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# **New York State Drought Plan**

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December, 1988

NEW YORK STATE  
DROUGHT PLAN

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NEW YORK STATE  
DROUGHT MANAGEMENT TASK FORCE

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Thomas C. Jorling, Chairman

NEW YORK STATE

DROUGHT MANAGEMENT TASK FORCE

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## EXECUTIVE SUMMARY

### A. INTRODUCTION

New York State normally has abundant water supplies and severe droughts had been relatively infrequent until 1980. Although there has not been a drought condition to equal the record breaking events of southeastern New York during the 1960's, the period 1980 through 1985 reflects a drought pattern inconsistent with historic trends.

In December 1980, Governor Carey established a State Drought Management Task Force (DMTF) to coordinate State drought response activities and to assist localities. The Task Force was charged with the development of contingency plans, the establishment of a drought assessment procedure and reporting system, and the identification of needs for legislation, funding or other actions to improve the State's drought-response capabilities.

The Task Force includes the Departments of Environmental Conservation (lead agency), Health, Transportation, Economic Development, Agriculture and Markets, the Office of Parks, Recreation and Historic Preservation, the Public Service Commission, the Division of Military and Naval Affairs, and the Division of the Budget.

To minimize the adverse impacts of droughts, the State Drought Management Task Force in 1982 developed and recommended a State Drought Preparedness Plan. The plan presented an action program for drought prevention/mitigation, response and recovery. It specified a number of actions that needed to be undertaken immediately to prepare for possible drought conditions and included options that could be developed over a longer range period. The plan was primarily concerned with public water supplies and was largely based on the 1980-81 drought experience.

Since the completion of that plan, significant drought events have occurred in 1982 and 1984-85, adding to the experience and knowledge of all involved agencies and staff. Based on that experience, the 1982 plan has been substantially revised and split into two parts: the State Drought Preparedness Plan focusing on study needs, possible legislative actions, and drought monitoring criteria; and the State Drought Response Plan defining specific actions which can be taken at the various stages if a drought does occur. Other changes include modification of the State Drought Index, updates to reflect actions taken and legislations passed since the 1982 draft was written. Together, the Drought Preparedness and Response Plans comprise the New York State Drought Plan.

The Drought Management Task Force has functioned effectively since its creation and believes completion of the revised State Drought Preparedness and Response Plans will fulfill its major responsibilities to date. The Task Force will be on standby for normal conditions, but will meet as needed to ensure adequate response during various drought stages. The Department of Environmental Conservation, as lead agency, will continue to

be the focal point through its Communications Office for responses to drought inquiries from the press and other media. As appropriate, other federal and local agencies are asked to participate in Task Force deliberations and responses.

## B. DROUGHT PREPAREDNESS PLAN

The Drought Preparedness Plan includes two activities: monitoring and evaluation of drought indices and the consideration of short and long term options for programs and projects to minimize drought impacts.

The most commonly used drought criteria has been the Palmer Index developed by the Weather Bureau in 1965. This index is primarily a measure of soil moisture deficiency. It is not dependable by itself to adequately identify drought conditions, particularly public water supply shortages. The Task Force also determined that regional differences in drought vulnerability existed in the State and should be taken into account in the drought criteria.

The four major elements of the hydrologic cycle were investigated as drought indicators and a State Drought Index has been developed for use in determining drought on a regional basis. The indicators are precipitation, reservoir and lake storage, streamflow and groundwater levels. Eight drought regions have been established based on climatological, physiographic and other factors. The State Drought Index is determined by the indicator status, which is weighted according to its significance for public water supply in each region. The Palmer Index is also evaluated on a regional basis. Drought stage is then determined by appraisal of both indices. The normal and four different drought stages have been established: drought alert, drought warning, drought emergency and drought disaster.

The Task Force considered various options for programs (including legislation) and projects to meet the needs of any drought condition. The options include those that could be developed in the short range (up to 3 years) and the long range (3 to 10 years or more).

At a minimum, fiscal needs for these plan recommendations must include State funds to continue maintenance and replacement of inadequate equipment in the State Emergency Equipment Stockpile. Under direction of the State Emergency Management Office (SEMO), considerable progress was made on improving the stockpile with appropriations for FY 84-85, FY 85-86, FY 86-87, and FY 87-88 totalling about \$2.0 million. The Task Force has determined that replenishment of the stockpile is the highest priority drought need in the State. Many smaller and mid-sized communities would be completely dependent on pipes and pumps from the Stockpile in the event of a water shortage.

Other recommended actions in this plan provide the basic State and local abilities needed to cope with droughts. They will provide limited additional water supplies for emergency water use in southeastern New York, accelerate the completion of drought contingency plans, and facilitate the implementation of water conservation programs on a statewide basis. However, these accomplishments will not resolve all drought problems. Southeastern New York, in particular, will continue to be faced with critical water shortages under extreme drought conditions requiring possible severe use restrictions. The Task Force urges that drought preparedness planning be continued at the State and local levels to improve and refine drought mitigation capabilities.

Actions recommended in the Drought Preparedness Plan are tabulated in Table i. They are listed in general order of priority in the following categories: statewide programs; projects and project investigations in southeastern New York; and options for investigations in other areas of the state. More detailed information is included in the main body of the report.

### C. DROUGHT RESPONSE PLAN

Based on the 1980-81 drought experience, the Task Force concluded that the Drought Response Plan should specify actions to be taken at each drought stage. The Task Force also recognized the joint and separate State and local responsibilities for drought actions and that local governments and suppliers of water have the primary responsibility for insuring the availability of adequate quantities of good quality water. The Task Force considers drought contingency planning at the local level to be essential.

Organizationally, the Drought Management Task Force coordinates and manages all drought related actions through the activities of the member agencies prior to the declaration of drought emergency. In the event of a drought emergency declaration, the Disaster Preparedness Commission (DPC) through the State Coordinating Officer directs the emergency management efforts.

Actions to respond to the various stages of a drought situation, as reflected by the drought indices, are shown in Table ii. These specific actions by the State Disaster Preparedness Commission, the Task Force, State agencies and local governments are intended to help communities mitigate and recover from a drought occurrence.

The Task Force recommends implementation of the drought response actions by the respective agencies, as appropriate for drought conditions. The actions have been determined to be implementable with available resources and will mitigate the impacts of drought to the extent practicable at this time.

TABLE i

DROUGHT PREPAREDNESS PLAN RECOMMENDATIONS (1)

RECOMMENDED ACTION	TIME REQUIREMENT (Years)	PRINCIPAL AGENCY(ies)	COMMENTS
<u>A. Statewide Programs</u>			
1. Continue to Replenish and Expand Preparedness Stockpile	2-5	State Emergency Management Office	Needed to provide adequate pipe, pumps and other equipment for emergency water supply use.
2. Complete and/or Update Water System Drought Contingency Plans	1.5	Dept. of Health (DOH)	Plans now required by law from water suppliers. Need to complete plan preparation updated by DOH in 1984-85 and expand effort as needed. Plans to be reviewed by DOH or local health representatives and provided to the Drought Management Task Force.
3. Complete Local, Regional and State Drought Plans	3	DEC/DOH	The scope of regional plans will vary based on drought vulnerability. Regional and State plans are contingent on local planning efforts.
4. Implement State Water Conservation Program		All	Long-term water conservation program required to utilize existing resources most efficiently. Program includes public information and educational activities and water supply management efforts. More intensive activities are reserved for drought emergencies. State legislation now requires a local water conservation plan as a condition of a DEC water supply permit.
a. Normal Conditions	Continuous	DEC/Dept. of Educ.	
b. Drought Emergency	Variable, depending on drought	DEC/Dept. of Educ., other agencies	

(1) Although costs are not included, actions require funds to implement.

DROUGHT PREPAREDNESS PLAN RECOMMENDATIONS

(Continued)

RECOMMENDED ACTION	TIME REQUIREMENT (Years)	PRINCIPAL AGENCY (ies)	COMMENTS
5. Provide Technical Assistance	Continuous Variable, depending on drought.	DEC/DOH/LHU	Localities require technical assistance on identification of emergency sources, information on how to use them and how to determine drought alert, warning, and emergency conditions. DEC and DOH have limited existing capability for in-kind services. Local health units (LHU) would lead on providing technical assistance. DEC to develop model water conservation manual.
a. Normal Conditions b. Drought Emergency		DEC/DOH/LHU	
6. Enact Mandatory Water Metering Legislation		---	Needed to attain more efficient management of water systems and to better manage drought situations. Proposed legislation for mandatory water metering applies to all service connections to all public water systems.
<u>B. Projects and Project Investigations in Drought Region II (Southeastern New York)</u>			
1. Activate Chelsea Pumping Station as Emergency/Disaster Supply	0	NYC	Station was used in 1984-85 to provide up to 100 mgd emergency supply. New York City has completed a DEIS as part of their water supply application. Hearings are underway.
2. Investigate Expansion of Chelsea Pumping Station	0.5	DEC/DOH/NYC	Engineering feasibility report has been completed for expanding Chelsea or pumping up to 300 mgd from the Hudson at other locations as a permanent addition to NYC water supply. Need to initiate action.

DROUGHT PREPAREDNESS PLAN RECOMMENDATIONS

(Continued)

RECOMMENDED ACTION	TIME REQUIREMENT (Years)	PRINCIPAL AGENCY (ies)	COMMENTS
3. Investigate Utilization of Brooklyn/Queens Aquifer as Emergency/ Disaster Water Source	2	DEC/DOH/NYC	Study completed by U.S. Army Corps of Engineers. Treatment of groundwater would probably be required. Economic feasibility of this supplemental source is being studied by the Intergovernmental Task Force.
4. Investigate Existing Upland Water Bodies	1	DEC/OPRHP	Objective is to determine potential for using recreational lakes in State parks for water supply.
5. Evaluate Water Supply Interconnections for Emergency Use	1	DEC/DOH/Water Suppliers	Objective is to determine potential and priorities for system interconnections for emergency use. Needed Rockland County projects (2) have been identified in prior studies.
6. Evaluate Regional Groundwater Supply Development for Emergency Use	1	DEC/DOH/Water Suppliers	Objective is to develop groundwater supplies for drought emergency/ disaster use. Investigations would be coordinated with ongoing DOH/DEC evaluation of selected aquifers and with local plans. Development would be contingent on results.
7. Investigate Hudson River Utilization in Addition to Chelsea Pumping Station	1	DEC/DOH/NYC	Objective is to determine feasibility of project to pump Hudson River water to Ashokan Reservoir in NYC system with additional Black River diversion and/or reregulation of Great Sacandaga Lake & Indian Lake to augment flow. Yield of up to 800 mgd possible.

DROUGHT PREPAREDNESS PLAN RECOMMENDATIONS

(Continued)

RECOMMENDED ACTION	TIME REQUIREMENT (Years)	PRINCIPAL AGENCY (ies)	COMMENTS
<u>C. Options for Investigations in Other Drought Regions</u>			
1. Investigate Water Supply Interconnections	1.5	DEC/DOH	To determine potential inter-connections and priority for use during emergencies.
2. Investigate Groundwater Supplies for Emergency Use	1	DEC/DOH/Water Suppliers	To determine how groundwater supplies could be further developed and utilized during droughts. Would utilize results of ongoing DOH/USGS aquifer study.
3. Investigate Reservoir and Lake Reregulation Potential	2	DEC/DOT	To determine potential for reregulation of existing lakes and reservoirs to provide additional water supply and meet other essential demands as necessary during drought periods.
4. Analyze Barge Canal System for Emergency Use	2	DOT/DEC	To determine potential use of Barge Canal system for additional water supplies and water transfer to critical areas during droughts.
5. Examine Cowanesque Reservoir Potential for Emergency Use	2	DEC	To evaluate need for reallocated water in Cowanesque Reservoir in Pennsylvania for drought emergency use in New York and resolve water rights questions through the Susquehanna River Basin Commission (SRBC). Potential supply is 74 mgd.

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TABLE ii  
SUMMARY OF STATE AND LOCAL RESPONSE ACTIONS

Normal Conditions

State

Local

DMTF

- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>- Maintain the means to monitor and appraise drought status.</li><li>- Develop and keep current State and Regional drought contingency plans.</li><li>- Plan for "worst case" situations including use and transfer of water.</li><li>- Maintain adequate drought contingency planning process.</li></ul> | <ul style="list-style-type: none"><li>- Develop and keep current local drought contingency plans.</li><li>- Maintain adequate drought resource and response capability.</li><li>- Make necessary improvements to water systems.</li></ul> |
|---|---|

State Agencies

- Review and provide technical assistance in the development of local drought contingency plans.

DPC

- Support development of State and local drought contingency plans.

Drought Alert

State

Local

DMTF

- |  |  |
|--|--|
| <ul style="list-style-type: none"><li>- Monitor and appraise drought status.</li></ul> | <ul style="list-style-type: none"><li>- Review and update local contingency plans.</li></ul> |
|--|--|

State Agencies

- |  |  |
|--|--|
| <ul style="list-style-type: none"><li>- Review and update local, regional and State drought contingency plans.</li><li>- Provide technical assistance to localities.</li><li>- Intensify monitoring and appraisal of drought status.</li><li>- Prepare drought updates for DMTF.</li></ul> | <ul style="list-style-type: none"><li>- Promote voluntary water conservation measures.</li></ul> |
|--|--|

Drought WarningLocalDMTF

- Convene to initiate drought actions.
- Accelerate drought management efforts as the situation worsens.
- Continue to monitor and appraise drought status.
- Initiate coordination with Federal agencies and other states to alleviate potential drought impacts.
- Alert the Disaster Preparedness Commission (DPC) as to status of situation.
- Designate Regional/State Drought Preparedness Coordinator.
- Intensify voluntary water conservation efforts.
- Intensify leakage control efforts.
- Make provisions for utilization of emergency sources of supply.
- Designate local drought preparedness coordinator.

State Agencies

- Promote public information and technical assistance programs.
- Request replenishment of emergency stockpile.

DPC

- Urge completion of drought contingency plans.

Drought EmergencyLocalDMTF

- Intensify monitoring and appraisal of drought status.
- Restrict water uses in stages, banning non-essential uses first and then reducing water for essential uses.
- Review options for water from Barge Canal feeder reservoirs and/or Hudson River-Black River Regulating District.

Local

- Recommend special state legislation and funding, if needed.
- Review Regional/State drought implications.
- Support National Weather Service surveys for estimating water equivalent of snow cover.
- Assess capability of governmental interactions.
- Review drought preparedness plans for deficiencies.
- Intensify Regional/State water conservation programs.
- Assess requirements for State assistance.
- Establish priorities for use of equipment and technical assistance.
- Make recommendations to DPC.
- Advise DPC of local and State emergency actions.
- Review and prepare to initiate actions to meet "worst case" situation.
- Use emergency equipment and tap emergency sources of water. Activate Chelsea Pumping Plant if appropriate.
- Request technical assistance and equipment from the State, if necessary.
- Implement local public awareness and water conservation campaign.
- Initiate/expand leak detection and repair programs.
- Initiate penalties for violations of water use restrictions.

State Agencies

- Coordinate stockpile use.
- Inventory industrial users for emergency supplies.
- Provide equipment and technical assistance to localities.
- Provide assistance on financing.
- Provide limited resources on a priority basis.

TABLE ii (cont.)

- Implement water conservation in State office buildings.
- Utilize regulatory and emergency powers.
- Establish alert procedures to warn of oil spills in stream that are used as emergency pumping facilities.
- Distribute Fire Service Guide "Suggested Fire Department Operations for Drought Emergencies."

DPC

- Consider DMTF recommendations.
- Consider need for State declaration.
- Appoint liaison officer to DMTF if a declaration is made.
- Request Federal emergency assistance from Federal Emergency Management Agency.
- Request suppliers, by letter, to adopt measures to conserve water.
- Direct State agency response.
- Establish task force to develop phased emergency disaster plans where needed.

Drought Disaster (in addition to Emergency Action)

State

Local

DMTF

- |   |   |
|---|---|
| - Respond to directives to implement DPC actions. | - Initiate further restrictions on water use. |
|---|---|

TABLE ii (cont.)

State

Local

State Agencies

- Take actions as directed by the Governor and DPC.

- Undertake all possible local disaster efforts.
- Request State and Federal disaster declarations.
- Enact emergency legislation and issue emergency orders as required.

DPC

- Request Federal disaster assistance.
- Implement appropriate "worst case" option.
- Declare State disaster, if appropriate.

## CHAPTER I

### DROUGHT PREPAREDNESS PLAN

#### A. DROUGHT CRITERIA

There is no precise definition of drought. Webster's definition is simple: a prolonged period of dryness. Meteorologists define a drought as a substantial deficit from average precipitation during a given period of time. Hydrologists include other elements of the hydrologic cycle, as well as precipitation for determining drought; these are stream flows, groundwater levels, reservoir or lake levels and soil moisture.

Qualitatively, a drought may be defined by its effects, such as crop failures or shortages in individual or public water supplies. Other water uses may also be impacted by drought, such as power generation, fish and wildlife, recreation and navigation.

The drought period is not a fixed time but may be months or years. Droughts progress through stages and drought intensity may vary considerably during the drought period. They are not sudden, extreme events like floods. The time of occurrence and duration can cause significant variations in drought impacts. For example, a drought which occurs in the fall and winter months (such as in 1980-81) has little direct impact on crop production. For public water supplies, drought is more serious during the reservoir refill and groundwater recharge periods in the spring.

The beginning and end of a drought are difficult to identify because of the variability of precipitation. Rainfall or snowfall can be excessively high or low from month to month. For example, in 1981, precipitation in the upper Delaware Basin in southeastern New York varied from 24 percent of average in January to 209 percent in February and 16 percent in March. During the serious drought that occurred in southeastern New York in the mid-1960's, there were periods of several months when precipitation was normal or above normal. This gave the false impression that the drought was over a number of times. During the 1984-85 drought, precipitation deficits occurred from August 1984 through January 1985 and were particularly severe in April 1985, a normally high runoff month. Precipitation in May, June and July was slightly above normal, but it was too late to attain the normal reservoir storage.

#### 1. DROUGHT INDICATORS

Because of the nature of droughts, procedures for determining drought conditions are not well developed. The most commonly used indicator of meteorological drought is the Palmer Index developed in 1965. In addition, four major elements of the hydrologic cycle were analyzed and will be used

for drought determinations. They are precipitation, reservoir and lake storage, streamflow and groundwater levels. These hydrologic indicators are weighted on a regional basis and used to establish a State Drought Index which will be considered in conjunction with the Palmer Index to make decisions on drought status. Following is a brief discussion of the Palmer Index and hydrologic indicators. A more detailed discussion is presented in Appendix A.

a. Palmer Index

The Palmer Index is used by the National Weather Service to describe periods of unusually wet or dry weather. The expanded network assures evaluation of reliable indices for each zone. It is designed to give an indication of drought severity based upon the magnitude and duration of moisture deficiency. The index is developed on the basis of a general concept of supply and demand. Supply is determined by precipitation and stored soil moisture. Demand is determined from a combination of factors, including evapotranspiration, water needed to recharge soil moisture and runoff needed to keep streams, lakes and reservoirs at normal levels.

The water balance accounting procedure results in a computed excess or deficit which is then weighted by a climatic factor. The final product is an index that expresses the moisture condition for a particular area for a particular time, usually a month. Each new monthly increment is added to a portion of the prior month's index to include the factor of duration in the final index. Ranges of indices have been established to define drought severity, as listed in Section 4 of this chapter.

b. Precipitation

Lack of precipitation is the underlying cause of droughts. A deficit in precipitation over a certain time period is the usual measure of drought severity. The time of occurrence of a deficit in precipitation is important in determining the effect of drought. A precipitation deficit in the winter and spring, when large reservoirs normally refill, can severely impact public water supplies and a precipitation deficit in the summer growing season is critical for agricultural crops. Each of the other indicators is all or partly dependent on precipitation. However, precipitation alone is not sufficient for determining drought conditions because of its variability which may obscure drought trends, particularly at the beginning and end of drought periods.

c. Reservoir/Lake Storage

Reservoir storage is considered a leading indicator of impending or actual drought for water supply systems relying on surface storage. The usual approach is to compare current storage, expressed as percent of usable capacity, with historic or normal storage taking into account the normal seasonal pattern of reservoir fluctuation. Similarly, comparisons of lake levels are indicative of drought conditions.

Another measure of reservoir drought conditions is an estimate of the number of days of water supply remaining. The National Weather Service also expresses drought status in terms of the inches of rainfall required to fill a reservoir or lake in a very short period of time based on existing soil moisture.

d. Streamflow

Streamflow may indicate drought conditions and flow frequency curves developed on a statistical basis are used as an index of flow conditions. The curves show the probability of flow magnitudes being equalled or exceeded based on the period of record at a particular stream gaging station. The flow must be representative of natural conditions and not be influenced by reservoir releases, for example. Flow frequency curves may be developed for annual, seasonal or monthly durations. At this time, monthly frequency curves appear to have the most applicability to drought determinations.

Streamflow has two components, base flow made up of discharges from groundwater and surface runoff resulting directly from precipitation. During normal periods, the base flow component is a relatively small part of total streamflow. During drought periods it is a major portion because of low runoff. On a seasonal basis most of the streamflow during the late summer and fall consists of groundwater discharge. Surface runoff is variable depending upon the characteristics of precipitation and the drainage basin and is usually highest in the spring months.

e. Groundwater Levels

Groundwater levels also may indicate drought conditions and observation wells are used to measure groundwater levels. The wells are located in two major types of aquifers, upland and valley floor. Based on long-term records the maximum, minimum and average groundwater levels have been established and can be compared with current levels to determine drought status. Changes in groundwater levels are gradual and show trends that assist in predicting groundwater supplies and base flows in streams.

Groundwater levels are influenced by the infiltration of surface water and may be interconnected with streams and lakes. Shallow groundwater levels are affected in the early stages of drought but deeper levels may not be affected for some time. Typically, there is a lag in the initial effect of a precipitation deficit on groundwater levels as compared to the effect on streamflow and reservoir and lake levels. Streamflow and reservoir and lake levels also recover to normal levels before groundwater. Recovery of groundwater levels is not as sensitive to temporary weather aberrations, such as short periods of above normal precipitation, and recovery after a lengthy drought period usually is a clear indication that a drought is over.

## 2. USE OF DROUGHT INDICATORS

Certain hydrologic indicators are more important than others for specific water uses, generally as follows:

<u>USE</u>	<u>PRIMARY INDICATORS</u>
Public water supply Individual domestic, and some industrial uses	Reservoir storage, groundwater levels Groundwater levels
Crop production	Precipitation, Palmer Index
Water quality management, fish and wildlife, power generation, navigation	Streamflow
Recreation	Lake water levels

Although the primary concern in the 1980-81 and 1984-85 droughts was with public water supply, all the water uses and associated indicators will be considered in making decisions on drought stage and actions. However, more weight will be given to some indicators than others in the rating and decision-making process depending on the region and other factors.

