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North Atlantic Regional Water Resources Study

Annex 2.

May 72

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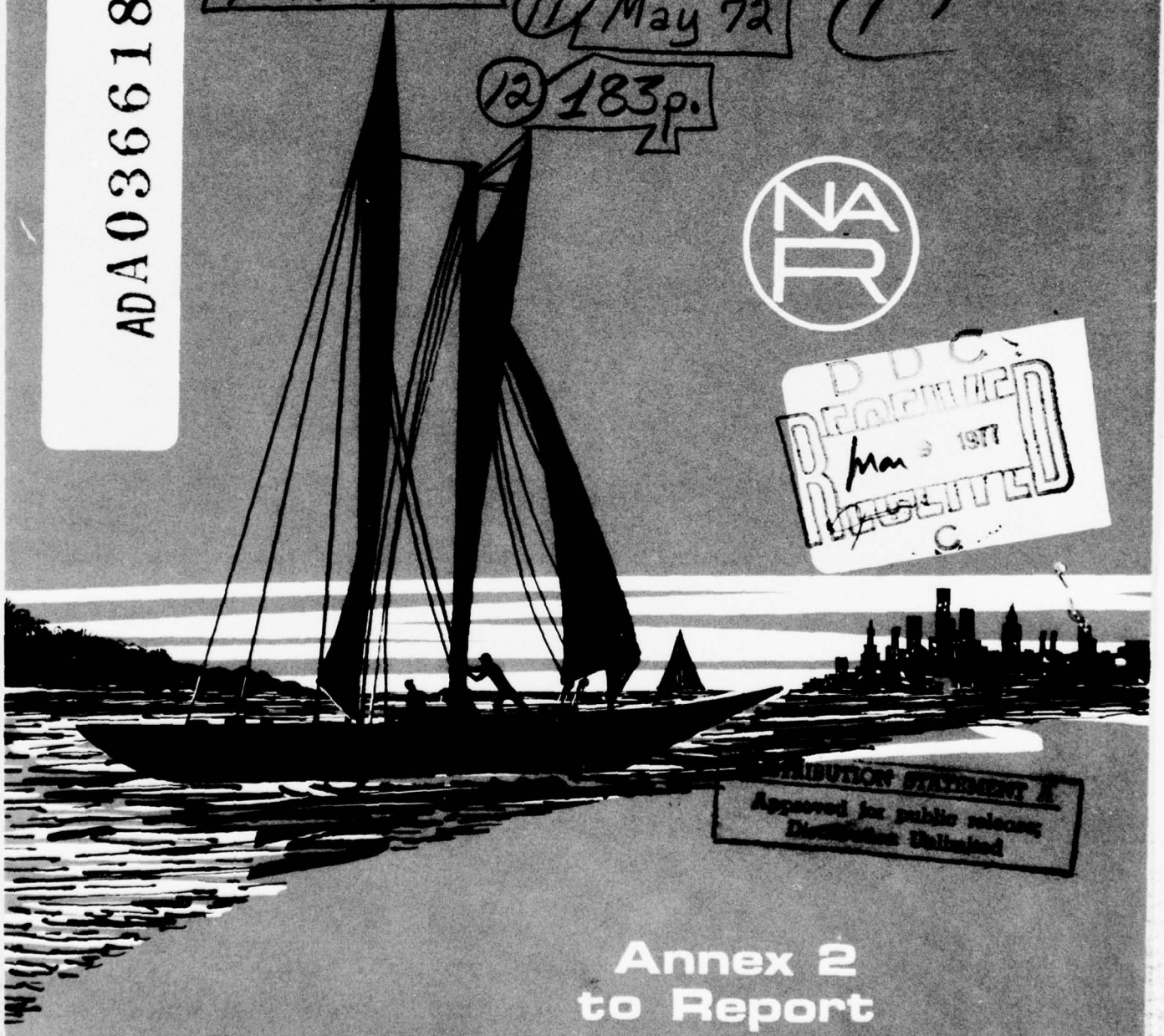


Annex 2 to Report

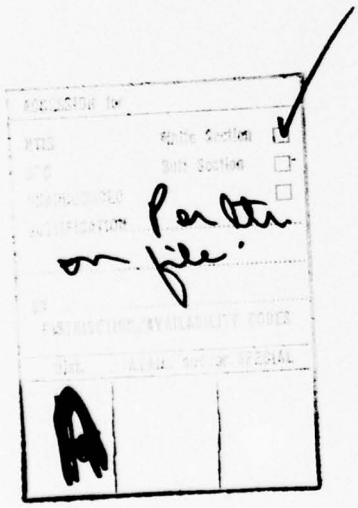
NORTH ATLANTIC REGIONAL WATER RESOURCES STUDY COORDINATING COMMITTEE
MAY 1972

The North Atlantic Regional Water Resources (NAR) Study examined a wide variety of water and related land resources, needs and devices in formulating a broad, coordinated program to guide future resource development and management in the North Atlantic Region. The Study was authorized by the 1965 Water Resources Planning Act (PL 89-80) and the 1965 Flood Control Act (PL 89-298), and carried out under guidelines set by the Water Resources Council.

The recommended program and alternatives developed for the North Atlantic Region were prepared under the direction of the NAR Study Coordinating Committee, a partnership of resource planners representing some 25 Federal, regional and State agencies. The NAR Study Report presents this program and the alternatives as a framework for future action based on a planning period running through 2020, with bench mark planning years of 1980 and 2000.

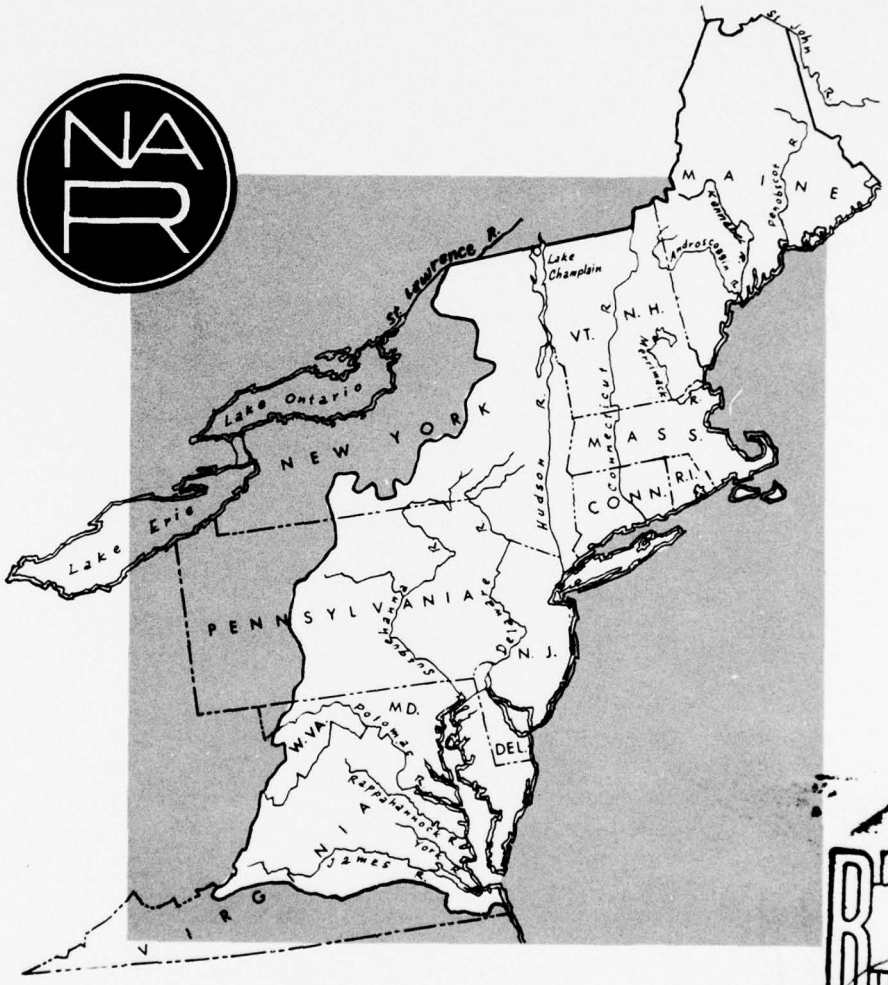
The planning partners focused on three major objectives -- National Income, Regional Development and Environmental Quality -- in developing and documenting the information which decision-makers will need for managing water and related land resources in the interest of the people of the North Atlantic Region.

In addition to the NAR Study Main Report and Annexes, there are the following 22 Appendices:



A. History of Study
B. Economic Base
C. Climate, Meteorology and Hydrology
D. Geology and Ground Water
E. Flood Damage Reduction and Water Management for Major Rivers and Coastal Areas
F. Upstream Flood Prevention and Water Management
G. Land Use and Management
H. Minerals
I. Irrigation
J. Land Drainage
K. Navigation
L. Water Quality and Pollution
M. Outdoor Recreation
N. Visual and Cultural Environment
O. Fish and Wildlife
P. Power
Q. Erosion and Sedimentation
R. Water Supply
S. Legal and Institutional Environment
T. Plan Formulation
U. Coastal and Estuarine Areas
V. Health Aspects

Annex 2 to Report



Prepared by

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North Atlantic Division
Corps of Engineers, U.S. Army

for the

NORTH ATLANTIC REGIONAL WATER RESOURCES STUDY
COORDINATING COMMITTEE

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CHAPTER 1 INTRODUCTION

Fourteen State Programs are presented in this Annex and each is a reformulation along state boundaries of the appropriate Area Programs of Annex 1. The procedures used for these reformulations were agreed to by the personnel of the agencies responsible for the appendices to the NAR Report.

These are mixed objective State Programs and the reformulations were done in a manner that would insure no changes in the plan formulation decisions on alternative planning elements: objectives, needs, devices, benefits and costs.

CHAPTER 2 METHODOLOGY

These State programs are rearrangements of the Area Programs along state boundaries. Each portion of a state within a given Area is designated as a state-area sector and the mixed objective information for that Area's Program has been distributed to the state-area sectors found within the Area. Thus, Area 4 has been divided into two state-area sectors: the Maine-4 sector composed of all of Area 4 which lies in Maine and the New Hampshire-4 sector for the portion that lies in New Hampshire. Planning elements (needs, devices and costs) of each Area have been distributed among the state-area sectors in that Area according to various methodologies that, with the available information, best describe the distribution of the elements in the Area.

This Annex is written in conjunction with the Report and Annex 1 to the Report and detailed definitions, descriptions and methodologies presented in those volumes have not been repeated. Chapters 2, 4, 5, 6 and 7 of the Report and chapters 2 and 3 of Annex 1 are of particular value to the understanding of this Annex. Chapters 6 and 7 of the Report are of special significance as they give detailed definitions of the planning elements and brief descriptions of the methodologies used in determing projections. Of particular value in Annex 1 is Chapter 2, which gives detailed methodologies used in writing the Area programs, and Chapter 3, which gives comparisons between the Area programs and other published basin studies.

Each State Program consists of four sectors and contains similar information presented in the following order:

State Map
State Description
State Program - needs
devices
costs
State Tables - needs
devices
costs

CONTENTS OF EACH SECTION

State Map. A map of each state is included showing the boundaries of the state and the state-area sectors within the state as well as the location of the more important cities.

State Descriptions. Each State Program is introduced by a brief description which indicates the major physical and economic characteristics of the state such as area, topography, population, major industries and per capita income levels.

State Program. A program for each state is given which highlights the significant needs, devices and costs within the state. Each state-area sector in the state is examined in relation to the other sectors and the state as a whole, for large, important and key planning elements. An element is considered large or small as it related to other sectors of the state. An important need is one which must be fulfilled before the mixed objective of the sector in which it is located can be achieved. An important device is on that is essential for fulfilling a particular need(s) of a sector. A key need is one which must be fulfilled in order that other needs of the sector can be fulfilled and a key device must be used for the successful use of other devices in the sector.

State Tables. All of the mixed objective information that is presented in the Area Program tables of Annex 1 is included in the State Program tables by state total and by state-area sectors. An exception to this is that the devices the uses of which are indicated by check marks rather than by figures in the Annex 1 device tables, could not be allocated to state-area sectors and are not included in the tables of Annex 2. All of the needs and costs which were similarly check marked in the Area tables when they occured, are assumed to apply to all sectors in an Area and are included in the Annex 2 tables.

DETAILED METHODOLOGIES

Needs. The following fifteen major need catagories are included in the State Programs.

Publicly Supplied Water
Industrial Self-supplied Water
Rural Water Supply
Irrigation Water
Power Plant Cooling Water
Hydroelectric Power Generation
Navigation
Water Recreation
Fish and Wildlife
Water Quality Maintenance
Flood Damage Reduction
Drainage Control
Erosion Control
Visual and Cultural Environment
Health

The methodologies for distributing these needs from Area to state-area sectors are given in the following paragraphs.

The need for Publicly Supplied Water in each Area was allocated to the state-area sectors in accordance with the population distribution on the assumption that the distribution of the Publicly Supplied Water is directly related to the population distribution in the Area.

The Industrial Self-supplied Water need was distributed according to the distribution of the economic value added for the six major water using industries. It was assumed that the total self-supplied water use in each sector of an Area for all industries would be proportional to the present total value added of the major water using industries: food, textiles, paper, chemicals, petroleum and primary metals.

The Rural Water need was assumed proportional to the rural population and was distributed in this manner.

The need for agriculture Irrigation Water was assumed to be proportional to the amount of irrigated land in each sector and the Area need was distributed according to these percentages. The location of non-agriculture Irrigation Water was allocated by the percentage of total non-agriculture irrigated land in each sector as determined by the staff of the Department of Agriculture.

Distribution of the needs for Power Plant Cooling Water -- saline, brackish and fresh withdrawal and brakish and fresh consumption -- were obtained from the staff of the Federal Power Commission (FPC). The original sources for determing the needs of Annex 1 were evaluated by the FPC staff to determine the assumed location of the power needs by sectors.

The presumed need for Hydroelectric Power Generation was distributed by the FPC in the same manner as for Power Plant Cooling Water.

The needs for Navigation were distributed to the appropriate state-area sectors on the basis of the present location of navigational facilities: commercial navigation according to present commercial ports and recreational boating according to present recreational boating sites.

All the needs for Water Recreation -- visitor days, stream or river miles, water surface, beach and pool areas and acreage for land facilities -- were allocated primarily by population. This assumption, that Water Recreation needs are proportional to population, was modified in some instances to account for the location of available recreational sites. The distribution of these needs was done by the staff of the Bureau of Outdoor Recreation, Department of the Interior.

The Fish and Wildlife needs were distributed by various methods. The man-day requirements for sport fishing, hunting and nature study were allocated to the state-area sectors according to the total population distribution on the assumption that the needs were proportional to population distribution on the assumption that the needs were proportional to population. The lake and stream surface areas, and the sport fishing access for anadromous and freshwater fish were distributed by the percentage of water area in each sector as these needs would be proportional to the available resources. Piers and salt water fishing access needs were

determined by estimating the approximate miles of coastline in each sector and distributing the needs in proportion to these figures. Hunting access was assumed proportional to land suitable for game animals and was apportioned by the percentages of total forest, crop and pasture land in each sector. Nature study access, the primary need for which was assumed to occur only in urban areas, was allocated by the percentage of urban and other land in the sectors.

The non-industrial portion of the Water Quality Maintenance need was assumed to be proportional to the total population distribution. The industrial portion of the Water Quality Maintenance need consists of the summation of the needs of eight major categories of industries. The population equivalent loading (PE's) from each of these industries, as identified in Appendix L, was allocated to the state-area sectors according to the distribution of the economic value added for each industry. In each sector the needs of each industrial category -- food, textiles, paper, chemicals, petroleum, primary metals, mining, and miscellaneous industries -- were added together for the sector total.

The upstream Flood Damage Reduction needs were obtained from the sources originally used to determine upstream damages for Annex 1 which were site specific and readily identified. The mainstream **and** tidal and hurricane Flood Damage Reduction needs were determined by identifying the state-area sectors in which these land areas occur.

The needs for Drainage Control on cropland, forest land and wet land were obtained from the percentages of total land area in each sector.

The Erosion Control needs in each sector were determined by the staff of the Department of Agriculture from the original sources used for the Area needs of Annex 1. The needs are based on the actual location of the sites which are most likely to receive erosion protection.

The needs for Health were assumed to occur in each state-area sector in the Region.

The Visual and Cultural needs were determined by locating on the original maps used for the preparation of Appendix N the actual sites considered for improvement and, thus, the proportion of the total need in each sector.

Devices. The devices considered in this Annex are described in the following eleven categories:

Storage facilities
Withdrawal facilities
Conveyance facilities
Quality control facilities
Desalting facilities
Flood plain management
Local flood protection
Watershed management
Land controls
Flood controls storage
Waste water

The devices used for storage facilities are upstream reservoirs (storage less than 5000 sq. ft.) and mainstream reservoirs (storage greater than 5000 sq. ft.). The upstream reservoirs were allocated on the assumption that the devices would be distributed among the state-area sectors in proportion to the available sites which are suitable for upstream storage facilities. The locations of proposed mainstream reservoirs sites were noted and estimates were made as to the projects most likely to be completed. The required devices were then distributed to sectors which contained these most probable project sites.

The device used for withdrawal facilities are fresh water intakes and pumping, brackish water intakes and pumping and wells. The fresh water intakes and pumping devices were distributed in two ways: those used to meet the Publicly Supplied Water needs and those used to meet the Industrial Self-supplied Water needs. The first set of fresh water intakes and pumping devices were distributed in proportion to the total population and the second set according to the value added percentages for industry. Brackish water intakes and pumping devices were also apportioned according to the value added percentages for industry. The distribution of wells was based on the actual location of available ground water sources. It was assumed that well utilization would be approximately proportional to the available supplies.

Conveyance facilities for interbasin diversions were known to be located in specific Areas and state-area sectors.

Potable water treatment plants and waste water treatment plants are the devices used for water quality control facilities. The first type of plan is used primarily for Publicly Supplied Water needs and is apportioned to the state-area sectors according to the distribution of total population. Waste treatment plants (secondary treatment with both 85% and 90% PE removal and advanced treatment with 95% PE removal) were directly distributed to state-area sectors according to the distribution of Water Quality Maintenance needs in each sector and the degree of treatment required.

Site locations for desalting facilities were known and these facilities distributed to state-area sectors according to these locations.

The use of upstream flood plain management in each state-area sector was determined from the amount of flood plain in each sector and the mixed objective of the Area. The amount of flood plain in each sector was determined from the original sources used to locate the upstream flood control devices for Appendix F. The distribution to state-area sectors of local flood protection projects was made on the basis of available sites in each sector for upstream river protection projects and on the basis of the actual location of the projects for mainstream river and coastal protection projects. Flood control channels were distributed on the basis of available sites as determined from the sources originally used to determine the upstream flood damage control devices of Appendix F.

Watershed management devices were also distributed according to the percentage of available sites in each state-area sector, as determined from the sources used for Appendix F.

Land control devices are primarily used to meet Visual and Cultural needs. The amount and type of land control devices used in each state-area sector are distributed in direct relationship to the amount and type of Visual and Cultural needs in each sector and the mixed objective chosen for the Area. A need for a specific amount of land for a particular purpose and a given objective require specific devices for that same amount of land.

Upstream flood control reservoirs were distributed according to the percentage of available sites in each state-area sector. Sites for mainstream flood control reservoirs were identifiable in each Area and state-area sector.

Waste water is used to help fulfill the Industrial Self-supplied Water needs and was distributed according to the percentage of industrial need in each state-area sector as determined from the value added for industry.

Costs. Methodologies used to allocate costs in each area are described in thirteen catagories:

Water Development
Water Withdrawal and Conveyance
Power Plant Cooling Water
Hydroelectric Power Generation
Navigation
Water Recreation
Fish and Wildlife
Water Quality Maintenance
Flood Damage Reduction
Drainage Control
Erosion Control
Health
Visual and Cultural

Water development costs were derived from the supply model and allocated according to differing methodologies. Upstream reservoir costs were allocated on the basis of the percentage of available upstream reservoir sites as determined from Appendix F. Mainstream reservoir costs were distributed according to differing methodologies. Upstream reservoir costs were allocated on the basis of the percentage of available upstream reservoir sites as determined from Appendix F. Mainstream reservoir costs were distributed according to the percentage of mainstream reservoir projects in each state-area sector and informed estimates of the projects most likely to be constructed. Costs for well development were assumed proportional to the available resource and were distributed according to the percent of ground water development in each state-area sector. As the possible location by state-area sector of the desalting devices are known their costs were allocated to the sectors containing the devices.

Water withdrawal and conveyance costs were allocated by different methods. The conveyance costs for inter-basin transfers were allocated to the state-area sectors identified as receiving the benefits of the transfers. The withdrawal and conveyance costs for Public Water Supply were allocated according to the percentage of total population in each sector. These devices costs for Industrial Self-supplied Water were distributed according to the distribution of the industrial need as determined by the distribution of value added for industry. The Rural Water Supply costs were unknown. The costs for agricultural Irrigation Water were distributed according to the percent of irrigated land in each sector. The non-agriculture Irrigation Water costs were allocated according to the percent of total land in each sector.

The costs for Power Plant Cooling Water were provided by the staff of the Federal Power Commission from the original sources used for Appendix P, Power.

Hydroelectric Power Generation costs are unknown.

Navigation costs were distributed according to device locations in the case of commercial navigation and according to the location of present recreational boating for recreational boating needs.

Water Recreation costs were distributed according to the percentages of total population in each state-area sector.

Only fishing access costs for Fish and Wildlife needs are known and these were distributed according to total population.

Water Quality Maintenance costs for secondary and advanced treatment are directly proportional to the waste load and the degree of treatment used in each state-area sector. It was assumed that "other costs", which were for combined sewer overflow control, occur in the major urban centers and that these costs were allocated to the sectors containing these centers in each Area. The "other costs" for acid mine drainage control were distributed to the sectors which contain coal mining.

Each of the structural devices used for fulfilling upstream and mainstream Flood Damage Reduction needs have an associated cost and each state-area sector containing the devices carries the associated costs.

Drainage Control costs were distributed according to the percentage of total land area in each state-area sector.

Erosion Control costs were distributed by the staff of the Department of Agriculture to those state-area sectors which would receive the erosion control devices.

Costs for Health were unknown.

Visual and Cultural costs in each state-area sector depend on the location and amount of land associated with each of the land control devices.

Visual and Cultural needs and devices for meeting these needs were located on maps so that the sector containing the needs also contain the devices and the associated costs.

DISTRIBUTION PERCENTAGES

Many of the planning elements were distributed among the state-area sectors according to percentages derived from various sources. These percentage distributions are displayed in Tables of Percentage Distribution of Areas Among States, pages to . The sources and methodologies used to determine these percentages are described in the following section.

Population. The population of each county in the NAR region was determined from the 1967 County and City Data Book, U.S. Bureau of the Census. Counties were located in the appropriate state-area sectors (see Table B-7, Appendix B, Economic Base) and percentages of total area population in each state-area was determined. The County and City Data Book gives percentages of urban population for each county which was used to determine the percentage of urban and rural population in each state-area sector. (It was assumed that the percent rural was equal to one hundred minus the percent urban.) For urban and rural population each county with a few exceptions was considered to be located in one of the 21 Areas depending upon the location of major population concentrations. For total population, the population of counties in two or more Areas were distributed to those Areas in proporation to surface area on the assumption of uniform population density within the county. It was assumed that these methods of determining population distribution would give the best overall distribution of the planning elements dispite the fact that discrepencies occured which would indicate that a state-area sector could have a given percentage of total population but zero urban and rural populations.

Area. All of the area distribution percentages with the exception of irrigated land area was obtained from Table G-11 page G-38 of Appendix G, Land Use Management. The irrigated area percentages were obtained by the staff of the Department of Agriculture from sources used in developing irrigation requirements for Appendix L, Irrigation.

Value Added. The value added percentages were obtained from the economic value added of selected industries as determined from the 1963 Census of Manufactures, U.S. Department of Commerce, Bureau of the Census. Six major water using industries were used to determine the percentages of value added for each state-area sector for Industrial Self-supply. These industries were Food and Kindred products, Textile Mill products, Paper and Allied products, Petroleum and Coal products, and Primary Metal industries. For Water Quality Maintenance the product of the percentage of value added in each sector for each industry and the before treatment waste load of the industry (obtained from Tables L-6, Appendix L, Water Quality and Pollution) was used to determine an approximate distribution of the pollution loading for that industry. The population loading of all industries considered (the six for Industrial Self-supplied plus mining and miscellanous) were then used

to determine percentage distribution for Water Quality Maintenance.

Recreational Boating. The recreational boating percentages were determined from the present distribution of recreational boating which was used in the development of Appendix K, Navigation, by the NAR Study staff.

Storage. The upstream storage percentages were based on the storage capacity of all available upstream storage sites as determined from material obtained by the Department of Agriculture for the development of Appendix F, Upstream Flood Prevention and Water Management. The mainstream storage distribution is based on the location of storage projects most likely to be completed of all projects identified in Appendix E, Flood Damage Reduction and Water Management for Major River and Coastal Areas.

Groundwater Development. The percentage distribution of ground water development was based on the location and capacities of the available groundwater fields as determined from material used in developing Appendix D, Geology and Ground Water.

TABLES OF PERCENTAGE DISTRIBUTION OF AREAS AMONG STATES

AREA 1 - ST. JOHN RIVER BASIN

100 percent of all needs, devices, and costs in Area 1 are allocated to Maine.

AREA 2 - PENOBSCOT RIVER BASIN

100 percent of all needs, devices, and costs in Area 2 are allocated to Maine.

AREA 3 - KENNEBEC RIVER BASIN

100 percent of all needs, devices, and costs in Area 3 are allocated to Maine.

AREA 4 - ANDROSCOGGIN RIVER BASIN

	Maine	New Hampshire			
Percent of:					
Population					
Total	82	18			
Urban	79	21			
Rural	76	24			
Area					
Total	79	21			
Land	79	21			
Water	84	16			
Forest, Crop, and Pasture	78	22			
Urban and Other	91	9			
Irrigated	100	0			
Value Added					
for Industrial Self-Supply	100	0			
for Water Quality Maintenance	80	20			
Recreational Boating	97	3			
Storage					
Upstream	66	34			
Mainstream	0*	0*			
Groundwater Development	87	13			

* No mainstream storage in Area 4.

AREA 5 - MAINE COASTAL BASINS

100 percent of all needs, devices, and costs in Area 5 are allocated to Maine.

AREA 6 - SOUTHERN MAINE AND COASTAL NEW HAMPSHIRE

	Maine	New Hampshire	Mass.		
Percent of:					
Population					
Total	60	37	3		
Urban	66	34	0		
Rural	55	45	0		
Area					
Total	60	40	0		
Land	57	43	0		
Water	90	10	0		
Forest, Crop, and Pasture	55.2	44.6	0.2		
Urban and Other	68.0	31.3	0.7		
Irrigated	70	30	0		
Value Added					
for Industrial Self-Supply	89	11	0		
for Water Quality Maintenance	58	42	0		
Recreational Boating	80	20	0		
Storage					
Upstream	39	61	0		
Mainstream	0*	0*	0*		
Groundwater Development	72	28	0		

* No mainstream storage in Area 6.

AREA 7 - MERRIMACK RIVER BASIN

	New Hampshire	Mass.			
Percent of:					
Population					
Total	32	68			
Urban	28	72			
Rural	46	54			
Area					
Total	76	24			
Land	76	24			
Water	82	18			
Forest, Crop, and Pasture	81	19			
Urban and Other	47	53			
Irrigated	33	67			
Value Added					
for Industrial Self-Supply	31	69			
for Water Quality Maintenance	35	65			
Recreational Boating	80	20			
Storage					
Upstream	79	21			
Mainstream	100	0			
Groundwater Development	71	29			

AREA 8 - CONNECTICUT RIVER BASIN

	New Hampshire	Vermont	Mass.	Conn.	
Percent of:					
Population					
Total	9	7	35	49	
Urban	5	3	39	53	
Rural	17	19	28	36	
Area					
Total	27	35	25	13	
Land	27	36	24	13	
Water	24	15	40	21	
Forest, Crop, and Pasture	29	37	23	11	
Urban and Other	12	16	34	38	
Irrigated	1	4	29	66	
Value Added					
for Industrial Self-Supply	4	1	61	34	
for Water Quality Maintenance	2	4	83	11	
Recreational Boating	25	15	30	30	
Storage					
Upstream	30	35	13	22	
Mainstream	50*	50*	0*	0*	
Groundwater Development	26	28	26	20	

* 1980 and 2000. In 2020, 39% N. H., 0% Vt., 52% Mass., 9% Conn.

AREA 9 - SOUTHEASTERN NEW ENGLAND

	Mass.	Rhode Island	Conn.		
Percent of:					
Population					
Total	83	17	0		
Urban	82	18	0		
Rural	83	17	0		
Area					
Total	74	25	1		
Land	73	25	2		
Water	64	36	0		
Forest, Crop, and Pasture	73	25	2		
Urban and Other	78.4	21.2	0.4		
Irrigated	92	8	0		
Value Added					
for Industrial Self-Supply	78	22	0		
for Water Quality Maintenance	82	18	0		
Recreational Boating	75	25	0		
Storage					
Upstream	84	11	5		
Mainstream	0	100	0		
Groundwater Development	83	17	0		

AREA 10 - THAMES AND HOUSATONIC RIVER BASINS

	Mass.	Conn.	Rhode Island	New York	
Percent of:					
Population					
Total	7	82	3	8	
Urban	3	97	0	0	
Rural	9	91	0	0	
Area					
Total	17	76	1	6	
Land	17	76	1	6	
Water	17	83	0	0	
Forest, Crop, and Pasture	17	75	2	6	
Urban and Other	12.6	82.4	0.4	4.6	
Irrigated	2	98	0	0	
Value Added					
for Industrial Self-Supply	7	93	0	0	
for Water Quality Maintenance	24	76	0	0	
Recreational Boating	8	90	1	1	
Storage					
Upstream	43	57	0	0	
Mainstream	0*	100*	0*	0*	
Groundwater Development	29	71	0	0	

* 1980 and 2000. In 2020, 49% Mass., 23% Conn., 0% R. I., 28% N. Y.

