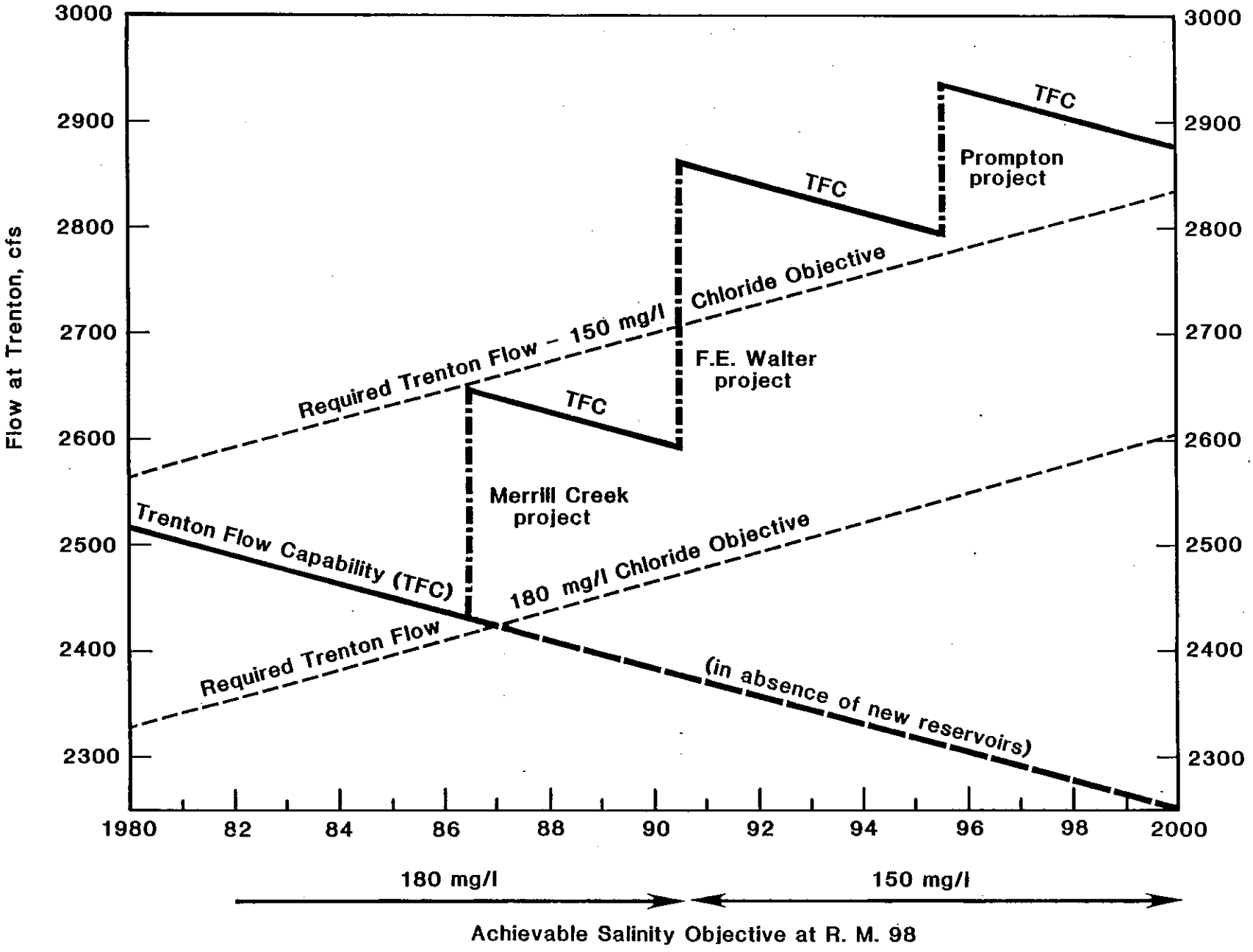
The Good-Faith negotiators recognized that the proposed ultimate standard would be attainable most of the time, but not during a severe drought unless additional reservoir storage capacity becomes available. Therefore, they recommended a less stringent interim objective of 180 mg/l as the maximum 30-day average chlorinity at mile 98, with a corresponding sodium concentration of 100 mg/l.