In this analysis, criteria have been established for definition of normal conditions and four different drought stages: alert, warning, emergency and disaster. The Palmer Index will be used as one basis for determining drought stage. The other will be the hydrologic factors which will be weighted on a regional basis to determine a State Drought Index which, in turn, will indicate the drought stage. The weighting reflects the priority of public water supply.

Use of both of the indices is desirable because they indicate different aspects of drought and to some extent complement each other. Soil moisture is an important factor in the Palmer Index, so that index is useful for agricultural droughts and for identifying the early stages of drought, as well as short-term droughts. The State index is oriented toward reservoir/lake storage for public water supply and is more indicative of long-term and severe droughts during which low precipitation, streamflow and groundwater levels impact storage.

The drought stage that is determined from the two indices will not automatically trigger particular drought actions, but it will be used in combination with other factors to make drought action decisions. Economic, social, political and other factors will be important, particularly in the drought emergency and disaster stages. The indices will be evaluated on a regional basis, but actions may be taken for larger areas, such as more than one region or the whole State, or for smaller areas, such as counties, depending on the situation.

## 3. DROUGHT REGIONS

Based on experience which includes the 1980-81 and 1984-85 droughts, the six drought regions used for evaluations during those droughts have been revised. A drought management region should (a) reflect relatively

consistent indices throughout, (b) provide sensitive and accurate evaluation of conditions around the State's population centers, and (c) be covered by reliable and sufficient data collection points for calculation of indices. The ideal format would be attained as the number of regions are increased, each region becoming smaller and reflecting drought conditions more uniformly throughout. The following alternative configurations were evaluated:

- current six drought regions
- thirteen regions of the water resources management strategies
- ten climatological regions used by National Oceanic and Atmospheric Administration (NOAA)

The thirteen strategy regions are good for a common water supply base, but using a thirteen or a ten region configuration increases assessment and reporting requirements. In addition, some regions would not have enough data collection points to provide a good drought evaluation, especially in terms of streamflow, groundwater and reservoir storage.

A compromise eight region configuration was selected (Figure 1). Region II now incorporates all of the New York City water supply system. Climatologically, this breakdown is better than the previous configuration and it relates more closely to the NOAA regions.

The drought regions are as follows:

- I. Long Island
- II. Catskills
- III. Susquehanna
- IV. Mohawk/Upper Hudson
- V. Adirondacks
- VI. Great Lakes
- VII. Finger Lakes
- VIII. Southern Tier

The eight regions are representative of major areas of the State with somewhat similar characteristics and are a manageable number for monitoring conditions and determining drought status. Essentially, the same drought indicators are used regardless of the regional configuration and drought actions will not necessarily be on a regional basis. Thus, the regions are important but not critical for drought management.

Pertinent data for the hydrologic stations being monitored in each region will be obtained by the responsible agency. These include: National Weather Service precipitation stations, U.S. Geological Survey stream gaging stations and groundwater observation wells, New York City reservoir storage, and storage in other reservoirs and lakes on a State Department of Health watch list. The Palmer Index is computed by the National Oceanic and Atmospheric Administration.

The Department of Environmental Conservation, in cooperation with the appropriate Federal, State and local agencies, will assess drought status as warranted by conditions. Under normal conditions, the data from



indicator stations will be assessed on a monthly basis. If a drought develops, more stations will be monitored by the responsible agencies and the frequency of drought assessment will be increased in the successive drought stages.

Under normal conditions, no special reports will be prepared on drought conditions. Periodic summaries will be prepared in the drought alert stages and more frequent reports prepared with increasing drought intensity. Following is a general schedule for assessment and reporting:

<u>Condition</u>	<u>Frequency of Assessment</u>	<u>Frequency of Reports</u>
Normal	Monthly	None
Drought Alert	Monthly	Periodic Summary
Drought Warning	Weekly to monthly	Monthly
Drought Emergency	Daily to weekly	Weekly
Drought Disaster	Continuous to daily	Daily

#### 4. DROUGHT INDICES

##### a. Palmer Index

The Palmer Index is discussed in more detail in Appendix A. The drought stage will be determined from the following classification of the index values:

<u>Palmer Index</u>	<u>National Weather Service Class</u>	<u>New York Drought Stage</u>
0.49 to -0.49	Near Normal	Normal
-0.50 to -0.99	Incipient Drought	Normal
-1.00 to -1.99	Mild Drought	Alert
-2.00 to -2.99	Moderate Drought	Warning
-3.00 to -3.99	Severe Drought	Emergency
-4.00 to -4.99	Extreme Drought	Disaster
-5.00 or less	-----	Disaster

##### b. State Drought Index

The State Drought Index consists of a weighted point system varying between 0 and 150 points. The range of points for the five stages is as follows:

Normal	100 - 150
Alert	75 - 100
Warning	50 - 75
Emergency	25 - 50
Disaster	0 - 25

The drought index is calculated as a function of precipitation, reservoir/lake level, streamflow and groundwater level. Each indicator is assigned values for the five conditions based on a percent weight. Determination of drought condition for each indicator is discussed in Appendix A.

The percent weights on a regional basis are as follows:

PERCENT WEIGHT BY REGION

<u>INDICATOR</u>	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>	<u>V</u>	<u>VI</u>	<u>VII</u>	<u>VIII</u>
Precipitation	20	10	20	20	20	20	20	20
Reservoir/Lake Storage	0	80	60	50	50	60	60	50
Streamflow	0	5	10	10	10	10	10	10
Groundwater Level	$\frac{80}{100}$	$\frac{5}{100}$	$\frac{10}{100}$	$\frac{20}{100}$	$\frac{20}{100}$	$\frac{10}{100}$	$\frac{10}{100}$	$\frac{20}{100}$

Based on this weighting, the ranges of indicator values for each region for the different drought stages are shown in Table 1. The State Drought Index for a region is the sum of the weighted values of each indicator.

TABLE 1

WEIGHTED INDICATOR VALUES  
and  
DROUGHT INDEX VALUES  
by  
REGION

<u>Stage</u>	<u>INDICATOR VALUE</u>				<u>Value of State Drought Index*</u>
	<u>Precipitation</u>	<u>Reservoir/Lake Storage</u>	<u>Streamflow</u>	<u>Groundwater Levels</u>	
<u>REGION I</u>					
Normal	20-30	0	0	80-120	100-150
Alert	15-20	0	0	60- 80	75-100
Warning	10-15	0	0	40- 60	50- 75
Emergency	5-10	0	0	20- 40	25- 50
Disaster	0- 5	0	0	0- 20	0- 25
<u>REGION II</u>					
Normal	10-16	80-120	5- 7	5- 7	100-150
Alert	9-10	60- 80	3- 5	3- 5	75-100
Warning	6- 9	40- 60	2- 3	2- 3	50- 75
Emergency	3- 6	20- 40	1- 2	1- 2	25- 50
Disaster	0- 3	0- 20	0- 1	0- 1	0- 25
<u>REGIONS III, VI and VII</u>					
Normal	20-30	60- 90	10-15	10- 15	100-150
Alert	15-20	45- 60	7.5-10	7.5- 10	75-100
Warning	10-15	30- 45	5.0-7.5	5.0-7.5	50- 75
Emergency	5-10	15- 30	2.5-5.0	2.5-5.0	25- 50
Disaster	0- 5	0- 15	0-2.5	0-2.5	0- 25
<u>REGIONS IV, V and VIII</u>					
Normal	20-30	50- 75	10-15	20- 30	100-150
Alert	15-20	37.5- 50	7.5-10	15- 20	75-100
Warning	10-15	25-37.5	5.0-7.5	10- 15	50- 75
Emergency	5-10	12.5- 25	2.5-5.0	5- 10	25- 50
Disaster	0- 5	0-12.5	0-2.5	0- 5	0- 25

\* The value of the State Drought Index equals the sum of the weighted indicator values.

## B. PLAN FORMULATION

In order to formulate the 1982 Drought Preparedness Plan, the Task Force examined numerous options for programs and projects to meet both immediate-action-needs and long-term drought preparedness needs.

The following criteria were taken into consideration when determining which options the Task Force would recommend:

1. The option should represent the least costly means of mitigating the impacts of drought emergency and drought disaster.
2. Options addressing immediate actions were preferred over more costly, long range options.
3. The option should utilize, to the extent possible, existing information from available investigations.
4. Sufficient additional information must be able to be developed to adequately assess the likely effects of each option.
5. The emergency/disaster drought possibility must be considered.

Based on the examination and appraisal, the Task Force developed recommendations for programs and projects to meet the needs of any drought situation in the state. These are listed in general order of priority in the Executive Summary in the following categories: (1) statewide programs, (2) projects and project investigations in southeastern New York, and (3) options for investigations in other areas of the state. The implementation status of these 1982 recommendations is presented in Table 2.

Immediate action needs and options for immediate action are described in more detail in this chapter. Immediate action needs include replenishment of the disaster preparedness emergency stockpile, preparation of water system drought contingency plans, and development of local, regional, and state drought plans. Additional options for immediate action include enactment of legislation, implementation of programs, and initiation of studies and projects.

The legislative proposals are for mandatory water metering and for the development of water conservation programs as a requirement for water supply permit applications. Programs which could be implemented are the Statewide Water Resources Management Strategy, the Upstate and Long Island Groundwater Management Programs, and programs developed by the Mayor's Intergovernmental Task Force on New York City Water Supply Needs. Included in these programs are options for initiation of studies and projects relating to water supply interconnections, groundwater supply development in southeastern New York, groundwater supply utilization from the Brooklyn-Queens Aquifer in New York City, and statewide identification of areas where groundwater can be utilized in an emergency.

TABLE 2  
Implementation Status of Recommendations in 1982  
State Drought Preparedness Plan

<u>Recommended Actions</u>	<u>Status</u>
<b>A. <u>Statewide Programs</u></b>	
1. Replenish and Expand Emergency Preparedness Stockpile	Total of about \$1.8 million spent in FY 84-85, FY 85-86, FY 86-87, and FY 87-88 for Stockpile rehabilitation. Need additional funds to improve the maintenance and operation of the stockpile.
2. Complete Water System Drought Contingency Plans	Many water system plans were prepared in '80-'81 drought and updated during '84-'85 drought. Emergency plans are now required by law to be prepared by December 31, 1990 for systems with an annual gross operating revenue in excess of \$125,000 (see page 81 for details).
3. Enact State Water Finance Authority Legislation	NYC legislation and generic statewide legislation enacted for financing.
4. Complete Local, Regional and State Drought Plans	Regional drought contingency plan prepared for Upper Delaware Basin. County plans prepared for Rockland and Westchester counties.
5. Implement State Water Conservation Program	DEC/DOW resources allocated for staff (1+) and informational materials.
6. Provide Technical Assistance for Drought Planning and Response	No significant action.
7. Enact Mandatory Water Metering Legislation	New York City presently implementing. State legislation submitted by the Governor to legislature.
8. Examine Proposed Water Allocation Legislation	Draft study bill prepared.

TABLE 2 (cont.)

**B. Projects and Project Investigations  
in Drought Region II  
(Southeastern New York)**

- |   |   |
|---|---|
| 1. Activate Chelsea Pumping Station as Emergency/Disaster Supply  | New York City has prepared a DEIS with DEC as the lead agency as part of their water supply application.  |
| 2. Investigate Expansion of Chelsea Pumping Station for Emergency/ Disaster Supply  | NYC has prepared an engineering feasibility report for expanding Chelsea or pumping up to 300 mgd from the Hudson River at other locations as a permanent addition to their supply. |
| 3. Implement Stage 1 Test Wells and Model Study for Utilization of Brooklyn/Queens Aquifer as Emergency/Disaster Water Source | Completed   |
| 4. Complete Feasibility Study and EIS for Increasing Cannonsville Reservoir Storage   | State completed studies and determined the enlargement project was not practicably feasible.  |
| 5. Investigate Existing Upland Water Bodies for Emergency Water Supplies  | Included in recommendations of Statewide Water Resources Strategy.  |
| 6. Evaluate Water Supply Interconnections for Emergency Use   | Included in recommendations of Statewide Water Resources Strategy.  |
| 7. Evaluate Regional Groundwater Supply Development for Emergency Use   | Included in recommendations of Statewide Water Resources Strategy.  |
| 8. Investigate Hudson River Utilization in Addition to Chelsea Pumping Station  | If long term demand projections exceed capacity of City system with Chelsea expansion, this option will be considered by Mayor's Intergovernmental Task Force.                      |

**C. Options for Investigations in Other  
Drought Regions**

- |   |   |
|---|---|
| 1. Investigate Water Supply Interconnections          | Included in recommendations of Statewide Water Resources Strategy |
| 2. Investigate Groundwater Supplies for Emergency Use | Included in recommendations of Statewide Water Resources Strategy |

TABLE 2 (cont.)

3. Investigate Reservoir and Lake Reregulation Potential	Included in recommendations of Statewide Water Resources Strategy
4. Analyze Barge Canal System for Emergency Use	Not done
5. Examine Cowanesque Reservoir Potential for Emergency Use	Not done

1. IMMEDIATE ACTION NEEDS

a. State Emergency Equipment Stockpile

The State Emergency Management Office (SEMO) maintains a stockpile of pipe, pumps and other equipment which may be used by local governments to augment their normal water supply during drought emergency/disaster periods. Although most of the equipment in the stockpile is more than 30 years old, it has been extensively used in past droughts of 1960's, 1980-81 and 1984-85. The stockpile consists of pipes, pumps, water filters and other equipment that can be borrowed for water supply emergencies.

During these periods the stockpile was not sufficient to accommodate all emergency requests. In 1980 the Drought Management Task Force, recognizing the deficiencies of the stockpile, recommended that the SEMO prepare a budget request to replenish and expand the stockpile to meet projected needs. In early 1981, SEMO staff projected a cost of \$2.5 million for stockpile replenishment in the ensuing year. That amount was estimated to meet 60% of the expressed local needs as reported at that time. An amount of \$811,000 was authorized in FY 84-85, and amounts of \$401,000 were authorized in FY 85-86 and \$376,000 in FY 86-87, and FY 87-88 for Stockpile replenishment. The Task Force considers the restoration and expansion of the stockpile to an adequate level for disaster/emergency conditions to be the highest priority drought need in the State. The stockpile has not yet reached the levels recommended by the Task Force. If the State goes into a prolonged drought, the stockpile will be inadequate and many localities will suffer. In addition to the equipment replenishment, manpower to maintain the stockpile and handle emergencies is required.

b. Water System Drought Contingency Plans

i. 1980-81 Drought

On January 30, 1981, the State Health Commissioner sent letters to water suppliers in the 22-county area affected by the 1980-81

drought, requesting preparation of written drought emergency plans. Each plan was to contain the following information:

- Criteria for imposing drought warnings, issuing water use restrictions, and use of emergency sources.
- Listing of alternative emergency sources.
- Actions to be taken in drought emergency situations.
- Descriptions of local resources and anticipated State assistance.

There was a 90-95% response from 40 suppliers which serve populations of 10,000 or greater and approximately 75% of these plans were acceptable. There was also a 40% response from the smaller suppliers with fair quality plans.

Where plans were inadequate, the supplier was requested to resubmit an acceptable version to the local public health engineer (LPHE). Where plans were not submitted, the LPHE is continuing an effort to encourage the supplier to submit an acceptable plan. Review of drought preparedness is now a part of the Health Department's annual inspection of water suppliers.

The primary area of State assistance in the local drought emergency plans is utilization of the Disaster Preparedness Emergency Stockpile.

On December 8, 1981 the State Health Department requested New York City to provide the same information on their emergency plan that was requested of the other water suppliers. The New York City Drought Contingency Plan was submitted for review in 1982 and is included as an appendix to this State Drought Plan.

ii. 1984-85 Drought

During the 1984-85 drought, disaster emergency was declared on July 10, 1985 by Governor Cuomo for the counties of Delaware, Dutchess, Putnam, Orange, Rockland, Sullivan, Ulster and Westchester, the City of New York, and contiguous areas. A Drought Disaster Emergency Coordinator was appointed by the Chairman of the State's Disaster Preparedness Commission. As the drought intensified but before the disaster emergency was declared, the State Health Commissioner, on May 8, requested 144 water suppliers in the 13-county drought-impacted area to prepare or update drought contingency plans. This request was similar to one made during the 1980-81 drought. The suppliers were asked to include an appraisal of their current water supply situation, criteria for determining various drought response actions, lists of approved emergency sources of supply, lists of available equipment and needs, and water conservation and leak detection programs. By mid-October, 120 plans (83%) were received at the local health unit level; 108 plans (75%) were reviewed and endorsed, and 12 plans (8%) were under review. 24 suppliers (17%) did

not respond. Letters were also sent out on July 30, 1985 to all community public water system suppliers in the designated drought areas to review the adequacy of their drought contingency plans and urging water conservation. The Drought Management Task Force gives high priority to the completion of water system drought contingency plans.

### iii. New Legislation

#### Water Supply Emergency Plans

In 1987, a bill was passed by the State legislature to amend the public health law to require water suppliers to prepare a water supply emergency plan. The intent of the bill is to ensure that potable water is available during a water supply emergency. The following components are the minimum requirements for the plan:

- Establishment of criteria and procedures to determine critical water levels or safe yield of the system
- Identification of existing and future sources of water under normal and emergency conditions
- Condition of present interconnections and identification of additional interconnections to meet a water supply emergency
- Specific action plan to be followed during a water supply emergency including a phased implementation of the plan
- General water conservation programs and water use reduction strategies for water supply emergencies
- Prioritization of water users
- Identification and availability of emergency equipment needed during a water supply emergency
- System capacity and ability to meet peak demand and fire flows concurrently
- Storage capacities
- Public notification program coordinated with the phased implementation schedule

~~from~~ A vulnerability analysis assessment.

#### Water Conservation Programs

In 1988, a bill was passed by the State legislature to incorporate the requirement for a water conservation program as a prerequisite for attaining a water supply permit. A detailed

description of a near and long range water conservation program appropriate for local conditions must be submitted as part of the application and may include:

- Implementation and enforcement procedures
- Effectiveness to date and any planned modifications
- The identification of and cost effectiveness of distribution system rehabilitation to correct sources of lost water
- Measures which encourage proper maintenance and water conservation
- A public information program to promote water conservation, including household conservation measures
- Contingency measures for limiting water use during seasonal or drought shortages.

c. Local, Regional and State Drought Plans

A continuing state effort is needed to develop and maintain local and regional drought contingency plans and to make revisions in the State Drought Preparedness and Response Plans as warranted by further drought experience and additional information.

The Task Force drought planning effort focused on state and local actions on a statewide basis and on projects needed in southeastern New York. Only limited consideration was given to specific local and regional plans in the remainder of the state. However, based on their review of local drought plans, the Health Department (DOH) concluded that emergency sources are generally available to community water systems outside the New York City-Westchester and Rockland County area in periods of drought. The availability of emergency equipment to transport the water may, in some cases, impede the use of these sources. A more detailed discussion of the assessment is included in Appendix B.

Upon adoption of new regulations based on specific changes to Part 5 of the State Sanitary Code, community water systems meeting the gross revenue requirement of \$125,000 would be directed to prepare and adopt water supply emergency plans. In the drought prone areas of the State, community water systems not meeting the revenue requirement would also be directed to prepare and adopt water supply drought emergency plans.

Based on this assessment, the need for local and regional drought contingency plans is a function of the vulnerability to drought of the community water systems in the various regions and the availability of an emergency source or interconnection. DOH's regional assessment indicates that the majority of community water systems most vulnerable to drought are in the lower Hudson Valley and southwestern Catskill area (Region II).

During the recent drought, water suppliers in Region II who had access to alternate (non-New York City) sources of water supply were asked to take steps to minimize use of the City sources. The Jamaica Water Supply Company and other suppliers who impact the City supply were also asked to implement water conservation. In addition, releases were requested from the Sacandaga Reservoir to maintain a minimum flow of 3,500 cfs at Green Island to prevent the Hudson River salt front from reaching the Poughkeepsie and New York City water supply intakes. These steps demonstrate how water suppliers can benefit from alternative sources available within their region and indicate the need for preparing Regional Drought Plans.

Although the scope of regional plans may vary depending upon drought vulnerability, they should generally cover the three phases of prevention/mitigation, response and recovery. The plans would include provisions for utilization of alternate sources of supply, interconnections between systems, and measures to reduce water demands most effectively. Water conservation would be an essential element. A schedule of progressively more severe restrictions--including rationing--would be developed for increasingly more severe drought stages to reduce the possibility of endangering public health and safety, economic dislocation and system failure.

A program to assist communities and regions in developing workable, technically sound drought emergency plans is needed.

## 2. ADDITIONAL OPTIONS FOR IMMEDIATE ACTION

### a. Legislation

#### i. Mandatory Water Metering

Proposed state legislation would require installation of meters in all structures over a two year period for commercial and industrial structures or on a ten year schedule based on number of units for residential buildings. The bill does not apply to any city with a population over 1 million in which a program to achieve universal metering over a ten year period is being implemented.

In January 1986, the Mayor of New York City announced the goal of metering all New York City water supply system customers within ten years. The Department of Environmental Protection coordinated an interagency effort to develop an implementation plan for conversion to full metering. Under this plan, the City would be responsible for the purchase and installation of all new meters and the maintenance or replacement of all new and existing meters. The cost of meters and installation would be paid for from rate revenues.

### b. Program Implementation

#### i. Water Resources Management Strategy

The most active program relating to water resources management is the ongoing Water Resources Management Strategy.

The broad overall objective of the statewide water resources management strategy is to meet the water resources requirements of residential, agricultural, industrial and commercial users and to assure the highest possible quality and quantity of New York State's water resources.

Strategy development is guided by a 15 member council, with responsibility for reviewing and, if necessary, amending the strategy every two years. In addition, it is expected the council will provide the continuing overall guidance and direction at the state level on implementation actions, particularly those related to policy considerations and legal, financial and institutional aspects.

This implementation potential, combined with the high priority implementation recommendations in the draft Statewide Strategy provides the best vehicle for implementing those program elements of the Drought Preparedness Plan requiring action.

The following recommendations of the draft Statewide Strategy relate directly to major program elements of the Drought Preparedness Plan.

#### Water Conservation

-- Water supply plans shall be required and shall include a contingency plan for the use of emergency sources, especially for droughts, interconnections where feasible for flexible and reliable system operation, water use restrictions and other appropriate actions.

-- A water conservation program shall be required in public water supply permits as a standard condition. The program should at least include leak detection and repair, decrease of excessive pressures, metering with fair and equitable water rates and useful public information and contingency measures.

-- More stringent water restrictions shall be implemented during drought and other water supply emergencies.

-- Comprehensive public information and education programs on water conservation will be established and maintained. Technical assistance will be provided to water suppliers regarding their conservation programs.

#### Technical Assistance

-- Technical assistance will be provided to small water systems on source evaluations, dependable yields, future needs and other aspects related to water resources development and the assurance of adequate water supply.

Drought management aspects would include the identification of emergency sources, information on how to use the emergency sources and how to determine a drought alert, warning and emergency condition.