AREA 11 - LAKE CHAMPLAIN AND ST. LAWRENCE RIVER DRAINAGE

	Vermont	New York			
Percent of:					
Population					
Total	48	52			
Urban	52	48			
Rural	46	54			
Area					
Total	44	56			
Land	44	56			
Water	45	55			
Forest, Crop, and Pasture	44	56			
Urban and Other	40	60			
Irrigated	54	46			
Value Added					
for Industrial Self-Supply	7	93			
for Water Quality Maintenance	10	90			
Recreational Boating	26	74			
Storage					
Upstream	79	21			
Mainstream	0	100			
Groundwater Development	27	73			

AREA 12 - HUDSON RIVER BASIN

	New Jersey	Vermont	Mass.	New York	Conn.
Percent of:					
Population					
Total	15	1	1	81	2
Urban	0	0.7	0	99.3	0
Rural	0	2.2	0	97.8	0
Area					
Total	2	3	2	93	0
Land	2	4	1	93	0
Water	6	0	2	92	0
Forest, Crop, and Pasture	1.4	3.8	1.5	93.0	0.3
Urban and Other	4.0	1.3	1.0	93.6	0.1
Irrigated	0	0	0	100	0
Value Added					
for Industrial Self-Supply	0	0	0	100	0
for Water Quality Maintenance	0	0	0	100	0
Recreational Boating	2	1	1	96	0
Storage					
Upstream	0	0.1	3.7	96.2	0
Mainstream	0	0	0	100	0
Groundwater Development	4	16	5	75	0

AREA 13 - SOUTHEASTERN NEW YORK METROPOLITAN AREA

100 percent of all needs, devices, and costs in Area 13 are allocated to New York.

AREA 14 - NORTHERN NEW JERSEY

	New Jersey	New York			
Percent of:					
Population					
Total	98	2			
Urban	100	0			
Rural	100	0			
Area					
Total	93	7			
Land	94	6			
Water	73	27			
Forest, Crop, and Pasture	93	7			
Urban and Other	95	5			
Irrigated	100	0			
Value Added					
for Industrial Self-Supply	100	0			
for Water Quality Maintenance	100	0			
Recreational Boating	90	10			
Storage					
Upstream	100	0			
Mainstream	100	0			
Groundwater Development	100	0			

AREA 15 - DELAWARE RIVER BASIN

	New York	New Jersey	Penn.	Delaware	Maryland
Percent of:					
Population					
Total	1	20	73	6	0
Urban	0.4	19.7	74.5	5.4	0
Rural	6	23	63	8	0
Area					
Total	19	23	50	8	0
Land	19	23	51	7	0
Water	17	22	36	25	0
Forest, Crop, and Pasture	21.2	22.4	49.8	6.5	0.1
Urban and Other	8.2	26.9	54.0	10.8	0.1
Irrigated	1	78	8	13	0
Value Added					
for Industrial Self-Supply	0.4	19.0	78.6	2.0	0
for Water Quality Maintenance	0.3	16.1	80.5	3.1	0
Recreational Boating	5	35	40	20	0
Storage					
Upstream	30	35	30	5	0
Mainstream	0	0	100	0	0
Groundwater Development	14	38	42	6	0

AREA 16 - COASTAL NEW JERSEY

100 percent of all needs, devices, and costs in Area 16 are allocated to New Jersey.

AREA 17 - SUSQUEHANNA RIVER BASIN

	New York	Penn.	Maryland		
Percent of:					
Population					
Total	20	78	2		
Urban	20	80	0		
Rural	21	79	0		
Area					
Total	23	76	1		
Land	23	76	1		
Water	22	74	4		
Forest, Crop, and Pasture	22	77	1		
Urban and Other	27.8	71.7	0.5		
Irrigated	24	76	0		
Value Added					
for Industrial Self-Supply	6	94	0		
for Water Quality Maintenance	5	95	0		
Recreational Boating	20	70	10		
Storage					
Upstream	19	80	1		
Mainstream	14*	86*	0*		
Groundwater Development	23.2	76.2	0.6		

* 1980 only. In 2000, 25% N. Y., 75% Penn., 0% Md.; in 2020, 49% N. Y., 51% Penn., 0% Md.

AREA 18 - CHESAPEAKE BAY AND DELMARVA PENINSULA DRAINAGE

	Delaware	Penn.	Maryland	Virginia	
Percent of:					
Population					
Total	4	1	93	2	
Urban	0.9	0	99.1	0	
Rural	9	0	83	8	
Area					
Total	13	1	74	12	
Land	15	1	75	9	
Water	1	0	68	31	
Forest, Crop, and Pasture	16	1	76	7	
Urban and Other	9.2	0.7	70.0	20.1	
Irrigated	21	0	42	37	
Value Added for Industrial Self-Supply	3.1	0	96.5	0.4	
for Water Quality Maintenance	4.1	0	95.4	0.5	
Recreational Boating	0.4	0	95.3	4.3	
Storage					
Upstream	0.4	0	99.6	0	
Mainstream	0*	0*	0*	0*	
Groundwater Development	18	0	67	15	

* No mainstream storage in Area 18.

AREA 19 - POTOMAC RIVER BASIN

	Penn.	Maryland	District of Columbia	Virginia	West Virginia
Percent of:					
Population					
Total	5	35	26	30	4
Urban	2.2	36.6	39.5	20.5	1.2
Rural	12	35	0	38	12
Area					
Total	11	26	0	39	24
Land	11	26	0	39	24
Water	4	56	0	31	9
Forest, Crop, and Pasture	11	26	0	37	26
Urban and Other	10	22	4	56	8
Irrigated	20	24	0	43	13
Value Added					
for Industrial Self-Supply	16	31	29	21	3
for Water Quality Maintenance	8	63	15	9	5
Recreational Boating	0	53.2	14.9	30.0	1.9
Storage					
Upstream	0	48	0	41	11
Mainstream	0*	35*	0*	23*	42*
Groundwater Development	2.8	23.4	0.2	44.9	28.7

* 1980 only. In 2000, 8% Penn., 14% Md., 0% D. C., 50% Va., 28% W. Va.; in 2020, 14% Penn., 19% Md., 0% D. C., 43% Va., 24% W. Va.

AREA 20 - RAPPAHANNOCK AND YORK RIVER BASINS

100 percent of all needs, devices, and costs in Area 20 are allocated to Virginia.

AREA 21 - JAMES RIVER BASIN

	Virginia	West Virginia			
Percent of:					
Population					
Total	100	0			
Urban	100	0			
Rural	100	0			
Area					
Total	100	0			
Land	100	0			
Water	100	0			
Forest, Crop, and Pasture	99.5	0.5			
Urban and Other	100	0			
Irrigated	100	0			
Value Added					
for Industrial Self-Supply	100	0			
for Water Quality Maintenance	100	0			
Recreational Boating	100	0			
Storage					
Upstream	100	0			
Mainstream	100	0			
Groundwater Development	99	1			

NOTES FOR TABLES
OF ALL STATE PROGRAMS

1. The following notations are used in the tables:

blank	-	no application in this area
X	-	application but no figures available
0	-	a value of zero

2. Need abbreviations used in the Device Tables include the following:

Publicly Supplied Water	PS
Industrial Self-supplied Water	Ind
Rural Water Supply	Rur
Irrigation Water	Irrig
Power Plant Cooling	Pow
Hydroelectric Power Generation	HPG
Navigation	Nav
Water Recreation	Rec
Fish and Wildlife	FW
Water Quality Maintenance	WQ
Flood Damage Reduction	FDR
Drainage Control	Drn
Erosion Control	Ern
Health	Hlth
Visual and Cultural Environment	VC

3. Major tributaries are included in all mainstream figures that are under Flood Damage Reduction Needs of Table 1, Flood Plain Management and Waterway Management Devices ot Table 2 and Flood Damage Reduction Costs of Table 3.

4. All figures in the Needs Table 1 are gross; that is, each target year figure includes all previous needs. The Devices and Costs figures of Tables 3 and 4 show only increments for periods between target years.

5. Figures for base years of Water Recreation needs in Table 1 are included in the first target year figure.

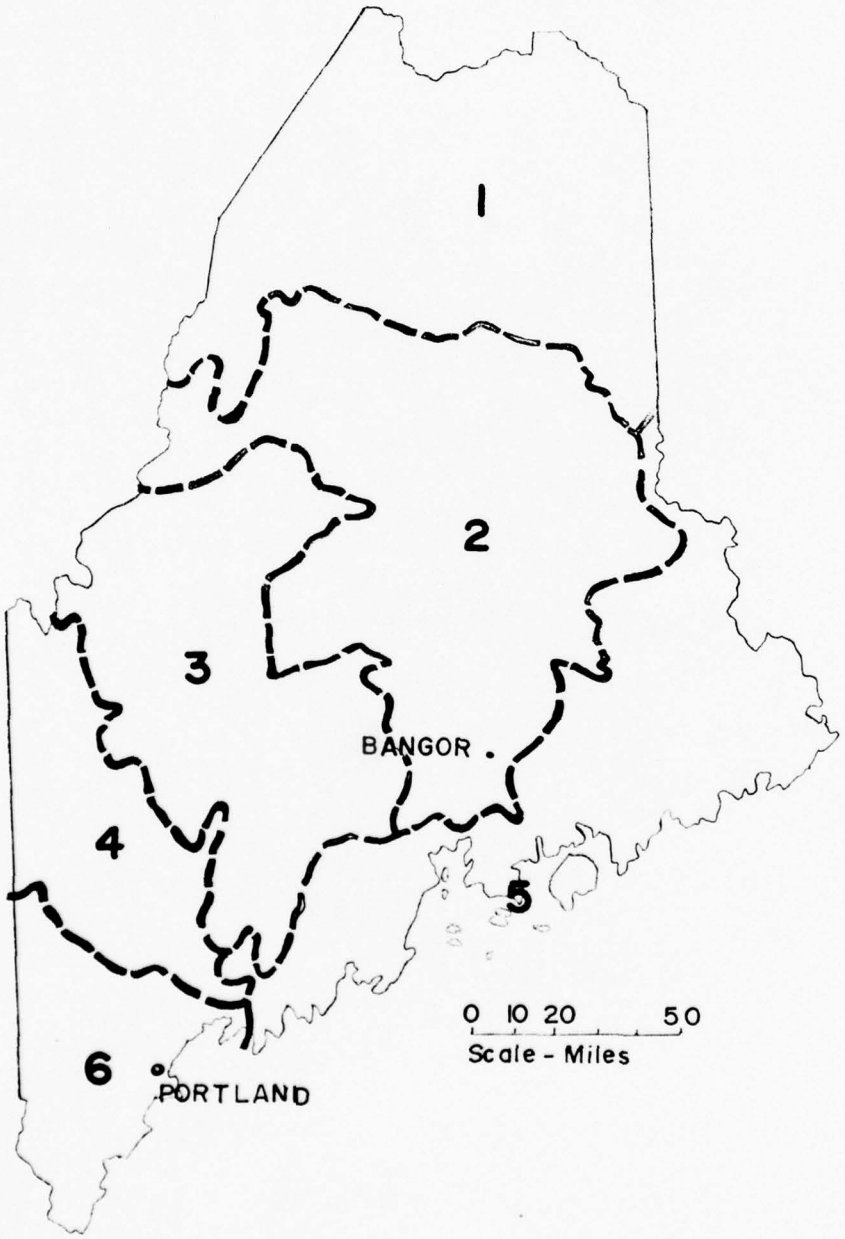
6. Power plant cooling costs are almost all privately incurred. Those costs shown in Table 3 are additional expenses beyond those necessary for the National Income objective.

7. Mainstream Flood Damage Reduction needs, because of the expenses that would be involved, are most completely fulfilled in any Area.

8. The need levels shown for Industrial Self-supplied Water are for fresh water use only. The devices and costs levels are these required to meet all Industrial Self-Supplied Water needs.

CHAPTER 3 STATE PROGRAMS

MAINE



MAINE

The State of Maine covers 33,214 square miles including all of Areas 1, 2, 3 and 5, most of Area 4, and over half of Area 6. The major river drainages are the St. John, Penobscot, Kennebec and Androscoggin Rivers. Overall visual quality for this predominantly forest and wildland State is high, though some portions comprise medial quality. The topography ranges from the mountainous western sections of Areas 3 and 4, through the wilderness segments of Areas 1 and 2, to the rolling hills and coastal marshes and plains of Areas 5 and 6. Water is generally abundant in Maine, but serious pollution problems exist in the lower reaches of the major streams below industrial, manufacturing and population centers.

In 1970 the State's population was just under one million, concentrated primarily around Augusta, Bangor and Portland, and is expected to increase by one-half million by 2020. Per capita income was 17 percent below the national average in 1970 but is projected to rise to only 12 percent below by 2020. Employment will continue to be highest in services and related industries, but increases are projected for manufacturing, especially paper and allied products. Employment in agriculture, fisheries and forestry is projected to decrease 50 percent by 2020.

Needs to be Satisfied. The need for Publicly Supplied Water is important in Areas 1, 3, 4, 5 and 6 and is largest in Area 6. Industrial Self-supplied Water needs are largest in Area 2, and important in all Areas of the State. Rural Water Supply is important only in Area 6, and largest in Area 1. Irrigation needs are both largest and most important in Area 1, although non-agricultural Irrigation needs are relatively large in Area 6. Power Plant Cooling needs, important in Areas 4, 5 and 6 are greatest in Area 5. Hydroelectric Power Generation is large in Areas 1 through 4. Commercial navigation is large in Area 6 and recreational boating, though largest in Area 6, is important in Area 1. Water Recreation needs, largest in the portion of Area 6 contained in Maine, is important in Areas 1, 2, 4 and 5. Fish and Wildlife needs, important in Areas 1, 4 and 5, are greatest in Area 6. Water Quality needs are key in all Areas except 6, important in Areas 2 and 4 and largest in Area 2. The need for Flood Damage Reduction is both largest and important in Area 4. Drainage Control needs are of the greatest magnitude in Area 3 while Erosion Control needs are largest in Area 5. Visual and Cultural needs, key in Areas 1 and 4, are important in Areas 2 through 5, and largest in Areas 1 and 2.

Devices. Storage facility devices are largest in Area 1 and withdrawal facility devices are largest in Area 2. Quality control facilities are key in Areas 3 and 4, important in Areas 1, 3 and 4 and largest in Areas 1 and 2 for waste treatment plants and in Areas 3 and 4 for potable water treatment plants. Water/land management devices are of greatest magnitude in Area 5. Land control devices are large in Areas 1 and 2, but key in Area 4 and important in Areas 1, 2 and 4.

Costs. Water development costs are largest in Area 1, while water withdrawal and conveyance costs, except for Irrigation, are greatest in Area 3. The Irrigation costs are greatest for agriculture in Area 1 and for non-agriculture in Area 6. Costs for Power Plant Cooling Water are greatest in Area 5, and for Navigation in Area 2. The costs for Water Recreation are largest in Area 3. The costs are largest in Area 6 for Fish and Wildlife, in Area 2 for Water Quality Maintenance and Flood Damage Reduction, Area 3 for Drainage Control, Area 6 for Erosion Control and Area 5 for Visual and Cultural.

NEEDS-cumulative		STATE TOTAL			
		Pres.	1980	2000	2020
Publicly Supplied Water	(mgd)	88	115	164	243
Industrial Self-Supplied Water	(mgd)	340	630	1160	1880
Rural Water Supply	(mgd)	18	24	31	30
Irrigation Water: agriculture	(1000 afy)	2	33	75	119
non-agriculture	(1000 afy)	1	8	14	22
Power Plant Cooling: withdrawal, saline	(cfs)	410	1550	10420	21540
brackish	(cfs)	0	0	70	155
fresh	(cfs)	76	57	1075	3105
consumption, brackish	(cfs)	0	0	33	75
fresh	(cfs)	1	1	11	110
Hydroelectric Power Generation	(mw)	590	550	2820	7200
Navigation: commercial	(m. tons annually)	35	52	85	133
recreational boating	(1000 boats)	86	102	173	297
Water Recreation: visitor days	(m.)	x	35	54	76
stream or river	(miles)	x	330	420	570
water surface	(1000 acres)	x	79	115	152
beach	(acres)	x	930	1170	1310
pool	(m. sq. ft.)	x	16	20	22
land facilities	(1000 acres)	x	47	62	75
Fish & Wildlife: sport fishing man-days	(m.)	7.4	9.1	10.8	12.9
surface area, lake	(acres)				
stream	(acres)				
access, fresh	(acres)	x	0.13	0.37	0.65
salt	(acres)	x	0.36	1.07	1.96
anadromous	(acres)	x	0.10	0.13	0.16
piers	(1000 feet)			x	x
hunting, man-days	(m.)	2.8	3.1	3.7	4.3
access	(1000 sq. mi.)	x	0.29	1.43	2.61
nature study, man-days	(m.)	1.2	1.4	1.7	2.0
access	(1000 ac.)	x	0.20	0.41	0.82
Water Quality Maint.: non-industrial	(m. PEs)	940	1090	1290	1540
industrial	(m. PEs)	10300	20500	38700	72400
Flood Damage Reduction:					
avg. ann. damage, upstream	(m. $)	0.83	1.19	2.11	4.11
mainstream	(m. $)	1.9	2.8	5.3	10.9
tidal and hurricane	(m. $)	0.03	0.06	0.11	0.23
Drainage Control: cropland	(1000 acres)	61	91	149	241
forest land	(1000 acres)	0	0	28	112
wet land	(1000 acres)				
Erosion Control: agriculture	(1000 acres)	480	600	670	680
urban	(1000 acres)	780	840	920	1020
stream bank	(mi.)	0	10	32	53
coastal shoreline	(mi.)	0	1	3	5
Health: vector control and pollution control		x	x	x	x
Visual & Cultural:					
landscape maintenance, unique natural	(sq. mi.)	1300	8400	8400	8400
unique shoreline	(mi.)	90	540	540	540
high quality	(sq. mi.)	400	6700	12200	17200
diversity	(sq. mi.)				
agriculture	(sq. mi.)	x	x	x	x
landscape development, quality	(sq. mi.)				
diversity	(sq. mi.)				
metro. amenities	(mi.)				
" "	(sq. mi.)				

	AREA 1				AREA 2				AREA 3				AREA 4			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	6	8	11	17	11	15	24	40	17	21	29	41	11	15	19	26
	20	40	80	150	100	210	420	700	50	80	130	190	90	140	210	310
	4	5	7	8	3	3	4	3	3	4	5	5	1	1	2	2
	0.1	21	40	73	0.3	1	1	3	0.1	6	20	26	0.3	4	10	12
	0	1	1	1	0.1	1	1	2	0	1	2	3	0.3	1	2	3
	19	0	500	550	57	57	300	926	0	0	275	1285	0	0	0	304
	0	0	4	34	1	1	4	23	0	0	3	18	0	0	0	16
	2	0	800	1300	130	140	140	2000	210	220	1720	2800	160	160	160	1100
					2	2	5	9	0.03	0.04	0.08	0.10				
	9	10	16	23	12	13	24	35	13	17	40	65	11	12	18	27
	x	2	4	5	x	5	7	10	x	5	8	12	x	4	6	8
	x	30	40	50	x	60	70	100	x	70	90	120	x	50	60	80
	x	8	11	14	x	15	21	28	x	18	26	34	x	12	17	23
	x	80	90	110	x	140	180	200	x	170	210	230	x	120	140	160
	x	1	2	2	x	2	3	3	x	3	4	4	x	2	2	3
	x	4	5	7	x	8	10	12	x	10	12	15	x	7	8	10
	0.7	0.9	1.0	1.2	1.1	1.1	1.3	1.5	0.7	1.2	1.4	1.6	0.7	1.0	1.2	1.4
	x	0	0.02	0.05	x	0.002	0.03	0.06	x	0.03	0.06	0.08	x	0.02	0.04	0.06
	x	0.004	0.01	0.01	x	0.04	0.04	0.05	x	0.02	0.03	0.03				
	0.3	0.4	0.5	0.5	0.7	0.7	0.8	0.9	0.4	0.5	0.6	0.7	0.3	0.3	0.4	0.5
	x	0	0.11	0.33	x	0	0.35	0.55	x	0.20	0.40	0.60	x	0.04	0.12	0.23
	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.3
	110	120	140	160	140	160	190	220	150	170	190	220	110	120	130	150
	2100	4500	8800	16600	3300	7200	14900	29300	1600	2700	4500	7700	2000	3400	5600	9500
	0.06	0.10	0.17	0.34	0.11	0.17	0.30	0.59	0.29	0.42	0.67	1.22	0.08	0.13	0.23	0.47
	0.2	0.3	0.5	1.0	0.2	0.3	0.6	1.2	0.5	0.7	1.4	2.8	0.7	1.0	1.8	3.8
	11	17	28	47	10	13	21	35	19	29	48	81	5	7	12	19
	0	0	7	29	0	0	9	36					0	0	4	16
	180	240	270	280	40	50	50	50	80	100	110	110	20	30	40	40
	40	50	60	70	110	120	130	140	100	110	110	120	80	80	80	90
	0	1	4	7	0	2	7	12	0	3	9	15	0	2	5	8
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	400	6400	6400	6400	700	1500	1500	1500								
					400	2000	3600	5200	x	1600	3200	4800	x	1200	2000	2600
					x	x	x	x	x	x	x	x				

NEEDS-cumulative		AREA 5			
		Pres.	1980	2000	2020
Publicly Supplied Water	(mgd)	13	17	23	33
Industrial Self-Supplied water	(mgd)	50	110	210	340
Rural Water Supply	(mgd)	4	5	8	3
Irrigation Water: agriculture	(1000 afy)	0.3	1	2	3
non-agriculture	(1000 afy)	0.1	2	3	5
Power Plant Cooling: withdrawal, saline	(cfs)	150	1350	7530	15230
brackish	(cfs)	0	0	55	120
fresh	(cfs)	0	0	0	10
consumption, brackish	(cfs)	0	0	27	57
fresh	(cfs)	0	0	0	5
Hydroelectric Power Generation	(mw)	28	25	0	0
Navigation: commercial	(m. tons annually)	1	2	3	5
recreational boating	(1000 boats)	13	16	24	33
Water Recreation: visitor days	(m.)	x	6	10	14
stream or river	(miles)	x	40	50	70
water surface	(1000 acres)	x	11	16	21
beaches	(acres)	x	150	190	200
pool	(m. sq. ft.)	x	3	3	3
land facilities	(1000 acres)	x	4	5	6
Fish & Wildlife: sport fishing man-days	(m.)	1.7	1.8	2.1	2.5
surface area, lake	(acres)				
stream	(acres)				
access, fresh	(acres)	x	0.01	0.04	0.07
salt	(acres)	x	0.10	0.30	0.55
anadromous	(acres)	x	0.02	0.03	0.04
piers	(1000 feet)			x	x
hunting, man-days	(m.)	0.5	0.5	0.6	0.7
access	(1000 sq. mi.)	x	0	0.15	0.35
nature study, man-days	(m.)	0.2	0.2	0.3	0.3
access	(1000 ac.)				
Water Quality Maint.: non-industrial	(m. PEs)	160	180	210	240
industrial	(m. PEs)	1000	2000	4000	7700
Flood Damage Reduction:					
avg. ann. damage, upstream	(m. $)	0.15	0.18	0.37	0.73
mainstream	(m. $)	0.04	0.04	0.09	0.18
tidal and hurricane	(m. $)	.01	.02	.04	.07
Drainage Control: cropland	(1000 acres)	11	17	28	45
forest land	(1000 acres)	0	0	8	32
wet land	(1000 acres)				
Erosion Control: agriculture	(1000 acres)	110	120	130	130
urban	(1000 acres)	370	380	400	410
stream bank	(mi.)	0	1	4	7
coastal shoreline	(mi.)				
Health: vector control and pollution control		x	x	x	x
Visual and Cultural:					
landscape maintenance, unique natural	(sq. mi.)	100	500	500	500
unique shoreline	(mi.)	90	490	490	490
high quality	(sq. mi.)	x	1500	2600	3300
diversity	(sq. mi.)				
agriculture	(sq. mi.)				
landscape development, quality	(sq. mi.)				
diversity	(sq. mi.)				
metro. amenities	(mi.)				
" "	(sq. mi.)				

	AREA 6				AREA				AREA				AREA			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	30	39	58	86												
	40	70	120	200												
	3	4	6	5												
	1	2	2	2												
	1	3	5	8												
	260	200	2890	6310												
	0	0	15	35												
	0	0	0	30												
	0	0	6	18												
	0	0	0	14												
	58	0	0	0												
	32	48	78	119												
	29	35	51	115												
	x	12	19	27												
	x	90	120	160												
	x	16	24	33												
	x	280	370	420												
	x	5	6	7												
	x	15	21	26												
	2.5	3.1	3.8	4.7												
	x	0.06	0.18	0.33												
	x	0.26	0.77	1.41												
	x	0.02	0.03	0.03												
	0.7	0.7	0.9	1.1												
	x	0.06	0.30	0.55												
	0.4	0.4	0.5	0.6												
	x	0.20	0.41	0.82												
	270	350	440	550												
	300	600	1000	1600												
	0.13	0.21	0.38	0.76												
	0.3	0.5	1.0	2.1												
	0.02	0.04	0.07	0.16												
	6	7	12	14												
	40	60	70	70												
	90	100	140	190												
	0	1	3	5												
	0	1	3	5												
	x	x	x	x												
	100	100	100	100												
	0	50	50	50												
	x	400	800	1300												

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	VC,Rec*	52	91	89
mainstream (1000 af)	WQ*	13	33	63
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	290	520	710
brackish (mgd)	Ind	32	42	55
wells (mgd)	*	38	52	44
Conveyance Facilities				
interbasin diversions, into (mgd)				
out of (mgd)				
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	11	17	33
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ	18400	0	0
secondary (90%) (m. PEs removed)	WQ	0	36000	66500
advanced (95%) (m. PEs removed)	WQ	0	2000	3700
Desalting Facilities				
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC,Rec	11	151	82
Local Flood Protection				
ocean (projects)				
river (projects)	FDR	3.3	5.2	6.5
flood control channels (miles)				
Watershed Management (1000 acres)	FDR,VC,Drn,Rec	850	1560	1530
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,Rec,FW	6940	590	490
fee simple purchase (buying) (mi.)	VC,Rec,FW	450	0	0
purchase lease (sq.mi.)				
easements (sq.mi.)	VC,Rec,FW	1100	1100	1100
deed restrictions (sq.mi.)				
tax incentive subsidy (sq.mi.)	VC,FW	700	450	300
zoning (sq.mi.)	VC,FW	1900	450	300
zoning (mi.)				
zoning and/or tax inc. subs.(sq.mi.)	VC,FW,Rec	2800	2400	2300
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage (1000 af)	FDR	27	64	58

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

	AREA 1			AREA 2			AREA 3			AREA 4		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	28 13	19 33	0 63	0	16	0	4	17	0	5	4	0
	20 17	40 17	70 26	118 2	200 3	280 1	30 6	50 15	70 6	50 3	70 7	90 3
	1 3900 0 0	3 0 8000 400	6 0 15100 800	1 6300 0 0	2 0 13600 800	4 0 26500 1500	2 2500 0 0	5 0 4200 200	8 0 7100 400	2 3000 0 0	2 0 5200 300	3 0 8700 500
	1	1	0	1	0	0	6	30	8	1	9	2
	1.0	0	2.0	1.0	0	4.0				0	0.5	0
	40	0	30	20	0	160	130	260	260	120	260	210
	4800 1200 x	0 0 x	0 0 x	1250 500 600	0 500 600	0 500 600	300 500 800	300 500 800	300 500 800	 1200	 800	 600
	8	0	16	8	0	38				0	13	0

DEVICES - incremental	Purposes	AREA 5 1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	Rec,VC*	5	10	51
mainstream (1000 af)	WQ*			
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	60	100	120
brackish (mgd)	Ind	19	35	37
wells (mgd)	*	4	4	6
Conveyance Facilities				
interbasin diversions, into (mgd)				
out of (mgd)				
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	4	3	6
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ	1900	0	0
secondary (90%) (m. PEs removed)	WQ	0	3800	7200
advanced (95%) (m. PEs removed)	WQ	0	200	400
Desalting Facilities				
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC,Rec	1	104	62
Local Flood Protection				
ocean (projects)				
river (projects)	FDR	1.3	2.7	0.5
flood control channels (miles)				
Watershed Management (1000 acres)	FDR,VC,Drn,Rec	340	680	680
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,Rec,FW	500	200	100
fee simple purchase (buying) (mi.)	VC,Rec,FW	400	0	0
purchase lease (sq.mi.)				
easements (sq.mi.)	VC,Rec,FW			
deed restrictions (sq.mi.)				
tax incentive subsidy (sq.mi.)	VC,FW	700	450	300
zoning (sq.mi.)	VC,FW	700	450	300
zoning (mi.)				
zoning and/or tax inc. subs.(sq.mi.)	VC,FW,Rec			
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage (1000 af)	FDR	11	27	4

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

	AREA 6			AREA			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	12	25	38									
	20	60	80									
	13	7	18									
	6	8	4									
	1	3	7									
	800	0	0									
	0	1300	2000									
	0	100	100									
	1	7	9									
	0	2.0	0									
	200	350	190									
	90	90	90									
	50	0	0									
	100	100	100									
	200	200	200									
	0	27	0									

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	5.1	7.7	5.3
mainstream	6.8	9.5	16.1
wells	20	29	25
desalting			
Water Withdrawal and Conveyance Costs:			
inter-basin transfers			
public water supply	13	19	33
industrial self-supplied water	1.7	2.9	4.0
rural water supply	x	x	x
irrigation, agriculture	7.8	11.3	12.6
non-agriculture	5.5	4.5	5.6
Power Plant Cooling Water	0	25	200
Hydroelectric Power Generation	0	x	x
Navigation: commercial	65	152	44
recreational boating	4.2	5.1	8.0
Water Recreation	218	69	81
Fish and Wildlife: fishing	3.1	3.6	4.4
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	500	960	1730
advanced	0	410	760
other /	190	0	0
Flood Damage Reduction: upstream	2.3	3.3	4.9
mainstream			
Drainage Control	1.1	2.7	4.6
Erosion Control	15	19	16
Health	x	x	x
Visual and Cultural	114	47	40
Summation of Available Estimated Costs	1200	1800	3000

* From the supply model and includes OMR costs.