The proposed new salinity objectives for the Delaware estuary represent a compromise between the extremes considered in the Level-B Study. The proposed standards also represent a balancing of interests of the upper- and lower-Basin water users.

The interim salinity-control objective proposed by the Good-Faith negotiators can be met under severe drought conditions with current (1983) levels of depletive use and current sea level, assuming emergency reductions of out-of-Basin diversions and depletive use as called for by the Level B report and by the Good-Faith recommendations. However, projected increases in sea level and depletive use within the Basin, if the latter occurs as predicted, will require construction of new storage capacity by 1987. Figure 1 shows the relationship between available and required reservoir capacity from 1980 to the year 2000, taking into account increasing depletive use and rising sea level. For the current year (1983) the graph indicates a Trenton flow-capability about 110 cfs greater than that required to meet the interim salinity objective. The vertical lines show increases in storage capacity to be provided by Merrill Creek Reservoir (scheduled for completion in 1987), Francis E. Walter Reservoir modification (1990), and Prompton Reservoir modification (1995). The proposed ultimate chlorinity objective, 150 mg/l, could be sustained for several years after completion of the Walter modification, but the Trenton flow capability would diminish from year to year because of increasing depletive water use above Trenton. At the same time, the flow requirement at Trenton would increase from year to year because of increasing depletive use below Trenton coupled with rising sea level. The lines in figure 1 representing "Trenton flow capability" and "required Trenton flows" are shown as straight lines, based on an assumption that depletive uses above and below Trenton will increase at a steady rate over the period depicted. However, the actual rates of increase will vary with economic conditions and other factors.

Instantaneous versus 7-day and 30-day criteria.--The current primary salinity-control standard for the Delaware estuary is in terms of a maximum instantaneous chloride concentration, whereas the proposed new standard would be in terms of the maximum 30-day average concentration. Also, for purposes of reservoir operations to meet streamflow objectives during drought-warning and drought conditions, the salinity-control flow objectives would be based in part on the seven-day average location of the "salt front" (defined by the 250-mg/l isochlor), as called for by Good-Faith recommendation 3.

Relationship of Chloride Objectives at River Mile 98 to Flow Requirements at Trenton, Projected Depletive Water Uses, and Future Water Supply Storage



The 30-day average concentration was selected as the proposed new criterion for River-Mile 98, as opposed to an instantaneous value, because an instantaneous peak concentration in the estuary at that location has no significant relation to the quality of water drawn from wells that are recharged in part by the estuary. Water traveling through the aquifers from the tidal river to the wells is mixed with other ground water of low chloride and sodium concentrations. Thirty days is believed to be a conservatively low estimate of the period of travel from the tidal river to the nearest well serving a potable water system. The resulting mixture of river water and ground water from other sources is expected to have a maximum instantaneous sodium concentration of 50 mg/l or less, which is the New Jersey State drinking water standard, if the proposed maximum 30-day standard for the estuary at River-Mile 98 is not violated.

It should be noted that in addition to the proposed new salinity-control standard at river-mile 98, a proposal has been made to operate New York City's reservoirs and other reservoirs in the Basin to achieve various minimum flows in the Delaware River at Montague and Trenton. These minimum flow objectives would be geared to the location of the 7-day, 250 mg/l isochlor in the Delaware estuary. The seven-day average was selected as a criterion for salinity monitoring and reservoir-operation control because it provides a short-term check on the movement of the salt front up or down the estuary. The lowest flow objectives would prevail when this isochlor is seaward of river-mile 82.9, and the highest flow objectives would be in effect when the 7-day, 250 mg/l isochlor is up-estuary of river-mile 92.5. Computer model simulations using the above 7-day, 250 mg/l salinity-triggered flow objectives, and 1982 depletive use, have shown that the proposed 30-day average salinity-control standard for River-Mile 98 would be achieved during a repeat of the drought of record.

Corps of Engineers' salinity study

The Delaware Estuary Salinity Intrusion Study was initiated by the Philadelphia District Office, Corps of Engineers, in December 1977. This study was directed by a resolution of the Committee on Public Works and Transportation, U. S. House of Representatives, dated September 23, 1976. Early in this study, the DRBC informed the Corps that the DRBC staff was using the Thatcher-Harleman salinity intrusion model to determine the relationship between fresh-water inflows and salinity in the Delaware estuary. The results of these modeling efforts, as well as the model itself, were made available to the Corps of Engineers. The DRBC requested that the Corps concentrate its study efforts on determining the economic benefits of controlling salinity in the estuary, or the costs entailed in permitting salinity intrusion.