#### Interconnections

-- Interconnections will be required for permanent use where technically, economically and environmentally feasible and for temporary use during emergencies. Technical assistance and financial incentives will be provided by the State for interconnections.

#### Instream Flow Management

-- Standards should be developed for minimum flows to be applied to all waters of the state based on natural stream hydrology.

-- Stream flows in all streams, from source to mouth, shall be sufficient to balance the protection of natural resources, as well as to maintain adequate water quantity, quality, assimilative capacity, recreation, agriculture, transportation and power generation uses, while recognizing domestic water supply has the priority use of the state's water resources. This minimum flow policy should apply to all new impoundments, diversions and withdrawals, including withdrawals from primary and principal aquifers.

-- Operation of all existing impoundments which meet the thresholds of ECL 15-0503 should be reviewed to identify problems and opportunities to optimize the protection of fish and wildlife habitat while not significantly impairing the intended purpose of the impoundment.

#### ii. Mayor's Intergovernmental Task Force on New York City Water Supply Needs

This task force was convened by the Mayor of New York City at the height of the 1984-85 drought. Its charge was to reassess the city's long-range water supply needs in light of the 1980-81 and 1984-85 droughts and to review the adequacy of planning efforts to meet those needs. The Mayor asked the task force to recommend what the city's long-term priorities should be and what actions the city should be taking to ensure that those priorities can be achieved.

The Task Force has separated its tasks into seven areas of concern, each the responsibility of a separate sub-committee. Interim reports detailing the efforts and progress of each sub-committee were published in February 1986 and December 1987. The sub-committees are as follows:

- Conservation/Metering
- Groundwater
- Demand
- Hudson River/Long Range Planning
- Water Quality and Watershed Management
- Financial and Institutional Arrangements

The Intergovernmental Task Force is conducting extensive analyses of short and long-term actions to ensure an adequate supply of water to New York City under all circumstances. A crucial part of this analysis is the determination of the nature of the City's current demand in order to refine projections for future needs. In 1982, it appeared that no major projects for development of new water supplies in the State would be necessary. However, the 1986 Interim Report projected a supply deficit of 400-1,600 mgd by the year 2030. An accurate projection of future demand and expected deficits, if any, is required for proper selection of water supply projects for implementation. A study is underway to evaluate future demands both with and without conservation programs in effect.

A second crucial challenge is the analysis and institution of every reasonable measure to control and contain water demand. As demand continues to exceed safe yield by larger and larger amounts, minor droughts could result in serious water shortages. Programs including metering with rate differentials between flat and metered accounts can encourage conservation and better system management. On-going conservation efforts which don't cease when a drought ends can promote water supply awareness and reduce unnecessary waste. The ability of such programs to slow the current steady increase in water demand will be analyzed by the Intergovernmental Task Force.

Evaluation of existing information shows that there are available, through diversion or re-regulation, the means of providing some additional supplies from existing sources. The major need is for facilities to transmit the water from those sources to existing water supply systems.

Potential projects for additional water supply in southeastern New York include utilization of the Hudson River and tapping of groundwater resources. The Task Force recommends that these options be investigated to determine their technical and economic feasibility.

#### Hudson River Projects

The Hudson River may represent the only large source of supplemental water supply for New York City which could be realistically developed within the next 10 to 15 years. A special committee of the Intergovernmental Task Force on New York City Water Supply Needs is investigating several options for use of Hudson River water.

A draft environmental impact statement was prepared for the emergency operation of the existing Chelsea Pumping Station. This station was used during the 1984-85 drought to provide up to 100 mgd of additional supply to the City from the Hudson River. An engineering feasibility report has also been prepared for the expansion of the Chelsea plant to a capacity of 200 to 300 mgd or for the construction of an additional facility at Newburgh or Kingston. Full-scale treatment for this water would be required. This expanded Hudson River supply, if shown to be feasible and acceptable, would be used year-round to provide additional safe yield for the City system.

If the long term (year 2030) demand projections exceed the capacity of the City system with the expanded Chelsea option, the Intergovernmental Task Force will consider the Corps of Engineers' "High-Flow Skimming" Project. This project would entail taking an annual equivalent of 400 mgd from the Hudson River near Hyde Park by pumping up to 900 mgd (1,500 cfs) during non-sensitive, high flow periods when the river flow characteristically exceeds 15,000 cfs. A further proposal by the Corps would increase this yield to an annual equivalent of 800 mgd by releasing extra water to the Hudson from upstate reservoirs.

These Hudson River project options will be thoroughly investigated by the Intergovernmental Task Force as possible additional sources of supply for both drought emergencies and long-range City needs.

#### Groundwater Utilization Projects

Groundwater resources may be able to provide a viable, supplemental source of water supply for New York City. Several studies have been or are being performed, focusing mainly on the aquifers underlying Brooklyn, Queens, Nassau, and Suffolk Counties. Different operating scenarios with varying withdrawal rates have been investigated with safe yield depending, in part, on whether or not recharge is practiced.

Some form of treatment would probably be required for the groundwater before blending with the City's upstate water. The Intergovernmental Task Force is carefully studying the groundwater supply option, including the economic feasibility of this supplemental source of supply for New York City.

#### iii. Upstate New York Groundwater Management Program

This program describes problems with upstate groundwaters, summarizes government programs and recommends a program of management actions to protect this resource.

Key recommendations of the program having a special relationship to drought management pertain to groundwater mapping and resource assessment and the development of local water supply emergency and drought contingency plans.

#### iv. Long Island Groundwater Management Program

This program identifies the problems and causes associated with the State's largest and most important groundwater resource and proposes the programs required to address these problems.

While many of the recommendations pertain to water management, in general, they are also effective as drought management actions.

Some of the more important program needs are as follows:

- DEC should refine and augment the current Long Island Well Permit program to more fully achieve regional groundwater quantity management.
- DEC and DOH should prepare a regional water quantity/water supply strategy for Long Island.
- NYCDEP and NYCDOH should continue to implement a phased program leading to the determination of the feasibility of using the Brooklyn/Queens Aquifer as a supplemental supply.
- NYCDEP should enter negotiations with the Jamaica Water Supply Company on system interconnections and on equitable arrangements for complimentary utilization of supplies.
- Nassau County should enact a water conservation program, with emphasis on:
  - Installation of water saving appliances
  - Increasing unit prices for increased use
  - Public education program
  - Investigating restrictions on proportion of developed areas in lawns.
- Nassau County should seek project approval of an intercounty transmission system.
- Nassau County should construct or require installation of system interconnections.
- All agencies on Long Island should actively promote water conservation as a basic element of good water management.
- DEC should require the subsequent recharge of suitable quality water where appropriate, as a condition of the Long Island Well Permit Program.

## CHAPTER II

### DROUGHT RESPONSE PLAN

#### A. DROUGHT RESPONSE MANAGEMENT

Soon after its establishment, the Drought Management Task Force prepared a report which included a directory of available State resources and capabilities. The inventory showed a broad range of activities that might be undertaken and provided a basis for decisions on actions to be included in this Drought Response Plan. An overriding consideration was the availability of resources to take the specified action. Thus, only State actions which can be carried out with existing resources were included in this plan. The same criteria was applied to consideration of local actions.

Drought-related actions are specified in the plan for the State Disaster Preparedness Commission (DPC), the Drought Management Task Force (DMTF), and State and local agencies. Actions to be taken are specified for normal conditions of water availability and for four levels of drought: drought alert; drought warning; drought emergency; and drought disaster. The actions are designed to mitigate, respond to and recover from drought.

The Task Force will coordinate the drought activities of member State agencies and others that may be able to provide assistance. The Task Force agencies will also assist localities and water suppliers in their mitigation, response and recovery activities.

Local governments and suppliers of water have the primary responsibility for ensuring the availability of adequate quantities of good quality water. Water supply systems must be developed and maintained in good physical condition and their sources and emergency sources of supply must be kept free from contamination. Drought contingency planning is essential at the local level.

Response organization during drought disaster emergency is detailed (Figure 2). Table 3 summarizes specific State and local actions under various drought conditions. State actions are described in more detail in Section B, and local actions are described in more detail in Section C.

RESPONSE ORGANIZATION  
1985 DROUGHT DISASTER EMERGENCY

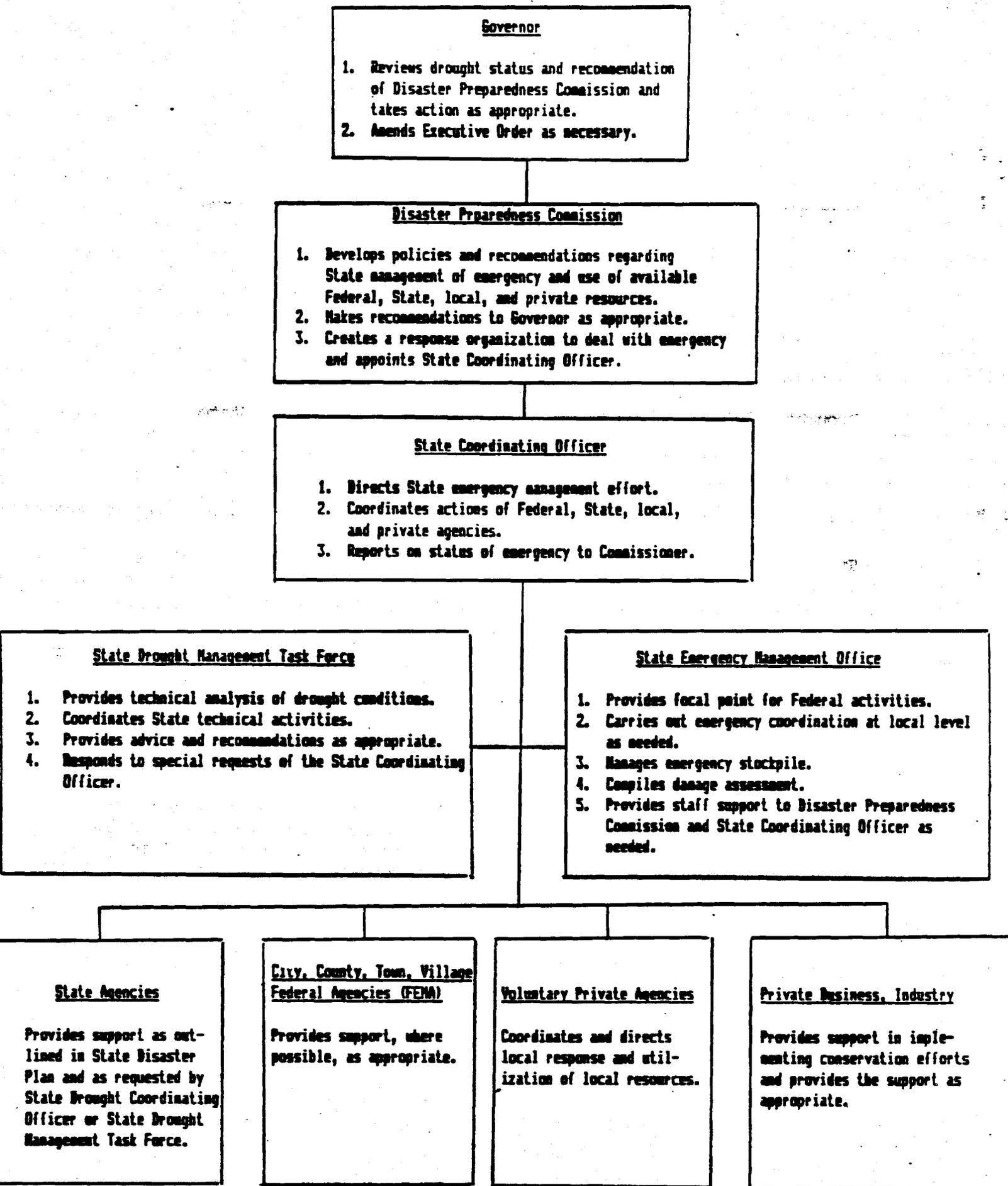


Figure 2

TABLE 3  
SUMMARY OF STATE AND LOCAL RESPONSE ACTIONS

Normal Conditions

- | <u>State</u>   | <u>Local</u>  |
|--|---|
| <u>DMIF</u>  |   |
| <ul style="list-style-type: none"> <li>- Maintain the means to monitor and appraise drought status.</li> <li>- Develop and keep current State and Regional drought contingency plans.</li> <li>- Plan for "worst case" situations including use and transfer of water.</li> <li>- Maintain adequate drought contingency planning process.</li> </ul> | <ul style="list-style-type: none"> <li>- Develop and keep current local drought contingency plans.</li> <li>- Maintain adequate drought resource and response capability.</li> <li>- Make necessary improvements to water systems.</li> </ul> |

State Agencies

- Review and provide technical assistance in the development of local drought contingency plans.

DPC

- Support development of State and local drought contingency plans.

Drought Alert

- | <u>State</u>  | <u>Local</u>   |
|---|--|
| <u>DMIF</u>   |  |
| <ul style="list-style-type: none"> <li>- Monitor and appraise drought status.</li> </ul>  | <ul style="list-style-type: none"> <li>- Review and update local contingency plans.</li> </ul>     |
| <u>State Agencies</u>   |  |
| <ul style="list-style-type: none"> <li>- Review and update local, regional and State drought contingency plans.</li> <li>- Provide technical assistance to localities.</li> <li>- Intensify monitoring and appraisal of drought status.</li> <li>- Prepare drought updates for DMIF.</li> </ul> | <ul style="list-style-type: none"> <li>- Promote voluntary water conservation measures.</li> </ul> |

TABLE 3 (cont.)

Drought Warning

Local

DMTF

- Convene to initiate drought actions.
- Accelerate drought management efforts as the situation worsens.
- Continue to monitor and appraise drought status.
- Initiate coordination with Federal agencies and other states to alleviate potential drought impacts.
- Alert the Disaster Preparedness Commission (DPC) as to status of situation.
- Designate Regional/State Drought Preparedness Coordinator.
- Intensify voluntary water conservation efforts.
- Intensify leakage control efforts.
- Make provisions for utilization of emergency sources of supply.
- Designate local drought preparedness coordinator.

State Agencies

- Promote public information and technical assistance programs.
- Request replenishment of emergency stockpile.

DPC

- Urge completion of drought contingency plans.

Drought Emergency

Local

DMTF

- Intensify monitoring and appraisal of drought status.
- Restrict water uses in stages, banning non-essential uses first and then reducing water for essential uses.
- Review options for water from Barge Canal feeder reservoirs and/or Hudson River-Black River Regulating District.

TABLE 3 (cont.)

Local

- Recommend special state legislation and funding, if needed.
- Review Regional/State drought implications.
- Support National Weather Service surveys for estimating water equivalent of snow cover.
- Assess capability of governmental interactions.
- Review drought preparedness plans for deficiencies.
- Intensify Regional/State water conservation programs.
- Assess requirements for State assistance.
- Establish priorities for use of equipment and technical assistance.
- Make recommendations to DPC.
- Advise DPC of local and State emergency actions.
- Review and prepare to initiate actions to meet "worst case" situation.
- Use emergency equipment and tap emergency sources of water. Activate Chelsea Pumping Plant if appropriate.
- Request technical assistance and equipment from the State, if necessary.
- Implement local public awareness and water conservation campaign.
- Initiate/expand leak detection and repair programs.
- Initiate penalties for violations of water use restrictions.

State Agencies

- Coordinate stockpile use.
- Inventory industrial users for emergency supplies.
- Provide equipment and technical assistance to localities.
- Provide assistance on financing.
- Provide limited resources on a priority basis.

TABLE 3 (cont.)

- Implement water conservation in State office buildings.
- Utilize regulatory and emergency powers.
- Establish alert procedures to warn of oil spills in stream that are used as emergency pumping facilities.
- Distribute Fire Service Guide "Suggested Fire Department Operations for Drought Emergencies."

DPC

- Consider DMTF recommendations.
- Consider need for State declaration.
- Appoint liaison officer to DMTF if a declaration is made.
- Request Federal emergency assistance from Federal Emergency Management Agency.
- Request suppliers, by letter, to adopt measures to conserve water.
- Direct State agency response.
- Establish task force to develop phased emergency disaster plans where needed.

Drought Disaster (in addition to Emergency Action)

State

Local

DMTF

- |   |   |
|---|---|
| - Respond to directives to implement DPC actions. | - Initiate further restrictions on water use. |
|---|---|

TABLE 3 (cont.)

State

Local

State Agencies

- Take actions as directed by the Governor and DPC.

- Undertake all possible local disaster efforts.
- Request State and Federal disaster declarations.
- Enact emergency legislation and issue emergency orders as required.

DPC

- Request Federal disaster assistance.
- Implement appropriate "worst case" option.
- Declare State disaster, if appropriate.

## B. STATE ACTIONS IN RESPONSE TO DROUGHT

### 1. NORMAL CONDITIONS

#### a. Task Force (DMTF)

i. Maintain the means to monitor and appraise drought status. The lead state agency is the Department of Environmental Conservation assisted principally by the State Department of Health and Federal agencies including the U.S. Geological Survey and the National Weather Service. Criteria including two drought indices have been developed for eight regions of the State to identify the different levels of drought. The indices are the Palmer Index and the State Drought Index based on four hydrologic indicators: precipitation; streamflow; groundwater levels; and reservoir/lake storage. DEC in cooperation with the other agencies has established the procedures and system to assess drought status and to determine drought stage as described in the New York State Drought Preparedness Plan.

ii. Develop and keep current State and Regional drought contingency plans. The Department of Environmental Conservation has the lead role and will be assisted by the Department of Health and other state agencies, as appropriate. Contingent upon available resources, state and regional drought contingency plans will be developed. They will reflect elements of local drought contingency plans to the extent practicable and will focus on: (1) drought criteria to identify the various drought stages, and (2) the drought actions to be taken in the various drought stages.

iii. Plan for "worst case" situation including use and transfer of water. The Department of Environmental Conservation is the lead state agency primarily assisted by the Department of Health, the U.S. Army Corps of Engineers and the U.S. Geological Survey. A state plan for "worst case" situations is necessary so that the state can respond and minimize potential catastrophic impacts from severe droughts. New York City undertook "worst case" type planning during the 1984-85 drought. The State planning for "worst case" situations will be centered on: (1) drastic reductions and/or shut off of water supplies, and (2) utilization of major emergency sources of water including expansions, modifications and interconnections which could be activated in a short-range period (up to 3 years) and long-range period (3-10 years or more).

iv. Maintain adequate drought contingency planning process. The Drought Management Task Force will be on standby during normal conditions of water availability and will meet as needed in order to maintain a process that will ensure readiness in the event of a drought.

b. State Agencies

i. Review and provide technical assistance in the development of local drought contingency plans. The Departments of Health and Environmental Conservation are the lead agencies in this work. The Department of Health requested water suppliers in 22 counties in eastern and southeastern New York to submit drought contingency plans and will continue to work with them on improving plans that are deficient. DEC has assisted Rockland County on their local drought contingency plan and held workshops on plan preparation. Similar assistance will be provided to other local areas contingent on available resources. Local drought contingency plans are an essential part of the State program and will be developed where needed and updated as necessary.

c. Disaster Preparedness Commission (DPC)

i. The Disaster Preparedness Commission, utilizing the technical expertise of the State Emergency Management Office and other State agencies, will encourage and support state and local drought contingency planning efforts. Completed local contingency plans will become an integral part of Regional and State drought contingency plans.

2. DROUGHT ALERT

a. Task Force (DMTF)

i. Monitor and appraise drought status. Upon receipt of information from DEC staff that the drought indices show a drought alert condition, the Task Force will review the situation to analyze the potential for worsening drought conditions and to ensure that the appropriate state and local agencies are in sufficient readiness to cope with such conditions.

b. State Agencies

i. Review and update local, regional and State drought contingency plans. The Departments of Health and Environmental Conservation will lead the review of the status of local, regional and state drought contingency plans. Any deficiencies will be noted and steps will be taken to improve the plans.

ii. Provide technical assistance to localities. State agencies led by the Departments of Environmental Conservation and Health will provide to localities to the extent possible and upon request, technical assistance and information on engineering, hydrology, public information activities, water conservation measures and other programs related to manpower and resources (including equipment).

iii. Intensify monitoring and appraisal of drought status. DEC will monitor and provide an appraisal of the drought situation on a regular basis when the alert condition is reached. Timing will initially be at one month intervals unless more frequent assessment is necessary.

iv. Prepare drought updates for DMIF. Drought updates will be prepared at a frequency necessary to keep the DMIF informed of significant changes in the drought status.

3. DROUGHT WARNING

a. Task Force (DMIF)

i. Convene the DMIF to initiate drought actions. The DMIF will be provided with drought updates prepared by DEC. If the drought condition approaches the warning stage, the DMIF will be convened to consider further action.

ii. Accelerate drought management efforts as the situation worsens. The Task Force will meet more frequently and undertake additional activities, as required by the situation.

iii. Continue to monitor and appraise drought status. DEC will intensify the monitoring and appraisal effort in cooperation with other agencies and will provide drought status reports to the Governor's Office, to Task Force members, and to others who are concerned as required by the situation.

iv. Initiate coordination with Federal agencies and other states to alleviate potential drought impacts. State Emergency Management Office (SEMO) will lead the coordination with appropriate Federal agencies regarding Federal assistance to state and local governments. These activities will intensify as the situation worsens.

The Department of Environmental Conservation will provide the lead in the coordination with other states concerning potential issues and problems of an interstate nature or of mutual concern.

v. Alert the Disaster Preparedness Commission (DPC) as to status of situation. The Task Force will alert the DPC concerning the situation and will keep the Commission informed of its activities.

vi. Designate Regional/State Drought Preparedness Coordinator. The Task Force will designate a coordinator so that all state activities among state agencies and with local and Federal entities will be channeled through one individual. This should enable more rapid and timely overall state responses to emergency and disaster situations.

b. State Agencies

i. Promote public information and technical assistance programs. DEC, in cooperation particularly with the Departments of Education, Economic Development and Health, will implement a public information and education program to the extent possible with existing resources.

Localities will be notified of the availability of technical assistance from the various state agencies. SEMO and other appropriate state agencies will request necessary replenishment of the emergency stockpile.

c. Disaster Preparedness Commission (DPC)

i. Urge completion of drought contingency plans. Advise local governments of their responsibility to complete drought contingency plans and urge those that have not completed such plans to do so.

4. DROUGHT EMERGENCY

a. Task Force (DMTF)

i. Intensify monitoring and appraisal of drought status. DEC will intensify the drought monitoring and assessment effort and provide weekly or more frequent reports, if necessary, to the Governor's Office, Task Force members and others.

ii. Review options for water from Barge Canal feeder reservoirs and/or Hudson River-Black River Regulating District. The need for supplemental flows in applicable streams for additional supply and/or to prevent salt water intrusion will be evaluated and requests will be made to appropriate agencies for increased releases.

iii. Recommend special state legislation and funding, as needed. The Task Force will recommend to the Disaster Preparedness Commission and to the Governor any special legislation and/or funding determined to be needed.