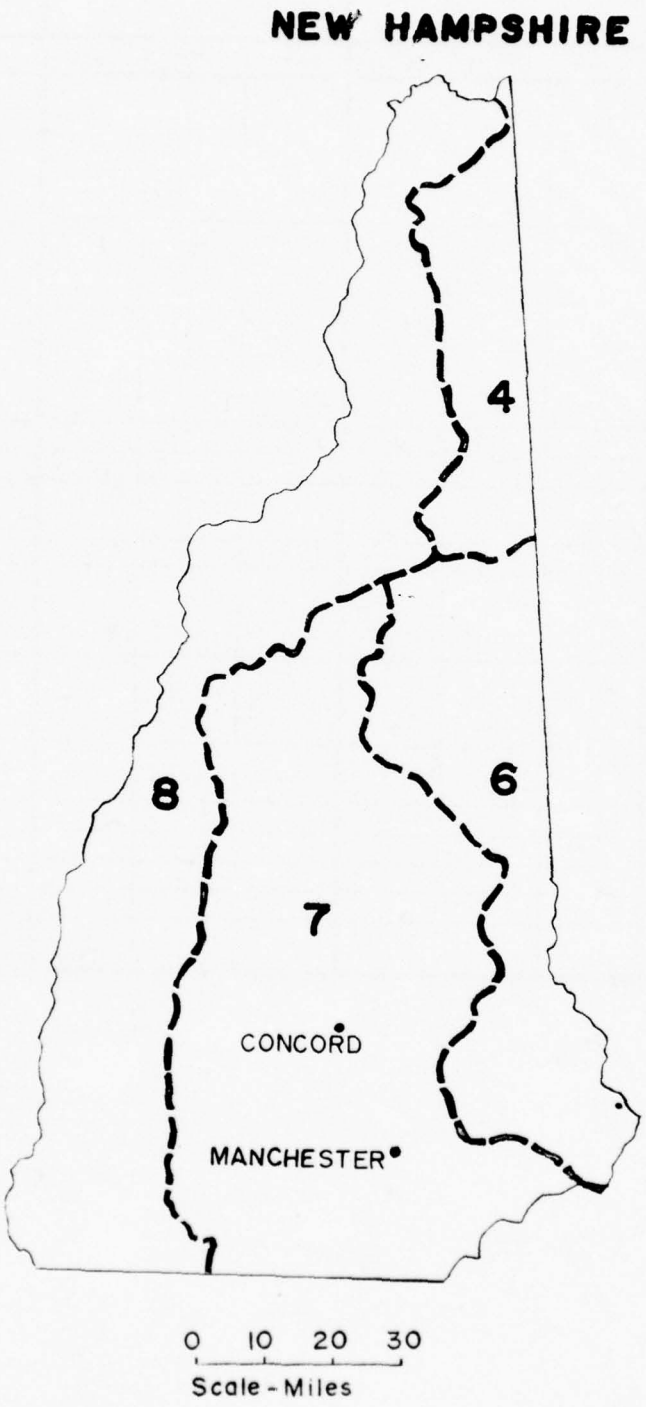
/ Combined sewer overflows control and acid mine drainage control.

AREA 1			AREA 2			AREA 3			AREA 4		
1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
3.1	2.3	0	0	1.2	0	0.4	1.4	0	0.4	0.3	0
6.8	9.5	16.1									
9	10	14	1	1	1	4	8	3	2	4	1
1	4	6	2	2	4	3	6	10	2	2	2
0.1	0.2	0.4	0.6	1.1	1.5	0.2	0.2	0.3	0.3	0.4	0.5
x	x	x	x	x	x	x	x	x	x	x	x
5.8	6.5	9.7	0	0.2	0.7	1.1	2.9	1.4	0.7	1.3	0.6
0.4	0.4	0.4	0.4	0.5	0.4	1.0	0.6	0.6	0.8	0.7	0.8
0	2	16	0	0	25	0	0	22	0	0	12
0	x	x	0	0	x	0	x	x	0	0	x
			0.3	1	36						
0.1	0.2	0.2	0.5	0.6	0.8	0.2	0.6	1.1	0.1	0.3	0.6
28	8	19	62	18	14	74	20	15	48	13	9
0.1	0.3	0.3	0.5	0.5	0.5	0.4	0.4	0.4	0.5	0.3	0.5
x	x	x	x	x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x	x	x	x	x
80	170	310	100	230	450	60	100	170	50	90	150
0	90	170	0	150	300	0	50	80	0	60	100
10	0	0	30	0	0	40	0	0	24	0	0
0.7	0	1.4	1.1	0	3.3				0	1.6	0
0.2	0.5	1.0	0.1	0.4	0.9	0.3	0.6	1.1	0.1	0.2	0.4
4	3	2	2	1	1	3	2	1	1	1	1
x	x	x	x	x	x	x	x	x	x	x	x
22	0	0	13	7	7	14	14	14			
170	310	570	210	410	850	200	210	320	130	180	280

FIRST COSTS - incremental ($ million 1970)	AREA 5			
	1980	2000	2020	
Water Development Costs:				
storage, upstream	0.2	0.4	2.1	
mainstream				
wells	2	2	3	
desalting				
Water Withdrawal and Conveyance Costs:				
inter-basin transfers				
public water supply	3	4	6	
industrial self-supplied water	0.4	0.7	0.9	
rural water supply	x	x	x	
irrigation, agriculture	0.1	0.3	0.2	
non-agriculture	1.2	0.9	1.4	
Power Plant Cooling Water	0	19	78	
Hydroelectric Power Generation				
Navigation: commercial	0	6	8	
recreational boating	0.2	0.6	0.7	
Water Recreation	0.4	0.2	0.3	
Fish and Wildlife: fishing	0.5	0.6	0.7	
hunting	x	x	x	
nature study	x	x	x	
Water Quality Maint.: waste treatment, secondary	100	200	380	
advanced	0	40	80	
other ≠	20	0	0	
Flood Damage Reduction: upstream	0.5	0.9	0.2	
mainstream				
Drainage Control	0.2	0.5	1.0	
Erosion Control	1	1	1	
Health	x	x	x	
Visual and Cultural	38	13	7	
Summation of Available Estimated Costs	170	290	570	

* From the supply model and includes OMR costs.
≠ Combined sewer overflows control and acid mine drainage control.

	AREA 6			AREA			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	1.0	2.1	3.2									
	3	4	3									
	1	2	6									
	0.2	0.3	0.5									
	x	x	x									
	0.1	0.02	0									
	1.7	1.5	2.0									
	0	4	47									
	65	145	0									
	3.1	2.8	4.6									
	6	10	25									
	1.0	1.6	2.0									
	x	x	x									
	x	x	x									
	100	170	260									
	0	20	20									
	60	0	0									
	0	0.9	0									
	0.2	0.4	0.2									
	4	10	12									
	x	x	x									
	28	13	13									
	270	390	400									


NEW HAMPSHIRE
4
8
6
7
CONCORD
MANCHESTER
0 10 20 30
Scale - Miles

NEW HAMPSHIRE

The State of New Hampshire contains 9,303 square miles including portions of Areas 4, 6, 7 and 8. The State's major drainages are the northeastern drainage of the Connecticut River and most of the Merrimack River drainage, while Lake Winnesquam has the State's largest water surface area. The topography is comprised of rolling hills, steep hills and mountains, and the overall visual quality is high, with only small portions being of medial quality. Water is plentiful throughout the State, but it is uniformly poor in quality with many areas of extreme pollution. The only supplies of good water are located in the extreme northern portions of the State and many of the population centers have supplies that are so degraded as to preclude the use of the water for many purposes.

The 1970 population of the State totalled 680,000 and is projected to increase to 12.5 million by 2020. The only significant concentrations are around Manchester and Concord. Per capita income was 3 percent below the national average in 1970 but it should be at that average by 2020. Employment was highest for services and is projected to more than double by 2020, and manufacturing should increase by 40 percent. Decreases are anticipated in textile mill products, agriculture and forestry and fisheries.

The State of New Hampshire comprises portions of Areas 4, 6, 7 and 8. Areas 4 and 6 occupy the northeastern, southeastern and coastal, parts of the State, respectively, and Area 8 the southwestern and northwestern portion. Area 7, in central and south-central New Hampshire, includes the State's major urban and industrial concentrations.

Needs to be Satisfied. The most significant key and important need is for Water Quality Maintenance, particularly in the Merrimack, Connecticut and upper Androscoggin Basins. Visual and Cultural landscape maintenance is key and important in Area 4, and important in Areas 7 and 8 as well. Other important needs include Water Recreation and Fish and Wildlife in Areas 4, 7, and 8; Publicly Supplied Water, Industrial Self-Supplied Water, and Power Plant Cooling Water in Areas 4 and 6; Flood Damage Reduction in Area 7 and Rural Water Supply in Area 6. The needs are largest in Area 6 for saline and brackish withdrawal and consumption for Power Plant Cooling, for Water Recreation (water surface excluded), sport fishing and hunting man-days and salt access for Fish and Wildlife, tidal and hurricane Flood Damage Reduction, coastal shoreline Erosion Control, and unique natural and unique shoreline landscape maintenance for Visual and Cultural. The needs that are largest in Area 7 are for Public Supplied Water, Industrial Self-supplied Water, Irrigation Water and recreational boating. They are also largest in this Area for fresh withdrawal and consumption for Power Plant Cooling, stream surface area, fresh access and nature study man-days and access for Fish and Wildlife, non-industrial Water Quality Maintenance, Flood Damage Reduction (tidal and hurricane excepted), urban and stream bank Erosion Control, and quality and metropolitan amenities landscape development for Visual and Cultural. The remaining needs are largest in Area 8 except for industrial Water Quality Maintenance which is largest in Area 4.

Devices. Key devices are limited to the Androscoggin River Basin and include potable water and waste treatment plants for Water Quality Maintenance, and land controls for the Visual and Cultural need. Treatment plants are also an important device in Areas 4, 7 and 8. Other important devices include withdrawal facilities in the Merrimack Basin, and Power Plant Cooling tower and storage facilities in the Connecticut Basin. Most of the device levels are highest in Area 7. Exceptions to this are secondary (85%) and advanced waste treatment plants in Area 4, watershed management in Area 6, fee simple purchase (mi.) in Area 6 and mainstream flood control storage in Area 4.

Costs. By far the greatest cost in New Hampshire will be incurred in Water Quality Maintenance, specifically secondary waste treatment and combined sewers overflow control, particularly in Area 7. Other costs of large magnitude include upstream and mainstream storage, again chiefly in Area 7; Water Recreation, principally in Area 8; and Visual and Cultural in Areas 7 and 8. Hydroelectric Power Generation costs, initially small, will be significant by the 2020 time frame.

NEEDS-cumulative		STATE TOTAL			
		Pres.	1980	2000	2020
Publicly Supplied Water	(mgd)	72	92	133	197
Industrial Self-Supplied Water	(mgd)	38	65	118	197
Rural Water Supply	(mgd)	7.8	9.9	12.2	10.6
Irrigation Water: agriculture	(1000 afy)	1.4	2.6	3.3	3.2
non-agriculture	(1000 afy)	6.4	14.5	22.7	33.2
Power Plant Cooling: withdrawal, saline	(cfs)	190	1410	4270	6960
brackish	(cfs)	0	0	26	46
fresh	(cfs)	610	590	690	990
consumption, brackish	(cfs)	0	0	14	22
fresh	(cfs)	6	24	25	51
Hydroelectric Power Generation	(mw)	410	380	1490	3840
Navigation: commercial	(m. tons annually)				
recreational boating	(1000 boats)	68	90	130	235
Water Recreation: visitor days	(m.)	x	24	39	58
stream or river	(miles)	x	150	200	280
water surface	(1000 acres)	x	37	56	77
beach	(acres)	x	430	580	690
pool	(m. sq. ft.)	x	7.5	9.9	11.8
land facilities	(1000 acres)	x	24	32	41
Fish & Wildlife: sport fishing man-days	(m.)	2.9	3.6	4.5	5.5
surface area, lake	(acres)	x	0.29	1.18	2.14
stream	(acres)	x	1.4	3.3	5.6
access, fresh	(acres)	x	0.11	0.27	0.46
salt	(acres)	x	0.029	0.085	0.157
anadromous	(acres)	x	0.18	0.25	0.31
piers	(1000 feet)				
hunting, man-days	(m.)	0.92	1.02	1.26	1.56
access	(1000 sq. mi.)	x	0.51	1.27	1.77
nature study, man-days	(m.)	0.85	1.03	1.28	1.59
access	(1000 ac.)	x	2.0	4.8	8.6
Water Quality Maint.: non-industrial	(m. PEs)	730	870	1100	1350
industrial	(m. PEs)	1100	1900	3200	5400
Flood Damage Reduction:					
avg. ann. damage, upstream	(m. $)	3.2	5.0	9.4	19.1
mainstream	(m. $)	2.6	4.0	7.7	15.7
tidal and hurricane	(m. $)	0.01	0.01	0.02	0.03
Drainage Control: cropland	(1000 acres)	26	34	54	65
forest land	(1000 acres)	0	0	2.8	11.2
wet land	(1000 acres)				
Erosion Control: agriculture	(1000 acres)	160	210	240	250
urban	(1000 acres)	440	640	850	1160
stream bank	(mi.)	0	6.9	21.3	35.8
coastal shoreline	(mi.)	0	0.1	0.3	0.5
Health: vector control and pollution control		x	x	x	x
Visual & Cultural:					
landscape maintenance, unique natural	(sq. mi.)	1400	1400	1400	1400
unique shoreline	(mi.)	x	6	6	6
high quality	(sq. mi.)	x	1300	2500	3600
diversity	(sq. mi.)				
agriculture	(sq. mi.)				
landscape development, quality	(sq. mi.)	x	7	14	21
diversity	(sq. mi.)				
metro. amenities	(mi.)				
" "	(sq. mi.)	x	3	3	3

	AREA 4				AREA 6				AREA 7				AREA 8			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	3	3	4	6	18	24	36	53	34	43	62	90	17	22	31	48
					5	8	16	25	21	36	65	108	12	21	37	64
	0.4	0.4	0.5	0.5	2.2	2.6	2.6	2.4	2.6	3.4	4.3	3.7	2.6	3.5	4.7	4.0
					0.4	1.0	1.0	1.0	0.9	1.2	2.0	1.9	0.1	0.4	0.3	0.3
	0.1	0.3	0.5	0.8	0.6	2.1	3.6	5.6	4.4	7.8	11.2	15.4	1.3	4.3	7.4	11.4
					190	1410	4190	5960	0	0	80	1000				
					0	0	26	46								
	0	0	0	100					520	480	360	310	90	110	340	580
					0	0	14	22								
	0	0	0	2					5	5	6	29	1	19	19	20
									70	80	490	1840	330	300	1000	2000
	0.1	0.1	0.2	0.3	10	12	13	20	40	54	74	140	18	24	43	75
					x	9	16	23	x	7	11	18	x	8	12	17
					x	70	90	140	x	20	20	30	x	60	80	110
					x	13	20	28	x	5	8	12	x	19	28	37
					x	220	300	340	x	50	70	90	x	170	220	260
					x	3.6	4.9	5.7	x	1.0	1.3	1.7	x	2.9	3.8	4.4
					x	12	17	21	x	2	3	4	x	10	13	16
	0.1	0.2	0.3	0.3	1.5	1.9	2.4	2.9	0.8	1.0	1.3	1.6	0.3	0.5	0.6	0.7
													x	0.29	1.18	2.14
									x	0.7	2.1	3.6	x	0.6	1.2	2.0
	x	0.004	0.01	0.01	x	0.01	0.02	0.04	x	0.06	0.15	0.26	x	0.05	0.09	0.15
					x	0.029	0.085	0.157								
					x	0.002	0.003	0.003	x	0.08	0.10	0.13	x	0.10	0.14	0.18
	0.07	0.07	0.09	0.10	0.40	0.43	0.54	0.66	0.32	0.35	0.44	0.54	0.13	0.16	0.20	0.25
	x	0.01	0.03	0.07	x	0.05	0.25	0.45	x	0.16	0.53	0.57	x	0.29	0.46	0.68
	0.04	0.04	0.05	0.06	0.22	0.26	0.31	0.39	0.40	0.47	0.59	0.73	0.19	0.26	0.33	0.42
					x	0.1	0.2	0.4	x	1.7	4.2	7.5	x	0.2	0.4	0.8
	20	30	30	30	170	220	270	340	390	460	600	700	150	170	210	280
	500	900	1400	2400	200	400	700	1200	300	500	900	1500	50	100	200	300
	0.1	0.2	0.4	0.8	1.2	1.9	3.4	6.8	1.2	1.9	3.6	7.2	0.7	1.1	2.1	4.3
	0.4	0.7	1.2	2.5	0.1	0.2	0.4	0.9	1.8	2.8	5.5	11.2	0.2	0.3	0.6	1.1
					0.01	0.01	0.02	0.03								
	1	2	3	5	4	6	9	10	8	10	16	20	12	16	26	29
	0	0	1.1	4.2									0	0	1.8	7.0
	10	10	10	10	30	50	50	50	30	50	50	60	90	110	120	130
	20	20	20	20	70	80	110	150	220	330	440	620	140	220	280	370
	0	0.5	1.5	2.5	0	0.8	2.0	3.3	0	3.0	10.0	16.5	0	2.6	7.8	13.5
					0	0.1	0.3	0.5								
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	200	200	200	200	700	700	700	700	400	400	400	400				
					x	6	6	6								
	x	300	500	700	x	300	600	800	x	300	600	900	x	400	800	1200
									x	7	14	21				
									x	3	3	3				

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	Rec,FW,VC*	29	111	397
mainstream (1000 af)	FW,VC,Rec,WQ*	29	201	239
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	27	57	83
brackish (mgd)	Ind	5	6	6
wells (mgd)	*	11.9	11.4	6.4
Conveyance Facilities				
interbasin diversions, into (mgd)				
out of (mgd)				
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	8.7	17.7	20.7
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ,VC	2300	0	0
secondary (90%) (m. PEs removed)	WQ,Rec	0	3800	6100
advanced (95%) (m. PEs removed)	WQ,Rec	0	210	340
Desalting Facilities				
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC,Rec	21	23	21
Local Flood Protection				
ocean (projects)				
river (projects)	FDR	8.0	10.5	0
flood control channels (miles)				
Watershed Management (1000 acres)	FDR,VC,Drn,Rec	360	650	520
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,Rec,FW	420	220	220
fee simple purchase (buying) (mi.)	VC,Rec,FW	6	0	0
purchase lease (sq.mi.)				
easements (sq.mi.)	VC,Rec,FW	250	250	250
deed restrictions (sq.mi.)				
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)				
zoning (mi.)				
zoning and/or tax inc. subs.(sq.mi.)	VC,FW,Rec	630	530	480
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage (1000 af)	FDR	97	108	0
Mainstream Flood Control Storage (1000 af)	FDR	2.8	58.0	0

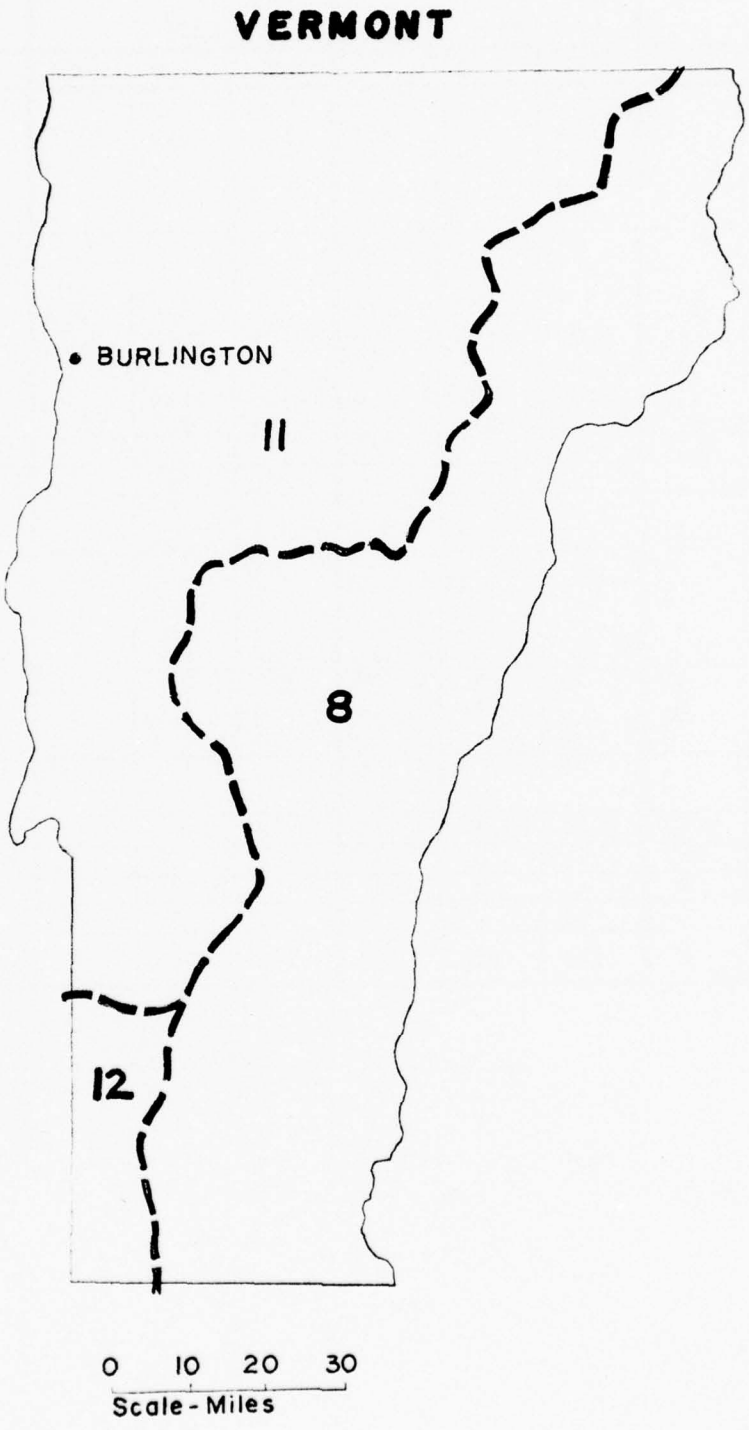
* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

	AREA 4			AREA 6			AREA 7			AREA 8		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	2	2	0	18	39	60	1 5	1 175	337 190	8 24	68 26	0 49
	0.1 0.4	0.2 1.0	0.3 0.4	3 2 2.4	7 1 2.9	10 2 1.5	16 3 2.1	35 5 4.6	51 4 4.5	7 7.0	15 2.9	21 0
	0.4 700 0 0	0.3 0 1200 70	0.7 0 2200 120	0.7 600 0 0	1.8 0 900 50	4.4 0 1400 80	5.4 800 0 0	12.7 0 1300 70	10.9 0 2000 110	2.2 200 0 0	2.9 0 400 20	4.7 0 600 30
	0.5	0.2	0.5	8	7	7	10	12	10	3	4	3
	0.5	0	0	2.5	2.5	0	4.0	7.0	0	1.0	1.0	0
	30	70	60	130	230	120	90	180	180	110	180	170
				60 6 60	60 0 60	60 0 60	160 80	160 80	160 80	200 110	0 110	0 110
	320	210	170	160	160	160	80	80	80	90	90	90
	6	0	0	46	28	0	38	69	0	8	11	0
	0	58.0	0							2.8	0	0

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	3.6	13.7	63.0
mainstream	12	46	46
wells	6.6	6.2	3.7
desalting			
Water Withdrawal and Conveyance Costs:			
inter-basin transfers			
public water supply	5.9	14.2	19.9
industrial self-supplied water	0.16	0.29	0.43
rural water supply	x	x	x
irrigation, agriculture	0.14	0.17	0
non-agriculture	6.6	6.3	8.0
Power Plant Cooling Water	0	15	47
Hydroelectric Power Generation		x	x
Navigation: commercial			
recreational boating	1.7	1.8	2.7
Water Recreation	127	70	93
Fish and Wildlife: fishing	1.7	1.9	2.3
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	220	370	570
advanced	0	44	70
other /	140	0	0
Flood Damage Reduction: upstream	15	12	0
mainstream	0.5	12.5	0
Drainage Control	0.67	1.82	1.07
Erosion Control	35	35	50
Health	x	x	x
Visual and Cultural	84	82	82
Summation of Available Estimated Costs	660	730	1060

* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

AREA 4			AREA 6			AREA 7			AREA 8		
1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
0.2	0.1	0	1.5	3.3	5.1	0.2	0.5	57.9	1.7	9.8	0
						4	42	30	8	5	17
0.2	0.5	0.2	1.3	1.6	1.1	1.3	2.5	2.3	3.8	1.6	0.1
0.5	0.4	0.5	0.7	1.2	3.4	3.6	11.0	13.3	1.0	1.7	2.6
			0.03	0.04	0.06	0.09	0.17	0.24	0.04	0.08	0.13
x	x	x	x	x	x	x	x	x	x	x	x
			0.04	0.01	0	0.06	0.16	0	0.03	0.001	0
0.2	0.2	0.2	1.3	1.1	1.5	2.4	2.7	3.3	2.7	2.4	3.0
			0	8	47				0	7	0
							x	x		x	x
0	0.01	0.01	1.0	0.7	0.8	0.6	0.6	1.2	0.1	0.4	0.7
			5	8	24	25	17	20	98	45	49
0.1	0.1	0.1	0.6	1.0	1.2	0.7	0.6	0.7	0.3	0.2	0.3
x	x	x	x	x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x	x	x	x	x
10	20	40	70	120	180	120	210	320	20	20	30
0	15	24	0	10	15	0	15	23	0	4	6
10	0	0	30	0	0	70	0	0	20	0	0
2	0	0	7	3	0	5	8	0	1	2	0
0	12.5	0							0.5	0	0
0.02	0.06	0.12	0.11	0.31	0.11	0.18	0.53	0.35	0.36	0.92	0.49
0.3	0.4	0.2	2	5	7	20	20	29	13	10	14
x	x	x	x	x	x	x	x	x	x	x	x
			11	9	9	28	27	27	46	46	46
24	49	67	130	170	300	280	360	530	220	160	170


VERMONT
BURLINGTON
11
8
12
0 10 20 30
Scale - Miles

VERMONT

The State of Vermont covers a total of 9,608 square miles including the north-west drainage of the Connecticut River in Area 8, the eastern drainage of Lake Champlain in Area 11, and a small portion of northeastern Area 12. The topography ranges from mountains and steep hills in and near the Green Mountains to rolling terrain and flatlands near Lake Champlain. The visual quality of the State is exceptionally good because of the variety of diverse landscapes throughout the State. Water is abundant, except on the Connecticut River during periods of low flow, and pollution is localized around industrial and population centers.

The State's 1970 population was 409,000, which is projected to reach 651,300 by 2020, and the only significant concentrations are around Montpelier, in Area 11, and Burlington in Area 12. Per capital income was 17 percent below the national average in 1970, but it is expected to rise to 13 percent below by 2020. Employment in services and related industries was by far the highest in 1970 and is expected almost to double by 2020. Increases are projected for manufacturing, while a 50 percent decrease is expected in agriculture, and in forestry and fisheries.

Needs to be Satisfied. The only key need is for Water Quality Maintenance in the Connecticut (and to a lesser degree, the Hudson) basin within the State. It is essential for the satisfaction of the important Water Recreation, Fish and Wildlife, and Visual and Cultural needs. The important needs in Area 11 are for Publicly Supplied Water, Industrial Self-supplied water, and Visual and Cultural (this drainage area contains, among other features, the Green Mountains National Forest). The important needs in Area 8 are Water Recreation, Fish and Wildlife, Water Quality Maintenance and Visual and Cultural needs. The needs which are important in Area 12 are Publicly Supplied Water, and Water Quality Maintenance. The needs in Vermont are largest in Area 11 except for several that are largest in Area 8, including non-agricultural Irrigation, fresh withdrawal for Power Plant Cooling, recreational boating, Fish and Wildlife (sport fishing, hunting and nature study man-days excluded), upstream Flood Damage Reduction and urban Erosion Control.

Devices. Habitat management in Area 11 is the only key device in Vermont: it is an essential adjunct to land controls for preserving and developing the natural qualities of the Area for Visual and Cultural, Fish and Wildlife, and Water Recreation needs. The important devices in this State are storage facilities in Areas 8 and 12, withdrawal facilities in Area 12, temperature control in Area 8, and water quality control in all three Areas. Other important devices in Area 11 are watershed management, land facilities, and habitat management. The use of devices will also be highest in Area 11 except for storage facilities, advanced waste treatment, watershed management, zoning and/or tax incentive subsidies, and flood control storage in Area 8, and wells in Area 12.

Costs. The costs will be distributed fairly equally between Areas 8 and 11. In the initial period large costs will be incurred in meeting the

Visual and Cultural needs and in providing combined sewer overflow controls. Power Plant Cooling Water costs will be large in the later periods and secondary treatment costs for Water Quality Maintenance will be large in all time periods. The costs required to meet the other needs in Areas 8 and 11 and to meet the needs of area 12 will be relatively small.

NEEDS-cumulative	STATE TOTAL			
	Pres.	1980	2000	2020
Publicly Supplied Water (mgd)	39	52	74	110
Industrial Self-Supplied Water (mgd)	11	16	28	44
Rural Water Supply (mgd)	12	15	18	17
Irrigation Water: agriculture (1000 afy)	0.6	8.4	25.6	25.6
non-agriculture (1000 afy)	2.4	9.4	15.9	24.2
Power Plant Cooling: withdrawal, saline (cfs)				
brackish (cfs)				
fresh (cfs)	40	149	386	681
consumption, brackish (cfs)				
fresh (cfs)	1	16	42	69
Hydroelectric Power Generation (mw)	180	210	3100	8450
Navigation: commercial (m. tons annually)	0.60	0.70	1.00	1.50
recreational boating (1000 boats)	18	23	40	65
Water Recreation: visitor days (m.)	x	11	18	29
stream or river (miles)	x	41	58	80
water surface (1000 acres)	x	12	18	25
beach (acres)	x	130	180	230
pool (m. sq. ft.)	x	2.3	3.2	4.1
land facilities (1000 acres)	x	4.7	6.5	8.5
Fish & Wildlife: sport fishing man-days (m.)	2.1	2.4	2.8	3.3
surface area, lake (acres)	x	0.18	0.74	1.34
stream (acres)	x	0.39	0.83	1.47
access, fresh (acres)	x	0.057	0.126	0.216
salt (acres)				
anadromous (acres)	x	0.060	0.090	0.110
piers (1000 feet)				
hunting, man-days (m.)	1.2	1.2	1.4	1.7
access (1000 sq. mi.)	x	0.39	1.04	1.70
nature study, man-days (m.)	0.51	0.61	0.72	0.87
access (1000 ac.)	x	0.32	0.83	1.45
Water Quality Maint.: non-industrial (m. PEs)	400	460	540	660
industrial (m. PEs)	190	340	610	1110
Flood Damage Reduction:				
avg. ann. damage, upstream (m. $)	1.6	2.3	4.1	7.9
mainstream (m. $)	5.8	8.9	16.5	33.5
tidal and hurricane (m. $)				
Drainage Control: cropland (1000 acres)	79	116	191	227
forest land (1000 acres)	0	0	8.7	34.9
wet land (1000 acres)				
Erosion Control: agriculture (1000 acres)	420	550	640	660
urban (1000 acres)	290	400	500	660
stream bank (mi.)	0	18	54	89
coastal shoreline (mi.)				
Health: vector control and pollution control	x	x	x	x
Visual & Cultural:				
landscape maintenance, unique natural (sq. mi.)	540	3580	3580	3580
unique shoreline (mi.)				
high quality (sq. mi.)	x	460	920	1380
diversity (sq. mi.)	x	25	50	75
agriculture (sq. mi.)	x	1600	1600	1600
landscape development, quality (sq. mi.)				
diversity (sq. mi.)				
metro. amenities (mi.)				
" " (sq. mi.)				