The Corps modified the DRBC's salinity model to include the Chesapeake and Delaware Canal as a tidal branch. Previously, the model treated the canal as a tributary, although the flow through the canal in either direction could be simulated--by assuming a flow input to the Delaware for eastward canal flow and by assuming a water withdrawal when the canal flow was westward. However, the treatment of the canal as a tidal branch was a significant improvement.

Using the branched model with current (post-enlargement) canal dimensions, the Corps simulated 50 years of salinity data for the entire Delaware estuary, using streamflows for water-years 1928 through 1977. The salinity model outputs for locations of surface water intakes were then used as inputs to an economic model to determine the average annual salinity-related costs incurred by withdrawal water users along the estuary. Based on 1978 price levels, the computed annual costs to all direct users of estuary water (excluding users of ground water recharged in part by the estuary) ranged from $14,992,000 in 1928, a wet year, to $29,426,000 in 1965, a very dry year. Average annual costs for the 50-year period from 1928 through 1977 were $19,807,000. These costs do not include health-related costs incurred by persons for medical treatment (or for bottled water to avoid drinking high-sodium water). Also, losses to the oyster industry from excessive salinities in upper Delaware Bay were not determined. However, the results of the Corps' analysis of the effects of the Chesapeake and Delaware Canal on Delaware estuary salinities suggest the strong probability that salinities over the seed oyster beds in the upper bay have been significantly lowered as a result of the recent enlargement of the canal. Also, analysis by the State of Delaware and reported in the Level B study final report showed that the projected levels of flow regulation and depletive use in the year 2000 would have much less effect on May-July salinity levels over the oyster beds than does the normal variation of runoff from year to year. The natural variation of salinity over the seed-oysters is at least an order of magnitude (ten times) greater than the variation caused by man in the past or as projected to the year 2000.

Details of the Corps' Delaware Estuary Salinity Intrusion Study are available in the report of that study issued in December 1982.

Salinity control at locations other than River-Mile 98

The proposed salinity standard protects not only the ground-water quality of the P-R-M aquifer system at mile 98, but also provides a greater or lesser degree of protection from excessive salinities at upstream or downstream locations, as control of salinity at any location entails control of salinity throughout the estuary. Such protection is provided for both instream and withdrawal uses. Thus, if salinity at river-mile 98 is limited by flow augmentation, such augmentation also tends to limit salinity intrusion at downstream locations, such as at the natural seed oyster beds in upper Delaware Bay. Similarly, limiting salinity at mile 98 also limits--even more so--the salinity at up-estuary locations, such as at the Torresdale water-supply intake.

On the other hand, it should not be inferred that control of salinity at River-Mile 98 would automatically provide potable water throughout the length of the tidal Delaware River from Trenton to Liston Point in Delaware. Low-flow augmentation provided to meet the proposed salinity objectives for the upper estuary will tend to reduce actual salinities throughout the estuary, including those in the reach of the estuary above Liston Point. However, because of frequently very high salinities in the Delaware estuary below Chester, Pa., potable water supplies taken from aquifers recharged by the lower estuary cannot be protected against excessive sodium or other seawater constituents by low-flow augmentation in the Delaware River at Trenton. No practical degree

of flow regulation would reduce the high salinities of the lower estuary to levels acceptable for public drinking water supplies. Therefore, the salinity-control standards adopted for protection of potable water supplies in the Philadelphia-Camden area are not relevant to the protection of potable supplies from aquifers near the lower estuary. Protection of these aquifers from salinity intrusion will require measures other than low-flow augmentation at Trenton.

Desalination as an alternative to salinity control

The DRBC for many years has investigated the possibility of desalting saline or brackish water to reduce reliance on water storage projects in the Delaware River Basin. Since the earliest days of the commission's existence, the staff has monitored progress in desalting of saline waters, and will continue to do so. Studies to date by government agencies, universities, and industries have failed to show feasibility of a large-scale desalting project for public water supply in the Northeastern United States. Available desalting technology is energy intensive, and current energy costs make it unlikely that large-scale desalting will become feasible in the Delaware Basin in the forseeable future.