- iv. Support National Weather Service surveys for estimating water equivalent of snow cover. The Task Force will cooperate with NWS in obtaining information on potential run-off from snow.
- v. Assess capability of intergovernmental actions. Coordination between State, local and interstate actions will be assessed to assure such actions are commensurate with the drought severity throughout the applicable areas.
- vi. Review drought preparedness plans for deficiencies. The NYS Department of Health will continue to require submittal and evaluation of local drought preparedness plans.
- vii. Intensify Regional/State water conservation programs. The Department of Environmental Conservation is the lead agency in promoting water conservation measures. All State agencies will intensify and expand their public information and water conservation programs. Such efforts will include technical assistance to localities, contingent upon available resources.
- viii. Assess Requirements for State assistance. The DMIF will keep alert to the needs of local communities and provide assistance as appropriate and available.
- ix. Establish priorities for use of equipment and technical assistance. The DMIF, due to the limited availability of stockpile equipment, will establish priorities based on severity and type of problem for the use of equipment and technical assistance.
- x. Make recommendations to DPC. The DMIF will make recommendations, as appropriate, to the DPC regarding all elements of the drought relating to severity and possible responses and actions.
- xi. Advise DPC of local and state emergency actions. The Task Force will keep DPC advised of the situation, state needs, and actions taken.
- xii. Review and prepare to initiate actions to meet "worst case" situations. At the initiative of the Task Force, each State agency will review its readiness condition for implementing appropriate elements of the "worst case" plan. Local interests will take steps to ensure utilization on a timely basis both of emergency sources of supply and water supply rationing programs.

b. State Agencies

- i. Coordinate stockpile use. The State Emergency Management Office will coordinate distribution of the stockpile based on priorities established by the DMIF.
- ii. Inventory industrial users for emergency supplies. DEC will review their list of industrial water users as possible suppliers to local communities.

iii. Provide equipment and technical assistance to localities. The appropriate state agencies will coordinate the use of the equipment stockpile. SEMO, assisted primarily by the Departments of Health and Transportation, will respond to requests for equipment (mostly pumps and pipes) to the extent of the State's capacity to provide them on a priority basis. Requests for technical assistance are expected to increase significantly as an emergency becomes more acute and/or widespread.

iv. Provide assistance on financing. Department of Public Service staff will be made available to assist municipal and private systems in financial planning, billing procedures and rate design associated with drought emergency actions. The intent of any financial planning will be to provide sufficient funds for continued adequate operation of a water system, as well as meeting additional project needs and costs which may be undertaken and incurred in a drought.

v. Provide limited resources on a priority basis. Each agency will provide services within their area of expertise to assist local municipalities and purveyors as requested.

vi. Implement water conservation in State office buildings. The Office of General Services will implement water conservation activities in State office buildings and consider reducing use of buildings for a specified period. OGS can also assist in purchase of equipment and in evaluation of building or property damage as well as in evaluation of reconstruction needs or costs, if there are any as a result of drought.

vii. Utilize regulatory and emergency powers. In the response to requests from local governments, state agencies will utilize regulatory and emergency programs and authorities to the fullest extent possible in their assistance to the localities.

viii. Establish alert procedures to warn of oil or hazardous chemical spills in streams that are used as emergency pumping sources. DEC will keep an updated inventory of emergency sources to be notified in the event of an oil or chemical spill at a threatening location.

ix. Distribute fire service guide "Suggested Fire Department Operations for Drought Emergencies." These guides will be distributed by the State Office of Fire Prevention and Control.

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c. Disaster Preparedness Commission (DPC)

- i. Consider DMIF recommendations. The DPC will evaluate and implement appropriate recommendations of the DMIF.
- ii. Consider need for State declaration. Based on the evaluation of the DMIF on drought severity in any of the regions of the State, the DPC shall consider requesting that the Governor make a Declaration of an Emergency Disaster (Drought).
- iii. Appoint liaison officer to the DMIF if a declaration is made. The Chairman of the Disaster Preparedness Commission will appoint the liaison officer.
- iv. Request Federal emergency assistance from Federal Emergency Management Agency. The Task Force will determine when Federal aid is needed, and will recommend to the Disaster Preparedness Commission and the Governor the kind of emergency assistance needed. (See Appendix C for application procedures and specific program assistance available.) Emergency or disaster assistance may be obtained from the Federal government, as follows: (1) without a Presidential declaration of a major disaster or emergency, or (2) after a Presidential declaration has been made. The procedures for requesting and declaring an emergency are similar to those for major disaster.

Drought related emergency assistance can be obtained, for example, for emergency health and sanitation measures, conservation measures and loans for agriculture.

For both emergency and disaster conditions, federal legislation and programs are needed to help state and localities cope with severe droughts. Programs for urban areas are especially needed.

- v. Request suppliers, by letter, to adopt measures to conserve water. The DPC will make appropriate requests to purveyors and municipalities to conserve water. These requests will be consistent in severity of actions required with the drought severity at each location.

- vi. Establish task force to develop phased emergency disaster plans where needed. If specific regions of the State reflect a drought severity approaching a disaster condition, the DPC will appoint a task force to plan for possible mitigation measures.

5. DROUGHT DISASTER  
(IN ADDITION TO EMERGENCY ACTIONS)

a. Task Force (DMIF)

- i. Respond to directives to implement DPC actions. The Task Force will recommend to the DPC specific actions that should be taken in

response to a particular drought disaster condition. These actions will depend on the severity of the drought, its location and geographical extent, the assistance needed by the local governments and the capabilities of the state to respond. The Task Force will respond to directives to implement DPC actions.

b. State Agencies

i. Take actions as directed by the Governor and DPC. State agencies will respond to the disaster situation through their programs and authorities and as directed by the Governor through the Disaster Preparedness Commission.

c. Disaster Preparedness Commission (DPC)

i. Request Federal disaster assistance. The Task Force will recommend to the DPC and to the Governor the kind of disaster assistance needed. The types of assistance available include: project grants; use of property, facilities and equipment; and provision of specialized services. (See Appendix C for application procedures and specific program assistance available.) The DPC will implement the necessary actions.

ii. Implement appropriate "worst case" option. The Task Force will recommend to the DPC and to the Governor when the implementation of all or elements of the "worst case" plan should be put into effect. The DPC will coordinate the necessary actions.

iii. Declare State disaster, if appropriate. Whenever the Governor finds that a disaster has occurred or may be imminent for which local governments are unable to respond adequately, the Governor shall declare a disaster emergency by executive order including a description of the disaster and the affected area.

Upon the declaration of a state disaster emergency, the Governor may direct state agencies to provide assistance to localities under the coordination of the Disaster Preparedness Commission. This assistance may be in the form of equipment, supplies, facilities, services of state personnel and other resources. (See Sections 28 and 29 of the Executive Law-Article 2-B for details.) The Department of Labor will waive the waiting period for eligible applicants for Unemployment Insurance who have become unemployed as a result of the drought disaster emergency.

Also, the Governor may consider directing state agencies to take the following actions:

a. Rationing Plan

Assist as necessary the implementation of a priority-of-use and rationing plan in cooperation with local officials. The actions (including

shutdowns) could apply to public and private water systems in the drought stricken area and would be based on state, regional and local plans.

b. Activation of Water Supply Interconnections

DOH and DEC assist as necessary the activation of major water supply interconnections by local water systems at pre-designated locations presently known or to be determined by further study.

c. Activation of Chelsea Pump Station (up to 100 mgd)

If not already being operated, DOH, in cooperation with DEC and New York City, would oversee activation of the existing Chelsea Station to pump water from the Hudson River into the NYC water system.

d. Emergency Reservoir Operations

DEC, in cooperation with the appropriate entities, would oversee predeveloped emergency operating procedures for certain reservoirs; for example, Great Sacandaga Lake and Indian Lake releases in conjunction with pumping from the Hudson River at the Chelsea Pump Station (expanded from 100 mgd to at least 200 mgd).

e. Use of Emergency Wells

DOH, in cooperation with DEC and affected entities, would oversee the drilling and pumping of existing and predetermined well locations for emergency sources of water.

f. Utilization of Milk Trucks for Water Supply

The Department of Agriculture and Markets, in cooperation with the Department of Transportation and local officials, would assemble the necessary vehicles and transport water to the affected drought areas with a plan of operation. The plan should include the bottling and transport of bottled water as well as water in volume.

C. LOCAL ACTIONS IN RESPONSE TO DROUGHT

1. NORMAL CONDITIONS

a. Develop and keep current local drought contingency plans. All local and private officials responsible for the operation of water supply systems should develop and keep current drought contingency plans for their systems. This includes the local response to "worst case" situations. State agencies, particularly the Departments of Health and Environmental Conservation, will assist in the development of the plans.

b. Maintain adequate drought resource and response capability. The officials responsible for the water system should ensure that

personnel and equipment are available to implement their drought contingency plan.

c. Make necessary improvements to water systems. The inefficient operation of water systems including obsolete rate structures, excessive leakage, and general deterioration of facilities from lack of maintenance and rehabilitation compound the impacts of drought. Therefore, it is essential that the necessary improvements to water systems be determined and undertaken at the earliest practicable time.

## 2. DROUGHT ALERT

a. Review and update local contingency plans. Officials responsible for the operation of water systems should review their contingency plans. Deficiencies should be noted and steps taken to correct them to ensure that the water system is capable of coping with a severe drought.

b. Promote voluntary water conservation measures. A water conservation program should be announced to the public. All phases of the program from voluntary to mandatory measures should be explained. At this stage, voluntary conservation measures should be promoted.

## 3. DROUGHT WARNING

a. Intensify voluntary water conservation efforts. The program for voluntary conservation should be intensified and steps should be taken so that mandatory measures can be rapidly initiated when needed.

b. Intensify leakage control efforts. Stepped-up measures should be taken to plug leaks and to reduce other unaccounted-for water uses.

c. Make provisions for utilization of emergency sources of supply. The readiness of the water system to respond to a severe drought should be reviewed. Arrangements should be made for use of emergency sources of water.

d. Designate local drought preparedness coordinator. The appropriate local government will designate a coordinator so that all local activities will be administered through one individual/agency. This will provide for more timely responses and more effective interactions with State and Federal entities.

## 4. DROUGHT EMERGENCY

a. Restrict water uses in stages banning non-essential uses first and then reducing water for essential uses. Water conservation measures should be implemented in stages as dictated by the situation. Non-essential uses of water should be banned and then essential uses should be reduced.

b. Use emergency equipment and tap emergency sources of water. As the situation worsens, emergency equipment should be used to tap emergency sources of water as outlined in the local contingency plan.

c. Request technical assistance and equipment from the state, if necessary. Technical assistance and equipment should be requested from the appropriate state agency. Requests for Federal assistance should be made through the appropriate state agencies. (See Appendix C for application procedures and specific program assistance available.)

d. Implement local public awareness and water conservation campaign. Local communities must take measures to improve public awareness and refine conservation efforts.

e. Initiate/expand leak detection and repair programs. Efforts to reduce unaccounted-for water through leak detection and control will be implemented.

f. Initiate penalties for violations of water use restrictions. Localities shall consider penalties to stress the importance of complying with water use restrictions.

## 5. DROUGHT DISASTER

a. Initiate further restrictions on water use. Severe reductions and/or shutoff of water should be made on the basis of a local rationing plan developed for the "worst case" situation or other exigency.

b. Undertake all possible local disaster efforts. Local authorities should undertake all possible actions to reduce the impact of the drought including water use restrictions and/or shutoffs, use of emergency sources of supply, requests for available state and Federal emergency assistance, enactment of emergency legislation and issuance of emergency orders as required.

c. Request State and/or Federal disaster declarations. After determination that the locality cannot respond adequately to a disaster that has occurred or may be imminent, the responsible local officials should seek assistance through the state for disaster declarations from the state or Federal governments or both as may be appropriate.

d. Enact emergency legislation and issue emergency orders as required. Local emergency actions and declarations shall be imposed to help cope with the disaster.

## D. THE 1984-85 DROUGHT EXPERIENCE IN NEW YORK STATE

### 1. DROUGHT DESCRIPTION

The 1984-85 drought in New York State was centered in southeastern New York in the Catskill region, which is the major water supply source area for New York City. For a limited time at its height the drought reached into the Mohawk Valley as far west as Utica and across the Southern Tier of the state. The drought was also regional in scope, encompassing northeastern New Jersey and the Delaware River Basin, including eastern Pennsylvania and part of Delaware and extending into the Susquehanna River Basin.

The drought began in August 1984 and ended in November-December 1985. At its peak, the maximum cumulative precipitation deficit was 17.5 inches for the 9-month period, August 1984-April 1985, at several locations in southeastern New York. For the New York City reservoir system watersheds, the maximum deficit for the same period amounted to 12.34 inches, a 40% deficiency.

The most severe impact of the below-normal precipitation was on public water supply systems dependent on reservoir storage. Watershed yield during the winter and spring months was the lowest of record for the New York City system, and other reservoirs did not refill as they normally would. The City system entered the 1985 drawdown period on June 1 at only 60.8% of capacity. DeForest Reservoir in Rockland County was at only 49.9% of capacity. The reservoirs normally are full on June 1. During the summer and fall of 1985, drought-related water supply problems were also reported for 23 smaller public water supply systems mostly in central and southeastern New York (see Table 4 and Figure 3).

State awareness of the emerging drought began to develop in the fall of 1984, based on monthly assessments of four drought indicators: precipitation, stream flow, groundwater levels, and reservoir storage. New York City's Delaware system storage entered a previously established drought warning zone on November 27, re-entered the normal condition on November 30, and continued to flirt with drought warning until it finally entered the zone on January 18, 1985 and remained there throughout the spring and summer. Storage in DeForest Reservoir in Rockland County declined rapidly until the end of November 1984, then at a slower rate until February 6, 1985 when it crossed a pre-established rule curve for restricted water supply operations.

The drought progressed through alert or watch, warning, and emergency stages culminating in New York State and New York City (Stage III) drought emergency declarations on July 10, 1985. Westchester and Rockland Counties also declared drought emergencies, as did New Jersey, Pennsylvania, and the Delaware River Basin Commission. As conditions improved, the emergencies were ended in November-December 1985, and January 1986. The City ended their drought emergency status on November 27 but continued in drought warning until February 25, 1986. The State declaration was allowed to expire on January 10, 1986.

## 2. DROUGHT RESPONSE

A broad range of drought response actions were taken at State, local, and interstate levels. Most of them were directed at reducing water demands to conserve available supplies. Water conservation was emphasized. There were only limited capabilities for utilization of additional supplies, primarily groundwater pumping in Rockland County and Hudson River pumping at Chelsea. By and large, the measures taken were effective in reducing demand. New York City estimated a savings of over 80 billion gallons in reservoir storage as a result of water use restrictions and other efforts. The State Drought Preparedness Plan and drought contingency plans prepared by New York City, Westchester County, Rockland County, and other localities were used to guide response actions.

### State

At the state level, response to the 1984-1985 drought began with the convening of the State Drought Management Task Force on February 13, 1985. The Task Force subsequently met regularly on about a monthly basis through January 1986 to review drought status and coordinate drought response actions by various agencies.

The State Drought Preparedness Plan completed in February 1982 was used as a basis for response to the drought as it developed and intensified. Response actions in the alert and warning stages are fairly specific and most of them were taken, as well as additional actions not included in the plan. Actions in the emergency and disaster stages are less well defined and the 1984-85 drought provided more insight into the necessary response at those stages.

A major State action was taken on July 10, 1985 when Governor Cuomo issued an Executive Order Declaring a Disaster Emergency in the Counties of Delaware, Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster, and Westchester, the City of New York, and contiguous areas. The order shifted responsibility for drought emergency actions to the State Disaster Preparedness Commission chaired by State Health Commissioner Dr. David Axelrod. The order also directed implementation of the State Disaster Preparedness Plan and applicable portions of the State Drought Preparedness Plan, and authorized State agencies to take appropriate actions to provide assistance to affected localities in protecting the public health and safety. Furthermore, the affected communities were enjoined to prepare and update their drought contingency plans and to undertake all reasonable efforts to increase public awareness of the continuing water shortage, as well as to implement both voluntary and mandatory water conservation measures. The Governor's declaration opened the way for possible federal or State financial assistance to firms or individuals damaged by drought conditions, for example, through forced shutdowns.

The following is a list and brief discussion of major State actions taken during the drought.

TABLE 4

New York State Department of Health  
Public Water Supply Systems With Drought  
Related Water Supply Problems

System	Date of Problem	Remarks
1. Ogdensburg City, St. Lawrence Co.	8/15/85	<ul style="list-style-type: none"> <li>- Unable to keep up with demand</li> <li>- Losing approximately 200,000 gallons per day</li> <li>- Phase I emergency - voluntary cutbacks imposed</li> <li>- No equipment on loan</li> </ul>
2. Sylvan Springs Water Company, (T) Vernon, Oneida County	8/12/85	<ul style="list-style-type: none"> <li>- Announced water shortage</li> <li>- Water use restrictions imposed</li> <li>- Emergency pumping of barge canal</li> <li>- DE filter in use</li> </ul>
3. Clayville Village Oneida County	8/7/85	<ul style="list-style-type: none"> <li>- Losing ground water source due to lowering water table</li> <li>- Sequoit creek being used as an emergency source</li> <li>- Pump and chlorinator on loan</li> <li>- Conservation measures and boil water notice in effect</li> </ul>
4. Brownville Village Jefferson County	7/28/85	<ul style="list-style-type: none"> <li>- Running out of water</li> <li>- Well No. 3 dry as of 7/26/85</li> <li>- Emergency pumping of Black River</li> <li>- DE filter in use</li> </ul>
5. Petersburg Town Water District, Rensselaer County	7/24/85	<ul style="list-style-type: none"> <li>- Declared water emergency</li> <li>- Seasonal problem - new source under development</li> <li>- Boil water notice issued</li> <li>- Fire pond emergency source is being used</li> <li>- DE filter on loan and on line</li> </ul>
6. Parrott I Home For Adults, (T) Middleburg, Schoharie County	6/25/85	<ul style="list-style-type: none"> <li>- Running out of water</li> <li>- Low yield wells</li> <li>- Trucking in water</li> <li>- Fold-A-Tank on loan</li> </ul>

TABLE 4 (cont.)

System	Date of Problem	Remarks
7. Castile Village, Wyoming County	8/85	- Wells/Springs not meeting demand - Water conservation measures in effect
8. Scott Water District Cortland County	8/5/85	- Well not meeting demand
9. D & R Village MHP Town of Halfmoon Saratoga County	9/17/85	- Trucking in water - Problem resolved per ARO Report 10/17/85
10. Middleburgh Village Schoharie County	9/17/85*	- Voluntary water conservation
11. West Conesville Water Company Schoharie County	9/17/85*	- Using auxiliary source - Voluntary water conservation
12. Dundee Village Yates County	9/9/85	- Low well capacity - Auxiliary well in use - Water conservation in effect
13. Country Line MHP Town of Murray Orleans County	9/5/85	- Wells unable to meet demand - Bulk water being used
14. Rural Ridge Water Town of Hamptonburgh Orange County	9/10/85**	- Emergency source (well) in use
15. Blooming Grove W.D. #4 Orange County	9/10/85**	- Emergency source (well) in use
16. Goshen Village Orange County	9/10/85**	- Emergency source (Glenmore Lake) in use
17. Blooming Grove W.D. #1 Orange County	9/10/85**	- Purchasing water (30,000 gpd) from Merriewold Water Company
18. Mt. Airy Trailer Park Town of New Windsor Orange County	9/10/85**	- Trucking in water - Poor well yield

\* Albany Regional Monthly Status Report

\*\* Orange County Health Department September Status Report

TABLE 4 (cont.)

System	Date of Problem	Remarks
19. Naples Village Ontario County	10/1/85	- Springs unable to meet system demands - Water conservation regulations in place - Emergency chlorinator on loan
20. Interlaken Village Seneca County	9/85	- Water conservation regulations in place
21. Gloversville City Fulton County	* 10/17/85*	- Low reservoir levels
22. Highland Glens (T) Bennington Wyoming County	7/85	- Low well yield - Trucking in water - Seasonal problem aggravated by drought
23. Hamilton Village Madison County	10/14/85	- Water conservation notice issued (less than 2.5 feet above outfall level)

\* Albany Regional Monthly Status Report

\*\* Orange County Health Department September Status Report



a. Monitoring and Reporting on Drought Status

Four drought indicators were monitored by various agencies on a monthly or more frequent basis, and the information was used by DEC to develop a drought index for six drought regions in the State. The Palmer Drought Index indicating soil moisture conditions was provided by the National Weather Service on a weekly basis during the agricultural growing season.

Reports on drought status were given at the Drought Management Task Force meetings by DEC or the National Weather Service based on precipitation; by the U.S. Geological Survey based on stream flows, ground water levels and Hudson River salinity; by the State Department of Health based on storage in public water supply systems; and by New York City based on precipitation, watershed yields, consumptive demands and storage in their system.

Other reports were prepared by DEC, the State Department of Health and the City on a monthly or more frequent basis. Periodic drought updates were sent by DEC to about 800 interested parties in southeastern New York. Press releases also were issued and DEC staff organized several public and media information sessions in July to increase drought awareness.

b. Rehabilitating and Expanding the Emergency Equipment Stockpile

Under direction of the State Emergency Management Office (SEMO), considerable progress was made on improving the State emergency equipment stockpile with appropriations for FY '84-'85, FY '85-'86, FY '86-'87, and FY '87-'88 totalling about 2.0 million dollars. At the height of the drought, 30 communities were utilizing stockpile equipment. SEMO is currently developing a long range stockpile management plan. Complete rehabilitation of the stockpile should have the highest State priority.

c. Requiring Water Suppliers to Prepare or Update Drought Contingency Plans

As the drought intensified the State Health Commissioner, on May 8, requested 144 water suppliers in the 13-county drought-impacted area to prepare or update drought contingency plans. The suppliers were asked to include an appraisal of their current water supply situation, criteria for determining various drought response actions, lists of approved emergency sources of supply, lists of available equipment and needs, and water conservation and leak detection programs. By mid-October, 120 plans (83%) were received at the local health unit level; 108 plans (75%) were reviewed and endorsed, and 12 plans (8%) were under review. 24 suppliers (17%) did not respond (Table 5).

TABLE 5

New York State Department of Health  
Public Water Supply Drought Emergency Plans  
Response Summary  
October 1985

County	No. of Systems	Plans Received*		No Action
		Endorsed	Under Review	
Albany	6	4	1	1
Delaware**	17	16	0	1
Greene	8	3	3	2
Otsego	7	6	0	1
Schoharie	8	0	8	0
Dutchess**	10	5	0	5
Orange**	20	14	0	6
Putnam**	14	11	0	3
Rockland**	6	4	0	2
Sullivan**	14	13	0	1
Ulster**	21	19	0	2
Westchester**	13	13	0	0
Total	144	108	12	24
	100%	75%	8%	17%

\* At the Local Health Unit Level

\*\* Drought Emergency Counties

d. Promoting Water Conservation

On May 1, 1985 Dr. Axelrod asked State agencies on the Disaster Preparedness Commission to implement water conservation measures at their facilities in the drought area.