	AREA 8				AREA 11				AREA 12				AREA			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	13	17	24	37	24	32	45	65	2	3	5	8				
	4	6	11	18	7	10	17	26								
	3	4	5	4	8	10	11	11	1	1	2	1				
	0.3	1.0	1.0	1.0	0.3	7.4	24.6	24.6								
	1.8	5.8	9.8	15.1	0.4	3.0	5.2	7.7	0.2	0.6	1.0	1.4				
	0	109	336	591	40	40	50	90								
	0	15	19	20	1	1	23	49								
	110	140	1000	2000	70	70	2100	6450								
					0.60	0.70	1.00	1.50								
	11	15	26	45	6	8	12	17	1	1	2	3				
	x	1	2	3	x	9	15	24	x	1	1	2				
	x	10	13	18	x	29	42	58	x	2	3	4				
	x	3	5	7	x	8	12	18	x	1	1	1				
	x	30	40	40	x	90	130	170	x	10	10	20				
	x	0.5	0.7	0.8	x	1.6	2.3	3.0	x	0.2	0.2	0.4				
	x	1.7	2.2	2.8	x	2.7	3.9	5.3	x	0.2	0.3	0.5				
	0.3	0.4	0.4	0.6	1.8	2.0	2.3	2.7	0.03	0.03	0.03	0.04				
	x	0.18	0.74	1.34												
	x	0.39	0.78	1.25	0	0	0.05	0.23								
	x	0.029	0.058	0.093	x	0.028	0.068	0.123								
	x	0.060	0.090	0.110												
	0.1	0.1	0.2	0.2	1.0	1.1	1.2	1.5	0.01	0.01	0.02	0.02				
	x	0.37	0.59	0.87	x	0	0.40	0.75	x	0.02	0.05	0.08				
	0.15	0.20	0.26	0.32	0.34	0.38	0.43	0.50	0.02	0.03	0.03	0.04				
	x	0.22	0.58	1.01					x	0.10	0.26	0.44				
	120	130	160	220	270	310	350	410	20	20	30	30				
	100	190	360	690	90	150	250	420								
	0.8	1.3	2.5	5.2	0.7	1.0	1.5	2.7	0.003	0.004	0.01	0.01				
	0.3	0.5	1.0	2.0	5.4	8.4	15.5	31.5								
	16	22	35	39	61	91	152	182	2	3	5	6				
	0	0	2.2	8.8	0	0	6.2	24.6	0	0	0.4	1.4				
	120	150	160	170	250	350	410	420	50	60	70	70				
	190	290	370	500	70	90	110	130	20	20	20	30				
	0	4	11	18	0	13	40	66	0	1	3	5				
	x	x	x	x	x	x	x	x	x	x	x	x				
	240	1680	1680	1680	300	1900	1900	1900								
	x	210	420	630	x	250	500	750								
					x	25	50	75								
					x	1600	1600	1600								

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	Rec,FW,VC*	18	133	23
mainstream (1000 af)	FW,Rec,WQ*	24	26	24
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	8.5	13.5	20.3
brackish (mgd)				
wells (mgd)	*	12.6	18.6	8.9
Conveyance Facilities				
interbasin diversions, into (mgd)				
out of (mgd)				
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	5.3	11.1	20.6
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ,VC	660	0	0
secondary (90%) (m. PEs removed)	WQ,VC	21	1074	1596
advanced (95%) (m. PEs removed)	WQ	0	26	47
Desalting Facilities				
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC	15	23	16
Local Flood Protection				
ocean (projects)				
river (projects)	FDR	3.5	1.0	4.0
flood control channels (miles)	FDR	0.5	1.5	9.0
Watershed Management (1000 acres)	FDR,VC,Drn,FW	250	440	460
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,FW	3380	140	140
fee simple purchase (buying) (mi.)				
purchase lease (sq.mi.)				
easements (sq.mi.)	VC,FW	200	200	200
deed restrictions (sq.mi.)				
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)	VC,FW	1500	0	0
zoning (mi.)				
zoning and/or tax inc. subs.(sq.mi.)	VC,FW	45	45	45
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage (1000 af)	FDR	24.6	2.3	15.0
Mainstream Flood Control Storage (1000 af)	FDR	24	0	0

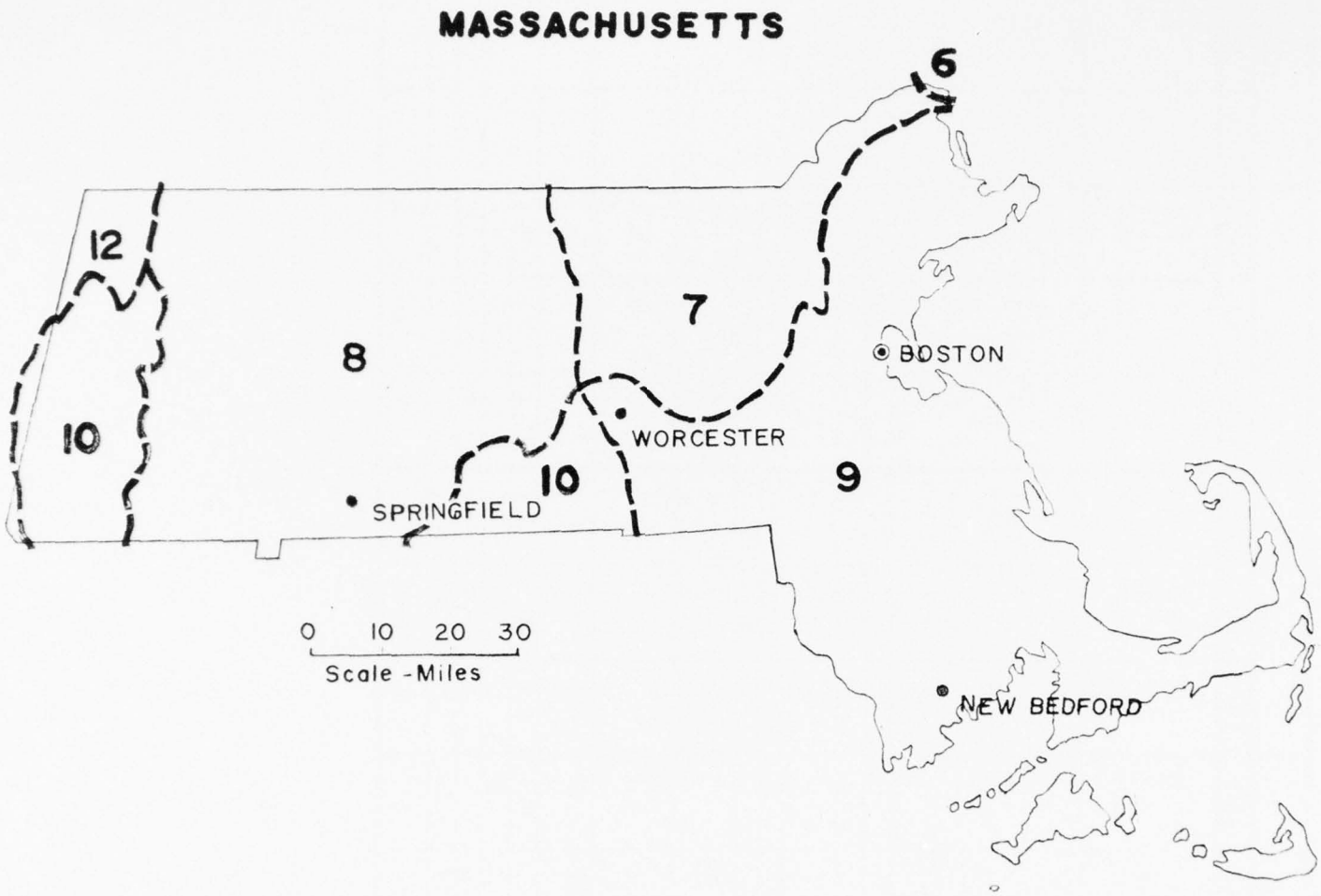
* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

	AREA 8			AREA 11			AREA 12			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	9	79	0	9	53	22	0.1	0.1	1			
	24	26	24									
	2.3	3.7	6.0	6.0	9.2	13.4	0.2	0.6	0.9			
	7.8	3.3	0	4.3	6.3	1.9	0.5	9.0	7.0			
	1.7	2.3	3.7	3.2	7.7	14.7	0.4	1.1	2.2			
	280	0	0	390	0	0						
	0	469	815	0	580	750	21	25	31			
	0	26	45				0	0	2			
	4	6	3	11	17	13	0.1	0.04	0.1			
	1.5	0.5	1.5	2.0	0.5	2.5						
				0.5	1.5	9.0						
	140	230	210	110	200	230	10	10	10			
	1550	0	0	1840	140	140						
	60	60	60	140	140	140						
				1500	0	0						
	45	45	45									
	17.6	0.3	6.5	7.0	2.0	8.5						
	24	0	0									

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	3.6	21.0	3.5
mainstream	8.4	4.6	0
wells	10.4	10.1	1.8
desalting			
Water Withdrawal and Conveyance Costs:			
inter-basin transfers			
public water supply	5.2	9.1	15.4
industrial self-supplied water	0.03	0.05	0.07
rural water supply	x	x	x
irrigation, agriculture	1.7	3.6	0.002
non-agriculture	6.1	5.0	6.4
Power Plant Cooling Water	0	20	46
Hydroelectric Power Generation	x	x	x
Navigation: commercial			
recreational boating	0.22	0.70	0.95
Water Recreation	30	29	29
Fish and Wildlife: fishing	0.67	0.83	1.08
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	55	71	110
advanced	0	5.4	10.1
other /	63	0	0
Flood Damage Reduction: upstream	6.85	0.95	4.25
mainstream	10	0	0
Drainage Control	2.6	5.6	3.4
Erosion Control	30	24	24
Health	x	x	x
Visual and Cultural	299	41	41
Summation of Available Estimated Costs	530	250	300

* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

	AREA 8			AREA 11			AREA 12			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	2.0	11.4	0	1.6	9.6	3.4	0	0	0.1			
	8.4	4.6	0									
	4.2	1.8	0.1	2.4	3.4	1.2	3.8	4.9	0.5			
	0.8	1.3	2.0	4.1	6.9	12.0	0.3	0.9	1.3			
	0.01	0.02	0.03	0.02	0.03	0.04						
	x	x	x	x	x	x	x	x	x			
	0.1	0.01	0.002	1.5	3.6	0						
	3.5	3.2	4.0	2.2	1.6	2.0	0.4	0.3	0.4			
	0	3	16	0	17	30						
	x	x	x		x	x						
	0.08	0.26	0.44	0.10	0.36	0.39	0.04	0.08	0.12			
	17	8	9	4	17	14	9	4	6			
	0.22	0.19	0.23	0.44	0.62	0.83	0.01	0.01	0.02			
	x	x	x	x	x	x	x	x	x			
	x	x	x	x	x	x	x	x	x			
	20	27	46	33	43	62	2	2	2			
	0	5.4	9.2				0	0	0.9			
	14	0	0	47	0	0	2	0	0			
	6.05	0.05	2.55	0.8	0.9	1.7						
	5	0	0	6	0	0						
	0.5	1.2	0.7	2.0	4.3	2.6	0.1	0.1	0.1			
	18	13	19	11	10	5	1	1	1			
	x	x	x	x	x	x	x	x	x			
	171	24	24	128	16	16						
	270	100	130	240	130	150	19	13	12			


MASSACHUSETTS
6
12
7
8
BOSTON
10
WORCESTER
10
9
SPRINGFIELD
0 10 20 30
Scale - Miles
NEW BEDFORD

MASSACHUSETTS

The Commonwealth of Massachusetts covers a total of 8,256 square miles including small portions of Areas 6, 10 and 12, part of south-central Area 8, the southern tip of Area 7 and most of Area 9. The only significant drainages are those for the south-central portion of the Connecticut River and the extreme southern Merrimack River. The topography of the Commonwealth varies from coastal plain to rolling hills with some steep hills and mountains. The visual quality is medial. Water pollution is extensive; the Connecticut River suffers from periods of low flow, and supplies must be imported to the eastern metropolitan centers.

The "megalopolis" of the North Atlantic Region starts in Massachusetts and population concentrations are particularly heavy along and south of a line stretching from Springfield to Boston. In 1970 the population totalled 5.6 million and this figure should surpass 9 million by 2020. Per capita income was 8 percent above the national average in 1970, but is expected to decline to average by 2020. Employment was highest in services and related industries in 1970 and should almost double by 2020. Increases are also projected for chemicals and allied products, paper and allied products and primary metals. Employment is expected to decline for textile mill products, agriculture, forestry and fisheries, and food and kindred products by the end of the Study period.

Needs to be Satisfied. Publicly Supplied and Industrial Self-Supplied Water are important needs in Areas 9 and 10, with Publicly Supplied being largest in Areas 9 and Industrial Self-Supplied largest in Area 8. Irrigation needs, both agricultural and non-agricultural, are greatest in Area 9. Power Plant Cooling needs are largest in Areas 8 and 9 and important in Area 9. Hydroelectric Power Generation is very large in Area 8. Commercial Navigation exists only in Area 9 and Recreational Boating, which exists throughout the State, is both very large and important in that Area. Recreation and Water Quality Maintenance are important in Areas 7 through 9 and largest in Area 9. In addition, Water Quality Maintenance is key in Areas 7, 8, and 9. Fish and Wildlife and Erosion Control needs are key and largest in Area 9 while Fish and Wildlife is important in Areas 7 and 8. Needs for Drainage Control are greatest in Area 8 and Flood Damage Reduction needs are important in Area 7 and largest in Area 9. Visual and Cultural Needs are important in Area 7 and 8 but largest in Area 9. Health is important in Area 9.

Devices. Storage facilities are important in Area 8 and 10, withdrawal facilities in Area 7, conveyance facilities in Area 8 and 9, temperature control facilities in Area 8 and water quality control devices in all Areas. Other important devices, all in Area 9, are watershed management, land controls, habitat management and water demand and allocation changes. All devices are largest in Area 9 except watershed management, largest in Area 8, and out of basin diversions in Area 7 (diverted to Area 9). The key devices are in Area 9 and are quality control and erosion protection.

Costs. The cost involved in meeting the needs of the State are largest in Area 9. Visual and Cultural and combined sewer overflow control costs are very large in the first time period and advanced waste treatment in the second and third time periods. Interbasin transfers, Water Recreation, secondary waste treatment and Erosion Control costs are large in all time periods.

NEEDS-cumulative	STATE TOTAL			
	Pres.	1980	2000	2020
Publicly Supplied Water (mgd)	670	870	1240	1920
Industrial Self-Supplied Water (mgd)	370	610	1100	1750
Rural Water Supply (mgd)	17	20	28	20
Irrigation Water: agriculture (1000 afy)	15	41	43	43
non-agriculture (1000 afy)	11	29	48	72
Power Plant Cooling: withdrawal, saline (cfs)	4300	11200	23900	38700
brackish (cfs)				
fresh (cfs)	730	570	440	1100
consumption, brackish (cfs)				
fresh (cfs)	8	8	25	59
Hydroelectric Power Generation (mw)	200	1800	1880	2960
Navigation: commercial (m. tons annually)	33	43	73	124
recreational boating (1000 boats)	170	230	520	880
Water Recreation: visitor days (m.)	x	140	220	320
stream or river (miles)	x	750	990	1400
water surface (1000 acres)	x	260	390	540
beach (acres)	x	2000	2600	3000
pool (m. sq. ft.)	x	34	45	54
land facilities (1000 acres)	x	130	170	220
Fish & Wildlife: sport fishing man-days (m.)	12	15	18	22
surface area, lake (acres)	x	1.9	7.8	20.9
stream (acres)	x	2.0	4.8	7.6
access, fresh (acres)	x	0.17	0.39	0.66
salt (acres)	x	0.78	2.07	3.59
anadromous (acres)	x	0.20	0.26	0.34
piers (1000 feet)	x	22	58	102
hunting, man-days (m.)	2.5	2.9	3.5	4.3
access (1000 sq. mi.)	x	0.68	1.39	1.81
nature study, man-days (m.)	6.8	8.0	10.0	12.3
access (1000 ac.)	x	11	28	50
Water Quality Maint.: non-industrial (m. PEs)	5200	6300	7800	9600
industrial (m. PEs)	5400	9600	17200	31300
Flood Damage Reduction:				
avg. ann. damage, upstream (m. $)	9.9	15.2	28.4	56.4
mainstream (m. $)	7.9	12.3	23.8	48.6
tidal and hurricane (m. $)	2.6	4.0	7.6	15.4
Drainage Control: cropland (1000 acres)	19	26	41	46
forest land (1000 acres)				
wet land (1000 acres)				
Erosion Control: agriculture (1000 acres)	160	210	230	240
urban (1000 acres)	650	900	1190	1650
stream bank (mi.)	0	8.6	25.3	41.0
coastal shoreline (mi.)	0	470	950	980
Health: vector control and pollution control	x	x	x	x
Visual & Cultural:				
landscape maintenance, unique natural (sq. mi.)	210	2030	2030	2030
unique shoreline (mi.)	x	16	16	16
high quality (sq. mi.)	x	63	126	189
diversity (sq. mi.)	x	10	20	30
agriculture (sq. mi.)				
landscape development, quality (sq. mi.)	x	210	430	640
diversity (sq. mi.)				
metro. amenities (mi.)				
" " (sq. mi.)	x	76	77	77

	AREA 6				AREA 7				AREA 8				AREA 9			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	2	2	3	4	70	90	130	190	70	90	120	190	510	670	940	1470
					50	80	150	240	180	290	540	930	140	230	400	540
					3	3	3	3	4	6	7	6	8	8	13	8
					2	3	4	4	2	7	7	8	11	31	32	32
					2	2	4	5	1	4	7	10	7	19	32	49
					0	0	200	2400					4300	10900	22900	34400
					40	20	20	0	690	560	420	1080				
					1	1	1	0	7	7	19	49				
									200	1800	1880	2960	3	0	0	0
													33	43	73	124
					10	10	20	30	20	30	50	90	130	170	420	710
					x	40	70	110	x	20	30	50	x	70	110	150
					x	110	150	200	x	150	200	290	x	460	590	850
					x	30	50	70	x	50	70	100	x	160	250	340
					x	300	400	500	x	400	600	700	x	1100	1500	1700
					x	6	8	10	x	7	10	12	x	19	25	30
					x	10	20	20	x	20	30	40	x	90	110	150
	0.1	0.2	0.2	0.2	2	2	3	3	1	2	2	3	8	10	13	15
									x	0.5	2.0	3.6	x	1.3	5.4	16.0
					x	0.2	0.5	0.8	x	1.0	2.1	3.3	x	0.5	1.3	2.3
					x	0.01	0.03	0.06	x	0.08	0.16	0.25	x	0.07	0.18	0.30
													x	0.78	2.07	3.59
					x	0.02	0.02	0.03	x	0.17	0.23	0.30	x	0.004	0.01	0.01
													x	22	58	102
	0.03	0.04	0.04	0.05	0.7	0.7	0.9	1.2	0.5	0.6	0.8	1.0	1.2	1.4	1.7	2.0
					x	0.04	0.12	0.13	x	0.23	0.37	0.54	x	0.37	0.73	0.88
	0.02	0.02	0.03	0.03	0.8	1.0	1.2	1.5	0.8	1.0	1.3	1.6	4.9	5.8	7.1	8.7
	x	0.003	0.01	0.01	x	2	5	8	x	0.5	1	2	x	9	22	39
	10	20	20	30	800	1000	1300	1500	600	700	800	1100	3600	4400	5400	6700
					500	900	1600	2800	2100	4000	7500	14300	2800	4700	8000	13700
					1.2	1.8	3.4	7.0	0.6	1.0	1.9	3.8	6.0	9.2	17.1	33.8
					2.2	3.5	6.7	13.7	3.0	4.7	9.2	19.1	2.4	3.8	7.2	14.5
													2.6	4.0	7.6	15.4
									11	14	23	26	5	6	10	11
					10	10	20	20	80	100	110	110	40	50	60	60
					70	100	140	190	130	190	250	330	400	510	690	970
					0	1.0	3.0	5.5	0	2.5	7.3	12.0	0	4.0	11.7	18.0
					0	4	10	10					0	470	950	970
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
									160	1180	1180	1180	50	850	850	850
	x	1	1	1									x	15	15	15
									x	63	126	189				
					x	60	130	190					x	150	300	450
					x	32	32	32					x	40	40	40

NEEDS-cumulative		AREA 10			
		Pres.	1980	2000	2020
Publicly Supplied Water	(mgd)	20	30	40	50
Industrial Self-Supplied Water	(mgd)	10	10	20	30
Rural Water Supply	(mgd)	2	2	5	2
Irrigation Water: agriculture	(1000 afy)	0.1	0.3	0.1	0
non-agriculture	(1000 afy)	1	3	5	8
Power Plant Cooling: withdrawal, saline	(cfs)	0	300	800	2000
brackish	(cfs)				
fresh	(cfs)	0	0	10	20
consumption, brackish	(cfs)				
fresh	(cfs)	0	0	5	10
Hydroelectric Power Generation	(mw)				
Navigation: commercial	(m. tons annually)				
recreational boating	(1000 boats)	10	10	30	50
Water Recreation: visitor days	(m.)	x	10	10	10
stream or river	(miles)	x	30	40	50
water surface	(1000 acres)	x	10	20	20
beaches	(acres)	x	100	100	100
pool	(m. sq. ft.)	x	1	2	2
land facilities	(1000 acres)	x	10	10	10
Fish & Wildlife: sport fishing man-days	(m.)	0.3	0.3	0.4	0.5
surface area, lake	(acres)	x	0.1	0.4	1.3
stream	(acres)	x	0.3	0.9	1.2
access, fresh	(acres)	x	0.01	0.02	0.04
salt	(acres)				
anadromous	(acres)	x	0.001	0.001	0.001
piers	(1000 feet)				
hunting, man-days	(m.)	0.1	0.1	0.1	0.1
access	(1000 sq. mi.)	x	0.03	0.14	0.22
nature study, man-days	(m.)	0.2	0.2	0.3	0.4
access	(1000 ac.)	x	0.03	0.1	0.2
Water Quality Maint.: non-industrial	(m. PEs)	100	200	200	300
industrial	(m. PEs)	100	100	200	400
Flood Damage Reduction:					
avg. ann. damage, upstream	(m. $)	1.1	1.7	3.3	6.8
mainstream	(m. $)	0.2	0.3	0.7	1.4
tidal and hurricane	(m. $)				
Drainage Control: cropland	(1000 acres)	3	4	7	8
forest land	(1000 acres)				
wet land	(1000 acres)				
Erosion Control: agriculture	(1000 acres)	20	20	30	30
urban	(1000 acres)	50	80	110	150
stream bank	(mi.)	0	0.8	2.4	4.0
coastal shoreline	(mi.)				
Health: vector control and pollution control		x	x	x	x
Visual and Cultural:					
landscape maintenance, unique natural	(sq. mi.)				
unique shoreline	(mi.)				
high quality	(sq. mi.)				
diversity	(sq. mi.)	x	10	20	30
agriculture	(sq. mi.)				
landscape development, quality	(sq. mi.)				
diversity	(sq. mi.)				
metro. amenities	(mi.)				
" "	(sq. mi.)	x	4	5	5

	AREA 12				AREA				AREA				AREA			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	2	3	10	10												
	0	0.2	0.3	0.5												
	1	1	2	3												
	0.03	0.03	0.03	0.04												
	x 0.001	0.002	0.004													
	x 0.001	0.001	0.001													
	0.01	0.01	0.02	0.02												
	x 0.01	0.02	0.04													
	0.02	0.03	0.03	0.04												
	x 0.1	0.3	0.4													
	20	20	30	30												
	1.0	1.5	2.7	5.0												
	1	1	2	2												
	20	20	20	20												
	10	10	10	10												
	0	0.3	0.9	1.5												
	x	x	x	x												

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ¢				
reservoirs, upstream (1000 af)	Rec,FW,VC*	149	35	190
mainstream (1000 af)	FW,VC,Rec,WQ*	0	0	180
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	330	730	1000
brackish (mgd)	Ind	78	123	149
wells (mgd)	*	37	22	50
Conveyance Facilities				
interbasin diversions, into (mgd)	*	240	400	470
out of (mgd)	*	240	590	750
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	82	164	478
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ,VC,Rec	14000	0	0
secondary (90%) (m. PEs removed)	WQ,Rec,VC	20	23000	37000
advanced (95%) (m. PEs removed)	WQ,Rec	0	1200	2000
Desalting Facilities				
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC,Rec	47	38	147
Local Flood Protection				
ocean (projects)	FDR	0	1	0
river (projects)	FDR	12	23	1
flood control channels (miles)	FDR	0	0.25	0
Watershed Management (1000 acres)	FDR,VC,Drn,Rec	600	1040	910
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,Rec,FW	1540	210	210
fee simple purchase (buying) (mi.)	VC,Rec,FW	16	0	0
purchase lease (sq.mi.)	VC,FW	6.5	3.5	2.5
easements (sq.mi.)	VC,FW	26	26	26
deed restrictions (sq.mi.)				
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)	VC,FW	600	0	0
zoning (mi.)				
zoning and/or tax inc. subs.(sq.mi.)	VC,FW	14	14	14
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage (1000 af)	FDR	26	85	1
Mainstream Flood Control Storage (1000 af)	FDR	224.7	2.4	0

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
¢ Flood control storage not included.

	AREA 6			AREA 7			AREA 8			AREA 9		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
				0.2	0.4	90	3 0	30 0	0 100	131	0	0
	0	0	0.1	30 8 1	80 10 2	110 10 2	100 3 7	210 4 3	320 4 0	190 54 24	430 91 8	560 126 7
				120 120	100 490	10 740	120	100	10	120	300	460
	0.1	0.1	0.4	11	27	23	9	11	19	61	100	432
	10 0 0	0 20 1	0 30 1	2000 0 0	0 3000 100	0 4000 200	4000 0 0	0 7000 400	0 14000 800	8000 0 0	0 12000 700	0 18000 1000
				7	8	45	6	6	8	28	17	80
				2	7	0	0 0	1 0.25	0 0	0 7	1 10	0 0
				280	560	560	130	180	160	150	240	140
	1	0	0	100	60	60	1050 18 14	0 18 14	0 18 14	390 15 600	150 0 0	150 0 0
				3	17	0	0	8	0	15	44	0
				11.4	2.4	0	213.3	0	0			

DEVICES - incremental	Purposes	AREA 10 1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	Rec,FW,VC*	11	3	76
mainstream (1000 af)	FW,VC,Rec,WQ*	0	0	80
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	3	10	10
brackish (mgd)	Ind	13	18	9
wells (mgd)	*	5	6	39
Conveyance Facilities				
interbasin diversions, into (mgd	*			
out of (mgd)	*			
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	1	24	2
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ,VC,Rec	300	0	0
secondary (90%) (m. PEs removed)	WQ,VC,Rec	0	400	600
advanced (95%) (m. PEs removed)	WQ,Rec	0	20	40
Desalting Facilities				
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC,Rec	4	4	10
Local Flood Protection				
ocean (projects)	FDR			
river (projects)	FDR	2	6	1
flood control channels (miles)	FDR			
Watershed Management (1000 acres)	FDR,VC,Drn,Rec	50	50	40
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,Rec,FW			
fee simple purchase (buying) (mi.)	VC,Rec,FW			
purchase lease (sq.mi.)	VC,FW	6.5	3.5	2.5
easements (sq.mi.)	VC,FW	8	8	8
deed restrictions (sq.mi.)				
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)	VC,FW			
zoning (mi.)				
zoning and/or tax inc. subs.(sq.mi.)	VC,FW			
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage (1000 af)	FDR	6	17	1
Mainstream Flood Control Storage (1000 af)	FDR			

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

	AREA 12			AREA			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	3	1	24									
	0.2	1	1									
	0.2	3	2									
	0.4	1	2									
	20	30	30									
	0	0	2									
	1	3	4									
	2	0	0									
	4	10	10									
	3	0	0									

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	45.2	7.7	47.8
mainstream	0	0	71
wells	19.2	11.0	7.8
desalting			
Water Withdrawal and Conveyance Costs:			
inter-basin transfers	77	154	46
public water supply	25	66	120
industrial self-supplied water	1.5	3.0	4.0
rural water supply	x	x	x
irrigation, agriculture	3.65	0.49	0.02
non-agriculture	15	15	19
Power Plant Cooling Water	0	28	123
Hydroelectric Power Generation	x	x	x
Navigation: commercial	20	110	59
recreational boating	3.4	10.9	13.1
Water Recreation	1170	700	780
Fish and Wildlife: fishing	6.7	8.8	10.2
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	830	1520	2450
advanced	0	260	420
other /	1700	0	0
Flood Damage Reduction: upstream	6.1	17.6	0.2
mainstream	82	16	0
Drainage Control	0.56	1.44	0.70
Erosion Control	870	900	130
Health	x	x	x
Visual and Cultural	482	80	80
Summation of Available Estimated Costs	5400	3900	4400