Even if otherwise economically feasible, a major desalting plant located on the estuary would produce waste heat, which would only increase the need for low-flow augmentation in the Delaware River to offset the evaporative loss of water caused by the waste heat. Thus, as a substitute for low-flow augmentation, a desalting plant in the lower basin would be self defeating. In addition to the waste heat, concentrated brine from a large desalting plant would create a major problem of waste disposal. To overcome the problems of waste heat and brine disposal, a desalting plant would have to be located outside the Delaware River Basin, and the product water would have to be piped or otherwise conveyed to areas of need within the Basin. The DRBC water charges to consumptive water users throughout the Basin, including those in the upper Basin, would have to be increased by 1,000 percent or more to provide the funds necessary to build and operate a seawater desalting and conveyance system.

Proposed versus existing standard

Of the four major impacts previously mentioned which are affected by sodium and chloride concentrations, it was obvious that the controlling factor is protection of the P-R-M aquifer. The proposed salinity-control standard is less stringent than the existing standard, which calls for a maximum instantaneous chloride concentration of 250 mg/l at the mouth of the Schuylkill River (River-Mile 98). This existing standard is equal to a maximum 30-day average chloride concentration of about 72 mg/l at River-Mile 98. The proposal being considered is that the current standard be relaxed to 180 mg/l at Mile 98 for an interim period, and ultimately changed to 150 mg/l at Mile 98.

In proposing to revise the existing salinity-control standard for the Delaware estuary, the Good-Faith parties recognized that the current standard was far more stringent than necessary to protect the water supplies pumped from the P-R-M aquifer system in the Camden area. It was also recognized that even the proposed relaxed salinity objectives could not be met at the year 2000 without additional flow augmentation or curtailment of depletive water use, including consumptive use within the Delaware Basin and out-of-Basin diversions. It's important to point out, however, that the

proposed salinity standard can be met today and through 1987 without additional storage, even if the drought of record were to occur during that period.

It should not be inferred from the proposed relaxing of the standard that the salinity or other water-quality characteristics of the Delaware estuary would be degraded. Water quality is not changed by revising the stated water-quality objective; the quality would be changed by changing the flow of fresh water into the estuary. Implementing the flow objectives necessary to meet the proposed new salinity-control standard would mean increasing the critical low flows of the Delaware River at Trenton, and this in turn would reduce the salinity concentrations that could occur under drought conditions with the existing flow capability.

Proposed changes in salinity objectives

After consideration of the findings of the Level-B Study report (1981), the Interstate Water Management Recommendations of the Parties to the U.S. Supreme Court Decree of 1954 to the Delaware River Basin Commission Pursuant to Commission Resolution 78-20, modeling studies of salinity intrusion in the Delaware estuary by the DRBC staff, the Delaware Estuary Salinity Intrusion Study by the Corps of Engineers (1982), and comments received on the Interstate Recommendations, the DRBC proposes the following changes in the Comprehensive Plan relating to salinity-control objectives for the Delaware estuary.

Zone 2.--No change is proposed for Zone 2. The current salinity-control standards (chlorides and total dissolved solids) for this reach of the tidal river are required to protect the water quality of the zone from inputs of nonocean salts from industrial, agricultural, and municipal wastewaters.

Zone 3.--It is proposed that the current salinity-control standard for Zone 3 be changed to allow maximum 30-day average chloride and sodium concentrations of 180 mg/l and 100 mg/l, respectively, at river-mile 98. These would be interim objectives, to be replaced by more stringent objectives, 150 mg/l and 83 mg/l for chlorides and sodium, respectively, when adequate new storage capacity becomes available to make these more stringent goals attainable.

No change in the water uses to be protected in Zone 3 is proposed. These uses include public water supply, with reasonable treatment. Attainment of the proposed new standard, by means of low-flow augmentation, will decrease the average salinity of water supplies taken from the estuary, relative to the salinities occurring with current (1983) streamflow capability under drought conditions.