DEC staff prepared packages of water conservation materials for release during State Water Week (June 16-22) and water conservation was also stressed by DEC and DOH at drought information meetings in July. Various water conservation materials were obtained and distributed by both agencies, and the need for water conservation was highlighted in media contacts.

e. Drought Projections

A "worst case" drought scenario was developed in July 1985, looking ahead to potential drought conditions late in 1985 and continuing into 1986. A simplistic predictive model for New York City composite reservoir storage was derived for this analysis, and "worst case" assumptions were made for the principal factors influencing reservoir storage, including runoff, consumption, releases, conservation measures, and other sources of supply as follows.

- Criteria - Worst case assumptions

1. Consumption - including those on system  
Estimated at 1390 mgd (42 bg/mo); use as basic water use against which conservation cutbacks apply by month

2. Releases

Drought emergency requires minimum of 1100 cfs at Montague. At low flows, assume 75 percent of Montague flow comprised of New York City reservoir releases: 825 cfs or 16 bg/mo. Expect worst location of Delaware River salt front requiring 1650 cfs at Montague during August, September, and October (24 bg/mo).

3. Runoff

During critical summer months, the National Weather Service estimates that it takes 5.5 inches of rain to generate 1.0 inch of runoff, which for the New York City system equals 34 bg. Worst case estimates of 1.5 inches of rain per month would generate only 10 bg per month during July, August, and September. Runoff for the remaining months of October 1985 through June 1986 is pro-rated on the basis of total 1985-86 runoff of 500 bg.

4. Conservation Measures

Based on recent media appeals by New York City for more commitment to conservation cutbacks, a phased-in approach to a maximum water usage reduction of 20 percent by August is used for worst case (Table 6).

TABLE 6  
SUMMARY - WORST CASE DROUGHT SCENARIO  
RESPONSE ACTIONS

<u>Date</u>	<u>Drought Status</u>	<u>State</u>	<u>Local</u>	<u>Federal</u>	<u>Region</u>	<u>IMPACT</u>
						<u>Media Status</u>
June 1985	Warning	DMTF Readies Emergency Stock- pile °DMTF compiles self-supplied industrial water use data °DMTF conducts public outreach program. State agencies adhere to local restric- tions	°Prepare Contin- gency plans °Voluntary water conservation °Designate local drought coordinator	°NWS, USGS assist w/drought	II	Reservoirs @ 60%; wells below record low, streams at 90-95% exceedance frequency
July-Oct. 1985	Emergency	°DPC appoints liaison officer °DPC directs response of State agencies °DPC directs communities from Catskill System to Croton System	°Prepare disaster contingency plans °Self-supplied industries prepare use reduction plans °Institute contin- gency plans in- cluding mandatory water use restric- tions °NYC activates Chelsea Pump Sta. °Achieve 20% water conservation	°FEMA alerted	II	Reservoirs below 40% wells at new record lows for 3-6 months; streams at 95-97.5% exceedance frequency
Nov. 1985-?	Disaster	°DPC directs implementation of disaster con- tingency plans	°Institute disaster plans °NYC adds Brooklyn- Queens, Jamaica increases pumpage from Chelsea	°FEMA provides assistance	I, II, III	Reservoirs below 25% wells at new record lows; more than six months; streams over 97.5% exceedance frequency

## 5. Other Sources

- Chelsea Pump Station is assumed to be on line as of July 1, 1985 and to continue throughout the emergency at a capacity of 100 mgd or 3 bg/mo.
- Brooklyn Queens aquifer offers an additional yield of 60 mgd but can be pumped for only one year; although not a popular source, it could contribute 1.8 bg per month perhaps to a critical section of the water supply system and with recharge up to 100 mgd could be developed; testing and well construction needed at estimated cost of \$20 million.
- Jamaica Water Supply is currently receiving some 28 mgd from the city system; if marginally contaminated wells in Jamaica Water Supply System could be reopened, at least 0.9 bg per month could stay in the New York City system.

### - Prediction Model

A simplistic prediction model for New York City composite reservoir storage was derived for this analysis:

$$\begin{aligned} \text{change in storage ( } s \text{)} &= \text{Input-Output} \\ \text{where Input} &= \text{runoff} + \text{auxiliary sources,} \\ \text{Output} &= \text{consumption} + \text{releases} \\ \text{or } s &= (\text{runoff} + \text{aux. sources}) - \\ &\quad (\text{consumption} + \text{releases}) \end{aligned}$$

### - Prediction Results/Observations

Results indicated that storage could reach a "disaster" level at the end of November 1985. This projection was transmitted to the Disaster Preparedness Commission with information on possible response actions. A concurrent projection by the City, based on 1964-65 hydrology and water demands, indicated that both the Catskill and Delaware systems could be empty by December 15, 1985. On June 1, 1986, storage would be at about 63 percent of capacity. The principal driving forces in the worst case scenario are water consumption, runoff, and release requirements. Auxiliary sources of water supply currently available are not nearly sufficient to offer a promise of averting disaster. Suspension of releases to control the Delaware River salt front could save 60 to 80 bg 1985 summer and early fall but would be sure to raise downstream litigation, depending on lower Delaware River basin conditions. Water conservation is the key to avoiding disasterous impacts. However, achievement of over 20 percent reduction in consumption on a sustained basis can only be realized with extreme enforcement of drastic cutback actions.

If the disaster situation materializes in the New York City system, other communities in the Drought Region II will be impacted. The State Department of Health is compiling contingency plans for these communities at present. Further actions will pend identification of state-local interfaces. Self-supplied industries are being assessed regarding quantity

and source(s) of supply. As conditions merit, cut-back plans for achieving reductions in water usage could be requested. However, self-supplied use is not large and water savings would be limited. Agricultural drought contingency plans will be requested as circumstances dictate.

Projections were made for three alternative hydrology scenarios:

- I. 1964-65 Hydrology (NYC Data)
- II. Median Hydrology (NYC Data)
- III. Forecast Hydrology (NYS DEC)

The results indicated that the City system would reach about 71 percent capacity by June 1, 1986 based on the 1964-65 hydrology. For the other two hydrology scenarios, the system filled in April 1986. Fortunately, these extreme drought conditions did not materialize. As the summer progressed and conditions improved, the projections were updated periodically.

f. Activation of the Hudson River Pumping Station at Chelsea, New York

On June 28, permission was requested by New York City to turn on the 100 mgd Hudson River pumping station at Chelsea as soon as preparatory work for operation was completed and there was an approved monitoring plan for surveillance and process control.

On July 3, Dr. Axelrod granted approval to activate the pumping station as an emergency source of water for New York City. The emergency approval was for a period not to exceed six months from that date, and a maximum withdrawal rate of 100 mgd was prescribed. A monitoring plan was also approved, subject to modification as drought and water quality conditions changed. It was noted that the emergency approval did not preclude the need for the City to continue to seek permanent approval from DEC through the State Environmental Quality Review Act and the water supply application provisions of the Environmental Conservation Law.

The pumping station at Chelsea was operated for the period July 10-December 11 and during that time produced 12.7 billion gallons of additional water supply. One of the major concerns was possible impact of the withdrawals on salinity in the Hudson River, particularly encroachment of the salt front farther up the river to the City of Poughkeepsie's water supply intake.

g. Additional State Actions

Other significant State drought response actions included the following:

- inventoried self-supplied industrial water users in the drought area for possible use of their supplies to meet emergency public water supply needs (DEC)

- sent letters to water suppliers in the drought area requesting them to adopt measures to conserve water and utilize sources other than the New York City system where possible (State Drought Coordinating Officer)

- established a task force (DEC, DOH, NYC and Westchester County) to develop a phased emergency disaster plan for the NYC system and prepare information on alternatives that could be incorporated into the disaster plan

- met with the Federal Emergency Management Agency seeking federal drought emergency assistance (SEMO)

- reviewed options for releasing water from Barge Canal feeder reservoirs to the Mohawk River based on information provided by the Department of Transportation. Only a minimal quantity of water appeared available (DMTF)

- established an alert procedure to notify NYC of an oil spill or other hazardous material release into the Hudson River which could impact on water quality at the Chelsea plant (SEMO)

- considered a consultant presentation on large-scale (400-500 mgd) emergency pumping from the Hudson River to provide additional supply for NYC (DMTF)

- supported a National Weather Service aerial survey program in the NYC watershed area during the 1985-86 winter to estimate the water equivalent of snow cover for improved runoff forecasting (DMTF)

- prepared and distributed a Fire Service Guide, "Suggested Fire Department Operations for Drought Emergencies" (State Office of Fire Prevention and Control)

#### Local      towns of      service of

##### a. New York City

On February 25, 1985 New York City declared a drought watch; on April 3, a drought warning; on April 26, a Stage I drought emergency; on June 5, a Stage II drought emergency; and on July 10, a Stage III drought emergency. At each of these stages, actions were taken generally in conformance with the City's drought contingency plan (Appendix D). Prior to the initial declaration in February, the City responded to the below-normal storage by intensifying their leak detection program and starting to pump from the Croton system to conserve water in the Catskill and Delaware systems.

During the drought watch and drought warning periods, the City urged residents to take steps to conserve water, and various actions were taken by City agencies to reduce water consumption and prepare for more severe drought. During the drought emergency stages, increasingly stringent

mandatory restrictions on water use were imposed with increasing emphasis on enforcement actions. Water consumption was reduced significantly, although targets were not met. City actions during the 1984-85 drought included:

- a public awareness program on the drought and an intensified water conservation campaign
- maximum use of the Croton system through pumping
- an expanded leak detection and repair program
- installation of about 30,000 hydrant locking devices (30% of total hydrants)
- elimination of spray cap program in 59 parts of City
- a mandate for installation of flow-restricting showerheads
- coordination with outside communities on reduction in water consumption
- increased penalties for violations of water use restrictions
- establishment of the Intergovernmental Task Force on New York City Water Supply Needs and completion of a six-month interim study recommending short-term and long-term actions to meet water supply needs
- establishment of a Task Force on Water Conservation
- a mandate for installation of water meters in all new and substantially renovated buildings
- In January 1986, the Mayor of New York City announced the goal of metering all New York City water supply system customers within ten years. The Department of Environmental Protection coordinated an interagency effort to develop an implementation plan for conversion to full metering. Under this plan, the City would be responsible for the purchase and installation of all new meters and the maintenance or replacement of all new and existing meters. The cost of meters and installation would be paid for from rate revenues.

b. Others

Westchester County, which receives about 80% of its water supply from the New York City system, acted in parallel with the City on related drought declarations and actions. Other communities that rely on the City system were requested by the City to implement comparable conservation measures and to utilize alternative sources of supply, for example, to draw from the Croton system instead of the Catskill system, if possible.

Rockland County also was severely impacted by the drought and implemented provisions of their drought contingency plan based on deficiencies in precipitation and storage in De Forest Reservoir. The County Commissioner of Health declared a Stage I water emergency on April 4, 1985 and a Stage II water emergency on May 2, 1985. Water use restrictions were imposed and withdrawals from De Forest Reservoir were ended and other sources of supply were utilized.

In addition to Westchester and Rockland Counties, the counties of Delaware, Dutchess, Orange, Putnam, Sullivan and Ulster were included in the Governor's July 10 Disaster Emergency Declaration. For the eight counties, the State Coordinating Officer sent letters to 384 public community water systems whose sources are surface water requesting them to review the adequacy of their drought contingency plans and water supply situation. If there was any indication that the quantity of water available was below normal or was likely to be below normal, they were asked to initiate a conservation program banning nonessential water uses. The water use restrictions were to be consistent with the Stage I restrictions of the New York City drought emergency. The extent to which these water use restrictions were imposed has not been determined.

### Interstate

#### a. Drought Operations

At the interstate level, the principal drought response actions involving New York were taken through the Delaware River Basin Commission (DRBC) based primarily on the "Good Faith" agreement on interstate water management reached in early 1983 among parties to the 1954 U.S. Supreme Court Decree, including New York State and New York City. Among other things, the agreement calls for phased reductions in diversions and releases from the City's Delaware River Basin reservoirs during drought conditions as defined by operation curves based on combined storage in Cannonsville, Neversink and Pepacton Reservoirs.

On January 23, 1985 the City's 800 mgd entitlement from the Delaware River Basin was reduced to 680 mgd (upper half drought warning); on February 7, 1985 it was further reduced to 560 mgd (lower half drought warning) and on July 24, 1985 as part of an agreement among the parties to the 1954 Supreme Court Decree there was an additional reduction to 540 mgd. Concurrent reductions in the Montague flow objective were made to 1655 cfs on January 23 and 1550 cfs on February 7. The July 24 agreement provided for a variable flow objective at Montague ranging from 1300 to 1650 cfs depending on the time of year and location of the salt front in the Delaware River estuary.

Augmented conservation releases from the City's reservoirs were reduced to basic levels on January 23. Thermal stress releases, which are normally available from May 1 to October 31, were also terminated. A special thermal emergency bank was established from July 5 through August 28, but it was exhausted on August 12.

DRBC declared a drought warning on January 23, and, in addition to the diversion and release reductions, adopted a resolution requesting all classes of water users in the basin and its service area in New Jersey and southeastern New York to conserve water on a voluntary basis.

On May 13, after public hearing, DRBC declared a drought emergency and adopted four conservation orders. The orders temporarily placed stored waters at power company reservoirs, including Orange and Rockland's Mongaup system in New York State, under conservation control; provided temporarily modified operation of federal and state reservoirs in the Delaware Basin; restricted nonessential water uses in communities in the basin; and required drought contingency information and plans by major water users. During July, DRBC adopted three additional interrelated conservation orders. The orders (1) authorized reallocation of diversions to New Jersey and associated changes in diversions and releases for transfer of 20 mgd across the George Washington Bridge into northeastern New Jersey; (2) amended the schedule of reductions in diversions, releases and stream flow objectives for a "Drought Warning-Special Operation" condition; and (3) authorized an emergency thermal release bank to prevent possible fishkills below the City's reservoirs.

By agreement, the City's allowable diversion was increased to 680 mgd and the Montague flow objective was increased to 1655 cfs on October 2. This action was ratified by DRBC on October 30 and the City's allowable diversion was increased to 740 mgd and the Montague flow objective was increased to 1700 cfs beginning November 1. On December 18, the drought emergency was terminated by DRBC. All the drought emergency conservation orders were repealed and diversions and releases were restored to normal levels.

#### b. Nonessential Water Uses

The May 13 DRBC action restricting nonessential water uses in the basin called on the signatory states to initiate or extend comparable programs in accordance with their drought contingency plans. The Commission cited the need to achieve uniformity on nonessential use bans to avoid problems in adjoining states where different restrictions were being applied. For example, Pennsylvania declared a drought emergency for their portion of the basin on April 26, and New Jersey followed suit for portions of the basin on May 17. Delaware was in drought warning status in June, but New York State did not make any formal announcement of drought status for the Upper Delaware Basin until July.

After further intense discussions, the DRBC on September 13 adopted a resolution defining seven nonessential water uses in the basin, having each state call for mandatory restriction of these uses and defining the area of the basin to be included.

### 3. DROUGHT IMPACTS

The 1984-85 drought adversely affected many different groups in southeastern New York, particularly in the New York City area. The general public, businesses and industry were asked to conserve water voluntarily

and then were subject to mandatory water use restrictions through the summer with increasingly strict enforcement actions and penalties for noncompliance.

a. Impact on Business

Direct impacts on business resulted from increasingly severe restrictions on nonessential water uses. Affected commercial establishments included commercial vehicle washing, commercial nurseries, restaurants, coin-operated laundries, public swimming pools, and golf course operations.

b. Impacts on Industry

Impacts on industry resulted from restrictions on water use which, in turn, affect the production of goods. While no specific information is available for New York State, a 1978 survey conducted in California revealed that 80 percent of the water-intensive industries could endure a 25 percent cut in water supply with no reduction in production. During the 1984-85 drought in New York City, the most severe industrial water use restriction imposed during the Stage III drought emergency called for a 25 percent reduction in commercial and industrial water use.

c. Impacts on Agriculture

Showers activity throughout the growing season maintained adequate soil moisture conditions and prevented widespread agricultural losses during the drought. Nevertheless, some impacts were noted, including an estimated \$5 million decrease in cabbage production for the fresh market. Sweet corn for the fresh market yielded \$2 million less than expected, and sweet corn for processing yielded \$2-3 million less than expected for the acreage produced because of the drought.

d. Impacts on Public Water Supplies

In addition to the New York City water supply system, the 23 public water supply systems listed in Table 4 and shown on the map in Figure 3 reported drought-related problems. Impacts resulted from reduced revenues from the sale of water or associated income (eg., power revenue) and a sometimes substantial added cost of facility operation. For example, pumping from the Croton system cost New York City about \$7,000 per day and pumping from the Hudson River at Chelsea cost about \$35,000 per day. Additional costs were associated with the leak detection and response programs, installation of hydrant locks, and enforcement of water use restrictions.

e. Fish and Wildlife Impacts

The drought severely impacted fish and wildlife resources and the environment in general. Associated local economic impacts also occurred. There were three principal areas of concern related to fishery resources:

- i. Impacts of severe stress on trout populations in the Delaware River Basin downstream from Cannonsville and Pepacton Reservoirs resulted from reduced conservation releases and the limited

availability of thermal stress releases. These reduced releases, coupled with adverse weather conditions on two consecutive days resulted in a fishkill on the Delaware River in mid-August shortly after the Thermal Emergency Bank was exhausted. Reduced fishing effort caused by the impact on fisheries of high water temperatures and low flow in the Delaware system resulted in an estimated 1985 revenue loss of \$1.2 million.

ii. High levels of chlorine residuals from chlorine added to Hudson River pumpage at Chelsea affected fishery resources in the West Branch Reservoir, the West Branch Croton River downstream of the reservoir, and Croton Falls and Kensico Reservoirs. Bioassays in the West Branch Reservoir during the week of August 19, 1985 revealed a chlorine plume that occupied most of the main section of the reservoir. No fishkills were reported, but it is believed that the fish were stressed. Chlorine residuals were reduced by DOH, but it was uncertain that they could be reduced sufficiently to prevent adverse effects on the fisheries while still protecting public health.

iii. In the East Basin of Ashokan Reservoir, cisco populations were eradicated when low storage levels were maintained for a prolonged period of time. Trout were not stocked in the East Basin, as is normally done, because of expected mortality.

APPENDICES

APPENDIX A

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Drought Indicator Criteria

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## APPENDIX A

### DROUGHT INDICATOR CRITERIA

#### A. PALMER INDEX

Precipitation records are the most useful and readily available data for monitoring drought conditions on a meteorological basis. Such records are available on the national, state and regional levels and long-term historical patterns of rainfall can be determined.

A number of drought indices have been developed utilizing meteorological data in order to determine stages of drought severity. One such index is the Palmer Index which provides a means of describing periods of unusually wet or dry weather. The index, which has been widely adopted, is based on long term records of temperature and precipitation. Normal weather has an index value of zero in all seasons in any climatic region. Droughts have negative index values while wet periods have positive values. During normal periods, consecutive negative values can provide initial warning of a developing drought. During actual drought, the magnitude of negative values indicates drought severity. During the 1960's drought, the most extreme Palmer Index was -6.8. The lowest value in the 1980-81 drought was -3.7. Both values were in the Hudson Valley.

The Palmer Index treats drought severity as a function of accumulated weighted differences between actual and required precipitation. The required precipitation depends on the carryover of previous rainfall in addition to evapotranspiration, moisture recharge and runoff that would be appropriate for a specific time and place. The average requirement is for normal rainfall for the particular location.

New York is divided into ten climatologic zones and Palmer Index values are normally prepared on a monthly basis during the growing season from April through October. During the 1980-81 and 1984-85 droughts they were prepared most of the time on a weekly basis by the National Oceanic and Atmospheric Administration (NOAA) in Washington, D.C., at the special request of DEC. Although the index values are less reliable during the November-March period, they serve as a general guide for assessment of drought conditions.

#### B. PRECIPITATION

The two most significant characteristics of precipitation in relation to drought are the magnitude and duration of departures from "normal" or long-term average precipitation. The departure measured on a percentage basis for a specified number of preceding consecutive months is one criteria used. This approach has also been applied in the DEC Rockland County water supply study. Based on DEC analysis of data for a local precipitation station, negative departures of 40 percent for the previous 3 and 6 month periods and 35 percent for the previous 9 and 12 month periods were established to indicate drought alert, warning, emergency and disaster conditions, respectively.

A similar approach has been developed for use in monitoring and evaluating precipitation as a drought indicator on a statewide basis. The following precipitation stations will be monitored:

<u>Region</u>	<u>Precipitation Station</u>
I. Long Island	La Guardia, Bridgehampton
II. Catskills	Yorktown Heights, Poughkeepsie, Clinton Corners, Slide Mountain, Roscoe, North Blenheim
III. Susquehanna	Sherburne, Binghamton
IV. Mohawk, Upper Hudson	Albany, Glens Falls, Gloversville, Utica
V. Adirondacks	Boonville, Stillwater Reservoir, Newcomb, Raybrook, Ellensburg Depot, Massena
VI. Great Lakes	Buffalo, Rochester, Watertown, Syracuse
VII. Finger Lakes	Jones Bridge, Locke, Syracuse
VIII. Southern Tier	Franklinville, Elmira, Jones Bridge

To illustrate how the procedure will be used, a description of the application to Region I follows:

1. The precipitation departure will be computed on a monthly basis for each station. A monthly departure is the difference between a given month's total precipitation and the normal for that month. A negative departure indicates a shortfall of precipitation. A regional monthly departure will be calculated by averaging the departures of each station in the region.
2. A "cumulative precipitation departure" will be computed for each region for each of the twelve prior months. For example, the three month cumulative precipitation departure represents the sum of precipitation departures for the three months prior to the report. (Precipitation surplus is included as a positive departure.)
3. The calculated cumulative departures for the region will be plotted (Figure A-1). The trend of the line of "best fit" will be compared with annual negative departure rates of 10-20 percent (alert), 20-30 percent (warning), 30-40 percent (emergency) and 40 percent (disaster).
4. A judgment will be made of which departure duration (eg., 3 month, 6 month, 9 month, or 12 month cumulative departure) is applicable to the region. Factors which will be considered are: short-term vs. long-term results, trends and patterns, and seasonal significance. A precipitation indicator value will be assigned to the region for the drought stage indicated in step 3.

This procedure is an empirical method of graphically representing the duration and intensity of precipitation deficit. This method relies upon judgment and interpretation for the determination of a precipitation index to be used as part of an overall drought index.