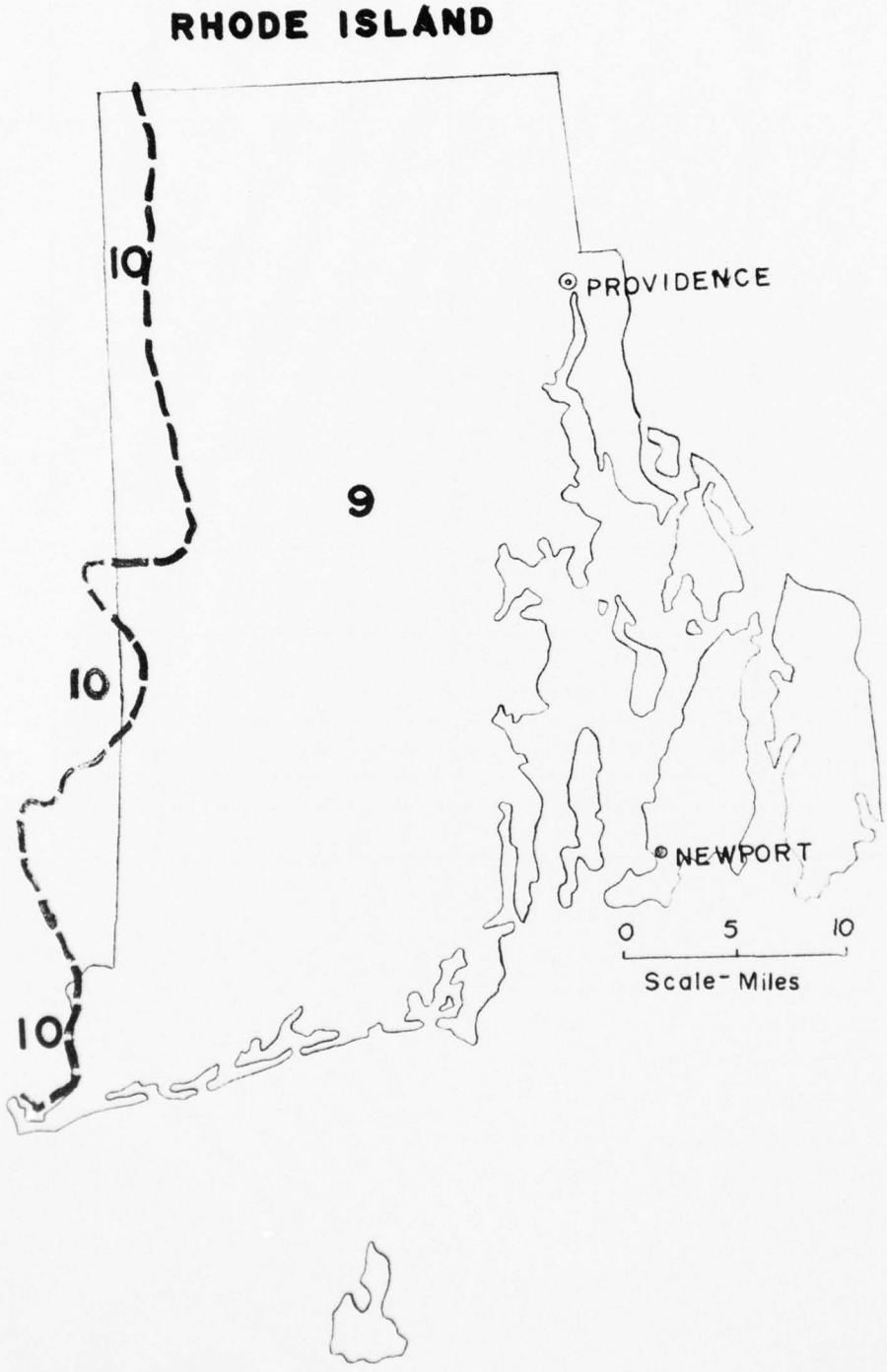
* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

	AREA 6			AREA 7			AREA 8			AREA 9		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
				0	0.1	15.4	0.8	4.2	0	39.2	0	0
							0	0	35			
				0.5	1.0	1.0	3.9	1.6	0.1	10.7	3.7	3.3
				77	49	4				0.4	104	42
	0.1	0.1	0.3	8	23	28	4	7	10	13	24	79
				0.2	0.4	0.5	0.5	1.1	1.9	0.6	1.4	1.4
				x	x	x	x	x	x	x	x	x
				0.14	0.30	0	0.92	0.04	0.02	1.87	0.15	0
				1	1	1	2	2	3	10	10	13
				0	0	12	0	6	16	0	20	90
							x	x	x			
										20	110	59
				0.1	0.2	0.2	0.2	0.5	0.9	2.9	9.4	10.9
				160	100	110	250	120	150	700	450	500
	0.1	0.1	0.1	1.6	1.3	1.5	1.1	1.0	1.2	3.9	6.3	7.2
	x	x	x	x	x	x	x	x	x	x	x	x
	x	x	x	x	x	x	x	x	x	x	x	x
	2	3	3	240	420	630	290	420	790	280	640	970
	0	0.2	0.2	0	30	50	0	90	160	0	140	210
				200	0	0	200	0	0	1300	0	0
				0.2	5.0	0	0	1.8	0	3.4	6.6	0
				4	6	0	46	0	0	32	9	0
							0.32	0.82	0.44	0.13	0.36	0.13
				10	10	10	10	10	10	840	880	100
	x	x	x	x	x	x	x	x	x	x	x	x
	0.3	0	0	23	17	17	111	7	7	344	53	53
	2.5	3.4	3.6	730	660	880	920	670	1190	3600	2500	2100

FIRST COSTS - incremental ($ million 1970)	AREA 10		
	1980	2000	2020
Water Development Costs:			
storage, upstream	4.6	3.1	29.1
mainstream	0	0	36
wells	2.9	3.1	3.2
desalting			
Water Withdrawal and Conveyance Costs:			
inter-basin transfers			
public water supply	0.4	11	1
industrial self-supplied water	0.1	0.1	0.1
rural water supply	x	x	x
irrigation, agriculture	0.72	0	0
non-agriculture	2	2	2
Power Plant Cooling Water	0	2	5
Hydroelectric Power Generation			
Navigation: commercial			
recreational boating	0.1	0.7	1.0
Water Recreation	60	30	20
Fish and Wildlife: fishing	0.1	0.2	0.2
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	20	30	50
advanced	0	5	10
other ≠	10	0	0
Flood Damage Reduction: upstream	1.5	4.3	0.2
mainstream			
Drainage Control	0.09	0.23	0.11
Erosion Control	10	5	10
Health	x	x	x
Visual and Cultural	4	3	3
Summation of Available Estimated Costs	120	100	170

* From the supply model and includes OMR costs.
≠ Combined sewer overflows control and acid mine drainage control.

	AREA 12			AREA			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	0.6	0.3	3.3									
	1.2	1.6	0.2									
	0.3	1	1									
	0.1	0.1	0.1									
	0.04	0.1	0.1									
	0.01	0.01	0.02									
	x	x	x									
	x	x	x									
	2	2	2									
	0	0	1									
	1.1	0	0									
	0.02	0.03	0.03									
	0.3	0.3	0.2									
	x	x	x									
	5.7	5.4	8.0									


RHODE ISLAND
10
9
10
10
PROVIDENCE
NEWPORT
0 5 10
Scale- Miles

RHODE ISLAND

Rhode Island covers 1,213 square miles located primarily in Area 9, with a very small portion located in Area 10. The topography varies from coastal plain to rolling hills and the visual quality of the State is medial. The drainages are small and outlet either into Narragansett Bay or along the coast. Water must be imported because of insufficient natural supplies and the overall degradation of existing supplies.

The population is concentrated around Providence and Newport and should reach 1.5 million by 2020 from the 1970 total of 94,000. Per capita income was at the national average in 1970 and is projected to remain at that level throughout the Study period. Employment in 1970 was highest in services and related industries, which is expected to double by 2020. Paper and allied products and chemicals and allied products should also double employment by 2020, while decreases are projected for textile mill products, agriculture, and forestry and fisheries.

Needs to be Satisfied. The needs of the State are largest in Area 9 and either relatively small or nonexistent in Area 10. The key needs are Fish and Wildlife, Water Quality Maintenance and Erosion Control, all in Area 9. The important needs in Area 9 are Publicly Supplied Water, Industrial Self-supplied Water, Power Plant Cooling, Recreational Boating, Water Recreation, Water Quality Maintenance, and Health. The important needs in Area 10 are Publicly Supplied Water and Water Quality Maintenance.

Devices. The key devices are quality control facilities and erosion protection in Area 9. The important devices are conveyance facilities, watershed management, land controls, habitat management and water demand and allocation changes in Area 9 and quality control facilities in both Areas. Due to the low need levels in Area 10 the number of devices used will be very small.

Costs. The large costs in this State are in Area 9 and are incurred to meet the needs of Water Recreation, Water Quality Maintenance, Erosion Control and Visual and Cultural

NEEDS-cumulative		STATE TOTAL			
		Pres.	1980	2000	2020
Publicly Supplied Water	(mgd)	110	150	210	330
Industrial Self-Supplied Water	(mgd)	39	63	113	152
Rural Water Supply	(mgd)	1.5	1.6	2.5	1.7
Irrigation Water: agriculture	(1000 afy)	0.9	2.6	2.7	2.7
non-agriculture	(1000 afy)	2.5	6.4	10.6	16.2
Power Plant Cooling: withdrawal, saline	(cfs)	340	890	5610	11520
brackish	(cfs)				
fresh	(cfs)				
consumption, brackish	(cfs)				
fresh	(cfs)				
Hydroelectric Power Generation	(mw)				
Navigation: commercial	(m. tons annually)	9.9	12.8	21.0	34.4
recreational boating	(1000 boats)	57	76	143	210
Water Recreation: visitor days	(m.)	x	25	41	57
stream or river	(miles)	x	170	230	320
water surface	(1000 acres)	x	62	95	129
beach	(acres)	x	430	570	650
pool	(m. sq. ft.)	x	7.4	9.8	11.2
land facilities	(1000 acres)	x	33	44	55
Fish & Wildlife: sport fishing man-days	(m.)	1.8	2.2	2.7	3.4
surface area, lake	(acres)	x	0.72	3.06	9.00
stream	(acres)	x	0.29	0.76	1.30
access, fresh	(acres)	x	0.038	0.099	0.171
salt	(acres)	x	0.086	0.231	0.399
anadromous	(acres)	x	0.002	0.003	0.004
piers	(1000 feet)	x	2.4	6.5	11.3
hunting, man-days	(m.)	0.27	0.31	0.37	0.45
access	(1000 sq. mi.)	x	0.14	0.29	0.35
nature study, man-days	(m.)	1.1	1.3	1.6	1.9
access	(1000 ac.)	x	2.3	5.9	10.3
Water Quality Maint.: non-industrial	(m. PEs)	790	980	1210	1500
industrial	(m. PEs)	610	1030	1750	3010
Flood Damage Reduction:					
avg. ann. damage, upstream	(m. $)	0.005	0.008	0.015	0.030
mainstream	(m. $)	0.64	1.00	1.91	3.84
tidal and hurricane	(m. $)	4.2	6.6	12.6	25.4
Drainage Control: cropland	(1000 acres)	1.6	2.2	3.5	3.8
forest land	(1000 acres)	0	0	0.61	2.03
wet land	(1000 acres)				
Erosion Control: agriculture	(1000 acres)	14	18	20	20
urban	(1000 acres)	130	170	230	320
stream bank	(mi.)	x	0.9	2.3	4.0
coastal shoreline	(mi.)	x	70	140	150
Health: vector control and pollution control		x	x	x	x
Visual & Cultural:					
landscape maintenance, unique natural	(sq. mi.)				
unique shoreline	(mi.)	x	5	5	5
high quality	(sq. mi.)				
diversity	(sq. mi.)				
agriculture	(sq. mi.)				
landscape development, quality	(sq. mi.)	x	50	100	150
diversity	(sq. mi.)				
metro. amenities	(mi.)				
" "	(sq. mi.)	x	10	10	10

	AREA 9				AREA 10				AREA				AREA			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	110	140	190	300	10	10	20	20								
	39	63	113	152												
	1.5	1.6	2.5	1.7												
	0.9	2.6	2.7	2.7												
	2.4	6.2	10.3	15.7	0.1	0.2	0.3	0.5								
	340	890	5610	11520												
	9.9	12.8	21.0	34.4												
	56	74	140	203	1	2	3	7								
	x	25	41	57												
	x	170	230	320												
	x	62	95	129												
	x	430	570	650												
	x	7.4	9.8	11.2												
	x	33	44	55												
	1.7	2.1	2.6	3.1	0.1	0.1	0.2	0.2								
	x	0.72	3.06	9.00												
	x	0.29	0.76	1.30												
	x	0.038	0.099	0.171												
	x	0.086	0.231	0.399												
	x	0.002	0.003	0.004												
	x	2.4	6.5	11.3												
	0.25	0.29	0.34	0.41	0.02	0.02	0.03	0.04								
	x	0.14	0.27	0.32	x	0.004	0.02	0.03								
	1.0	1.2	1.5	1.8	0.1	0.1	0.1	0.2								
	x	2.3	5.9	10.3												
	740	900	1110	1380	60	80	100	120								
	610	1030	1750	3010												
	0.005	0.008	0.015	0.030												
	0.64	1.00	1.91	3.84												
	4.2	6.6	12.6	25.4												
	1.4	1.9	3.1	3.4	0.2	0.3	0.4	0.5								
	0	0	0.60	2.00	0	0	0.01	0.03								
	13	16	18	18	1	2	2	2								
	130	160	220	310	3	10	10	10								
	x	0.8	2.0	3.5	x	0.1	0.3	0.5								
	x	70	140	150												
	x	x	x	x	x	x	x	x								
	x	5	5	5												
	x	50	100	150												
	x	10	10	10												

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	Rec,FW,VC*	17	0	0
mainstream (1000 af)	FW,VC,Rec,WQ*	26	0	0
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	46	101	125
brackish (mgd)	Ind	16	26	36
wells (mgd)	*	4.7	1.7	1.4
Conveyance Facilities				
interbasin diversions, into (mgd)	*	0	190	280
out of (mgd)				
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	13	31	89
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ,VC	1700	0	0
secondary (90%) (m. PEs removed)	WQ,VC	0	2700	4100
advanced (95%) (m. PEs removed)	WQ	0	150	230
Desalting Facilities				
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC	1.7	1.4	2.7
Local Flood Protection				
ocean (projects)	FDR	0	2	0
river (projects)				
flood control channels (miles)				
Watershed Management (1000 acres)	FDR,VC,Drn	34	61	49
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,FW	60	50	50
fee simple purchase (buying) (mi.)	VC,FW	5	0	0
purchase lease (sq.mi.)				
easements (sq.mi.)				
deed restrictions (sq.mi.)				
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)				
zoning (mi.)				
zoning and/or tax inc. subs.(sq.mi.)				
zoning and/or tax inc. subs. (mi.)				
V. Others				

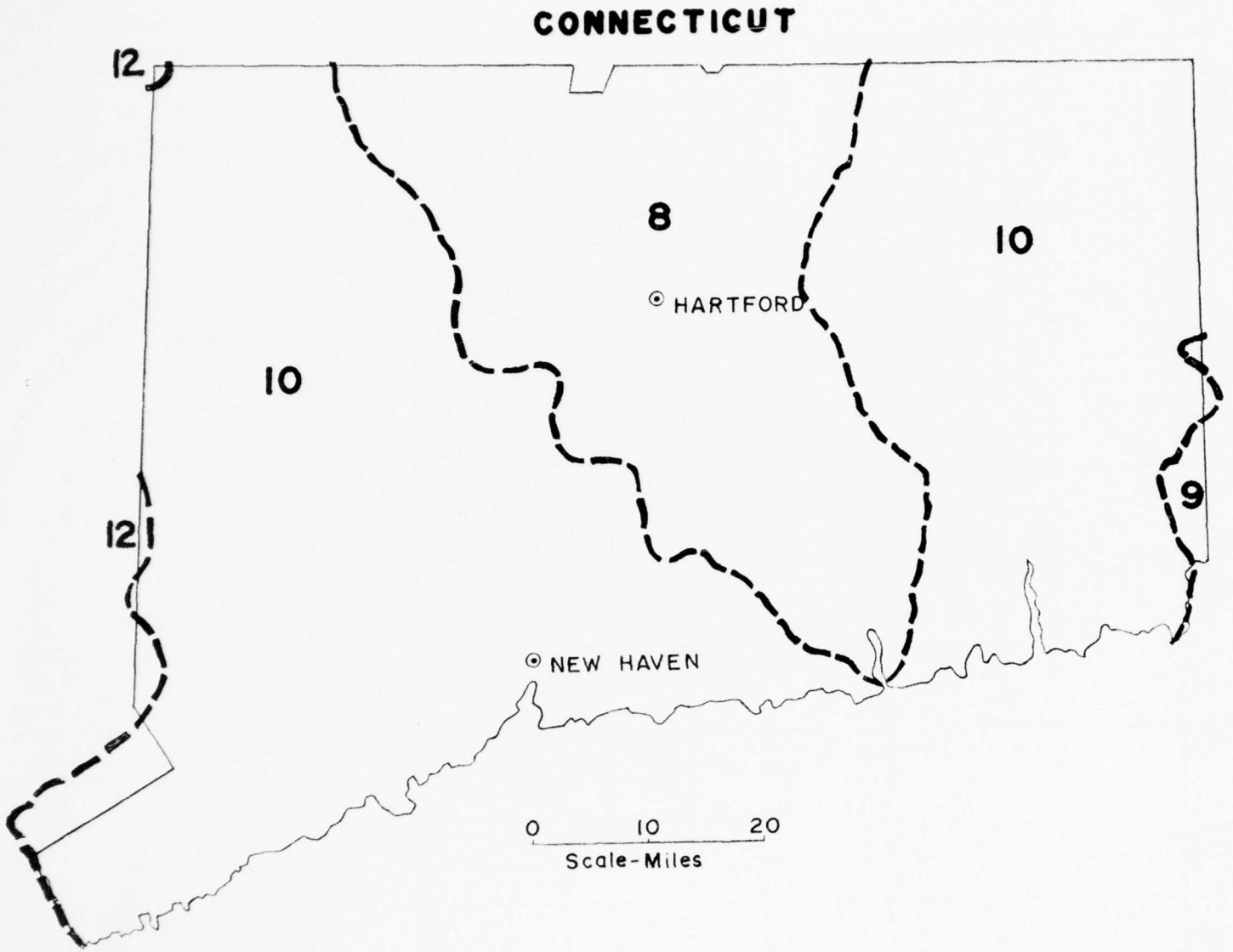
* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

	AREA 9			AREA 10			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	17	0	0									
	26	0	0									
	46	101	125	0.1	0.1	0.2						
	16	26	36									
	4.7	1.7	1.4									
	0	190	280									
	13	20	88	0.2	10	1						
	1600	0	0	100	0	0						
	0	2600	3900	0	100	100						
	0	140	220	0	10	10						
	1.7	1.4	2.7									
	0	2	0									
	34	61	49									
	60	50	50									
	5	0	0									

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	5.2	0	0
mainstream	9.7	0	0
wells	2.1	0.7	0.6
desalting			
Water Withdrawal and Conveyance Costs:			
inter-basin transfers	0	67	16
public water supply	2.8	9.7	16.6
industrial self-supplied water	0.18	0.38	0.41
rural water supply	x	x	x
irrigation, agriculture	0.163	0.013	0
non-agriculture	3.4	3.3	4.4
Power Plant Cooling Water	0	10	40
Hydroelectric Power Generation			
Navigation: commercial	0	25	50
recreational boating	1.3	3.2	3.8
Water Recreation	270	180	170
Fish and Wildlife: fishing	0.83	1.37	1.58
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	65	144	218
advanced	0	30	46
other /	280	0	0
Flood Damage Reduction: upstream			
mainstream	0	17	0
Drainage Control	0.047	0.131	0.048
Erosion Control	130	137	11
Health	x	x	x
Visual and Cultural	95	18	18
Summation of Available Estimated Costs	870	650	600

* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

	AREA 9			AREA 10			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	5.2	0	0									
	9.7	0	0									
	2.1	0.7	0.6									
	0	67	16									
	2.6	4.8	16.1	0.2	4.9	0.5						
	0.18	0.38	0.41									
	x	x	x									
	0.163	0.013	0									
	3.3	3.3	4.3	0.1	0.1	0.1						
	0	10	40									
	0	25	30									
	1.3	3.1	3.6	0.02	0.1	0.1						
	270	180	170									
	0.79	1.28	1.47	0.04	0.09	0.11						
	x	x	x	x	x	x						
	x	x	x	x	x	x						
	59	137	209	6	7	9						
	0	29	45	0	1	1						
	280	0	0									
	0	17	0									
	0.042	0.117	0.042	0.005	0.014	0.006						
	130	136	11	0.4	0.3	0.4						
	x	x	x	x	x	x						
	95	18	18									
	860	630	570	6.8	13.5	11.2						


CONNECTICUT
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HARTFORD
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NEW HAVEN
0 10 20
Scale-Miles

CONNECTICUT

Connecticut covers 5,007 square miles located primarily in Areas 8 and 10, with very small portions located in Areas 9 and 12. The topography of the State ranges from coastal plain to rolling hills with small amounts of steep hills. The visual quality of the State is medial. Water is generally abundant on the Housatonic and Thames Rivers, but the Connecticut River suffers from low flows, particularly in August and September. The quality of the water ranges from poor to extremely polluted.

A portion of coastal Connecticut lies within the metropolitan suburbs surrounding New York City, and that part of the State, plus the north-south route to Springfield, Massachusetts, is very densely populated. The 1970 population stood at almost 3 million and should surpass 5.9 million by 2020. Per capita income was 23 percent above the national average in 1970 but should decline to 12 percent above by the end of the Study period. Employment in services and related industries, which are highest in 1970, should increase by 150 percent by 2020, and increases are also projected for chemicals and allied products and paper and allied products. Employment declines are expected for agriculture forestry and fisheries, textile mill products and primary metals.

Needs to be Satisfied. The largest needs in this State are in Area 10 with the exception of Industrial Self-supplied Water, agricultural Irrigation, some Power Plant Cooling and Fish and Wildlife needs, forest Drainage Control, and high quality and unique natural landscape maintenance which are all largest in Area 8. The needs in Areas 9 and 12 are relatively insignificant or non-existent in size. The key needs are for Water Quality Maintenance in Area 8 and Erosion Control in Area 9. The important needs are Water Quality Maintenance in Areas 8, 10 and 12, Water Recreation in Areas 8 and 10 and Publicly Supplied Water in Areas 10 and 12. Other important needs are Fish and Wildlife and Visual and Cultural in Area 8, Health in Area 9, and Industrial Self-supplied Water in Area 10.

Devices. The largest levels of device implementation are all in Area 10 except fresh water intakes and pumping which is largest in Area 8. The one key device in this State is for erosion protection in Area 9. The important devices are storage facilities in Areas 8 and 10, withdrawal facilities in Area 12, quality control facilities in Areas 8, 10 and 12, and land controls and water demand and allocation changes in Area 10.

Costs. The agriculture Irrigation costs and the costs for combined sewer overflow controls are largest in Area 8. All other costs are largest in Area 10 which has the largest total cost in the State. The large expenditures are expected in Public Water Supply (2000), commercial navigation, (2020) Water Recreation (1980-2020), combined sewer overflow control (1980), Erosion Control (1980-2000), and Visual and Cultural (1980).

NEEDS-cumulative	STATE TOTAL			
	Pres.	1980	2000	2020
Publicly Supplied Water (mgd)	310	410	620	910
Industrial Self-Supplied Water (mgd)	190	320	590	1000
Rural Water Supply (mgd)	25	34	65	34
Irrigation Water: agriculture (1000 afy)	7	24	21	19
non-agriculture (1000 afy)	5	15	26	41
Power Plant Cooling: withdrawal, saline (cfs)	2100	5500	12600	18400
brackish (cfs)	1700	1500	2000	1900
fresh (cfs)	0	0	110	200
consumption, brackish (cfs)	16	15	19	20
fresh (cfs)	0	0	53	105
Hydroelectric Power Generation (mw)	130	780	3010	9010
Navigation: commercial (m. tons annually)	24	32	54	94
recreational boating (1000 boats)	130	180	330	690
Water Recreation: visitor days (m.)	x	110	190	280
stream or river (miles)	x	680	910	1280
water surface (1000 acres)	x	220	340	480
beach (acres)	x	1800	2400	3000
pool (m. sq. ft.)	x	31	41	51
land facilities (1000 acres)	x	120	170	220
Fish & Wildlife: sport fishing man-days (m.)	4.8	6.1	7.7	9.7
surface area, lake (acres)	x	0.8	3.0	8.2
stream (acres)	x	1.8	5.4	7.6
access, fresh (acres)	x	0.08	0.20	0.34
salt (acres)	x	0.19	0.63	1.15
anadromous (acres)	x	0.10	0.12	0.17
piers (1000 feet)	x	5	18	33
hunting, man-days (m.)	1.3	1.5	2.0	2.5
access (1000 sq. mi.)	x	0.26	0.81	1.23
nature study, man-days (m.)	3.3	4.0	5.1	6.5
access (1000 ac.)	x	0.7	2.0	3.5
Water Quality Maint.: non-industrial (m. PEs)	2400	3100	3900	4900
industrial (m. PEs)	460	910	1700	3200
Flood Damage Reduction:				
avg. ann. damage, upstream (m. $)	5	8	15	31
mainstream (m. $)	6	9	18	37
tidal and hurricane (m. $)	8	12	24	49
Drainage Control: cropland (1000 acres)	20	27	43	49
forest land (1000 acres)	0	0	2.4	8.0
wet land (1000 acres)				
Erosion Control: agriculture (1000 acres)	120	160	170	180
urban (1000 acres)	280	480	640	880
stream bank (mi.)	0	5	16	27
coastal shoreline (mi.)	0	70	150	150
Health: vector control and pollution control	x	x	x	x
Visual & Cultural:				
landscape maintenance, unique natural (sq. mi.)	100	640	640	640
unique shoreline (mi.)	x	80	80	80
high quality (sq. mi.)	x	28	56	84
diversity (sq. mi.)	x	10	20	30
agriculture (sq. mi.)				
landscape development, quality (sq. mi.)	x	230	460	690
diversity (sq. mi.)				
metro. amenities (mi.)				
" " (sq. mi.)	x	40	50	50

AREA 8				AREA 9				AREA 10				AREA 12			
Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
90	120	170	260					210	290	440	630	5	6	11	17
100	170	300	530					90	160	280	470				
6	8	10	8					20	26	55	25				
5	16	17	17					3	8	4	2				
1	2	4	6	0.1	0.2	0.4	0.6	4	13	22	35				
0	0	500	900					2100	5500	12100	17500				
1700	1500	2000	1400					0	0	0	500				
0	0	30	40					0	0	80	160				
16	15	19	15					0	0	0	5				
0	0	15	20					0	0	38	85				
								130	780	3010	9010				
4	5	7	10					20	28	47	84				
20	30	50	90					110	150	280	600				
x	30	40	70					x	90	140	210				
x	220	290	410					x	460	630	870				
x	70	100	150					x	150	240	330				
x	600	800	1000					x	1200	1600	2000				
x	11	14	17					x	20	27	34				
x	40	50	60					x	90	120	160				
1.8	2.5	3.1	3.9					3.0	3.6	4.6	5.8	0.1	0.1	0.1	0.1
x	0.3	1.0	1.9					x	0.6	2.0	6.3				
x	0.5	1.1	1.7					x	1.2	4.3	5.8				
x	0.04	0.08	0.13					x	0.04	0.12	0.21				
								x	0.19	0.63	1.15				
x	0.10	0.11	0.17					x	0.002	0.003	0.004				
								x	5	18	33				
0.7	0.9	1.1	1.4					0.6	0.6	0.8	1.1	0.03	0.03	0.03	0.04
x	0.11	0.18	0.26					x	0.15	0.64	0.98				
1.1	1.4	1.8	2.3					2.2	2.6	3.3	4.1	0.05	0.05	0.06	0.08
x	0.5	1.4	2.4					x	0.2	0.7	1.1				
800	900	1100	1500					1600	2100	2800	3400	40	50	60	70
270	530	990	1900					190	390	710	1310				
2	3	6	12	0.03	0.04	0.08	0.16	3	5	10	20				
3	4	9	18					3	5	9	19				
								8	12	24	49				
6	8	12	14	0.06	0.08	0.13	0.14	14	19	30	35				
0	0	1.1	4.2	0	0	0.4	1.0	0	0	0.9	2.8				
40	50	60	60	1	2	2	2	70	100	110	120				
70	100	130	180	10	10	10	10	200	370	500	690				
0	1	4	7	0	0.2	0.3	1.5	0	4	11	19				
								0	70	150	150				
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
100	640	640	640												
								x	80	80	80				
x	28	56	84												
								x	10	20	30				
								x	230	460	690				
								x	40	50	50				

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	Rec,FW,VC*	28	55	101
mainstream (1000 af)	FW,VC,Rec,WQ*	26	143	137
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	100	210	350
brackish (mgd)	Ind	180	250	120
wells (mgd)	*	18	17	95
Conveyance Facilities				
interbasin diversions, into (mgd)				
out of (mgd)				
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	18	301	56
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ,VC	3300	0	0
secondary (90%) (m. PEs removed)	WQ,VC	40	5080	7340
advanced (95%) (m. PEs removed)	WQ	0	280	410
Desalting Facilities	*	0	0	0.4
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC	7.6	12.6	6.6
Local Flood Protection				
ocean (projects)	FDR	2	0	0
river (projects)	FDR	10.0	1.0	2.5
flood control channels (miles)				
Watershed Management (1000 acres)	FDR,VC,Drn	290	350	280
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,FW	740	190	190
fee simple purchase (buying) (mi.)	VC,FW	15	0	0
purchase lease (sq.mi.)	VC,FW	84	52	43
easements (sq.mi.)	VC,FW	16	16	16
deed restrictions (sq.mi.)				
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)				
zoning (mi.)	VC,FW	65	0	0
zoning and/or tax inc. subs.(sq.mi.)	VC,FW	6	6	6
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage (1000 af)	FDR	31	0	3

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

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NORTH ATLANTIC REGIONAL WATER RESOURCES STUDY. ANNEX 2.(U)
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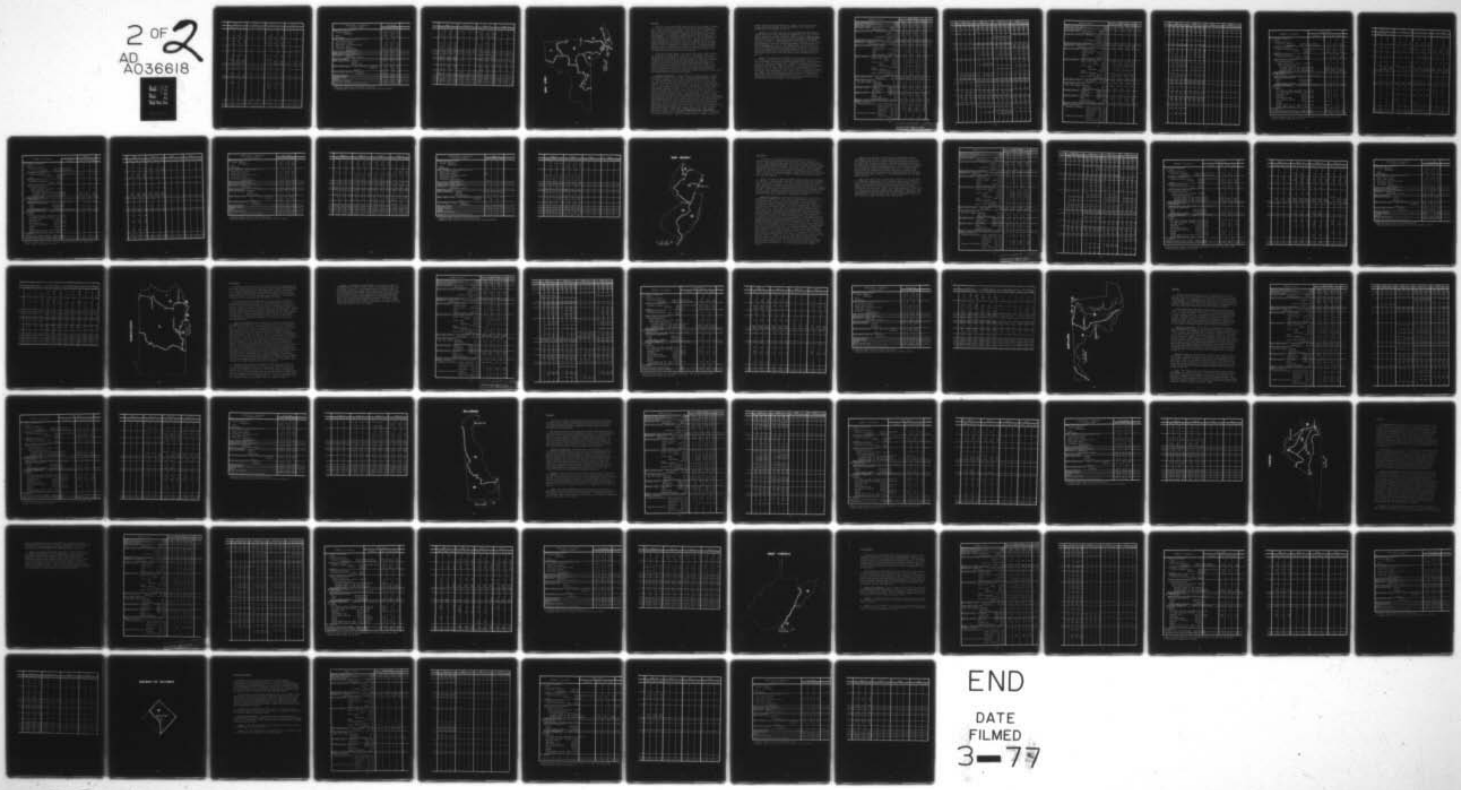