Zone 4.--It is proposed to delete the current salinity-control objective for Zone 4, which is a maximum concentration of 250 mg/l at river mile 92.47 (at the mouth of the Schuylkill River). The proposed interim objective for the up-estuary location at mile 98 (in Zone 3)--a maximum 30-day chloride concentration of 180 mg/l--is equivalent to a maximum 30-day chloride concentration of about 345 mg/l at mile 92.47. The proposed ultimate objective--a maximum 30-day average chloride concentration of 150 mg/l at river mile 98--is equivalent to a maximum 30-day average of about 285 mg/l at river mile 92.47.

No change in protected water uses in Zone 4 would be necessary as a result of the proposed change. Attainment of the proposed new salinity-control objective for Zone 3 would result in drought-period salinities in Zone 4 lower than those attainable with current (1983) streamflow capability.

Zone 5.--No change is proposed for Zone 5 of the estuary.

Zone 6.--No change is proposed for Zone 6 of the estuary.

Continuing review

Although this paper deals primarily with the proposed new salinity-control standard for the Delaware estuary, it should be noted that salinity control is not the only factor to be considered in establishing streamflow objectives. Flow objectives should take into account such factors as instream needs for treated-waste assimilation, recreation, and aquatic life, as well as weather forecasts and the availability of water in storage.

The DRBC will continue to evaluate and update past projections of future consumptive water use, and will refine the salinity and water-quality models, as well as estimates of future flow capability in order to determine the flow needed for water-quality control based on dissolved oxygen criteria, as well as salinity criteria.

Adoption of the proposed salinity objective would not foreclose later revision to take advantage of new research findings and new technology. The DRBC has a continuing planning program that frequently updates data and information on which the Comprehensive Plan is based. The Plan has been modified frequently in the past, and it is anticipated that there will be modifications in the future as new information warrants.

Position Paper on Proposed Amendment
to Comprehensive Plan

Water Conservation

Introduction

On November 10, 1976 the Delaware River Basin Commission adopted Resolution No. 76-17 amending its Comprehensive Plan to include policy on the conservation of water. Based upon a stated purpose of the Delaware River Basin Compact "...to encourage and provide for the...conservation...of the water resources of the basin" (Section 1.3(e)), the Commission committed itself to undertake a long-range continuing program to reduce water use, require maximum efficiency in the use of water by new industrial, municipal and agricultural users and require eventual application of feasible water conserving practices by existing water users. Toward this end, the Commission resolved to undertake research and planning programs needed to effect this policy; adopt regulations affecting water use, including the application of economic incentives; and integrate measures to reduce water demand with planning for the provision of new water supplies. Commission Resolution No. 81-9, adopted on February 18, 1981, strengthens Resolution No. 76-17, requiring leak detection and control programs and drought emergency plans for certain classes of users applying to the Commission for new water withdrawals under Section 3.8 of the Compact.

"The importance of developing a long-term conservation plan governing day-to-day use of water, as well as stringent control measures for emergency periods, has been strongly stated by representatives of the four Basin states". Echoing earlier Commission policy, the Delaware River Basin Comprehensive (Level B) Study of May, 1981 proposed that the Comprehensive Plan be amended to include a new conservation policy, that "Contingency plans shall be prepared by each Basin state for phased implementation during periods of drought warning and drought aimed at reducing depletive use of fresh water by 15%."

Among its other findings, the Level B Study concluded that practical conservation programs should be designed to reduce total water use and depletive uses in each of the major use categories. This is the goal of achieving long-term conservation.

The Level B Report envisioned a joint effort of the Commission, federal, state and local governments and the private sector to accomplish needed water conservation policies, programs and projects. The Commission could establish the framework and the implementation would be done on the state level.

Paralleling, and to a large degree overlapping, the Level B Study process were the negotiations of the parties to the 1954 U.S. Supreme Court Decree. On February 23, 1983 an agreement was announced by the Governors of New York, New Jersey, Pennsylvania, Delaware, and the Mayor of New York City for inter-state management of water resources in the Delaware Basin.

State Drought Contingency Plans

The Governors of the four Basin states and the Mayor of New York City through the "Good Faith" process unanimously agreed that each State will prepare drought contingency plans for phased implementation during periods of drought warning and drought. Such plans should be coordinated with action by the Commission in announcing a drought warning and in declaring a drought emergency under the Compact, and should be designed to achieve a target 15 percent reduction in depletive use at drought stage. Contingency plans should be completed no later than December 31, 1983, and should include:

-- Identification of those restrictions on non-essential water uses, such as car washing, lawn watering, et cetera, that can be effectively and practically applied; and outline procedures for coordinated initiation and termination of public controls over such uses as drought conditions develop and subside.