# REGION I

LONG ISLAND

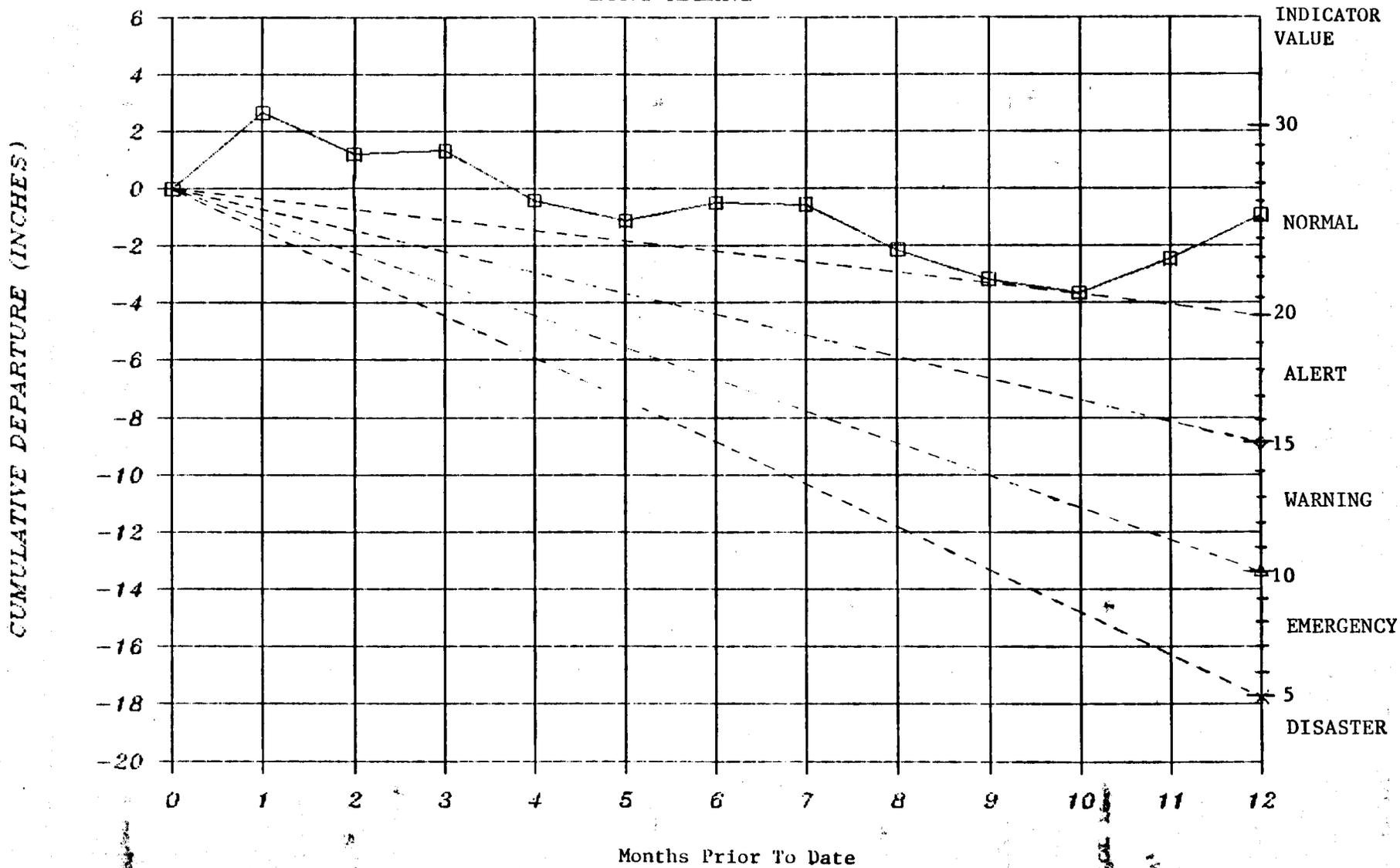


Figure A-1 Cumulative Precipitation Departure, Region I  
July 1988

### C. RESERVOIR/LAKE STORAGE

Reservoir/lake storage is a major indicator of drought conditions, and analyses taking into account inflow and outflow factors can lead to significant conclusions on drought status. Reservoir/lake inflow reflects precipitation, surface runoff and groundwater discharge. Outflow consists of withdrawals and releases. Evaporation, seepage and spillway overflows may be significant under certain conditions. If outflow is more than inflow, the reservoir/lake storage decreases; if outflow is less than inflow, storage increases.

For reservoirs and lakes with relatively fixed water demands, direct comparisons of storage levels can be made; if the demands change, appropriate adjustments must be made. Normal variations in storage must be taken into account since there is a seasonal pattern. Storage is usually at a maximum in May or June and at a minimum in October or November. The storage declines during the summer because of low inflow and high water demands and recovers during the winter and spring when inflow is higher and demand is less.

With the aid of models and computer facilities, simulation studies can be made of reservoir/lake operations to determine storage patterns for different conditions. The information provides a basis for establishing normal and drought stages and operations that are compatible with the storage status. DEC has made simulation studies of the New York City reservoir system and DeForest Lake Reservoir in Rockland County.

#### 1. New York City Reservoirs

Storage in the City systems will be assessed by obtaining information from the City on at least a monthly basis during normal conditions and more frequently depending on the drought stage.

The New York City reservoir system studies were initiated in the early 1970's for the City's three reservoirs in the Delaware River Basin. DEC prepared a flexible operation scheme for the three reservoirs based on drought criteria rule curves for releases and diversions. The rule curves defined normal, drought warning and drought conditions during the year based on the combined reservoir storage. Different release and diversion operations would be carried out in the three zones.

The rule curves were modified after further study and have been accepted by the other Delaware Basin States, New York City and the Delaware River Master and were used in the 1980-81 and 1984-85 droughts as the basis for normal, drought warning and drought emergency actions in the Basin by the Delaware River Basin Commission and parties to the 1954 Supreme Court Decree. Similar rule curves have been developed by DEC and NYC for the Catskills and Croton Systems, and composite rule curves have been developed for the City system as a whole.

When the Delaware<sup>f</sup> subsystem rule curves were used to calculate the State Drought Index in Region II, it was found that the resulting indications of drought severity did not correspond well with New York City drought response actions or with the drought status for the region as a

whole. For example, although New York City declared a Stage III Drought Emergency during the 1984-85 drought, the most severe State Drought Index calculated based on the Delaware system rule curves indicated only a "drought warning" status.

The State Drought Index was recalculated for the 1980-81 and 1984-85 droughts using modified composite rule curves for the entire City system to determine the storage component of the index. The original composite rule curves included ranges for normal, drought warning, and drought conditions. The modified curves include a total of five conditions: normal, drought alert, drought warning, drought emergency, and drought disaster (Figure A-2). The upper limit of the drought alert condition is based on the "watch" line on refill curves for the City system. Drought warning is defined as the original drought warning range. Drought emergency extends to 15 percent of gross storage capacity below the drought warning range. Drought disaster is defined as anything below the drought emergency condition.

Each month the storage component of the State Drought Index for Region II (New York City) is calculated by plotting the percentage of gross storage capacity on the modified composite rule curves. A storage indicator value is assigned according to the relationship between the month's storage and the drought stages defined in Figure A-2 and in Table 1 (main report). For example, Figure A-2 shows that the drought alert condition at the end of October ranges from 60 to 48 percent of gross storage capacity. The range of indicator values for the drought alert condition is 80 to 60, as shown on the right side of the figure and in Table 1 (main report). So, if the actual storage at the end of October were 54 percent, it would be plotted in the middle of the drought alert condition and would be assigned an indicator value of 70. Similarly, a storage of 57 percent is one quarter of the way into the drought alert stage at the end of October. It would therefore be assigned an indicator value of 75, which is one quarter of the way into the 80 to 60 range of indicator values. The storage indicator value thus obtained is added to the precipitation indicator value to determine the total State Drought Index for Region II.

The drought stages determined by calculating the State Drought Index using the modified composite rule curves corresponded more closely to actual City drought response actions than did drought stages based on the Delaware subsystem rule curves, as shown in Table A-1.

The Palmer Index was determined for Region II for the 1980-81 and 1984-85 drought periods, and is compared in Table A-2 with the State Drought Index calculated using the modified composite rule curves. The indices represent conditions at the end of each month. The Palmer Index, which is based on soil moisture deficiency, gives an earlier indication of the drought alert stage. This is to be expected because the State Drought Index for Region II is weighted for the reservoir storage factor which responds more slowly than does soil moisture deficiency to the shortfalls in precipitation which accompany an impending drought.

Figure A-2  
 STORAGE CURVES FOR  
 COMPOSITE NEW YORK CITY SYSTEM

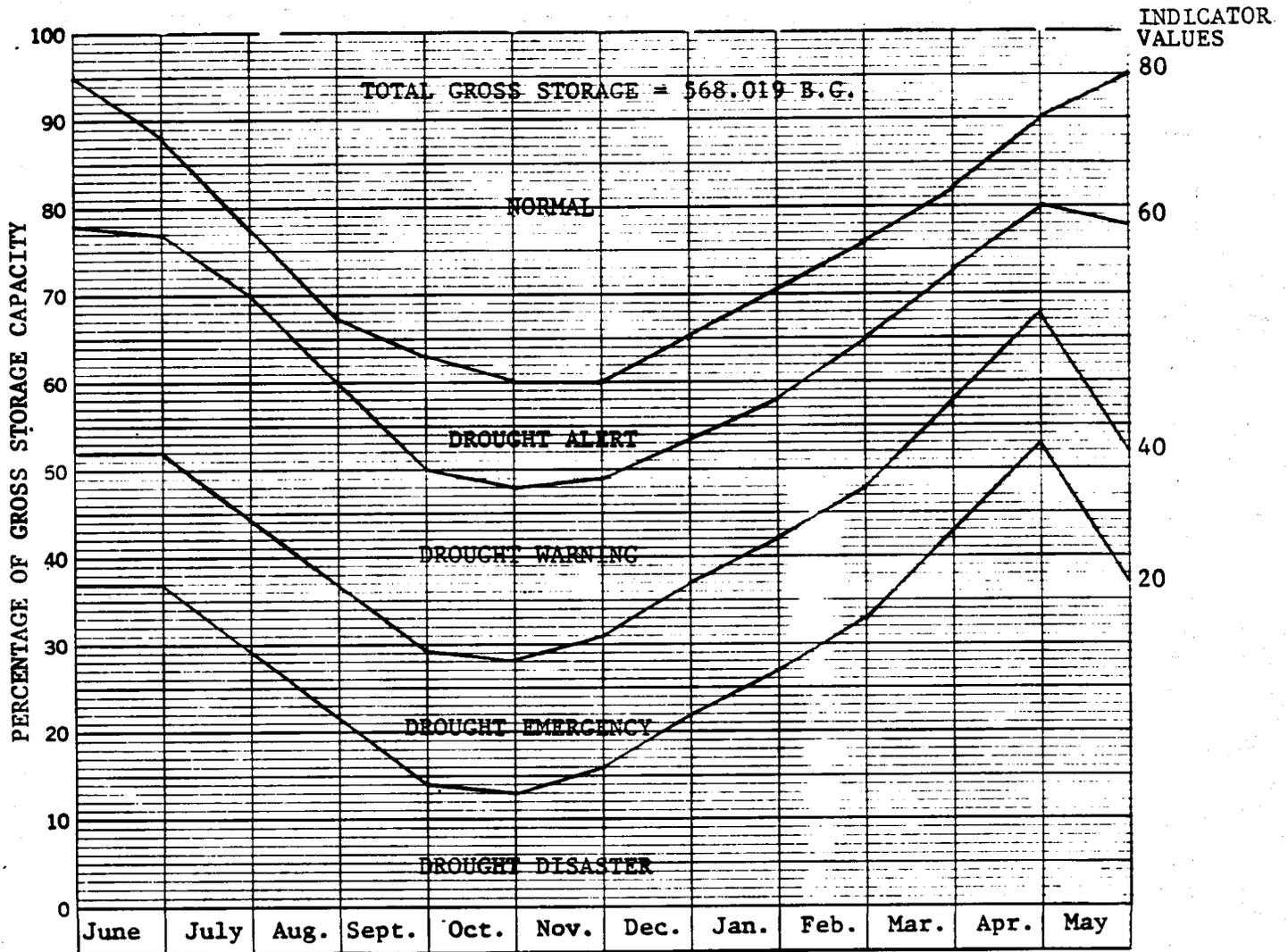


TABLE A-1  
Comparison Between Calculated Drought Stages  
and Historic Drought Response Actions

End of month	Drought Stage		NYC Action
	Using Delaware Rule Curves	Using Modified Composite Rule Curves	
1980 September	normal	normal/alert	Oct. 16: storage enters drought warning
October	normal	alert	Oct. 19: NYC diversions: 680 mgd Montague target: 1655 cfs
November	alert	alert	Nov. 19: NYC diversions: 580 mgd Montague target: 1560 cfs
December	alert	warning	Dec. 20: NYC diversions: 560 mgd Montague target: 1550 cfs
1981 January	warning	emergency	Jan. 15: NYC diversion: 520 mgd
February	warning	alert	Feb. 13: storage returns to drought warning
March	alert	alert/warning	Feb. 24: augmented releases could have been resumed
April	alert	warning	
May	warning	alert/normal	
1984 October	normal	normal	
November	alert	alert	Nov. 27: storage enters drought warning
December	alert	alert	
1985 January	warning	alert/warning	Jan. 18: storage re-enters drought warning
February	warning	warning	Feb. 25: "drought watch" declared
March	warning	warning	
April	warning	emergency	April 3: "drought warning" declared April 26: Stage I drought emergency
May	warning	warning	
June	warning	warning	June 5: Stage II drought emergency
July	warning	warning	July 10: Stage III drought emergency
August			
September	alert	alert	
October	normal	alert/normal	
November	normal	normal	Nov. 27: storage re-enters drought warning (from emergency)
December	normal	normal	Jan. 10, 1986: State disaster declaration expires

TABLE A-2  
COMPUTED REGION II DROUGHT INDICES, 1980-81 and 1984-85

<u>END OF MONTH</u>	<u>PALMER INDEX</u>	<u>DROUGHT STAGE</u>	<u>STATE DROUGHT INDEX*</u>	<u>DROUGHT STAGE</u>
<u>1980</u>				
April	1.82	Normal	130	Normal
May	-1.08	Alert	110	Normal
June	0.27	Normal	110	Normal
July	-0.70	Normal	114	Normal
August	-1.35	Alert	114	Normal
September	-1.77	Alert	102	Normal/Alert
October	-1.61	Alert	89	Alert
November	-1.45	Alert	79	Alert
December	-1.95	Alert	62	Warning
<u>1981</u>				
January	-2.82	Alert	40	Emergency
February	0.24	Normal	90	Alert
March	-1.73	Alert	77	Alert/Warning
April	-1.77	Alert	72	Warning
May	-1.05	Alert	100	Alert/Normal
<u>1984</u>				
August	-0.11	Normal		
September	-0.62	Normal	125	Normal
October	-1.11	Alert	112	Normal
November	-1.34	Alert	88	Alert
December	-1.25	Alert	84	Alert
<u>1985</u>				
January	-2.01	Warning	75	Alert/Warning
February	-2.34	Warning	63	Warning
March	-2.49	Warning	57	Warning
April	-3.21	Emergency	43	Emergency
May	-1.40	Alert	60	Warning
June	0.38	Normal	59	Warning
July	0.24	Normal	68	Warning
August	0.25	Normal		
September	0.85	Normal	81	Alert
October	0.67	Normal	100	Alert/Normal
November	1.62	Normal	120	Normal
December	1.29	Normal	125	Normal

\* Computed using modified composite rule curves.

## 2. Other Reservoirs/Lakes

The State Department of Health has established a "watch list" of key reservoirs and lakes used for public water supply. As an example, the status of the reservoirs on the watch list during October 1985 is shown in Table A-3 and Figure A-3. Rule curves or approximate rule curves will be developed by DOH to the extent practicable for each of the reservoirs or lakes and drought index values for reservoir and lake levels will be calculated based on the principles illustrated by the reservoir rule curves shown in Figure A-4. The reservoir rule curves for individual reservoirs will follow the same general seasonal pattern as for the New York City system.

Reservoir and lake levels for community water systems on the reservoir watch list will be continuously monitored by DOH. When reservoir levels on the watch list fall into the alert-warning stage, DOH will monitor drought conditions for all community water systems in that region and take their status into account in determining the drought severity.

### D. STREAMFLOW

Streamflow data for gaging stations may be analyzed statistically in a number of different ways for possible indication of drought conditions. Monthly flow duration curves appear to be the most useful at this time. They show graphically the percent of time given flows are equalled or exceeded during the period of record, and various ranges can be established to correspond to drought stages. Flows that are equalled or exceeded up to 75 percent of the time are considered in the normal condition. Flows that are equalled or exceeded 90 percent of the time are used for establishing drought alert conditions, flows equalled or exceeded 95 percent of the time are used for establishing drought warning conditions, and flows equalled or exceeded 97.5 percent of the time are used to establish drought emergency conditions.

The U.S. Geological Survey in cooperation with DEC and others maintains an extensive network of stream gaging stations in New York. There are twenty-eight good, long-term stations that could serve as index stations for monitoring current streamflow conditions (Table A-4). Fourteen of them are currently monitored for monthly status reporting by the U.S. Geological Survey. The following eight stations have been selected as key indicator stations and the USGS has developed flow duration data for them:

<u>Station</u>	<u>Region</u>
Wappinger Creek near Wappinger Falls	II
Beaver Kill at Cooks Falls	II
Susquehanna River at Conklin	III
Hudson River at Hadley	IV
W. Branch Oswegatchie River near Harrisville	V
Tonawanda Creek at Batavia	VI
Chemung River at Chemung	VI
Allegheny River at Salamanca	VIII

TABLE A-3

New York State Department of Health  
Reservoir Level Watch List  
Drought Management Task Force Meeting  
October 21, 1985

<u>Public Water Supply</u>	<u>Percent of Capacity</u>	<u>Date</u>	<u>Remarks</u>
1. Albany City Alcove Resv. Basic Resv.	55.7% 80.0%	10/1/85	15% Below Normal
2. Bethlehem Town Vly Resv.	45.0%	10/21/85	Below Normal
3. Conn. American Water Company Overall	85.6%	9/30/85	10% Above Normal
4. Glen Falls City Overall	50.0% (366.1 MG)	10/18/85	Below Normal (55%)
5. Gloversville Water Works Overall	52.0%	10/18/85	Below Normal
6. Hamilton Village Woodman Pond	65.0%	10/18/85	Below Normal
7. Kingston City Cooper Lake	90.0%	9/17/85	Above Normal
8. Monticello Village Kiamasha Lake	100.0%	10/18/85	Above Normal
9. Oneonta City Wilbur Lake	60.0%	10/18/85	Slightly Above Normal
10. Port Jervis City Resv. No. 1 Resv. No. 2 Resv. No. 3	100.0% 100.0% 100.0%	10/18/85	Above Normal
11. Rochester City Canadice Lake Hemlock Lake	85.0% 31.0%	10/4/85	Slightly Above Normal
12. Syracuse City Skaneateles Lake	53.0%	10/1/85	Slightly Above Normal
13. Great Sacandaga Lake			