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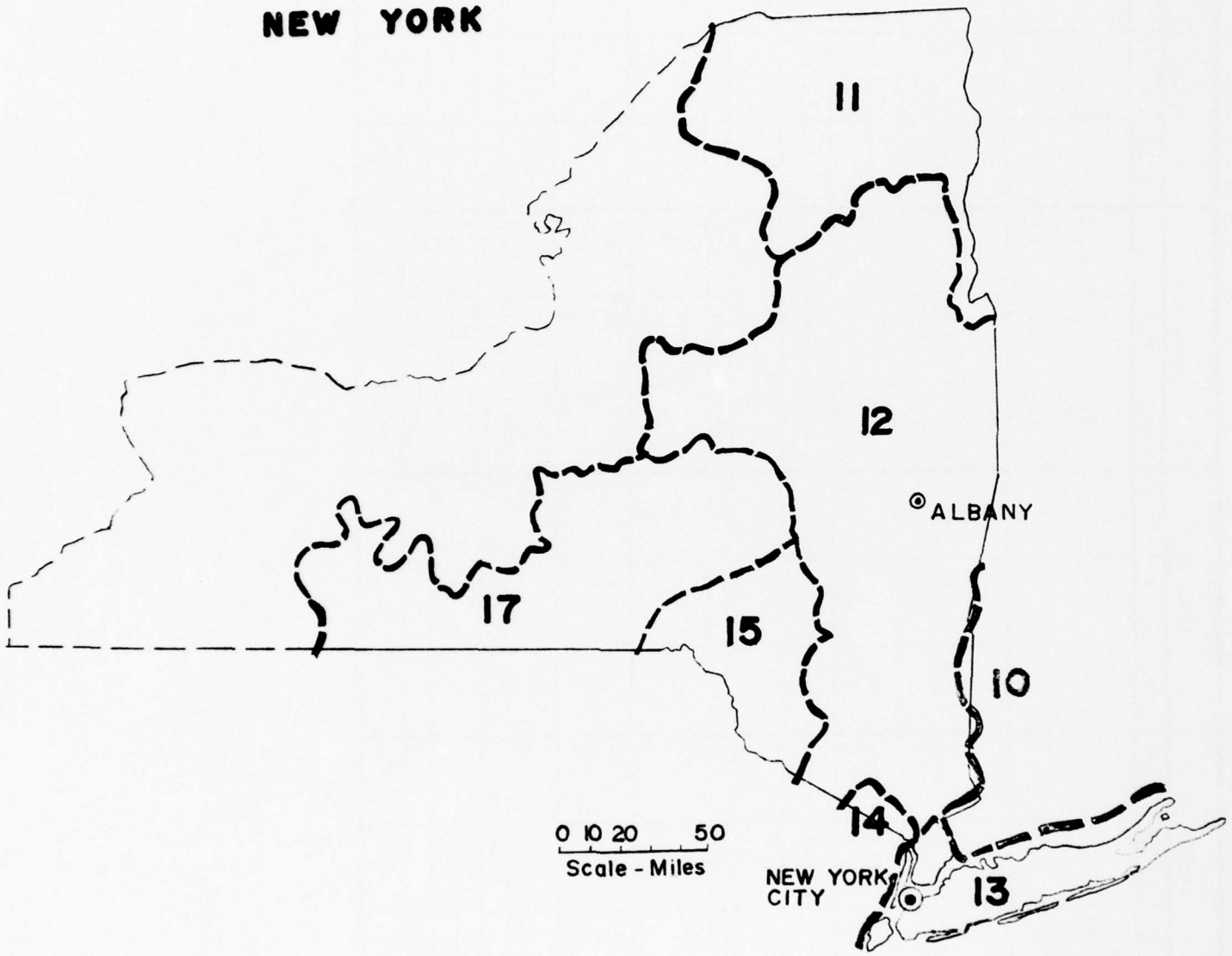
	AREA 8			AREA 9			AREA 10			AREA 12		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	6	50	0	8	0	0	15 26	5 143	101 137			
	60 1 6	120 2 2	180 3 0				50 180 13	90 250 14	170 120 95	0.4	1	2
	12 1200 0 0	16 0 1910 110	26 0 3070 170				6 2100 0 0	283 0 3120 170	25 0 4210 230	1 40 0	2 50 0	4 60 3
							0	0	0.4			
	2.2	2.5	4.0	0.4	0.4	0.5	5.0	9.7	2.0			
	1.0	0	0	0.5	0	0	2 8.5	0 1.0	0 2.5			
	70	90	80	3	5	2	220	250	200			
	550 8 6	0 8 6	0 8 6				190 15 84 8 65	190 0 52 8 0	190 0 43 8 0			
				2	0	0	29	0	3			

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL			
	1980	2000	2020	
Water Development Costs:				
storage, upstream	9.8	11.3	38.5	
mainstream	12	28	32	
wells	10.0	8.8	8.1	
desalting	0	0	0.8	
Water Withdrawal and Conveyance Costs:				
inter-basin transfers				
public water supply	11	144	30	
industrial self-supplied water	1.5	2.4	2.6	
rural water supply	x	x	x	
irrigation, agriculture	2.11	0.09	0.03	
non-agriculture	8.9	8.1	10.8	
Power Plant Cooling Water	0	39	75	
Hydroelectric Power Generation	x	x	x	
Navigation: commercial	58	57	122	
recreational boating	1.3	8.9	12.3	
Water Recreation	1210	690	640	
Fish and Wildlife: fishing	2.6	3.8	4.5	
hunting	x	x	x	
nature study	x	x	x	
Water Quality Maint.: waste treatment, secondary	270	360	510	
advanced	0	58	85	
other /	510	0	0	
Flood Damage Reduction: upstream	14.5	0	0.6	
mainstream	88.3	7.7	0	
Drainage Control	0.58	1.50	0.71	
Erosion Control	148	143	46	
Health	x	x	x	
Visual and Cultural	352	78	78	
Summation of Available Estimated Costs	2700	1600	1700	

* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

	AREA 8			AREA 9			AREA 10			AREA 12		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	1.3	7.2	0	2.3	0	0	6.2	4.1	38.5			
	0	0	4				12	28	28			
	3.0	1.2	0.1				7.0	7.6	8.0			
							0	0	0.8			
	6	9	14				4	133	13	1	2	3
	0.3	0.7	1.1				1.2	1.8	1.5			
	x	x	x				x	x	x			
	2.09	0.09	0.03				0.02	0	0			
	1.3	1.1	1.4	0.1	0.1	0.2	7.6	6.9	9.2			
	0	17	25				0	22	50			
							x	x	x			
	0	7	7				58	50	115			
	0.1	0.5	0.9				1.2	8.4	11.4			
	360	180	230				860	520	410			
	1.5	1.3	1.6				1.1	2.4	2.9	0.02	0.03	0.03
	x	x	x				x	x	x	x	x	x
	x	x	x				x	x	x	x	x	x
	90	110	170				180	250	330	3	4	4
	0	22	35				0	36	48	0	0	1
	270	0	0				250	0	0			
				0.4	0	0	14.2	0	0.6			
	42.1	0	0				46.2	7.7	0			
	0.17	0.44	0.24	0.002	0.005	0.002	0.41	1.05	0.47			
	6	5	7	0.2	0.4	1	142	138	39			
	x	x	x	x	x	x	x	x	x	x	x	x
	58	3	3				294	74	74			
	840	370	500	3.00	0.51	1.20	1900	1300	1200	4.0	6.0	8.0


NEW YORK
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ALBANY
NEW YORK CITY
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Scale - Miles

NEW YORK

New York State covers 30,099 square miles within the Region including all of Area 13; almost all of Area 12; over half of Area 11; parts of Area 15 and 17; and small portions of Areas 10 and 14. The major drainage of the State is the Hudson River, with other portions of the State draining into the St. Lawrence, Susquehanna and Delaware Rivers and into Lake Champlain. The topography ranges through the entire spectrum of classification from beach and coastal plain in the east to the mountains of the Catskills and Adirondacks in the west. Upstate New York is of high visual quality, central New York is rated medial, and the southern highly urbanized and metropolitan areas are classified as of low visual quality. Water is abundant in the State, but due to extreme population concentrations and considerable stretches of pollution along the major waterways, water must be imported, especially into Area 13 which is the most seriously water deficient Area in the Region.

Population totalled almost 15 million in the State in 1970, with by far the greatest concentration in the south in and around New York City, and projections for 2020 put the total at over 24 million. Per capita income was 26 percent above the national average in 1970, but is expected to decline to 15 percent above that average by 2020. Employment was highest in 1970 for services and related industries which employed 4.5 million and which are expected to employ over 8 million by 2020. Significant increases are also projected for chemicals and allied products while decreases are expected for agriculture, forestry and fisheries percent (50 percent), textile mill products (almost 50 percent), mining, food and kindred products and petroleum refining.

Needs to be Satisfied. The key needs in the State are Water Quality Maintenance in Areas 12, 13, 15 and 17, Publicly Supplied Water in Area 13, recreational boating in Area 15 and Visual and Cultural in Areas 13 and 14. The important needs are Publicly Supplied Water in all seven Areas, Industrial Self-supplied Water in Areas 11, 12, 15 and 17, Water Recreation in Areas 13, 15 and 17, and Water Quality Maintenance in all Areas except Area 11. Other important needs are Visual and Cultural in Areas 11 and 13, Flood Damage Reduction in Areas 12, 14, and 15, recreational boating in Area 13, and Fish and Wildlife in Area 14 and 15. Most of the needs are largest in either Area 12 or Area 13. The needs which are largest in Area 12 are Industrial Self-supplied Water, Rural Water Supply, Irrigation Water, Power Plant Cooling (except saline withdrawal) Hydroelectric Power Generation, Water Recreation (except visitor days), hunting access, upstream and mainstream Flood Damage Reduction, forest land Drainage Control, agricultural Erosion Control and Visual and Cultural (except unique shoreline and metropolitan amenities.) In Area 13 the needs are largest in Publicly Supplied Water, saline withdrawal, Navigation, Water Recreation, visitor days, and all of Fish and Wildlife (except stream surface area, fresh access, hunting man-days and hunting access). Other needs largest in Area 13 are Water Quality Maintenance, tidal and hurricane Flood Damage Reduction, urban Erosion Control and unique natural maintenance and metropolitan amenties development for Visual and Cultural. Cropland Drainage Control is largest in Area 11,

stream surface for Fish and Wildlife is largest in Area 15 and fresh access and hunting man-days for Fish and Wildlife and stream bank Erosion Control are largest in Area 17.

Devices. The devices which are key in the State are water quality control in Areas 13 and 15 and habitat management in Area 11. The important devices are storage facilities in Areas 10, 12, 15 and 17, withdrawal facilities in 12, 14, 15 and 17, wells in Area 15, and conveyance facilities in Area 13. Temperature control facilities are important in Areas 15 and 17, as are water quality control facilities in all Areas. Other important devices are watershed management, land facilities and habitat management in Area 11. The largest device levels occur in Area 12 with the following exceptions: mainstream flood control storage in Area 17, secondary (85%) waste treatment plants in Area 11, and brackish intakes and pumping, wells, diversions into basin, potable water treatment plants and secondary (90%) and advanced waste treatment plants in Area 13.

Costs. The largest costs incurred in meeting the needs of the State are in Areas 12 and 13 with the largest total expenditure in Area 13. Water development, Water Recreation and Drainage Control costs are largest in Area 12. Publicly Supplied water, Industrial Self-supplied Water, agricultural Irrigation, commercial navigation, and upstream Flood Damage Reduction costs are also largest in Area 12. The remaining costs are largest in Area 13, except for Erosion Control which is largest in Area 17. The largest total expenditures in the State will be for inter-basin transfers (2000), Publicly Supplied Water (2020), Power Plant Cooling Water (2020) and mainstream Flood Damage Reduction (1980). In addition, the expenditures for Water Recreation, Water Quality Maintenance and Visual and Cultural will be very large in all time periods.

NEEDS-cumulative			STATE TOTAL			
			Pres.	1980	2000	2020
Publicly Supplied Water		(mgd)	1700	2200	3000	4000
Industrial Self-Supplied Water		(mgd)	430	720	1290	2180
Rural Water Supply		(mgd)	86	118	141	110
Irrigation Water:	agriculture	(1000 afy)	31	82	128	134
	non-agriculture	(1000 afy)	25	64	106	162
Power Plant Cooling:	withdrawal, saline	(cfs)	9300	10900	18500	33100
	brackish	(cfs)	1500	10800	13300	5900
	fresh	(cfs)	630	1740	3510	5640
	consumption, brackish	(cfs)	14	98	119	52
	fresh	(cfs)	8	19	218	604
Hydroelectric Power Generation		(mw)	1600	4600	11000	27500
Navigation:	commercial	(m. tons annually)	100	120	190	290
	recreational boating	(1000 boats)	510	680	960	1870
Water Recreation:	visitor days	(m.)	x	200	320	560
	stream or river	(miles)	x	510	740	960
	water surface	(1000 acres)	x	120	170	240
	beach	(acres)	x	2000	2900	4500
	pool	(m. sq. ft.)	x	36	52	81
	land facilities	(1000 acres)	x	57	80	121
Fish & Wildlife:	sport fishing man-days	(m.)	21	24	29	35
	surface area, lake	(acres)	x	1.8	7.2	15.3
	stream	(acres)	x	0.08	0.54	1.29
	access, fresh	(acres)	x	0.19	0.52	0.92
	salt	(acres)	x	1.7	4.6	7.9
	anadromous	(acres)	x	0.046	0.063	0.084
	piers	(1000 feet)	x	49	130	224
	hunting, man-days	(m.)	4.8	5.3	6.4	7.6
	access	(1000 sq. mi.)	x	0.66	2.69	4.95
	nature study, man-days	(m.)	18	20	24	29
	access	(1000 ac.)	x	46	123	213
Water Quality Maint.:	non-industrial	(m. PEs)	13000	16000	20000	24000
	industrial	(m. PEs)	19000	38000	70000	133000
Flood Damage Reduction:						
avg. ann. damage,	upstream	(m. $)	4.1	6.0	10.9	20.4
	mainstream	(m. $)	13	19	37	75
	tidal and hurricane	(m. $)	32	49	91	176
Drainage Control:	cropland	(1000 acres)	210	310	490	570
	forest land	(1000 acres)	0	0.8	24.4	94.6
	wet land	(1000 acres)				
Erosion Control:	agriculture	(1000 acres)	3200	4100	4700	4800
	urban	(1000 acres)	1700	2000	2400	2900
	stream bank	(mi.)	0	73	219	366
	coastal shoreline	(mi.)	0	6	20	34
Health: vector control and pollution control			x	x	x	x
Visual & Cultural:						
landscape maintenance,	unique natural	(sq. mi.)	6200	6200	6200	6200
	unique shoreline	(mi.)	x	80	80	80
	high quality	(sq. mi.)	3400	3400	3400	3400
	diversity	(sq. mi.)	x	1200	2300	3400
	agriculture	(sq. mi.)	x	2600	2600	2600
landscape development,	quality	(sq. mi.)				
	diversity	(sq. mi.)				
	metro. amenities	(mi.)				
	" "	(sq. mi.)	x	110	110	110

AREA 10				AREA 11				AREA 12				AREA 13			
Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
20	30	40	100	30	30	50	100	200	300	400	700	1400	1700	2300	3000
				100	150	240	350	290	490	910	1560	20	30	60	110
				9	11	13	13	40	55	71	57	21	30	30	15
				0.3	7	20	20	9	41	82	82	19	15	0	0
0.3	1	2	3	1	4	6	10	5	18	30	46	14	27	44	66
												9300	10900	18500	33100
								1500	10800	13300	5900				
				0	0	30	80	400	1510	1900	2270				
								14	98	119	52				
				0	0	19	48	4	14	154	411				
				1200	1200	2100	2000	400	3400	7900	20500				
				1	1	1	2	30	40	60	90	60	70	110	170
1	2	3	10	20	20	30	50	70	120	180	310	380	490	680	1400
				x	10	10	20	x	70	110	200	x	110	170	280
				x	30	40	50	x	210	310	430	x	210	290	360
				x	10	10	20	x	50	80	110	x	50	60	80
				x	100	100	200	x	1000	1500	2300	x	700	900	1500
				x	2	2	3	x	17	25	40	x	14	18	28
				x	3	4	5	x	24	35	55	x	24	31	46
0.3	0.3	0.4	1	2	2	2	3	2	2	3	3	15	17	21	25
												x	1.2	3.4	5.9
				x	0	0.06	0.28								
				x	0.03	0.08	0.15	x	0.03	0.10	0.20	x	0.03	0.08	0.12
												x	1.7	4.6	7.9
								x	0.029	0.040	0.053				
												x	49	130	224
0.1	0.1	0.1	0.1	1.1	1.2	1.3	1.6	1.0	1.1	1.3	1.6	1.0	1.2	1.4	1.6
x	0.01	0.05	0.08	x	0	0.50	0.95	x	0.37	1.12	1.95	x	0.10	0.20	0.30
0.2	0.3	0.3	0.4	0.4	0.4	0.5	0.5	2	2	3	3	14	16	20	24
x	0.01	0.04	0.1					x	9	24	41	x	33	88	153
200	200	300	300	200	300	300	400	2000	2000	2000	3000	11000	13000	16000	19000
				1000	1000	2000	4000	4000	8000	14000	28000	14000	29000	53000	99000
				0.04	0.1	0.1	0.2	3.3	4.9	8.9	16.3				
				0.4	1	1	2	8	12	22	44	1	1	2	4
												32	49	91	176
1	2	2	3	80	120	190	230	60	90	150	190				
0	0	0.06	0.2	0	0	7.8	31.4	0	0	11.3	44.2				
10	10	10	10	300	400	500	500	1600	1900	2100	2200	100	100	100	100
20	30	40	100	100	100	100	200	500	600	700	800	600	600	700	700
0	0.3	1	2	0	17	50	84	0	14	43	71	0	1	4	7
												0	6	20	34
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
				2100	2600	2600	2600	3900	3900	3900	3900				
												x	80	80	80
								3400	3400	3400	3400				
				x	30	100	100	x	800	1600	2400	x	100	100	100
								x	2600	2600	2600				
								x	50	50	50	x	60	60	60

NEEDS-cumulative			AREA 14			
			Pres.	1980	2000	2020
Publicly Supplied Water		(mgd)	10	10	30	40
Industrial Self-Supplied Water		(mgd)				
Rural Water Supply		(mgd)				
Irrigation Water:	agriculture	(1000 afy)				
	non-agriculture	(1000 afy)	1	1	2	3
Power Plant Cooling:	withdrawal, saline	(cfs)				
	brackish	(cfs)				
	fresh	(cfs)				
	consumption, brackish	(cfs)				
	fresh	(cfs)				
Hydroelectric Power Generation		(mw)				
Navigation:	commercial	(m. tons annually)	10	10	20	30
	recreational boating	(1000 boats)	10	20	30	40
Water Recreation:	visitor days	(m.)				
	stream or river	(miles)				
	water surface	(1000 acres)				
	beaches	(acres)				
	pool	(m. sq. ft.)				
	land facilities	(1000 acres)				
Fish & Wildlife:	sport fishing man-days	(m.)	0.04	0.04	0.1	0.1
	surface area, lake	(acres)	0	0	0.3	0.8
	stream	(acres)	x	0.08	0.24	0.43
	access, fresh	(acres)	x	0.01	0.03	0.05
	salt	(acres)				
	anadromous	(acres)	x	0.001	0.001	0.001
	piers	(1000 feet)				
	hunting, man-days	(m.)	0.03	0.03	0.04	0.05
	access	(1000 sq. mi.)	x	0.01	0.03	0.05
	nature study, man-days	(m.)	0.1	0.1	0.1	0.1
	access	(1000 ac.)	x	1	3	6
Water Quality Maint.:	non-industrial	(m. PEs)	100	100	100	100
	industrial	(m. PEs)				
Flood Damage Reduction:						
avg. ann. damage,	upstream	(m. $)	0.004	0.01	0.01	0.02
	mainstream	(m. $)				
	tidal and hurricane	(m. $)				
Drainage Control:	cropland	(1000 acres)	1	2	2	3
	forest land	(1000 acres)				
	wet land	(1000 acres)				
Erosion Control:	agriculture	(1000 acres)	10	10	10	10
	urban	(1000 acres)	30	50	100	100
	stream bank	(mi.)	x	2	7	11
	coastal shoreline	(mi.)				
Health: vector control and pollution control			x	x	x	x
Visual and Cultural:						
landscape maintenance,	unique natural	(sq. mi.)				
	unique shoreline	(mi.)				
	high quality	(sq. mi.)				
	diversity	(sq. mi.)				
	agriculture	(sq. mi.)				
landscape development,	quality	(sq. mi.)				
	diversity	(sq. mi.)				
	metro. amenities	(mi.)				
	"	(sq. mi.)				

	AREA 15				AREA 17				AREA				AREA			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	10	10	10	20	100	100	100	200								
	4	10	20	30	20	40	70	130								
	3	5	7	6	13	17	21	20								
	0.4	1	1	1	3	19	25	31								
	3	8	13	21	2	5	9	15								
	0	0	590	710	230	230	1000	2590								
	0	0	25	81	4	5	20	64								
	30	100	1000	2000	0	0	0	3000								
	10	10	20	30	10	20	30	40								
	x	1	1	2	x	20	30	50								
	x	2	3	4	x	60	90	120								
	x	0.5	1	1	x	10	20	30								
	x	4	10	10	x	300	400	600								
	x	0.1	0.1	0.2	x	4	6	10								
	x	0.3	0.3	0.4	x	7	9	15								
	0.1	0.1	0.1	0.2	2	2	2	3								
	x	0.6	2.7	5.2	0	0	0.8	3.5								
	0	0	0.24	0.58												
	x	0.04	0.11	0.19	x	0.05	0.12	0.22								
	x	0.002	0.005	0.008	x	0.014	0.017	0.022								
	0.1	0.1	0.1	0.1	1.5	1.7	2.1	2.6								
	x	0.16	0.48	0.82	x	0	0.31	0.79								
	0.1	0.1	0.1	0.2	1	1	1	2								
	x	2	6	10	x	1	2	3								
	100	100	100	100	1000	1000	1000	1000								
	100	200	400	1000	100	100	300	1000								
	0.2	0.3	0.5	0.9	0.5	0.7	1.4	3.0								
	0.5	1	1	3	3	5	10	22								
	20	30	40	50	50	70	100	100								
	0	0	1.1	4.5	0	0.8	4.1	14.4								
	200	300	300	400	1000	1400	1600	1600								
	200	300	400	500	300	400	500	600								
	0	12	37	61	x	26	78	130								
	x	x	x	x	x	x	x	x								
	200	200	200	200												
	x	300	600	800												

DEVICES - incremental		STATE TOTAL			
		Purposes	1980	2000	2020
I. Resource Management					
A. Water					
Storage Facilities ϕ					
reservoirs, upstream	(1000 af)	Rec,FW,VC*	96	73	863
mainstream	(1000 af)	FW,VC,Rec,WQ*	23	150	691
Withdrawal Facilities					
intakes & pumping, fresh	(mgd)	PS,Ind,Pow,Irrig	280	860	1420
brackish	(mgd)	Ind	170	250	360
wells	(mgd)	*	190	330	370
Conveyance Facilities					
interbasin diversions, into	(mgd)	*	0	270	490
out of	(mgd)	*	0	270	1020
Quality Control Facilities					
chemical/biological					
potable water treat. plants	(mgd)	PS	50	463	815
waste treatment plants					
secondary (85%) (m. PEs removed)		WQ,VC	1600	0	0
secondary (90%) (m. PEs removed)		WQ,VC	47000	80000	141000
advanced (95%) (m. PEs removed)		WQ,VC	2100	3500	7600
Desalting Facilities					
B. Water/Land					
Upstream Flood Plain Mgmt.	(1000 acres)	FDR,VC,Drn,FW	13	93	114
Local Flood Protection					
ocean	(projects)	FDR	3	2	0
river	(projects)	FDR	17.5	10.5	1.0
flood control channels	(miles)				
Watershed Management	(1000 acres)	FDR,VC,Drn,FW	360	770	710
C. Land					
Controls					
fee simple purchase (buying)	(sq.mi.)	VC,FW	660	500	500
fee simple purchase (buying)	(mi.)	VC,FW	80	0	0
purchase lease	(sq.mi.)				
easements	(sq.mi.)	VC,FW	550	500	500
deed restrictions	(sq.mi.)	VC,FW	x	x	x
tax incentive subsidy	(sq.mi.)				
zoning	(sq.mi.)	VC,FW	500	0	0
zoning	(mi.)				
zoning and/or tax inc. subs.	(sq.mi.)	VC,FW	2690	90	90
zoning and/or tax inc. subs.	(mi.)				
V. Others					
Upstream Flood Control Storage	(1000 af)	FDR	44.8	5.1	3.8
Mainstream Flood Control Storage	(1000 af)	FDR	38	70	0

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

AREA 10			AREA 11			AREA 12			AREA 13		
1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
			3	14	6	69	35	613			
0	0	44	0	3	30	10	110	371			
0.2	0.4	0.5	50	80	100	200	420	660	5	310	560
						10	10	10	160	230	340
			10	20	10	3	40	30	150	210	290
									0	270	490
						0	270	1020			
1	28	3	4	8	16	31	87	179	5	309	562
200	0	0	1400	0	0						
0	200	300	0	2000	4000	9000	15000	28000	37000	61000	106000
0	10	20				0	0	1600	2100	3400	5900
			1	14	14	11	79	100			
									3	2	0
						11.5	0.5	0	0	1.0	0
			130	250	260	200	390	390			
			10	10	10	450	400	400	110	0	0
									80	0	0
			10	10	10	400	400	400	50	0	0
			500	0	0						
						2600	0	0			
						42.0	1.5	0			

DEVICES - incremental	Purposes	AREA 14 1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	Rec,FW,VQ*			
mainstream (1000 af)	FW,VC,Rec,WQ*			
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	0.5	4	20
brackish (mgd)	Ind			
wells (mgd)	*			
Conveyance Facilities				
interbasin diversions, into (mgd)	*			
out of (mgd)	*			
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	1	7	17
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ,VC			
secondary (90%) (m. PEs removed)	WQ,VC	100	100	100
advanced (95%) (m. PEs removed)	WQ,VC	10	10	10
Desalting Facilities				
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC,FW,Rec	0.02	0.4	0.3
Local Flood Protection				
ocean (projects)	FDR			
river (projects)	FDR	0	2.0	0
flood control channels (miles)				
Watershed Management (1000 acres)	FDR,VC,Drn,FW	4	10	10
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,FW			
fee simple purchase (buying) (mi.)	VC,FW			
purchase lease (sq.mi.)				
easements (sq.mi.)	VC,FW			
deed restrictions (sq.mi.)	VC,FW			
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)	VC,FW			
zoning (mi.)				
zoning and/or tax inc. subs.(sq.mi.)	VC,FW			
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage (1000 af)	FDR			
Mainstream Flood Control Storage (1000 af)	FDR			

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

	AREA 15			AREA 17			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	13	18	234	11 13	6 37	11 246						
	5 3 10	10 10 10	20 10 30	20 20	40 50	60 10						
	1 200 10	3 500 30	3 1000 50	9 1000 50	22 1000 100	36 2000 100						
	1	0	0.3									
	5.0	7.0	0	1.0	0	1.0						
	6	110	0	20	20	60						
	90 90 x 90	90 90 x 90	90 90 x 90									
	2.8	3.6	0	0 38	0 70	3.8 0						

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	26	22	157
mainstream	13	91	189
wells	41	48	29
desalting			
Water Withdrawal and Conveyance Costs:			
inter-basin transfers	0	380	150
public water supply	44	171	262
industrial self-supplied water	2.2	3.9	6.0
rural water supply	x	x	x
irrigation, agriculture	9.1	13.4	1.1
non-agriculture	34	34	45
Power Plant Cooling Water	0	140	320
Hydroelectric Power Generation	x	x	x
Navigation: commercial	30	98	27
recreational boating	12	24	40
Water Recreation	1400	1000	1900
Fish and Wildlife: fishing	19	31	35
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	3000	6100	10600
advanced	430	720	1920
other /	3700	0	0
Flood Damage Reduction: upstream	5.8	4.3	2.0
mainstream	211	90	0
Drainage Control	6.1	11.2	6.8
Erosion Control	105	122	91
Health	x	x	x
Visual and Cultural	760	210	210
Summation of Available Estimated Costs	9800	9300	16000

* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

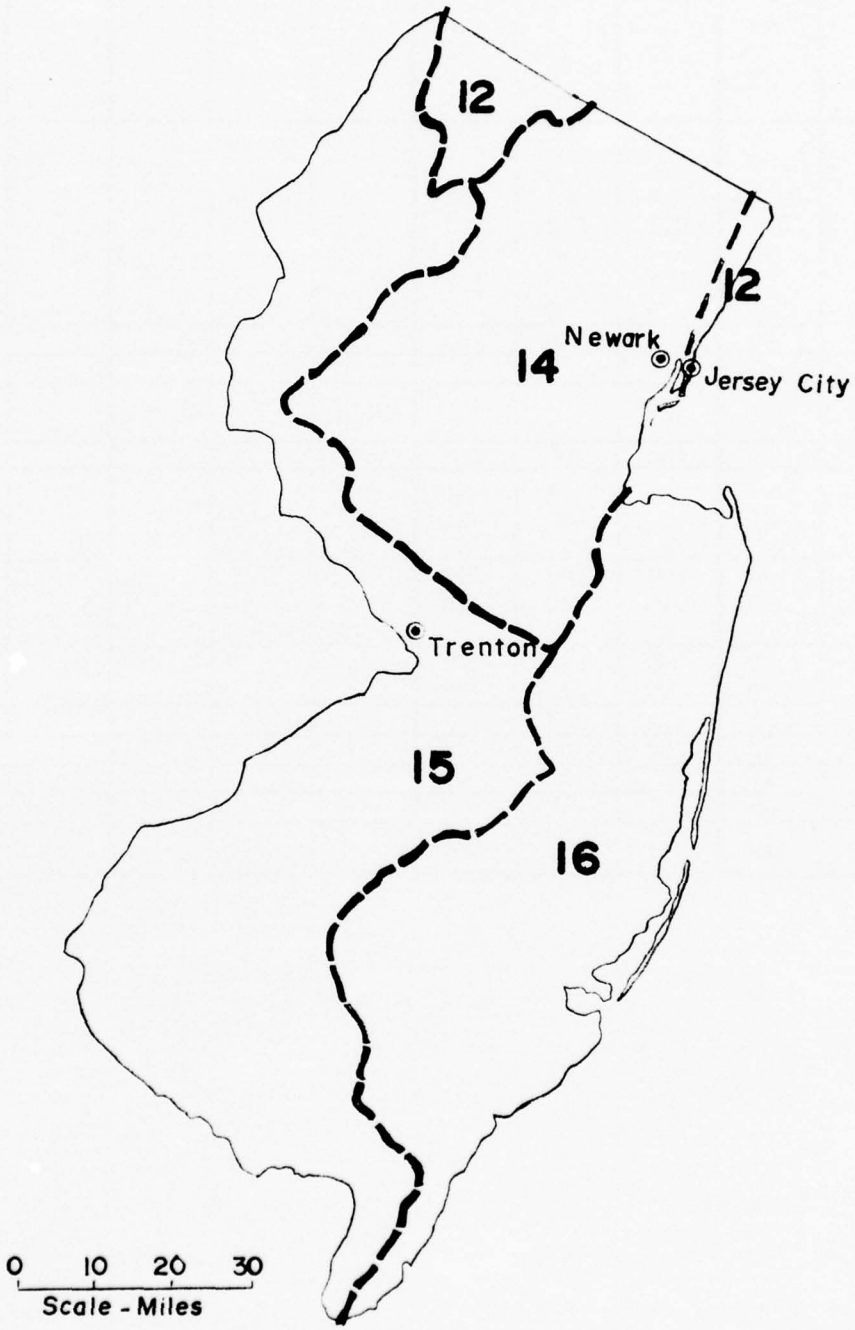
AREA 10			AREA 11			AREA 12			AREA 13		
1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
			1	3	1	16	7	87			
0	0	21	0	4	24	2	69	74			
			6	9	3	17	23	3	4	6	17
									0	380	150
0.4	13	1	4	7	13	27	70	109	5	63	112
			0.2	0.4	0.5	1.1	2.1	3.3	0.9	1.2	1.8
			x	x	x	x	x	x	x	x	x
			1.4	3.0	0	5.6	9.4	0			
1	1	1	3	2	3	11	10	12	11	14	19
			0	10	40	0	80	180			
				x		x	x	x			
						0	80	27	30	18	0
0.01	0.1	0.1	0.3	1	1	4	7	11	7	14	25
			4	10	10	900	500	900	300	400	700
0.1	0.2	0.3	0.5	1	1	1	1	1	17	27	31
x	x	x	x	x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x	x	x	x	x
10	20	20	100	200	300	600	1100	1900	2100	4700	8100
0	3	3				0	0	680	420	700	1210
			40	0	0	300	0	0	3400	0	0
						5.5	3.9	0			
						15	0	0	182	55	0
0.03	0.1	0.04	2.6	5.4	3.4	1.6	2.6	2.6			
2	2	2	14	13	6	32	31	21	11	23	15
x	x	x	x	x	x	x	x	x	x	x	x
			2	2	2	160	140	140	530	0	0
14	39	48	180	270	410	2100	2100	4200	7000	6400	10400

FIRST COSTS - incremental ($ million 1970)	AREA 14		
	1980	2000	2020
Water Development Costs:			
storage, upstream			
mainstream			
wells			
desalting			
Water Withdrawal and Conveyance Costs:			
inter-basin transfers			
public water supply	0.4	2	3
industrial self-supplied water			
rural water supply			
irrigation, agriculture			
non-agriculture	0.5	1	1
Power Plant Cooling Water			
Hydroelectric Power Generation			
Navigation: commercial			
recreational boating	1	1	1
Water Recreation			
Fish and Wildlife: fishing	0.01	0.02	0.02
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	10	10	10
advanced	1	1	2
other /			
Flood Damage Reduction: upstream			
mainstream	0	14	0
Drainage Control	0.03	0.1	0.02
Erosion Control	3	2	2
Health	x	x	x
Visual and Cultural			
Summation of Available Estimated Costs	16	31	19

* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

	AREA 15			AREA 17			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	4	9	61	5	3	8						
				11	18	70						
	2	2	2	11	9	4						
	1	2	2	6	14	22						
	0.03	0.1	0.1	0.1	0.2	0.3						
	x	x	x	x	x	x						
	0.1	0.1	0	2.1	1.0	1.1						
	4	4	6	3	3	4						
	0	40	60	0	10	40						
		x	x			x						
	0.02	0.3	0.5	0.2	1	1						
	2	2	3	200	100	200						
	0.04	0.1	0.1	1	1	1						
	x	x	x	x	x	x						
	x	x	x	x	x	x						
	10	30	100	100	100	200						
	0.4	5	10	10	10	20						
	0.3	0.4	0	0	0	2.0						
	2	4	0	12	16	0						
	0.5	1.3	0.5	1.3	1.7	0.3						
	11	14	14	32	37	30						
	x	x	x	x	x	x						
	60	60	60									
	97	174	319	395	325	604						

NEW JERSEY


12
12
14
Newark
Jersey City
Trenton
15
16
0 10 20 30
Scale - Miles

NEW JERSEY

New Jersey covers 7,836 square miles including all of Area 16, most of Area 14, a significant portion of Area 15 and a small part of Area 12. The significant drainages in the State are the eastern portion of the Delaware River drainage area and all of the smaller Passaic, Raritan and Hackensack Rivers in the north. The overall visual quality is medial, though there are sections of both high and low quality. The topography ranges from flatland and coastal plain to undulating land and rolling hills. The water is seriously degraded in many sectors and it is projected that the State will soon have to import considerable quantities to augment existing supplies.

Most of the State is densely populated, particularly in the northeast and southwest. The population was almost 7 million in 1970 and is expected to reach 13.3 million by 2020. Per capita income was 20 percent above by 2020. Employment is highest in services and related industries, which should increase by over 130 percent by the end of the Study period. Chemicals and allied products also has high employment and should have large increases by 2020. Other increases are projected in primary metals and paper and allied products, while decreases are projected for textile mill products, petroleum refining and agriculture, forestry and fisheries.

Needs to be Satisfied. Water Quality Maintenance is a key and important need in Areas 12, 15 and 16 and an important need in Area 14. Recreational boating is key, in the Delaware basin, to the fulfillment of its important Water Recreation need. Similarly, Visual and Cultural development of quality landscapes and metropolitan amenties is key to the important Water Recreation needs in the urban, industralized and densely populated Area 14. Other important needs are Publicly Supplied Water in all Areas, Fish and Wildlife, Flood Damage Reduction and recreational boating in Area 14, Industrial Self-supplied Water, commercial navigation, Fish and Wildlife and Flood Damage Reduction in Area 15 and Industrial Self-supply in Area 16. The need for Irrigation Water is largest in Area 15 (agriculture) and in Area 14 (non-agriculture). The Hydroelectric Power Generation and Power Plant Cooling needs are largest in Area 15 except for saline and brackish withdrawals which are largest in Area 16. The Fish and Wildlife needs are largest in Area 15 except for surface area stream access and nature study man-days and access in Area 14 and sport fishing man-days, salt access, and piers in Area 16. Flood Damage Reduction is largest in Area 14 except for tidal and hurricane in Area 16. The largest Drainage Control needs are for cropland in Area 15, forest land in area 16 and wet land in Area 14. Agriculture Erosion Control is largest in Area 15, urban and stream bank Erosion Control are largest in Area 14 and coastal shoreline erosion control is largest in Area 16. The Visual and Cultural needs that are largest in Area 14 are quality development and metropolitan amenties (mi.) in Area 15 they are diversity and agricultural development and metropolitan amenties (sq. mi.), and in Area 16, unique natural and unique shoreline maintenance. The remaining needs are all largest in Area 14.

Devices. The key device in the State is water quality control facilities in Area 15 which is also important in Areas 12, 14 and 15. Other important devices are storage facilities and withdrawal facilities in Areas 14 and 15, wells in Area 15, conveyance facilities in Area 14, and temperature control facilities in Area 15. The largest device levels in Area 15 are out-of-basin diversions, flood control channels, easements and zoning and/or tax incentive subsidies (sq. mi.). In Area 16 the devices which are largest are secondary (85%) waste treatment plants, desalting facilities, ocean projects, fee simple purchase (mi.) purchase lease and zoning (sq. mi. and mi.). The remaining devices are all largeest in Area 14.

Cost. The largest costs incurred in the State are in Area 14 which has the largest expenditures in all categories except for the following. Area 15 has the largest expenditures for agriculture Irrigation Water, commerical navigation, and Visual and Cultural needs and for wells. The largest costs in Area 16 are recreational boating, Fish and Wildlife, Drainage Control and Erosion Control. The large expenditures in the State as a whole are for Publicly Supplied Water (2000-2020), commercial navigation (1980-2000), and mainstream Flood Damage Reduction (1980-2000). The expenditures for Water Recreation, Water Quality Maintenance and Visual and Cultural are also very large in all time periods.

NEEDS-cumulative		STATE TOTAL			
		Pres.	1980	2000	2020
Publicly Supplied Water	(mgd)	780	1040	1800	2860
Industrial Self-Supplied Water	(mgd)	480	840	1260	1960
Rural Water Supply	(mgd)	30	41	57	51
Irrigation Water: agriculture	(1000 afy)	52	149	162	132
non-agriculture	(1000 afy)	14	34	57	87
Power Plant Cooling: withdrawal, saline	(cfs)	5000	9500	28600	58500
brackish	(cfs)	1100	800	3700	8500
fresh	(cfs)	710	500	390	470
consumption, brackish	(cfs)	9	13	47	114
fresh	(cfs)	5	10	41	78
Hydroelectric Power Generation	(mw)	350	850	1450	2400
Navigation: commercial	(m. tons annually)	160	210	290	460
recreational boating	(1000 boats)	200	270	410	650
Water Recreation: visitor days	(m.)	x	110	170	310
stream or river	(miles)	x	220	340	460
water surface	(1000 acres)	x	58	87	123
beach	(acres)	x	640	960	1560
pool	(m. sq. ft.)	x	12	19	30
land facilities	(1000 acres)	x	33	48	75
Fish & Wildlife: sport fishing man-days	(m.)	11	13	16	20
surface area, lake	(acres)	x	0.9	5.0	10.1
stream	(acres)	x	0.22	0.97	1.92
access, fresh	(acres)	x	0.089	0.242	0.423
salt	(acres)	x	0.92	2.77	4.96
anadromous	(acres)	x	0.008	0.015	0.022
piers	(1000 feet)	x	26	79	141
hunting, man-days	(m.)	3.7	4.2	5.1	6.2
access	(1000 sq. mi.)	x	0.36	1.14	1.88
nature study, man-days	(m.)	8.1	9.3	11.4	13.9
access	(1000 ac.)	x	39	104	180
Water Quality Maint.: non-industrial	(m. PEs)	7000	7700	9400	11500
industrial	(m. PEs)	14000	32000	69000	143000
Flood Damage Reduction:					
avg. ann. damage, upstream	(m. $)	2.1	3.1	5.4	9.9
mainstream	(m. $)	19	29	55	105
tidal and hurricane	(m. $)	7	11	21	41
Drainage Control: cropland	(1000 acres)	64	84	135	148
forest land	(1000 acres)	0	0	9.7	40.2
wet land	(1000 acres)	x	x		
Erosion Control: agriculture	(1000 acres)	520	660	760	770
urban	(1000 acres)	940	1300	1730	2130
stream bank	(mi.)	0	59	177	295
coastal shoreline	(mi.)	0	110	240	270
Health: vector control and pollution control		x	x	x	x
Visual & Cultural:					
landscape maintenance, unique natural	(sq. mi.)	x	300	300	300
unique shoreline	(mi.)	x	38	38	38
high quality	(sq. mi.)				
diversity	(sq. mi.)	x	280	560	850
agriculture	(sq. mi.)	x	200	200	200
landscape development, quality	(sq. mi.)	x	230	460	690
diversity	(sq. mi.)				
metro. amenities	(mi.)	x	2	2	2
" "	(sq. mi.)	x	170	170	170

AREA 12				AREA 14				AREA 15				AREA 16			
Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
30	50	80	120	500	660	1210	1980	160	200	280	410	90	130	230	350
				280	450	470	480	190	380	770	1440	10	10	30	40
				15	19	26	21	12	18	26	24	3	4	5	6
				4	9	6	3	34	94	111	84	14	45	45	45
0.2	1	1	2	7	16	27	40	4	10	17	27	3	8	12	18
				5000	4800	6400	10100	0	2000	8500	12100	0	2700	13700	36400
				0	0	0	1500	700	500	400	300	300	300	3300	6700
				0	0	10	60	710	500	370	410				
				0	0	0	14	6	10	14	31	3	3	33	69
				0	0	7	33	5	10	34	45				
				10	130	130	300	340	720	1320	2100				
				130	150	220	330	30	50	70	120	0.3	0.4	0.8	1
1	2	4	10	120	170	240	390	60	80	110	180	20	30	50	70
				x	80	130	230	x	3	10	10	x	20	40	70
				x	170	260	350	x	10	10	20	x	40	60	90
				x	48	70	99	x	2	3	5	x	8	13	19
				x	490	730	1170	x	20	30	50	x	120	200	340
				x	10	14	23	x	0.4	1	1	x	2	4	7
				x	27	39	61	x	1	2	3	x	4	7	11
0.4	0.4	0.5	1	2	2	3	3	2	2	3	3	7	8	10	13
				x	0	0.9	2.0	x	0.8	3.4	6.7	x	0.1	0.7	1.4
				x	0.22	0.66	1.17	0	0	0.31	0.75				
x	0.001	0.007	0.013	x	0.023	0.071	0.128	x	0.057	0.140	0.240	x	0.008	0.024	0.042
								x	0.06	0.15	0.26	x	0.86	2.63	4.71
x	0.002	0.003	0.004	x	0.001	0.002	0.003	x	0.003	0.007	0.011	x	0.002	0.003	0.004
								x	2	4	7	x	25	75	134
0.2	0.2	0.2	0.3	1.4	1.6	1.9	2.3	1.5	1.7	2.1	2.6	0.6	0.7	0.9	1.1
x	0.004	0.01	0.02	x	0.19	0.42	0.70	x	0.17	0.51	0.86	x	0	0.20	0.30
0.4	0.4	0.5	0.6	4.4	4.9	5.9	7.1	1.8	2.1	2.7	3.3	1.6	1.9	2.3	2.9
x	0.4	1	2	x	22	62	108	x	8	20	35	x	8	21	36
300	300	400	500	4000	4900	6000	7200	1300	1600	2000	2500	1500	800	1000	1300
				12000	26000	52000	105000	2000	5000	13000	30000	1000	1000	4000	8000
				1.0	1.6	2.9	5.4	1.0	1.4	2.3	4.2	0.1	0.1	0.2	0.3
				19	29	55	105								
								2	3	7	14	5	7	14	28
2	3	5	6	18	24	38	41	25	32	52	58	19	25	40	43
0	0	0.4	1.4					0	0	1.4	5.8	0	0	8.0	33.0
				x	x										
50	60	70	70	120	140	160	160	270	370	440	450	80	80	90	90
20	20	20	30	460	710	920	1090	240	330	460	590	220	250	320	420
0	1	2	3	0	35	104	174	0	16	47	78	0	8	24	40
								0	20	40	40	0	90	200	230
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
												x	300	300	300
								x	8	8	8	x	30	30	30
				x	30	60	90	x	250	500	760				
								x	200	200	200				
				x	130	260	390					x	100	200	300
				x	2	2	2								
				x	60	60	60	x	90	90	90	x	20	20	20

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	Rec,FW,VC*	163	21	273
mainstream (1000 af)	FW,VC,Rec,WQ*	0	108	15
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	300	530	1410
brackish (mgd)	Ind	530	820	1190
wells (mgd)	*	28	139	133
Conveyance Facilities				
interbasin diversions, into (mgd)	*	35	300	530
out of (mgd)	*	35	300	0
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	50	421	925
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ,VC	1900	0	0
secondary (90%) (m. PEs removed)	WQ,VC	34000	70000	139000
advanced (95%) (m. PEs removed)	WQ,VC	2100	3900	7700
Desalting Facilities	*	0	0	6.0
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC,Drn,FW	11	12	17
Local Flood Protection				
ocean (projects)	FDR	4	0	0
river (projects)	FDR	15.5	23.0	1.0
flood control channels (miles)	FDR	1.0	28.7	0
Watershed Management (1000 acres)	FDR,VC,Drn	57	310	109
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,FW	440	230	230
fee simple purchase (buying) (mi.)	VC,FW	25	0	0
purchase lease (sq.mi.)	VC,FW	220	100	100
easements (sq.mi.)	VC,FW	149	99	99
deed restrictions (sq.mi.)	VC,FW	x	x	x
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)	VC,FW	150	0	0
zoning (mi.)	VC,FW	15	0	0
zoning and/or tax inc. subs.(sq.mi.)	VC,FW	224	84	84
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage (1000 af)	FDR	13	91	9
Mainstream Flood Control Storage (1000 af)	FDR	47	314	0

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

	AREA 12			AREA 14			AREA 15			AREA 16		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
				138	0.4	0	15	21	273	10	0	0
				0	108	0				0	0	15
	3	10	10	140	190	780	150	320	610	20	20	10
				370	520	740	150	270	430	20	20	20
	0.2	3	2	9	119	16	20	17	79	0	0	36
				35	300	530						
							35	300	0			
	6	16	33	27	356	843	17	49	49			
										1900	0	0
	300	400	500	28000	52000	101000	6000	13000	29000	0	4000	9000
	0	0	30	1500	2900	5600	500	700	1600	0	200	500
										0	0	6.0
				6	12	16	4	0	1	1	0	0
										4	0	0
				13.5	13.0	1.0	2.0	10.0	0			
							1.0	28.7	0			
				48	148	109	9	162	0			
				210	150	150	80	80	80	150	0	0
				2	0	0	8	0	0	15	0	0
							100	0	0	120	100	100
				15	15	15	134	84	84			
							x	x	x			
										150	0	0
										15	0	0
							224	84	84			
				12	40	9	1	51	0			
				0	256	0	47	58	0			

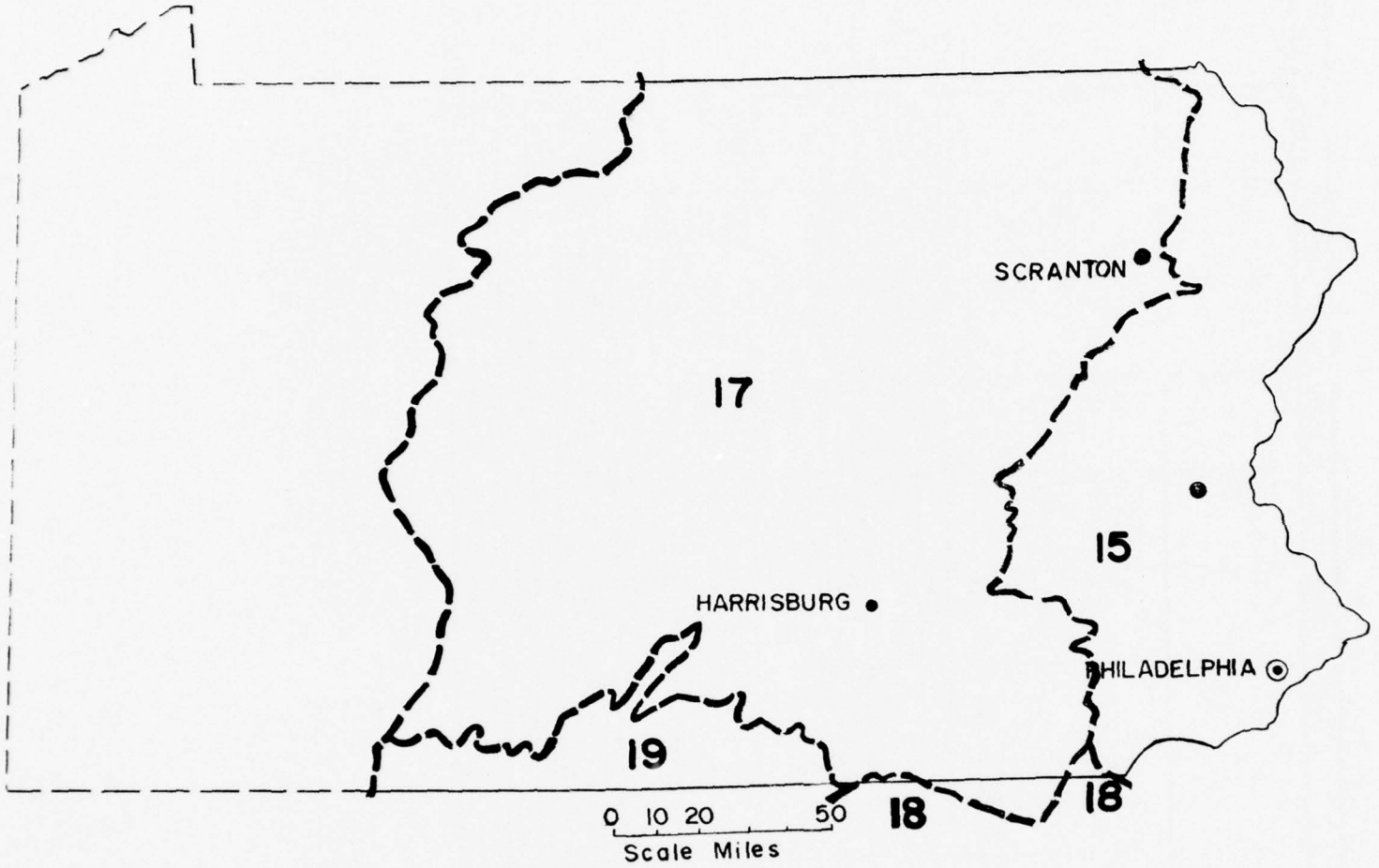
FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	36	11	72
mainstream	0	54	11
wells	11.2	13.6	8.7
desalting	0	0	13
Water Withdrawal and Conveyance Costs:			
inter-basin transfers	10	89	417
public water supply	38	133	210
industrial self-supplied water	4.4	6.2	9.8
rural water supply	x	x	x
irrigation, agriculture	11.5	4.7	0
non-agriculture	16	18	22
Power Plant Cooling Water	0	24	50
Hydroelectric Power Generation	x	x	x
Navigation: commercial	249	230	5
recreational boating	15	26	32
Water Recreation	440	380	640
Fish and Wildlife: fishing	4.8	8.9	10.6
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	2600	5400	11000
advanced	360	810	1590
other /	930	0	0
Flood Damage Reduction: upstream	5.3	14.9	0.8
mainstream	280	410	0
Drainage Control	1.6	4.4	2.2
Erosion Control	165	186	88
Health	x	x	x
Visual and Cultural	580	180	180
Summation of Available Estimated Costs	5800	8000	14400

* From the supply model and includes OMR costs.

/ Combined sewer overflows control and acid mine drainage control.

AREA 12			AREA 14			AREA 15			AREA 16		
1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
			31	0.2	0	4	11	72	1	0	0
			0	54	0				0	0	11
1.0	1.3	0.1	4.6	7.6	1.2	5.6	4.7	5.7	0	0	1.7
									0	0	13
			10	89	417						
5	13	20	17	86	143	16	34	46	0.1	0.1	0
			2.6	2.8	4.0	1.5	3.1	5.6	0.2	0.3	0.3
			x	x	x	x	x	x	x	x	x
			0.3	0	0	7.4	4.7	0	3.8	0	0
0.4	0.3	0.4	7	9	11	5	5	7	3	3	4
			0	6	7	0	17	40	0	2	3
			x		x	x	x	x			
			99	0	0	140	220	0	10	10	5
0.1	0.1	0.2	8	9	13	1	2	3	6	14	16
			430	360	610	10	10	20	2	10	10
0.1	0.2	0.3	0.5	1.0	1.1	0.8	1.2	1.4	3.4	6.6	7.7
x	x	x	x	x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x	x	x	x	x
20	30	30	2200	3900	7700	200	1000	2200	200	500	1000
0	0	10	350	610	1210	10	150	280	0	50	90
			910	0	0				30	0	0
			4.0	7.9	0.8	1.3	7.0	0			
			120	410	0				160	0	0
0.1	0.1	0.1	0.4	1.1	0.3	0.6	1.6	0.6	0.5	1.5	1.2
1	1	1	41	36	28	44	49	20	79	100	39
x	x	x	x	x	x	x	x	x	x	x	x
			130	70	70	230	60	60	220	50	50
28	46	62	4400	5700	10200	680	1580	2760	720	750	1250

PENNSYLVANIA



PENNSYLVANIA

Pennsylvania covers 28,994 square miles in the NAR including approximately half of Area 15, most of Area 17 and small portions of Areas 18 and 19. The major drainages are the Susquehanna river and the western portion of the Delaware River drainage. The predominant land form is rolling hills, and the visual quality is medial. Water quality is poor, in some upstream sections, due to acid mine drainage and municipal and industrial pollution, but it is generally good throughout the State.

The eastern portion of Pennsylvania is urban with heavy population concentrations east of Harrisburg. The 1970 population was almost 7.7 million and is projected to surpass 11.3 million by 2020. Per capita income was 2 percent above the national average in 1970 and is expected to decrease slightly to just over 1 percent above that average by 2020. Employment was largest in services and related industries and employment in that category and in paper and allied products and chemicals and allied products is projected to increase significantly by 2020. Decreases are expected for agriculture, forestry and fisheries (over 50 percent), petroleum (over 50 percent), textile mill products (over 50 percent) and in food and kindred products.

Needs to be Satisfied. The key needs in the State are Water Quality Maintenance in all Areas, recreational boating in Area 15 and Visual and Cultural in Areas 18 and 19. The important needs are Publicly Supplied Water in Areas 15, 17, and 19, and Water Quality Maintenance in all Areas. Other important needs in Area 15 are Industrial Self-supplied Water, commercial navigation, Water Recreation, Fish and Wildlife, and Flood Damage Reduction. There are important needs for Industrial Self-supplied Water and Water Recreation in Area 17, and for Erosion Control and Visual and Cultural in Area 19. The needs are the largest in Areas 15 for Publicly Supplied Water, Industrial Self-supplied Water, Navigation, and Water Quality Maintenance. The needs are largest in Area 17 for Rural Water Supply, Hydroelectric Power Generation, Drainage Control and Erosion Control. The Irrigation Water needs are largest in Area 17 for agriculture and Area 15 for non-agriculture. The Power Plant Cooling and Water Recreation needs are largest in Area 17 except for brackish withdrawal and consumption, visitor days and land facilities, which are largest in Area 15. The needs for Fish and Wildlife and Visual and Cultural are largest in Area 15 except for anadromous access, hunting man-days, unique natural landscape maintenance and diversity landscape development which are largest in Area 17. Mainstream Flood Damage Reduction is largest in Area 15 but upstream Flood Damage Reduction is largest in Area 17. The needs in Areas 18 and 19 are either relatively small or non-existant.

Devices. Water quality maintenance facilities are key devices in Area 15 and important devices in all Areas. Also important are storage facilities, withdrawal facilities and temperature control facilities in Areas 15 and 17 and wells in Area 15. All of the devices are largest in Area 15 with the following exceptions: mainstream reservoir storage, wells, watershed management, fee simple purchase (sq. mi.) and river projects and storage reservoirs for Flood Damage Reduction. These are largest in Area 17. Secondary (85%) waste treatment plants is largest in Area 18.

Costs. The largest total investments for Areas are in Area 17 (1980) and Area 15 (2000 and 2020). Most of the individual need costs are largest in Area 15. The remaining costs are largest in Area 17 and include mainstream storage, wells, agricultural Irrigation, Power Plant Cooling Water, Recreation, Flood Damage Reduction, Drainage Control and Erosion Control. The significantly large expenditures are for mainstream storage (2020), Industrial Self-supplied Water (2000-2020), Power Plant Cooling (2000-2020) commercial navigation (1980-2000), and advanced waste treatment (2000-2020). The needs for Water Recreation, secondary waste treatment and Visual and Cultural are also significantly large in all time periods.