-- Contingency plans by large water users that provide for phased reduction of use as drought conditions worsen.

-- Proposed or existing legal authority to establish emergency conservation programs with enforcement powers, including fines and penalties.

-- Effective and timely public information services concerning the drought and the necessity for conservation by all classes of water users.

If adequate legal authority does not exist to implement contingency plans, including the foregoing features, the parties should seek such authority prior to December 31, 1985.

To date, only New Jersey has completed its contingency plan. Drought contingency plans are presently being prepared by Pennsylvania, Delaware, and New York and are expected to be completed in the near future.

Conservation Objective of 15 Percent

The five chief executives, as parties to the 1954 Decree, have also agreed that:

> The Commission should include within its Comprehensive Plan a statement of general policy that conservation measures in the Basin designed for implementation during drought periods shall be based upon the objective of reducing overall depletive use of fresh water by 15 percent.

While water conservation measures can provide important benefits at any time, conservation during drought periods is especially critical. The distinction between depletive water uses and water which is used, treated, and

returned to a watercourse is significant because of flow-salinity relationships in the Delaware estuary and the importance of maintaining minimum fresh water flows during drought. Depletive use permanently removes water from the river basin from which it originates by evaporation, exportation outside the basin, evapotranspiration or other routes.

The Conservation Objective of 15 Percent reduction in depletive water use during drought periods derives from the Level B Study. The 15 percent represents an average of various levels of targeted reductions among different classes of users. As outlined in the Level B Study, conservation reduction goals are as follows:

Type Use	Conservation Reduction Goal
Municipal	25%
Industrial	5%
Steam Electric	10%
Agriculture	10%
Golf & Institutions	50%
Livestock	0%
Other	10%

When the above percentage conservation reductions are applied to projected year 2000 depletive use, the overall average conservation reduction is 15 percent.

Within these categories, wide variations may occur; for example, certain industrial and agricultural users could achieve higher or lower reduction goals, depending upon the product, nature of the production process, time of year and so on. Of necessity, the 15 percent reduction objective is a rough average, not designed to be strictly imposed on every user.

Water Conservation Advisory Committee

While the Commission has adopted certain water conservation policies and programs and is now considering the adoption of State Contingency Plans and a Conservation Objective of 15 Percent depletive use during drought periods, it is increasingly apparent that support for non-drought conservation measures is mounting.

The awareness that water and energy are related and are both limited and costly has focused attention on the desirability and need to conserve both. These considerations have led to a new emphasis in conservation with its attendant savings in dollars and natural resources.

As pointed out in the Level B Study, conservation of total water withdrawal is of value for lessening or preventing drought impacts for those systems which derive water supply directly from reservoirs, small streams, or from ground water. The incentive for residential conservation is based first on the use of smaller amounts of energy to heat lesser quantities of water. The returns are savings of fuel, electricity, water, and deferral of capital expenditures for new or expanded water treatment facilities. Significant savings of energy and money could be realized through conservation programs directed toward municipal uses.

Public concerns expressed during the Level B Study process and during public briefings on the draft "Good Faith" document have emphasized the importance of ongoing or non-drought water conservation. Similarly, strong support for the concept was expressed by an overwhelming majority of respondents who addressed the subject. Repeatedly, the themes of leakage detection and correction, metering, system interconnections, financial incentives, public information, education and regulatory programs were sounded. The evidence is persuasive that an improved non-drought conservation program covering the Basin service area would be well received.

It is therefore the recommendation of this Commission that a Water Conservation Advisory Committee be established at this time to advise the Commission on the adequacy of State Contingency Plans, possible conservation measures of various user categories during drought periods and improvement of the Commission's on-going non-drought conservation policies and programs.

It is further recommended that the Water Conservation Advisory Committee consist of one member appointed by each Commissioner, one member appointed by each of the New York City and Philadelphia Commission advisors, and five to eight members representing a cross-section of the public interest as determined by the Executive Director.

The Water Conservation Advisory Committee, its organization and functions, should be established and serve for such time as is necessary to accomplish its objectives.

The Committee should report its findings and recommendations to the Commission through the Executive Director.