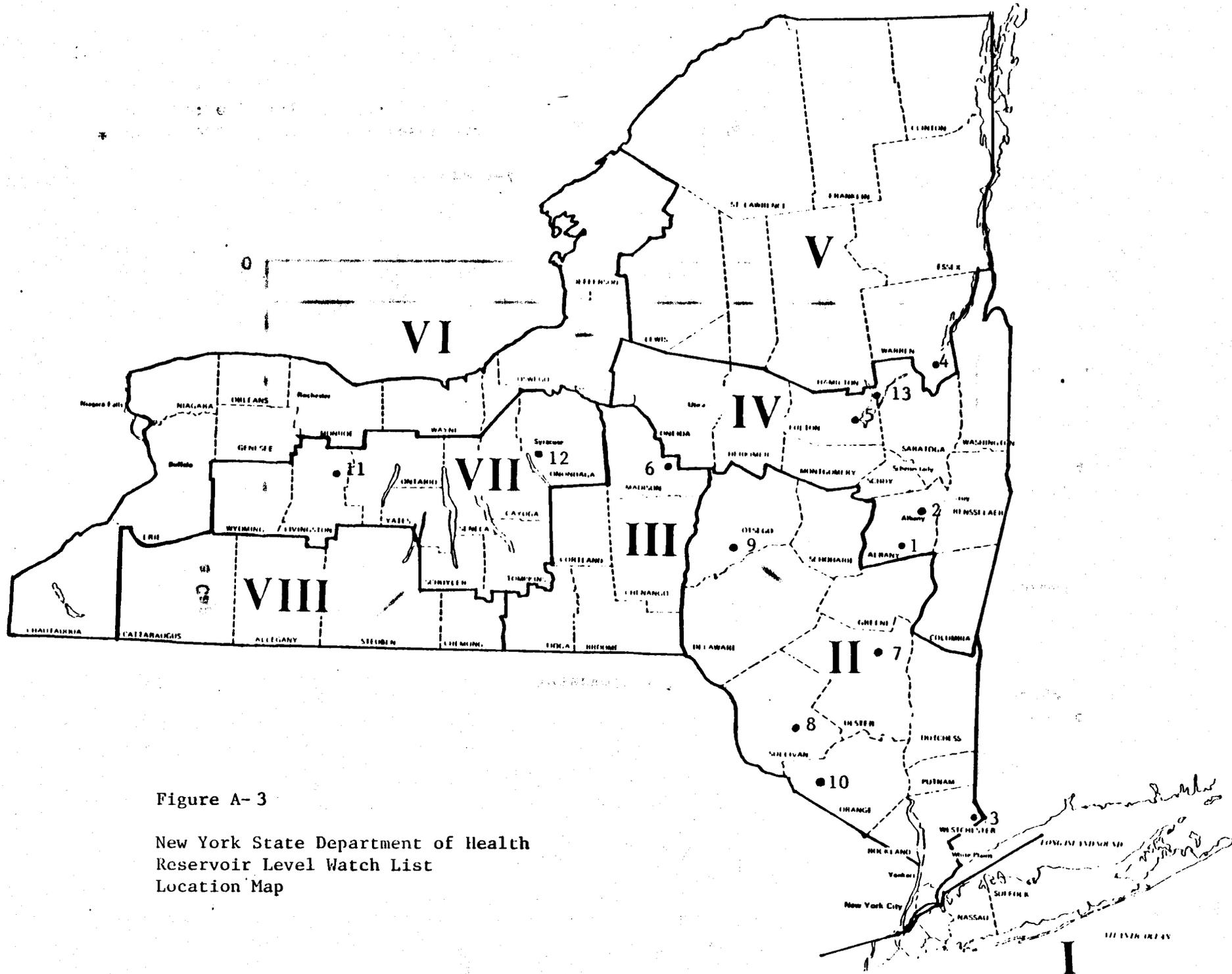


Figure A-3

New York State Department of Health  
Reservoir Level Watch List  
Location Map

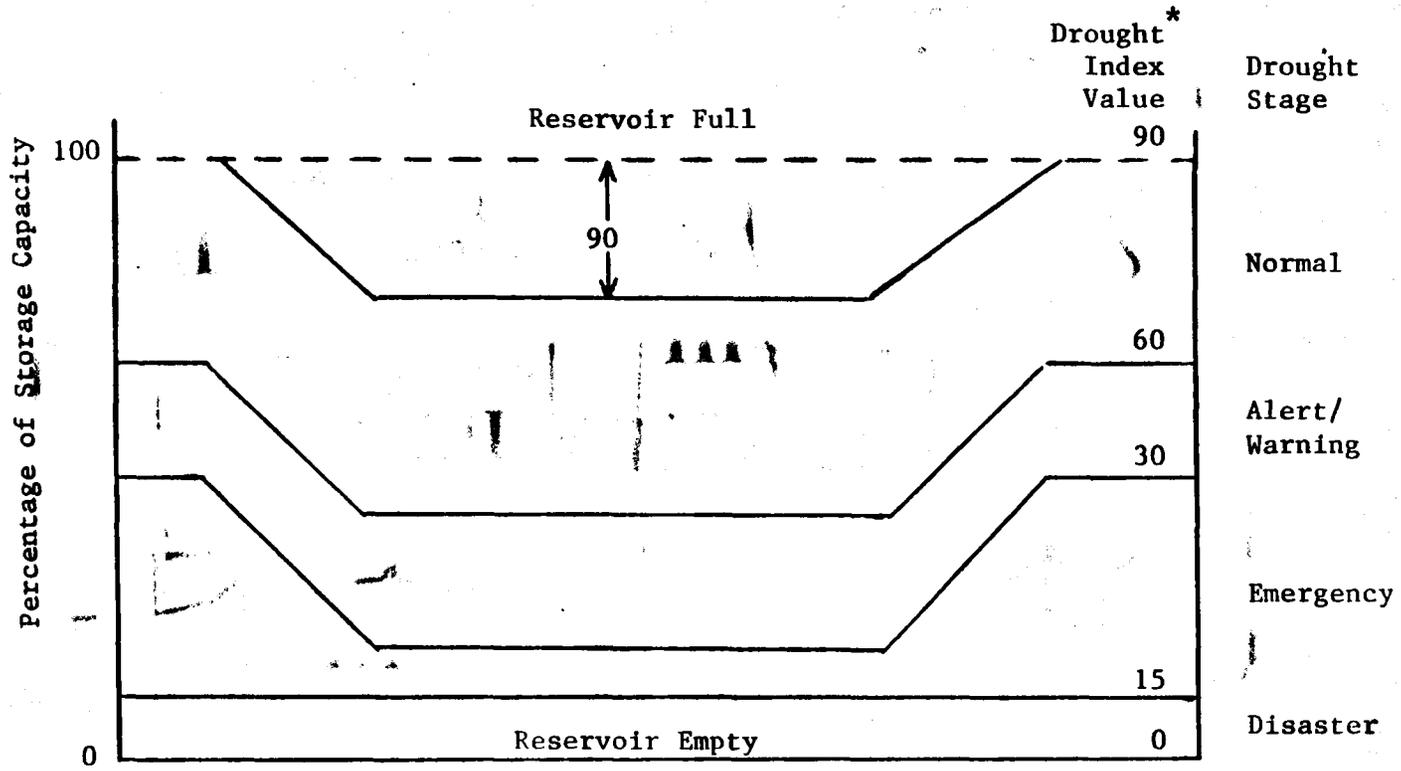


Figure A-4. Sample Reservoir Rule Curves

\* 60 percent weighting for reservoir storage: e.g. Region III.

TABLE A-4

Long-Term Gaging Stations That Could Serve As Index Stations  
For Monitoring Current Streamflow Conditions

	<u>Telemetry?</u>	<u>D.A. (mi<sup>2</sup>)</u>
*01318500 Hudson River at Hadley	yes	1664
01321000 Sacandaga River near Hope	yes	491
*01334500 Hoosic River near Eagle Bridge (seasonal)	yes	510
*01350000 Schoharie Creek at Prattsville	yes	236
*01357500 Mohawk River at Cohoes	yes	3456
*01371500 Wallkill River at Gardiner	yes	711
*01372500 Wappinger Creek near Wappinger Falls	yes	181
*01420500 Beaver Kill at Cooks Falls	yes	241
*01500500 Susquehanna River at Unadilla	yes	982
*01503000 Susquehanna River at Conklin	yes	2232
01512500 Chenango River near Chenango Forks	yes	1483
01528000 Fivemile Creek near Kanona	no	66.8
01530500 Newtown Creek at Elmira	no	77.5
*01531000 Chemung River at Chemung	yes	2506
*03011020 Allegheny River at Salamanca	yes	1608
04213500 Cattaraugus Creek at Gowanda	yes	432
04214500 Buffalo Creek at Gardenville	yes	144
*04217000 Tonawanda Creek at Batavia	yes	171
*04221000 Genesee River at Wellsville	yes	288
04234000 Fall Creek near Ithaca	no	126
04242500 East Branch Fish Creek at Taberg	no	188
04245000 Limestone Creek at Fayetteville	no	85.5
04252500 Black River at Boonville	yes	295
04260500 Black River at Watertown	yes	1876
*04262500 West Branch Oswegatchie River near Harrisville	yes	258
04269000 St. Regis River at Brasher Center	no	616
04270000 Salmon River at Chasm Falls	no	132
*04275000 East Branch Ausable River at Ausable Fork	yes	198

\*indicates stations currently monitored for month-end WRR Report

Streamflow at each of the eight stations will be analyzed on a monthly basis to determine the flow condition. If a drought stage is indicated, the monitoring will be expanded to include additional stations in the region. Plottings for consecutive months will also be evaluated. A number of other streamflow statistics are being considered and may provide a further guide on drought conditions.

Streamflow into New York City reservoirs has been analyzed as a drought indicator by DEC and city technical staffs. Cumulative reservoir inflow for preceding six-month periods has been identified as supplemental criteria to be used in conjunction with reservoir storage for improving the capability to determine approaching drought conditions. Frequency analysis was made of the six-months preceding inflows to each reservoir subsystem to develop preceding streamflow condition curves. Six months was used to smooth out shorter term events that would not affect the major reservoir system significantly without being long enough to mask a marked deviation from hydrologic experience.

Preceding streamflows reflect recent hydrologic conditions and indicate base flows which may carry over into the near future and sustain reservoirs during short duration droughts. They provide an added basis for evaluating the chance of reservoir refill. The preceding streamflow condition is used as a supplemental or "vernier" indicator with more weight given to the storage factor. Another factor which will be taken into account is the water content of the snow cover over the City's watersheds during the winter and early spring.

## E. GROUNDWATER LEVELS

### 1. Upstate

Drought criteria for groundwater have been established on the basis of observation wells in the two major types of aquifers, upland and valley-floor. Upland aquifers are above the major valley floors or plains and generally receive recharge only directly from precipitation and have discharge zones at or near the valley floor and related streams. Consequently, seasonal fluctuations of water levels are greatest on uplands, generally decreasing in amplitude toward the discharge zones. The upland aquifers consist of relatively shallow unconsolidated material, most commonly glacial till or sands, and underlying bedrock fractures which may extend several hundred feet. Therefore, upland-type wells are usually the first to show signs of deficient precipitation. The shallow private wells in unconsolidated material, commonly dug or driven points, have a limited saturated zone available to the well. This fact, plus the probable range of water-level fluctuations of upland wells (5-9 feet in index wells), causes private upland wells to be the first to suffer in droughts. Thus, they are important in the drought alert stage.

The underlying rock aquifers respond similarly to recharge. Their principal difference is that the wells are commonly drilled a few hundred feet and have a "saturated" zone of a hundred feet or more. Their range in seasonal water-level fluctuation is commonly greater than shallow wells, but the greater saturated zone allows for a delayed effect on lowered water levels. This characteristic makes them significant for the drought warning stage.

The valley-floor wells are situated at the "base level" of the groundwater gradient to a master stream draining the local or regional system. Because the upland aquifers drain toward the valley, the valley-floor aquifer has a much greater delay from upland water deficiencies. In general, the stream has to "dry up" in order for the valley-floor aquifer to have a lowered water level. Hence, if valley-floor water levels are lower than those of record, it probably is warning of a serious drought. However, most valley-floor aquifers are a few tens of feet thick and of high permeability, so the loss of a few feet of saturated thickness could be insignificant and a new record low water level would need to be evaluated in each specific case.

In summary, upland aquifer wells can be used for the drought alert, after upland wells are in warning status. A warning would be indicated after upland wells are in an emergency and an emergency condition when new low records are set. A disaster stage in valley-floor aquifers is not likely to occur but could be locally considered when record lows are broken 3 months in a row.

Current index observation wells for the upstate area are shown in Table A-5. The wells are monitored on a monthly basis by the U.S. Geological Survey. DEC with assistance from the USGS will make judgments on drought status for the wells based on the reported levels and aquifer characteristics.

## 2. Long Island

The Long Island aquifer system is composed of several unconsolidated-deposit units covering the entire island. The deposits, excluding a maximum of 450 feet of clay units, range from 0 to 1900 feet in thickness. The upper aquifer, the water-table aquifer, is composed of glacial deposits of sand and gravel and ranges in thickness from 0 to 400 feet. It is present in all except a small area in the northwest part of Long Island. The water-table aquifer is considered to be in hydraulic contact with the underlying aquifer in most areas and is the most readily affected by climatic conditions. The underlying aquifer, the Magothy aquifer, is the source of water supply for most of the Island.

About half the precipitation that falls on Long Island recharges the water-table aquifer. Consequently, the water table responds closely with precipitation and subsequently affects streams draining the aquifer. Long-term water level records indicate that the average water-level fluctuations for most of the island vary less than 5 feet. With a hundred feet or more of saturated thickness, a few feet of additional water-level decline from precipitation deficiency would normally be of no consequence. However, coastal areas have the thinnest aquifer, lowest water levels in relation to sea level, and the shallowest depth to saline water. Thus, water-level declines, naturally or with increased pumpage, can become serious in that saline water may be pulled into the well zone. It is in these areas, particularly heavy-pumpage areas, that observation-well records can be most useful in relation to drought conditions.

TABLE A-5

Current Index Observation Wells  
September 1981

UPLAND WELLS (reflect direct climatic effects on water table)

<u>County</u>	<u>Well No.</u>	<u>Aquifer</u>	<u>Record (years)</u>	<u>Depth (feet)</u>	<u>Seasonal extremes (feet)</u>	<u>Region</u>
*Albany	A 636	Sand	16	21	2-3	IV
*Dutchess	Du 321	Shale	30	128	7	II
*Greene	G 1	Till	36	18	10-13	II
*Montgomery	Mt 1	Till	39	12	3-5	IV
*Oneida	Oe 151	Sand	55	31	6-14	IV
*Otsego	Og 23	Till	28	15	4-9	II
Putnam	P 609	Till	42	17	7-16	II
*Rensselaer	Re 700	S&G	27	16	5	IV
*Rockland	Ro 18	Granite	32	60	5-17	II
*St. Lawrence	ST 40	Sand	28	12	4	V
Saratoga	Sa 1072	Sand	22	20	5-6	IV
Westchester	We 3	Sand	41	15	7-11	II
			Av 33		Av 5-9	

VALLEY-FLOOR WELLS (controlled, in part, by adjacent stream system)

*Broome	BM 121	Sand	34	53	8-15	III
Dutchess	Du 1009	S&G	14	28	3-8	II
Ulster	U 204	Till	27	46	4-10	II
*Ulster	U 405	Sand	15	36	3-5	II
*Chemung	CM 46	S&G	26	34	19-26	VIII
			Av 23		Av 7-12	

\*indicates stations currently monitored for month-end WRR Report

A network of fourteen observation wells in the water table aquifer on Long Island is used to report water-level changes on a monthly basis (Table A-6). The water-levels are averaged and used to represent overall conditions. Although the relationship between water levels in the Magothy (water supply) aquifer and the water-table aquifer is very complex, selected water-table wells along the coast and near pumpage centers are useful in alerting authorities to critical (for salt-water problem) conditions. Again, the alert/warning would be to forestall salt-water intrusion rather than depletion of groundwater storage. The present monthly reports will be modified to indicate which wells are the earliest indicators of "serious" water-level declines. The current 14-well averages could be analyzed, particularly in regard to the 60's drought, to see what stages may be designated alert, warning, emergency, or disaster.

TABLE A-6  
Water-Table Aquifer Observation Wells  
Long Island

<u>Well</u>	<u>Location</u>	<u>Depth of Well (Feet)</u>
N1259.5	Plainedge	41
N1263.4	Levittown	35
N1614.4	Garden City Park	53
N1615.3	East Meadow	33
N1616.2	Westbury	68
N8269.2	Old Westbury	86
N10035.1	Garden City	56
S1803.4	Babylon	10
S1805.4	Maywood	33
S1806.3	Pinelawn	45
S1807.5	West Islip	6
S1808.4	West Islip	12
S1809.4	Brightwaters	25
S1810.4	Brentwood	51

APPENDIX B

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Need for Local and Regional Drought

Contingency Plans

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## APPENDIX B

### NEED FOR LOCAL AND REGIONAL DROUGHT CONTINGENCY PLANS

Review of local drought plans by the State Department of Health indicates that emergency sources are generally available to community water systems outside of New York City-Westchester and Rockland County areas in periods of a drought. However, the availability of emergency equipment (pipe and pump) to transport the water may, in some cases, impede the use of these sources.

The need for local and regional drought contingency plans then becomes a function of reviewing the vulnerability to a drought of community water systems in the various regions in New York State and determining the availability of an emergency source or interconnection. Using the selection criteria that community water systems whose sources are small lakes or reservoirs are the most drought prone, systems whose sources are dependent upon rivers are less drought prone, and systems dependent upon large lakes, the Finger Lakes and Great Lakes are basically drought resistant, then Figure B-1, which shows the number of community water systems in each county which may be vulnerable to the effects of a prolonged drought becomes a valid selection criteria for determining the need for regional drought contingency plans. The numbers shown for counties in the Adirondack area may not be correct due to the small population using comparatively large lakes. Mobile home parks which are primarily dependent upon groundwater are not shown. Public water systems in the Great Lakes and Finger Lakes area are dependent on the lakes. The Southern Tier is greatly dependent on groundwater and has few systems which rely on reservoirs. Long Island is groundwater dependent. It appears that the majority of community water systems most vulnerable to a drought are located in the lower Hudson Valley and Southwest Catskill Region.

In January, 1981, suppliers of water in 21 counties impacted by the 1980-81 drought were requested to prepare a drought emergency plan. The water suppliers were asked to address the following issues in their plans:

1. The current and normal water levels for reservoirs, rivers, streams, or wells used as a source of water supply.
2. The criteria used to determine when to impose a drought warning, to issue water use restrictions and to commence use of an emergency water source.
3. A list of alternative emergency water sources.
4. The actions to be taken in a drought emergency.
5. A description of local emergency resources (pumps, piping, water tankers, etc.) expected to be available, including location and contact person, and a description of anticipated State emergency response needs.

Approximately 520 community water systems were impacted by the request, of which approximately 50 percent systems submitted plans. Systems serving populations greater than 10,000 responded significantly better with about 70 percent submitting plans.

In May, 1985, suppliers of water in a 13 county area impacted by the 1985 drought were asked to update their 1980-81 drought emergency plans or to prepare a plan if one was not submitted in 1981. The 1985 plans and/or updates addressed the same five issues required in the 1980-81 drought emergency plans. One hundred and forty four community water systems were impacted. At the end of the drought 76 percent had plans endorsed and an additional 8 percent were under review.

#### Summary of Drought Emergency Plans

A full summary of the 1980-81 drought emergency plans is contained in the Department of Health Report "Summary Report on Drought Planning by Community Water Systems" dated April, 1982. A summary of the 1985 drought emergency plans was not prepared as no new and/or significant information was gathered by the 1985 effort. The following findings were developed based on a review of the 1980-81 effort:

1. Emergency sources are, in general, readily available for most community water systems with the exception of the New York City system and the systems located in Westchester and Rockland Counties.
2. The only long term solution in New York City to future droughts and water shortages is to implement effective water conservation programs along with developing additional reliable water sources.
3. Westchester County, in which 79 percent of the population depends on New York City's reservoir system, has very few usable emergency sources and, therefore, must rely primarily on reducing water usage during a drought.
4. Rockland County, which is served primarily by Spring Valley Water Company (88 percent of the population), was in a precarious situation in 1980 due to excessive releases. New operating regulation imposed by DEC have helped reduce this problem.
5. Suppliers of water do not have, on hand, large stockpiles of emergency water supply equipment. The suppliers of water are dependent on the State emergency stockpile for equipment.
6. Community water systems in Southeastern New York are the most vulnerable to the effects of a severe drought.

#### Status of Drought Emergency Plan

There has been no effort to update the drought emergency plans. In light of the new requirement for community water systems (see next section) to develop water supply emergency plans to cover all types of emergencies, there is no need to update the previous drought emergency plans.

## Future Emergency Plan Initiatives

Chapter 590 of the Laws of 1987 requires that community water systems with gross operating revenues in excess of \$125,000 prepare a water supply emergency plan by December 31, 1990. The plans must be updated every five years. The plans must also be published in a newspaper of general circulation in the area served by the community water system. The plans must address all types of water emergencies including droughts. The water supply emergency plan must include the following:

1. The development of procedures for providing consumer notification during all phases of the water supply emergency.
2. The development of criteria and procedures for determining and the subsequent reporting of critical water levels or safe yield of the source or sources of water.
3. The identification of existing and future sources of water available during normal non emergency and water supply emergency conditions.
4. The identification of all available water storage. Available water storage includes source, transmission and distribution system storage.
5. The identification, capacity and location of existing inter-connections. Identification of additional inter-connections needed to provide potable water during a water supply emergency.
6. The development of a specific action plan outlining all the steps to be implemented, taken or followed during a water supply emergency, including State notification, emergency notification rosters of key water supply personnel with current telephone numbers both business and home, and follow-up corrective action to minimize the reoccurrence of an emergency.
7. The identification of an implementation of procedures for water conservation and water use restrictions to be put in place during a water supply emergency.
8. The identification of and the procedures for prioritization of potable water use during a water supply emergency.
9. The identification and availability of emergency equipment needed during a water supply emergency.
10. The development of criteria and procedures for determining and the subsequent reporting of the water supplier's capacity and ability to meet peak water demands and fire flow conditions concurrently.

In addition, a vulnerability assessment must be performed on the source or sources of water supply, the public water system, disinfection stations and water treatment plants to determine the vulnerability of these water supply components to a water supply emergency. The water supplier must then take whatever steps are necessary to ensure that potable water can be and is available during a water supply emergency.

As noted, the requirement to develop a water supply emergency plan applies to community water systems with gross operating revenues in excess of \$125,000. For those systems with gross operating revenues less than \$125,000 and located in the eight county 1985 drought emergency area, water supply drought emergency plans would be required. A vulnerability assessment specific to a drought would also be required. Specific changes to Part 5 of the State Sanitary Code regarding water supply emergency plans have already been published in the New York State Register (June 8, 1988).



COMMUNITY WATER SYSTEMS WITH SURFACE SOURCES  
IN THE LAKE ONTARIO REGION

(Figure B-1)

ORLEANS

Albion (V)  
Lyndonville (V)

Lake Ontario  
Lake Ontario

OSWEGO

Cleveland (V)  
Oswego (C)  
Sandy Creek (V)  
Lacona St., WW

Groundwater Well  
Lake Ontario  
Wells

MONROE

Brockport (V)  
Fairport (V)  
Hilton (V)  
Rochester (C)  
Rochester (C)  
Monroe County Water Authority

Lake Ontario  
Fairport V. Reservoir  
Lake Ontario  
Hemlock Lake  
Lake Ontario  
Lake Ontario

ONONDAGA

East Syracuse (V)  
Jamesville W.D.  
Marcellus (V)  
Metropolitan Water Board  
Onondaga County WD  
Onondaga County Water Authority  
Syracuse (C)

East Syracuse Reservoir  
Rush Creek-Coye Res.  
Rockwell Pond  
Lake Ontario

Otisco  
Skaneateles Lake

NIAGARA

Lockport (C)  
Middleport Village  
Niagara County WD  
Niagara Falls (C)  
North Tonawanda (C)

Niagara River  
Reservoir  
Niagara River  
Niagara River  
Niagara River

JEFFERSON

Alexandria Bay USGS  
Alexandria WD (V)  
Antwerp (V)  
Cape Vincent (V)  
Carthage (V)

St. Lawrence River  
St. Lawrence River  
Groundwater Springs  
St. Lawrence River  
Pine Creek

Chaumont (V)  
Clayton (V)  
Evans Mills (V)  
Philadelphia (V)  
Sacketts Harbor (V)  
Thousand Island Park WS  
West Carthage (V)

Lake Ontario  
St. Lawrence River  
West Creek  
Reservoir  
Lake Ontario  
St. Lawrence River  
Pleasant Lake Outlet

WAYNE

Lyons (V)  
Newark (V)  
Palmyra (V)  
Sodus (V)  
Sodus Point (V)  
Town of Ontario WD  
Williamson WD  
Wolcott (V)

Junius Pond  
Canandaigua Lake  
Canandaigua Lake  
Lake Ontario  
Lake Ontario  
Lake Ontario  
Lake Ontario

COMMUNITY WATER SYSTEMS WITH SURFACE SOURCES  
IN THE LAKE ERIE AND NIAGARA RIVER REGION

(Figure B-1)

ERIE

Akron (V)  
Angola (V)  
Buffalo (C)  
Erie County Water Authority  
    Sturgeon  
Erie County Water Authority  
    Woodlawn  
Gowanda State Hospital  
Grand Island WD  
Orchard Park (V)  
Tonawanda (C)  
Tonawanda (T)  
Wanakah Water Company

Murder Creek  
Lake Erie  
Lake Erie  
Lake Erie  
  
Lake Erie  
  
Clear Lake  
West Branch Niagara R.  
Pipe Creek-Orchard Park  
Niagara River  
West Branch Niagara R.  
Lake Erie

CHAUTAUQUA

Bournes Beach Campers  
    Association, Inc.  
Brockton (V)  
  
Chautauqua Institute  
Chautauqua Lake Estate  
    (Condominium)  
County View MH  
Dunkirk (C)  
Floramar Trailer Park  
    (T) Portland  
Forest Park Property Owners Assoc.  
Fredonia (V)  
  
Happy Homes  
Point Chautauqua Land Co.  
Ripley Water District  
St. Columban's-(T) Sheridan  
    Retirement Home (Silver Cr.)  
Shorehaven Assoc. Westfield  
Silver Creek (V)  
Tennessee Gas Co. (NCWS)

Lake Erie  
  
Slippery Rock Creek  
Bear Lake  
Chautauqua Lake  
Chautauqua Lake  
  
Stream  
Lake Erie  
Stream (Surface Res.)  
  
Lake Erie  
Lake Erie  
West Branch Canadaury Cr.  
Fredonia Reservoir  
Reservoir  
Chautauqua Lake  
Belson Creek  
Lake Erie  
  
Lake Erie  
Silver Creek Res.  
French Creek

FINGER LAKE REGION

(Figure B-1)

Communities in the Finger Lake Region are generally dependent upon the large Finger Lakes as sources and are therefore not drought prone.

The following are the systems by County which are dependent on surface sources.

GENESEE

Batavia (C)  
LeRoy (V)

Tonawanda Creek  
Lake LeRoy

WYOMING

Attica (V)  
Perry (V)  
Warsaw (V)

Crow Creek (impoundment)  
Silver Lake  
Oatka Creek

LIVINGSTON

Avon (V)  
C.B. Foods (Industrial)  
Colver Manor Mobil Home Park  
Craig Development Center  
Dansville (V)  
Eagle Pt., PWS  
Geneseo (V)  
Groveland Station  
Purchase from surface sources  
Lake View Pt. Mobil Home Park  
Lakeville WD  
Livonia (V)  
Mt. Morris (V)

Conesus Lake  
Genesee River  
Conesus Lake  
Keshequa Co.  
Little Mill Creek  
Conesus Lake  
Conesus Lake  
Groundwater

Purchase  
Conesus Lake  
Groundwater  
Mt. Morris Reservoir

ONTARIO

Bristol Harbor  
(Apart. complex)  
Canandaigua (C)  
Geneve (C)  
Gorham (T)  
Rushville (V)

Canandaigua Lake  
Canandaigua Lake  
Seneca Lake  
Canandaigua Lake  
Canandaigua Lake

YATES

Keuka College  
Keuka Park WD  
Penn Yan

Keuka Lake  
Keuka Lake  
Keuka Lake

SCHUYLER

Montour Falls (V)  
Salt Point WS  
Watkins Glen (V)

Johns Brook (impoundment)  
Seneca Lake  
Seneca Lake

SENECA

Gruman-on-the-Lake  
Ovid (V)  
Seneca Army Depot  
Seneca Falls (V)  
Waterloo (V)  
Willard State Hospital

Seneca Lake  
Seneca Lake  
Seneca Lake  
Cayuga Lake  
Seneca Lake  
Seneca Lake

TOMPKINS

Bolton Point WS  
Cornell University (inter-  
connected to Bolton Point)  
Croton (V)

Cayuga Lake  
Fall Creek

Ithaca (C) (inter-  
connected to Bolton Point)

Owasco Inlet (New  
Ponds Res., Old  
Pond Res.)  
Six Mile Creek  
(Ithaca Res.)

CAYUGA

Auburn (C)  
Aurora (V)  
Cayuga (V)  
Hibiscus Harbor, Inc.  
(T) Springport  
John Howard Apartments  
Osasco WD #1

Owasco Lake  
Cayuga Lake Purchase  
Cayuga Lake  
Cayuga Lake

Cayuga Lake  
Owasco Lake

OTSEGO

SOUTHERN TIER REGION

(Figure B-1)

Communities in the Southern Tier are generally groundwater dependent and, therefore, less vulnerable to a drought.

The following are the water systems, by County, which are dependent on surface sources.

CATTARAUGUS

Gowanda (V)  
Olean (C)  
Salamanca (C)

Pt. Peter Brook  
Olean Creek  
Newton Run

ALLEGANY

Wellsville (V)

Genesee River

STEUBEN

Arkport (V)  
Hammondsport (V)  
Hornell (C)

Linekiln Creek  
Keuka Lake  
Impounding Reservoir

CHEMUNG

Elmira (C)

Chemung River, Hoffman  
Brook, Wells

TIOGA

None

BROOME

Binghamton (C)  
Deposit (V)

Susquehanna River  
Big Hollow Brook  
Upland Supply Res.

APPENDIX C

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Request For Federal Disaster

or Emergency Assistance

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APPENDIX C  
REQUEST FOR FEDERAL DISASTER OR EMERGENCY ASSISTANCE

Procedure

If the Governor decides to ask the President to declare a major disaster or emergency under Public Law 92-288, State disaster officials, in coordination with other State and local officials, should:

1. Survey the affected areas jointly with Federal Emergency Management Agency (FEMA) regional disaster specialists, if possible, to determine the extent of public, private and agricultural damage (and potential impact);
2. Estimate the types and extent of Federal disaster assistance required;
3. Consult with FEMA Regional Director on the eligibility for Federal disaster assistance; and
4. Advise the FEMA Regional Office of the State's intention to request a major disaster declaration.

Specific Disaster Assistance Programs

Following a Presidential declaration of disaster, any person unemployed due to the impact of the drought, will be immediately eligible for Federal Disaster Unemployment Assistance.

Public assistance in the forms of grants, contributions and specialized services may be made available to States, local governments and eligible private nonprofit facilities for drought disasters as follows:

1. Suppression of forest and grassland fires which threaten to become major disaster;
2. Performance of essential protective work on public and private lands; and
3. Loans to local governments suffering substantial loss of tax and other revenue.

Individual assistance for individuals and families adversely affected by declared disasters or emergencies may be provided as follows:

1. Emergency shelter and temporary housing;
2. Assistance to the unemployed;
3. Crisis counseling; and
4. Legal services.

### Specific Emergency Assistance Programs

Assistance which may be provided under a Presidential declaration of an emergency is more limited in scope than that which may be made available to meet a specific need and is generally limited to those actions which may be required to save lives and protect property, public health and safety or to lessen the threat of a more severe disaster. Examples of emergency assistance which may apply in the event of a drought are:

1. Emergency mass care such as emergency shelter, emergency provision of food, water, medicine and emergency medical care;
2. Emergency protective measures, including: public information on health and safety measures; and other actions necessary to remove or to reduce immediate threats to public health and safety, to public property, or to private property when in the public interest; and
3. Emergency repairs to essential utilities and facilities as necessary to provide for their continued operation.

### Assistance Without a Presidential Declaration

In many instances, disaster assistance may be obtained from the Federal Government without a Presidential declaration of a major disaster or an emergency. The following are examples of the kinds of drought emergency related assistance which may be available from various Federal agencies:

1. Fire Suppression Assistance - FEMA has the authority;
2. Health and Welfare - the Department of Health and Human Services and the Public Health Service can provide assistance;
3. Emergency Conservation Program - for farm lands damaged by national disasters - by the Agricultural Stabilization and Conservation Service;
4. Emergency loans for agriculture - program under the Farmers Home Administration;
5. Disaster loans for homeowners and businesses - handled by the Small Business Administration; and
6. Tax Refund - the Internal Revenue Service can assist individuals in obtaining tax refunds for losses resulting from natural disasters.

### Need for Drought Related Disaster Assistance Programs

As can be seen from the programs listed above and the experience in trying to obtain Federal assistance during the 1980-81 drought, Federal

legislation and programs are needed to assist localities during droughts. This assistance is required to help avert major disasters and resultant damages. There are some drought related programs for rural areas, but essentially none exist for urban areas where catastrophic damages would occur and where public health and safety are major concerns. There is a particular need for:

1. Technical assistance program for drought management by the U.S. Army Corps of Engineers, the U.S. Geological Survey and the National Weather Service;
2. Emergency programs for Federal agencies to provide assistance in the repair, rehabilitation and installation of water supply facilities and systems which have an imminent emergency need; and
3. Emergency low interest loans to localities and to water supply systems to assist them in meeting water supply needs during an existing or imminent drought.

APPENDIX D

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New York City

Drought Contingency Plan

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CITY OF NEW YORK  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
BUREAU OF WATER SUPPLY

DROUGHT  
CONTINGENCY  
PLAN

1982

NEW YORK CITY

DROUGHT PREPAREDNESS PLAN

This plan is based on three drought stages:

- Drought Watch
- Drought Warning
- Drought Emergency

CRITERIA  
FOR  
DEFINITION OF STAGES

- o The "Drought Watch" will be triggered when there is less than 50 percent possibility that the major components of the reservoir system (Catskill or Delaware) will fill by June 1st. This will initiate internal actions to utilize more water from the Croton System. Augmented water supply personnel will be deployed to reduce that portion of the avoidable waste controllable by internal action.
- o The "Drought Warning" will be triggered when there is less than 33 percent possibility that either the Catskill or Delaware Reservoir System will fill by June 1st. Limited restricted usages will be mandated.
- o The "Drought Emergency" will be triggered when it becomes necessary to reduce consumption by stringent measures so as to assure that a protracted dry period (such as occurred from 1961 through 1967 and 1980 through 1981) would not cause the City's reservoirs to be drained. More severe restricted usages will be mandated.

ACTIONS

"DROUGHT WATCH" - DEP ACTIONS

1. Initiate Public Awareness Program via media.
2. Maximize usage of water from the Croton System by taking the following actions:
  - a. Increase Gravity Distribution
  - b. Fully utilize the Hydraulic Pumping Stations
  - c. Commence operation of standby Electric Pumping Stations.
3. Expand Leak Detection and Repair Program
  - a. Create Leak Survey Teams
  - b. Redeploy Manpower to address current backlogs
  - c. Utilize overtime to increase output.
4. Hydrant Surveillance
  - a. Initiate patrols to close illegally opened hydrants and reduce waste

- b. Exploit contract capability to replace defective leaking hydrants.
- 5. Initiate dialogue with other City agencies concerning actions on their parts to be undertaken should a "Drought Warning" be declared.
- 6. Initiate steps in the Budget process so that additional resources (including manpower) would be in place to be utilized in the event of a "Drought Warning."
- 7. Inform all "Outside Communities" taking water from N.Y.C.'s water system of situation and request their cooperation in reduction of water consumption.
- 8. Apprise New York State Departments of Health and Environmental Conservation, the Delaware River Master and the Delaware River Basin Commission of system status.

"DROUGHT WARNING" - DEP ACTIONS

- 1. Continue Media Campaign stressing Voluntary Conservation measures and limited restricted usages as mandated.
- 2. Continue maximum utilization of water from the Croton System.
- 3. Implement Expanded Leak Detection program utilizing resources budgeted for "Drought Warning."
- 4. Utilize Hydrant replacement contracts Citywide to permit redeployment of additional in-house forces to the Leak program.
- 5. Put the Chelsea Pumping Station on standby status.
- 6. Direct the implementation of Conservation programs by other City agencies.
- 7. Notify all outside communities of required compliance with N.Y.C. water use restrictions, and intent to enforce the maintenance of their drafts within their entitlements.
- 8. Continue efforts with New York State, the Delaware River Master and the Delaware River Basin Commission to manage releases and diversions to effect maximum utilization of available waters.
- 9. Expand program to shut off services to vacant buildings.

"DROUGHT WARNING" - ACTIONS BY OTHER CITY AGENCIES

1. Sanitation Department - Suspend street flushing program.
2. Police Department - Assist in closing illegally opened hydrants.
3. Parks Department - Restrict golf course watering. No make-up water for artificial lakes and ponds. No continuously running drinking foundations. No un-recirculated ornamental fountains.
4. Housing Authority - Request plumbing leak surveys.
5. Transit Authority - Request fleet washing 50% cutback.
6. Board of Education - Initiate student conservation education program.

"DROUGHT EMERGENCY" - DEP ACTIONS

1. The following regulations will be issued during the "Drought Emergency" by the Commissioner of Environmental Protection.

PHASE I

- (a) No person or entity shall:
  1. Allow any leak or waste to continue from any water pipe, valve, faucet or conduit connected to the City water system on or in any premises owned, used, operated or controlled by such person or entity;
  2. Wash any vehicle by means of a hose, fire hydrant, or other active source connected to the City water system, except that a commercial vehicle washing operation may use City water for vehicle washing if, pursuant to the timetable set forth below, equipment is installed and utilized so that at least 50% of the water used is recirculated by means of a system approved by the Department. Any facility not now utilizing recirculating equipment shall: (a) submit plans to the Department for the installation of such equipment within 30 days, (b) submit a copy of an executed contract to install such equipment within 60 days and (c) complete the installation of such equipment and commence its use within 90 days of the effective date of these regulations;

3. Wash any street, sidewalk, driveway, outdoor area, outdoor steps, building exterior or other structure by means of a hose, fire hydrant, or other active source connected to the City water system;
  4. Use water from the City water system for any ornamental purpose, including, but not limited to, use in fountains, artificial waterfalls, reflecting pools, lakes and ponds.
  5. Use water from the City water system for the purpose of watering any golf course;
  6. Open or use any fire hydrant for any purpose other than fire protection except in accordance with a permit obtained from the Department and only for the period of and the purposes authorized by such permit and in strict adherence to all terms and conditions set forth therein;
  7. Serve water from the City water system to any patron of a restaurant, club, or other eating place unless specifically requested by such patron;
  8. Operate an air conditioning system utilizing water from the City water system in a cooling tower, unless within 30 days from the effective date of this regulation, a separate meter is installed to continuously measure the flow of water to the cooling tower;
  9. Operate any air conditioning system in excess of two tons of rated capacity or greater or any refrigeration unit rated at 10 horsepower or greater using water from the City water system, unless such air conditioning system or refrigeration unit is equipped with a water recirculating device approved by the Department.
- (b) Each commercial and industrial user of water from the City water system shall prepare a water consumption reduction plan, enabling it to reduce its use of water in stages of 15%, 20% and 25%, based upon its average water consumption during calendar year 1980. Such plans shall be designed so as to achieve and maintain the 15% reduction promptly, and to achieve the 20% and 25% reduction immediately upon the declaration of a Phase II and Phase III emergency, respectively. Each such user is expected to implement the first steps of its plan during Phase I, reducing its consumption by 15%.

## PHASE II

If, at any time, the Commissioner of the Department of Environmental Protection (the "Commissioner") determines that the measures set forth under Phase I of this regulation have not resulted in a sufficient level of conservation in light of existing water supply conditions, a Phase II shall be declared. Upon declaration of Phase II in addition to those measures set forth hereinabove:

- (a) No person or entity shall:
  - 1. Use water from the City water system to fill or maintain the water level in any swimming pool;
  - 2. Use water from the City water system to water any lawn, ornamental shrub or plant;
- (b) Each commercial or industrial user of water from the City water system shall implement its water consumption reduction plan, reducing use of water by no less than 20%.

### PHASE III

If, after the imposition of the measures set forth in Phase II of this regulation, the Commissioner finds that water consumption must be further reduced, a Phase III shall be declared. Upon declaration of Phase III in addition to the measures set forth hereinabove:

- (a) All commercial or industrial users of water from the City water system shall reduce their consumption by no less than 25%;
  - (b) All residential users shall install water flow restricting devices in any shower head maintained in any residence;
  - (c) All air conditioning systems utilizing water from the City water system shall be operated only in accordance with hourly restrictions established by the Commissioner.
- 2. Continued Public Relations program geared to public information on drought status and overall conservation education including mass media and private sector efforts.
  - 3. Continue maximum utilization of waters from the Croton System including the possible use of the "standby" diesel motor driven pumps at 179th Street Pumping Station to use an additional 30 million gallons a day from this source.
  - 4. Continue leak detection efforts and reevaluate leak backlogs as to possible additional resource allocations to correct problems.
  - 5. Require "Outside Communities" to implement similar conservation measures.
  - 6. With agreement among all parties, continue curtailments in Delaware releases and diversions.
  - 7. Initiate Leak and Waste surveys in private buildings utilizing Water Use Inspectors (defer meter reading program).
  - 8. Staff Hudson River Pumping Station at Chelsea, New York, to facilitate pumping 100 MGD of Hudson River water into Shaft 6 of the Delaware Aqueduct. Current restraints on activation are discussed under the Alternate Emergency Source.

DROUGHT EMERGENCY - ACTIONS BY OTHER CITY AGENCIES

1. Department of General Services

Building Inspectors to be assigned to plumbing leakage surveys in private buildings.

2. Fire Department

Leak and waste reports from all units to be made on routine fire inspections of buildings.

3. Finance

Inclusion of conservation messages in billings.

4. WNYC RADIO & T.V.

Stress conservation theme in programming. Request presentation of prepared Radio and T.V. Tapes for public service messages.

5. Housing (Public and Private)

Voluntary installation of flow restricting devices.

6. Others

Same efforts as in "Drought Warning."

ACTION - CROTON SUPPLY

Although the Croton watershed has an estimated safe yield of 240 millions gallons per day (MGD), 140 (MGD) of this water is normally delivered by gravity and hydraulic pumping to the low elevation areas of the Bronx and Manhattan.

When hydrological analysis indicates that the Croton System has a better chance of filling than either the Catskill or Delaware Systems, pumping will be commenced at three standby electric stations; 86th Street in Manhattan, and Jerome and Mosholu in the Bronx. During a drought these plants can pump up to a rate of 120 MGD (Table D-1).

Adjustments to pressure regulators, distribution boundary changes, manipulation of reservoir controls and other actions can increase usage another 20 MGD, bringing the total draft on the system to 280 MGD, which is the Croton Aqueduct's delivery limit.

TABLE D-1  
CROTON CONSUMPTION (N.Y.C.)

	<u>Plant Capacity MGD</u>	<u>Operation</u>	
		<u>Normal MGD</u>	<u>Drought MGD</u>
<u>GRAVITY</u>			
Bronx	—	20	35
135th Street	—	65	65
Central Park Reservoir	—	<u>25</u>	<u>32</u>
Subtotal		110	132
<u>PUMPING STATIONS</u>			
Hydraulic 40th Street	36	30	36
Diesel 179th Street	30	0	5
Electric			
86th Street	50	0	44
Jerome	50	0	34
Mosholu	<u>52</u>	<u>0</u>	<u>39</u>
Subtotal	218	30	158
<b>TOTAL</b>	<b>218</b>	<b>140</b>	<b>290</b>

HYDRAULIC PUMPING STATIONS ON WATERSHEDS NOT INCLUDED:

Cross River	12 MGD
Croton Falls	10 MGD

DELAWARE SYSTEM

As a result of the "Good Faith" agreement among the parties to the United States Supreme Court amended decree, when drought warning is reached in the City's Delaware system reservoirs, as defined by accompanying Figure D-1, and remains below that level for five consecutive days, the following diversion and releases cutback schedule goes into effect automatically:

	<u>NYC DIVERSIONS MGD</u>	<u>NJ DIVERSIONS MGD</u>	<u>MONTAGUE FLOW OBJECTIVE cfs</u>	<u>TRENTON FLOW OBJECTIVE cfs</u>
UPPER HALF DROUGHT WARNING	680	85	1655	2700
LOWER HALF DROUGHT WARNING	560	70	1550	2700

When the City's Delaware system reservoirs, as defined by Figure D-1, reach drought conditions, then the following diversion and releases cutback schedule goes into effect:

<u>N.Y. DIVERSIONS MGD</u>	<u>N.J. DIVERSIONS MGD</u>	<u>MONTAGUE FLOW OBJECTIVES</u>	<u>TRENTON FLOW OBJECTIVES</u>
520	65	1100-1650*	2500-2900

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

Figure D-1  
 OPERATION CURVES FOR  
 CANNONSVILLE, PEPACTION AND NEVERSINK RESERVOIRS

SCHEDULED  
 BILLION  
 GALLONS

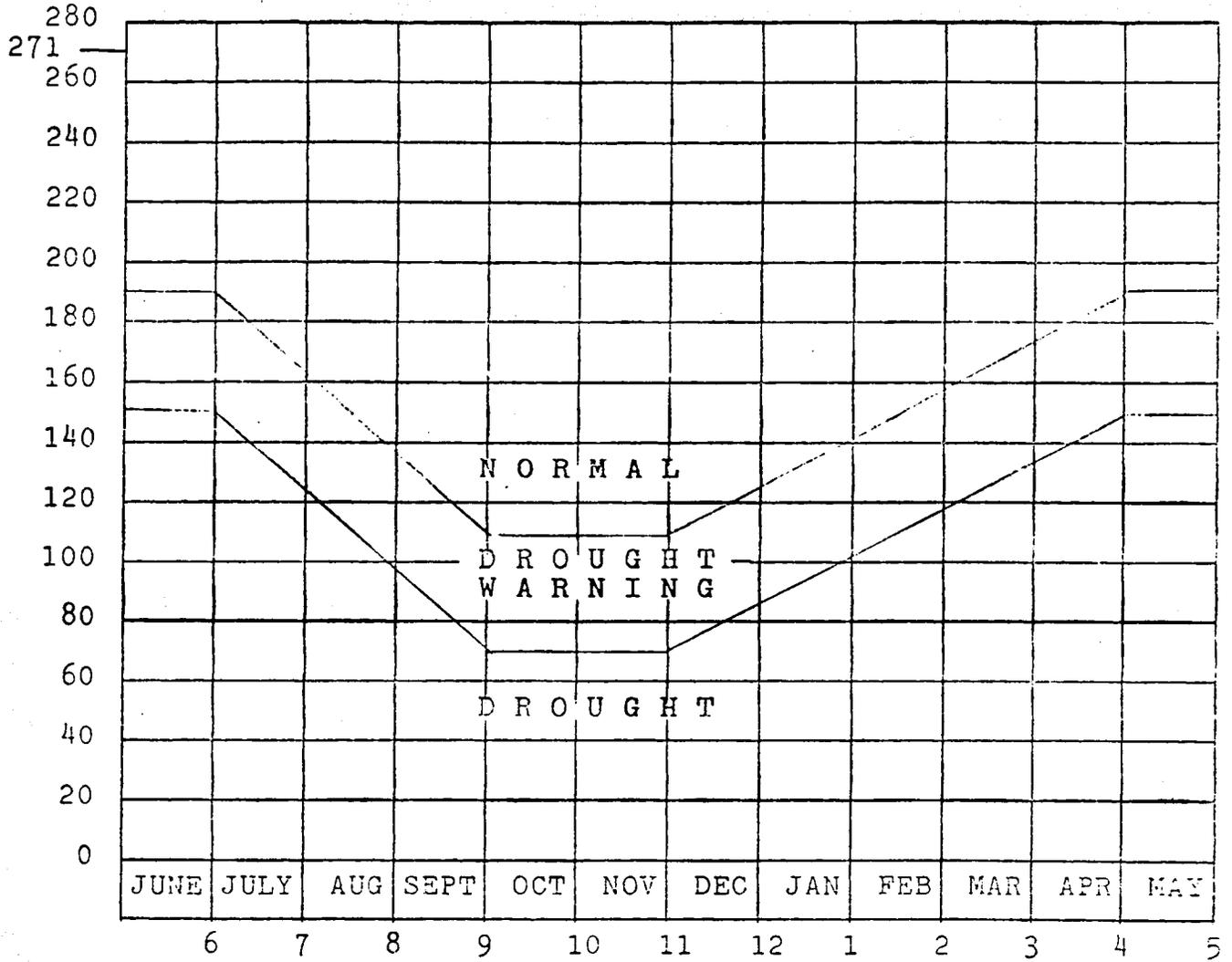


TABLE D-2

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

\*Varies with time of year and location of salt front.