NEEDS-cumulative		STATE TOTAL			
		Pres.	1980	2000	2020
Publicly Supplied Water	(mgd)	870	1120	1620	2430
Industrial Self-Supplied Water	(mgd)	1200	2200	4500	8300
Rural Water Supply	(mgd)	86	123	164	154
Irrigation Water: agriculture	(1000 afy)	13	78	100	115
non-agriculture	(1000 afy)	14	42	73	115
Power Plant Cooling: withdrawal, saline	(cfs)				
brackish	(cfs)	3600	3500	5100	10800
fresh	(cfs)	4300	5200	7900	9700
consumption, brackish	(cfs)	25	10	19	47
fresh	(cfs)	47	252	458	753
Hydroelectric Power Generation	(mw)	1200	3300	13300	32800
Navigation: commercial	(m. tons annually)	73	106	147	237
recreational boating	(1000 boats)	120	150	220	360
Water Recreation: visitor days	(m.)	x	180	280	480
stream or river	(miles)	x	640	930	1260
water surface	(1000 acres)	x	150	220	310
beach	(acres)	x	1700	2500	3900
pool	(m. sq. ft.)	x	32	46	71
land facilities	(1000 acres)	x	92	121	184
Fish & Wildlife: sport fishing man-days	(m.)	13	16	20	25
surface area, lake	(acres)	x	2.7	10.6	25.9
stream	(acres)	x	0.28	0.78	1.50
access, fresh	(acres)	x	0.27	0.68	1.18
salt	(acres)				
anadromous	(acres)	x	0.053	0.073	0.096
piers	(1000 feet)				
hunting, man-days	(m.)	11	13	16	20
access	(1000 sq. mi.)	x	0.41	2.42	5.01
nature study, man-days	(m.)	10	12	15	19
access	(1000 ac.)	x	18	49	87
Water Quality Maint.: non-industrial	(m. PEs)	7300	9100	11500	14400
industrial	(m. PEs)	11000	38000	71000	163000
Flood Damage Reduction:					
avg. ann. damage, upstream	(m. $)	6.0	9.0	16.8	33.8
mainstream	(m. $)	17	26	52	108
tidal and hurricane	(m. $)				
Drainage Control: cropland	(1000 acres)	240	330	470	480
forest land	(1000 acres)	0	2.7	17.4	62.8
wet land	(1000 acres)				
Erosion Control: agriculture	(1000 acres)	4200	5600	6700	6800
urban	(1000 acres)	1600	2000	2700	3600
stream bank	(mi.)	0	130	400	660
coastal shoreline	(mi.)				
Health: vector control and pollution control		x	x	x	x
Visual & Cultural:					
landscape maintenance, unique natural	(sq. mi.)	1000	1000	1000	1000
unique shoreline	(mi.)				
high quality	(sq. mi.)				
diversity	(sq. mi.)	x	950	1900	2860
agriculture	(sq. mi.)	x	1100	1100	1100
landscape development, quality	(sq. mi.)				
diversity	(sq. mi.)	x	180	180	180
metro. amenities	(mi.)				
" "	(sq. mi.)	x	140	140	140

	AREA 15				AREA 17				AREA 18				AREA 19			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	580	740	1030	1490	270	350	540	860	3	4	10	10	20	30	50	70
	800	1600	3200	6000	300	600	1200	2100					40	100	100	200
	31	48	70	65	49	64	79	75					6	10	15	15
	4	10	11	9	8	60	78	97					2	8	11	10
	8	21	38	61	5	18	31	48	0	0.1	0.2	0.3	1	2	4	6
	2800	2200	4400	9600									800	1300	700	1200
	1800	2000	2000	2200	2500	3200	5900	7500								
	25	10	19	47												
	22	88	189	349	25	164	269	404								
	40	1000	1900	3400	1200	2300	11400	29400								
	73	106	147	237												
	70	90	130	210	50	60	100	150								
	x	110	170	280	x	60	100	180					x	10	10	20
	x	270	400	530	x	330	490	650					x	40	40	80
	x	70	100	140	x	70	110	150					x	10	10	20
	x	700	900	1400	x	1000	1500	2400					x	100	100	100
	x	13	18	27	x	18	26	42					x	1	1	2
	x	45	50	72	x	43	65	102					x	4	6	9
	7	8	10	13	6	8	9	12	0.1	0.1	0.1	0.1	0.4	0.5	1	1
	x	1.2	5.6	10.9	0	0	2.7	11.6					x	1.4	2.2	3.4
	x	0	0.50	1.22									x	0.28	0.28	0.28
	x	0.09	0.23	0.39	x	0.16	0.42	0.14					x	0.02	0.04	0.05
	x	0.005	0.011	0.018	x	0.046	0.058	0.073					x	0.002	0.004	0.005
	5	6	8	10	6	6	8	10	0.02	0.02	0.02	0.03	0.2	0.2	0.3	0.4
	x	0.38	1.15	1.95	x	0	1.08	2.77	x	0.01	0.01	0.02	x	0.02	0.18	0.27
	6	8	10	12	3	4	5	6	0.03	0.03	0.04	0.05	0.2	0.3	0.4	0.6
	x	15	39	70	x	1	4	7	x	0.1	0.3	1	x	2	5	10
	4600	5800	7400	9200	2500	3000	3800	4800	20	30	30	40	100	200	300	400
	9000	25000	65000	151000	1000	3000	6000	11000					100	200	400	900
	2.0	2.8	4.7	8.4	4.0	6.1	12.1	25.4								
	9	14	28	57	8	12	24	51					0.1	0.1	0.3	1
	60	70	120	130	170	240	330	330	3	5	10	10	10	20	20	20
	0	0	3.1	12.8	0	2.7	13.7	47.5	0	0	0.1	0.5	0	0	0.6	2.1
	600	800	1000	1000	3400	4400	5300	5400	4	10	10	10	300	400	400	500
	500	700	1000	1300	1000	1200	1500	2100	4	10	10	20	100	100	100	200
	0	30	100	170	0	90	260	440	0	0.2	0.6	1	0	10	30	50
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
					1000	1000	1000	1000								
	x	550	1100	1660	x	300	600	900					x	100	200	300
	x	600	600	600	x	300	300	300					x	200	200	200
					x	180	180	180	x	180	180	180				
	x	90	90	90	x	50	50	50								

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ¢				
reservoirs, upstream (1000 af)	Rec,FW,VC*	59	45	279
mainstream (1000 af)	FW,VC,Rec,WQ*	84	137	484
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	880	1860	3430
brackish (mgd)	Ind	610	1130	1790
wells (mgd)	*	94	195	115
Conveyance Facilities				
interbasin diversions, into (mgd)	*	37	0	0
out of (mgd)				
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	110	280	350
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ,VC,Rec	24	0	0
secondary (90%) (m. PEs removed)	WQ,VC	34000	75000	160000
advanced (95%) (m. PEs removed)	WQ,VC	1700	4200	8900
Desalting Facilities				
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC,FW	6.3	1.0	2.7
Local Flood Protection				
ocean (projects)				
river (projects)	FDR	13	7	7
flood control channels (miles)				
Watershed Management (1000 acres)	FDR,VC,Drn	85	365	287
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,FW	820	330	330
fee simple purchase (buying) (mi.)				
purchase lease (sq.mi.)	VC,FW	500	0	0
easements (sq.mi.)	VC,FW	570	430	430
deed restrictions (sq.mi.)	VC,FW	x	x	x
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)				
zoning (mi.)				
zoning and/or tax inc. subs.(sq.mi.)	VC,FW	420	180	180
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage	FDR	13	35	51
Mainstream Flood Control Storage	FDR	61	0	0

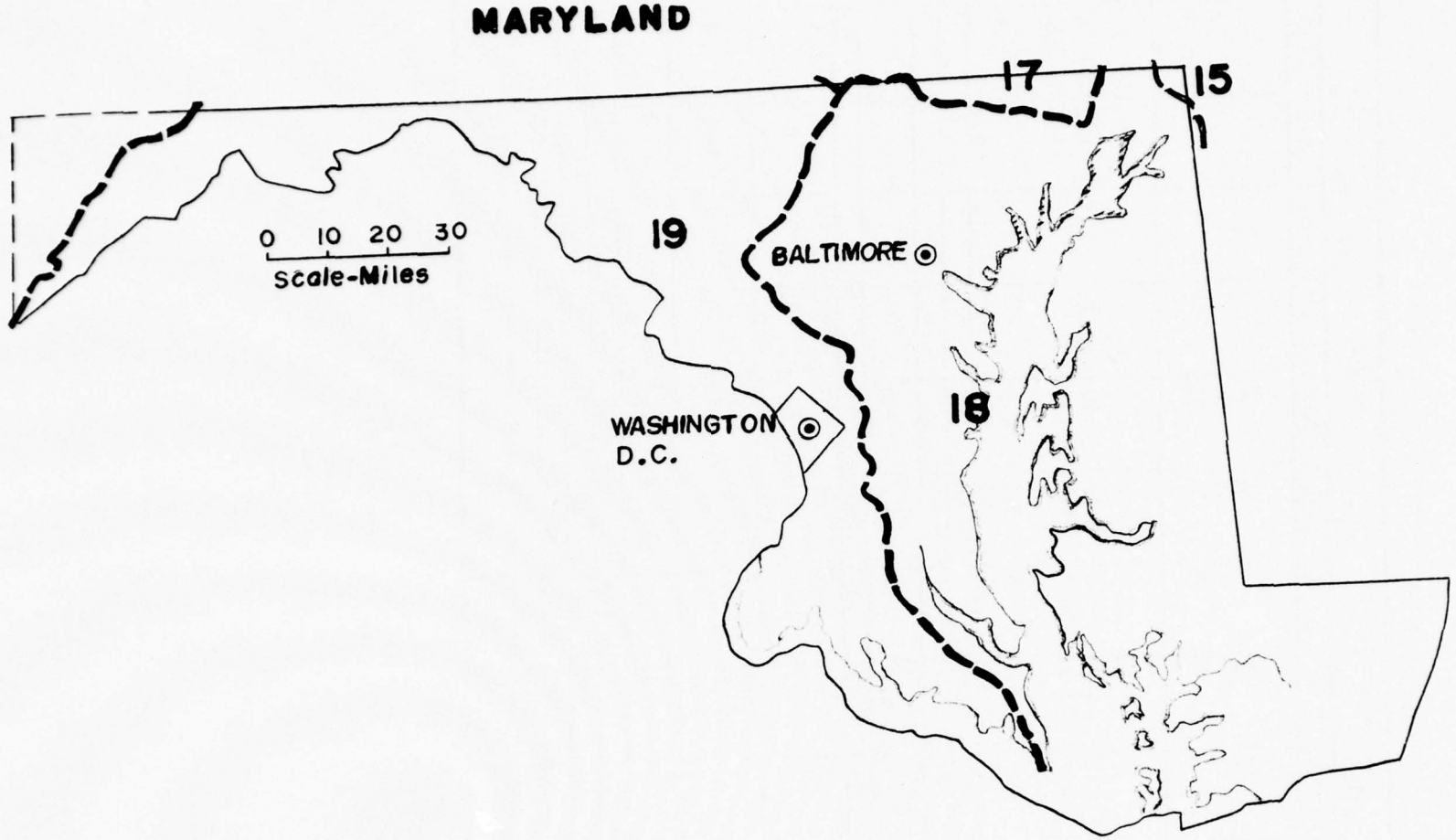
* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
¢ Flood control storage not included.

	AREA 15			AREA 17			AREA 18			AREA 19		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	13	18	234	45	27	45						
	4	19	173	79	111	260				0	8	51
	600	1300	2530	250	500	820				40	60	80
	610	1130	1790							2	3	4
	22	19	87	67	175	24				5	1	3
	37	0	0									
	60	180	180	40	80	140	0	0.1	1	10	20	30
							24	0	0			
	28000	66000	145000	5000	8000	14000	0	30	40	300	1000	1000
	1400	3700	8000	300	500	800	0	0	2	20	40	100
	6.3	0	1.7	0	1.0	1.0						
	6	4	0	7	3	7						
	13	245	0	72	60	287						
	180	180	180	630	150	150				10	0	0
	300	0	0							200	0	0
	330	180	180	150	150	150				90	100	100
	x	x	x									
	420	180	180									
	0	29	0	13	6	51						
				61	0	0						

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	26	21	97
mainstream	25	55	207
wells	43	37	20
desalting			
Water Withdrawal and Conveyance Costs:			
inter-basin transfers	9.7	0	0
public water supply	87	192	271
industrial self-supplied water	7.8	15.6	27.5
rural water supply	x	x	x
irrigation, agriculture	8.7	4.6	3.5
non-agriculture	24	23	30
Power Plant Cooling Water	0	150	340
Hydroelectric Power Generation	x	x	x
Navigation: commercial	200	230	0
recreational boating	1.4	4.6	6.7
Water Recreation	1190	880	1560
Fish and Wildlife: fishing	6.4	8.7	10.6
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	1300	5900	12600
advanced	84	846	1540
other /	3.4	0	0
Flood Damage Reduction: upstream	5.7	12.7	27.2
mainstream	60	0	0
Drainage Control	6.1	10.0	2.5
Erosion Control	140	170	140
Health	x	x	x
Visual and Cultural	690	220	220
Summation of Available Estimated Costs	3900	8800	17100

* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

AREA 15			AREA 17			AREA 18			AREA 19		
1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
4	9	61	22	12	35						
3	16	107	22	31	82				0	7	17
6	5	6	36	31	13				1	1	1
9.7	0	0									
57	126	169	25	56	87	0.04	0.1	0.2	5	11	15
6.3	12.7	22.9	1.3	2.6	4.2				0.2	0.3	0.4
x	x	x	x	x	x				x	x	x
0.8	0.5	0	6.8	3.3	3.5				1.1	0.8	0
11	12	16	11	10	13	0.1	0.1	0.1	1	1	2
0	60	120	0	90	220						
x	x	x	x	x	x						
200	230	0									
1.2	2.1	3.8	0.7	2.5	2.9						
270	350	530	900	500	990				20	30	40
3.0	4.4	5.3	2.8	3.8	4.7	0.05	0.04	0.04	0.5	0.5	0.6
x	x	x	x	x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x	x	x	x	x
700	4900	11000	600	900	1500	3	3	4	40	100	100
21	742	1365	59	97	162	0	0	0.4	4	7	13
3.4	0	0									
0	11.0	0	5.7	1.7	27.2						
19	0	0	41	0	0						
1.3	3.6	1.4	4.4	5.8	1.1	0.1	0.1	0.01	0.3	0.6	0.1
30	40	40	100	120	90	1	1	1	10	10	10
x	x	x	x	x	x	x	x	x	x	x	x
320	130	130	270	70	70				110	20	20
1700	6700	13600	2100	1900	3300	4.3	4.3	5.8	190	190	220


MARYLAND
17
15
19
0 10 20 30
Scale-Miles
BALTIMORE
18
WASHINGTON
D.C.

MARYLAND

Maryland covers 10,158 square miles including most of Area 18, part of Area 19 and a very small portion of Areas 15 and 17. The major drainages flow into chesapeake Bay or form part of the northern Potomac River drainage. The topography ranges from beach and flatland to heavily forested mountains, but in general is of low relief. Water supplies are polluted around population centers and supplies must be imported to augment the insufficient supplies around those population centers.

Maryland has heavy population concentrations in the center of the State. The 1970 population totalled over 3.7 million and is expected to top 7.4 million by 2020. Per capita income was 7 percent above the national average in 1970 but is projected to decline to 4 percent above by 2020. Employment in 1970 as highest for services and related industries, which is expected to increase by 150 percent by 2020. Increases are also expected for paper and allied products, chemicals and allied products, and primary metals, while decreases are projected for food and kindred products and agriculture, forestry and fisheries.

Needs to be Satisfied. The key needs in Maryland are for Water Quality Maintenance in Areas 17, 18 and 19 and for Visual and Cultural in Areas 18 and 19. The important needs are Publicly Supplied Water in Areas 17 and 19, Water Quality Maintenance in Areas 17, 18 and 19, Erosion Control in Areas 19 and Visual and Cultural in Areas 18 and 19. The needs in Area 18 are the largest with a few exceptions. These exceptions are the entire needs for Hydroelectric Power Generation, and Water Recreation and the needs for fresh withdrawal and consumption for Power Plant Cooling, surface area, access, piers and hunting man-days for Fish and Wildlife, mainstream Flood Damage Reduction, agricultural and stream bank erosion control and agricultural landscape maintenance and diversity landscape development for Visual and Cultural. All of the above needs are largest in Area 19 except for diversity landscape development which is largest in Area 17.

Devices. There are no key devices in the State. Quality control facilities is important in Areas 17, 18, and 19. Other important devices are storage facilities, withdrawal facilities, and temperature control facilities in Area 17, and land controls in Area 18. The largest device levels are in Area 18 except for out of basin diversions in Area 17 and mainstream storage, potable water treatment plants, secondary (90%) and advance waster treatment plants, watershed management and flood control storage in Area 19.

Costs. The largest total cost for an Area and most of the largest expenditures for needs are in Area 18. Area 19 has the largest costs for mainstream storage, publicly Supplied Water, Power Plant Cooling, Water Recreation, advanced waste treatment, and Flood Damage Reduction. The significantly large expenditures in the State will be for desalting (2000) inter-basin transfers (2020), Water Recreation (1980-2020), advanced waste treatment (2020) and Visual and Cultural (1980).

NEEDS-cumulative	STATE TOTAL			
	Pres.	1980	2000	2020
Publicly Supplied Water (mgd)	380	530	800	1200
Industrial Self-Supplied Water (mgd)	240	460	880	1510
Rural Water Supply (mgd)	48	75	114	121
Irrigation Water: agriculture (1000 afy)	8	36	55	53
non-agriculture (1000 afy)	4.3	12.2	22.0	35.3
Power Plant Cooling: withdrawal, saline (cfs)	200	200	12300	32700
brackish (cfs)	2600	6800	10900	10300
fresh (cfs)	400	380	990	1030
consumption, brackish (cfs)	42	96	112	119
fresh (cfs)	4	9	46	90
Hydroelectric Power Generation (mw)	440	480	980	2000
Navigation: commercial (m. tons annually)	55	70	115	186
recreational boating (1000 boats)	140	170	290	400
Water Recreation: visitor days (m.)	x	26	44	79
stream or river (miles)	x	200	270	440
water surface (1000 acres)	x	38	58	90
beach (acres)	x	300	460	720
pool (m. sq. ft.)	x	5.2	8.0	12.5
land facilities (1000 acres)	x	22	34	52
Fish & Wildlife: sport fishing man-days (m.)	8.5	10.0	13.0	16.6
surface area, lake (acres)	x	38	56	81
stream (acres)	x	3.9	4.6	4.6
access, fresh (acres)	x	0.47	0.78	1.15
salt (acres)	x	0.46	1.38	2.50
anadromous (acres)	x	0.040	0.061	0.089
piers (1000 feet)	x	13	39	71
hunting, man-days (m.)	3.1	3.6	4.5	5.8
access (1000 sq. mi.)	x	0.74	1.36	2.19
nature study, man-days (m.)	4.3	5.0	6.6	8.6
access (1000 ac.)	x	9.9	34.8	65.3
Water Quality Maint.: non-industrial (m. PEs)	2800	4200	5500	7100
industrial (m. PEs)	1100	2700	6600	14200
Flood Damage Reduction:				
avg. ann. damage, upstream (m. $)	9.7	13.4	18.8	27.7
mainstream (m. $)	4.1	7.8	16.6	36.4
tidal and hurricane (m. $)	4.0	6.7	12.9	25.5
Drainage Control: cropland (1000 acres)	260	380	510	510
forest land (1000 acres)	0	0.04	10	41
wet land (1000 acres)				
Erosion Control: agriculture (1000 acres)	980	1460	1840	1910
urban (1000 acres)	440	830	1180	1650
stream bank (mi.)	0	39	118	197
coastal shoreline (mi.)	0	38	78	81
Health: vector control and pollution control	x	x	x	x
Visual & Cultural:				
landscape maintenance, unique natural (sq. mi.)	x	140	140	140
unique shoreline (mi.)	x	260	260	260
high quality (sq. mi.)				
diversity (sq. mi.)	x	300	600	900
agriculture (sq. mi.)	x	200	200	200
landscape development, quality (sq. mi.)	x	200	400	600
diversity (sq. mi.)	x	120	120	120
metro. amenities (mi.)				
" " (sq. mi.)	x	85	85	85

AREA 15				AREA 17				AREA 18				AREA 19			
Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
				10	10	10	20	240	330	470	670	130	190	310	510
								150	300	600	1070	90	160	280	440
								29	44	68	75	19	31	46	45
								6	27	42	42	2	9	13	12
				0.1	0.2	0.4	0.6	3.3	8.8	16.2	26.3	0.9	3.2	5.4	8.4
								200	200	10300	26900	x	0	2000	5800
								2600	6800	10900	10300				
								0	0	50	90	400	380	930	940
6	10	10	16					29	80	97	93	7	6	5	10
								0	0	26	45	4	9	20	45
				440	480	480	1000	1	0	0	0	0	0	500	1000
				0.1	0.1	0.1	0.2	53	68	111	180	2	2	4	6
				10	10	10	20	90	110	200	260	50	50	90	120
								x	11	17	31	x	16	27	48
								x	90	140	190	x	110	130	250
								x	18	26	37	x	20	32	52
								x	140	200	330	x	160	260	400
								x	2.4	3.5	5.6	x	2.8	4.5	6.9
								x	10	15	23	x	11	19	29
				0.2	0.2	0.2	0.3	5.7	6.4	8.0	9.8	2.6	3.3	4.8	6.5
				x	0	0.1	1	x	18	24	33	x	20	31	47
								x	0	0.7	0.7	x	3.9	3.9	3.9
				x	0.01	0.02	0.04	x	0.18	0.27	0.37	x	0.28	0.49	0.75
								x	0.17	0.51	0.92	x	0.29	0.87	1.58
				x	0.002	0.003	0.003	x	0.003	0.008	0.015	x	0.035	0.050	0.071
								x	5	15	26	x	8	25	45
				0.1	0.2	0.2	0.3	1.6	1.9	2.1	2.5	1.4	1.5	2.2	3.0
				x	0	0.01	0.04	x	0.68	0.91	1.52	x	0.05	0.43	0.64
				0.1	0.1	0.1	0.2	2.6	3.0	3.7	4.5	1.6	2.0	2.8	3.9
								x	6.5	23.4	43.9	x	3.4	11.4	21.4
				100	100	100	100	2000	2600	3200	4000	700	1600	2200	3000
								700	1500	3400	7500	500	1300	3200	6700
				0.03	0.05	0.1	0.2	8.8	11.9	15.9	22.0	0.9	1.5	2.8	5.5
								0.7	1.2	2.2	4.4	3.4	6.6	14.4	32.0
								4.0	6.7	12.9	25.5				
				2	3	4	4	230	340	460	460	30	40	50	50
				0	0.04	0.2	0.6	0	0	9	35	0	0	1	5
				40	70	100	100	280	530	730	760	660	860	1010	1050
				10	60	80	130	300	580	810	1110	120	190	290	410
				0	1	3	5	0	14	41	68	0	25	74	124
								0	33	68	71	0	5	9	10
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
								x	140	140	140				
								x	220	220	220	x	50	50	50
								x	200	400	600	x	100	200	300
												x	200	200	200
								x	200	400	600				
				x	120	120	120								
				x	30	30	30	x	35	35	35	x	20	20	20

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	Rec,FW,VC*	33	266	3
mainstream (1000 af)	FW,VC,Rec,WQ*	26	43	72
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	220	430	620
brackish (mgd)	Ind	880	1810	2770
wells (mgd)	*	56	114	28
Conveyance Facilities				
interbasin diversions, into (mgd)	*	162	38	530
out of (mgd)	*	199	38	530
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	47	133	257
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ,VC,Rec	3400	0	0
secondary (90%) (m. PEs removed)	WQ,VC	2600	10900	19200
advanced (95%) (m. PEs removed)	WQ,VC	150	280	1070
Desalting Facilities	*	0	113	86
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC,Rec	425	688	27
Local Flood Protection				
ocean (projects)	FDR	1	0	0
river (projects)	FDR	24	23	0
flood control channels (miles)	FDR	730	270	0
Watershed Management (1000 acres)	FDR,VC,Drn,Rec	859	481	17
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,Rec,FW	350	100	100
fee simple purchase (buying) (mi.)	VC,Rec,FW	150	0	0
purchase lease (sq.mi.)	VC,Rec,FW	440	200	200
easements (sq.mi.)	VC,Rec,FW	190	200	200
deed restrictions (sq.mi.)	VC,FW	x	x	x
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)	VC,FW,Rec	70	0	0
zoning (mi.)	VC,FW,Rec	110	0	0
zoning and/or tax inc. subs.(sq.mi.)				
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage (1000 af)	FDR	76	119	0
Mainstream Flood Control Storage (1000 af)	FDR	36	0	0
Waste Water (mgd)	Ind	140	360	790

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

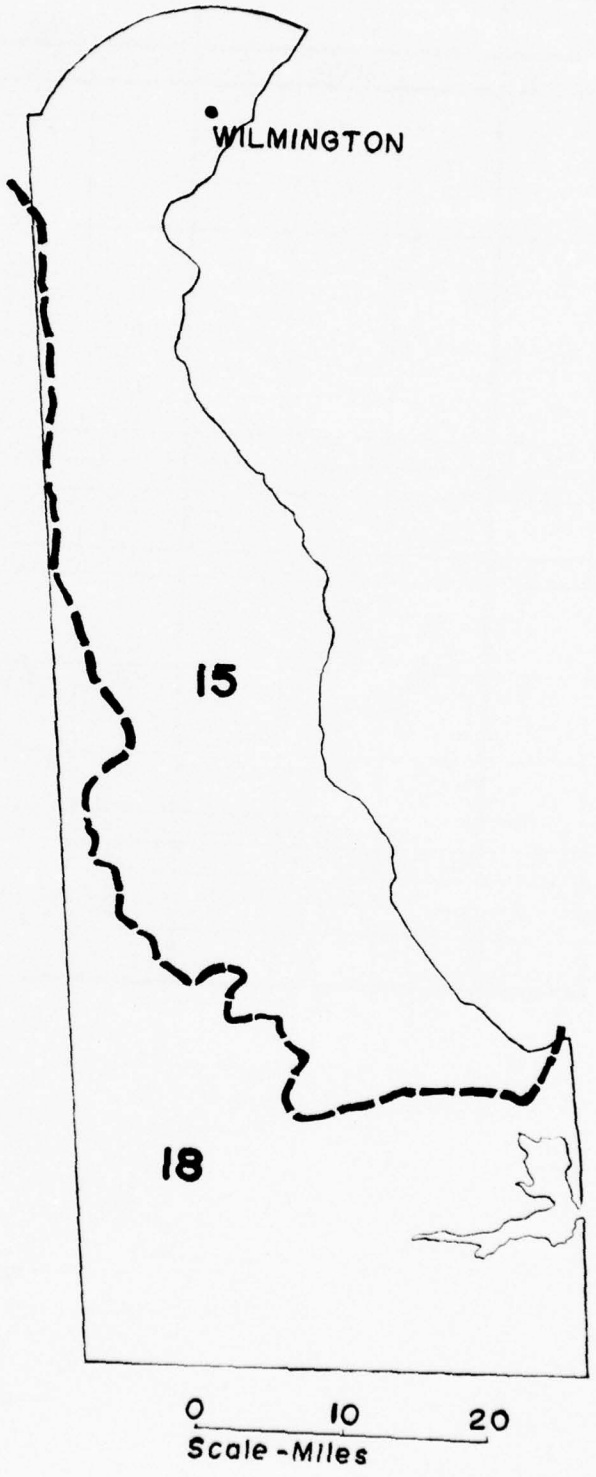
	AREA 15			AREA 17			AREA 18			AREA 19		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
				1	0.3	1	16	250	0	17	15	2
										26	43	72
				0.3	1	1	130	260	400	100	170	220
							870	1800	2760	4	10	10
				1	1	0.2	12	101	0	43	12	28
							162	38	530			
				199	38	530						
				1	2	4	3	8	55	43	123	198
							3400	0	0			
				100	100	100	0	5900	10300	2500	4900	8800
				4	5	10	0	0	570	140	270	490
							0	113	86			
				0.2	1	0.05	383	578	0	42	109	27
							1	0	0			
				1	0	0	17	16	0	6	8	0
							730	270	0			
				9	17	17	278	371	0	573	93	0
				150	0	0	170	100	100	30	0	0
							110	0	0	50	0	0
							240	200	200	200	0	0
							100	100	100	90	100	100
	x	x	x									
							70	0	0			
							110	0	0			
				4	0	0	33	31	0	39	89	0
										36	0	0
							140	360	790			

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	9.7	43.2	1.3
mainstream	14.8	5.2	19.7
wells	11.6	17.3	3.9
desalting	0	200	130
Water Withdrawal and Conveyance Costs:			
inter-basin transfers	2	30	194
public water supply	38	82	126
industrial self-supplied water	6.5	13.7	22.1
rural water supply	x	x	x
irrigation, agriculture	5.7	5.6	0
non-agriculture	6.3	6.8	8.8
Power Plant Cooling Water	0	10	47
Hydroelectric Power Generation		x	x
Navigation: commercial	120	150	0
recreational boating	19	23	26
Water Recreation	110	110	150
Fish and Wildlife: fishing	8.0	7.3	8.5
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	660	1160	2040
advanced	30	57	218
other /			
Flood Damage Reduction: upstream	17	32	0
mainstream	38	0	36
Drainage Control	7.9	8.8	1.0
Erosion Control	110	92	72
Health	x	x	x
Visual and Cultural	1640	140	140
Summation of Available Estimated Costs	2900	2200	3200

* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

	AREA 15			AREA 17			AREA 18			AREA 19		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
				0.3	0.1	0.4	2.7	36.7	0	6.7	6.4	0.9
										14.8	5.2	19.7
				0.3	0.2	0.1	4.4	13.6	0	6.9	3.5	3.8
							0	200	130			
							2	30	194			
				1	1	2	4	6	16	34	74	107
							6.1	13.1	21.3	0.4	0.7	0.8
							x	x	x	x	x	x
							4.3	4.7	0	1.3	1.0	0
				0.1	0.1	0.2	4.5	5.1	6.6	1.7	1.6	2.1
							0	0	7	0	10	40
						x					x	x
							120	150	0			
				0.1	0.4	0.4	11	13	15	7	9	10
							50	30	40	60	80	110
				0.1	0.1	0.1	4.4	3.7	4.1	3.5	3.5	4.3
				x	x	x	x	x	x	x	x	x
				x	x	x	x	x	x	x	x	x
				10	10	10	390	630	1090	280	520	930
				1	1	1	0	0	117	29	56	100
	0	5	0	1	0	0	9	8	0	7	18	0
							34	0	0	4	0	36
				0.1	0.1	0.01	7.1	7.4	0.8	0.7	1.3	0.2
				8	6	7	73	60	49	29	26	16
	x	x	x	x	x	x	x	x	x	x	x	x
				50	0	0	1440	120	120	150	20	20
	0	5	0	72	19	21	2200	1300	1800	640	840	1400

DELAWARE



DELAWARE

The State of Delaware covers 2,057 square miles in Area 15 and 18. The entire State is flat or undulating land and its overall visual quality is medial, being predominantly farm-forest or town-farm. The quality of the small drainage systems is degraded around the population centers and supplies must be imported.

The northern portion of the State has the only significant population concentrations which are around Wilmington and Dover. The 1970 population was over a half million and is projected to increases to 1.1 million by 2020. Per capita income is expected to decrease from 18 percent to 12 percent above the national average by the end of the Study period. Services and related industries is expected to continue as the largest employer, increasing over 140 percent by 2020. Chemicals and allied products are expected to keep pace with services, but agriculture, forestry and fisheries employment is expected to decrease by 50 percent.

Needs to be Satisfied. For the portion of Area 15 which is found in the State of Delaware the key needs are Water Quality Maintenance and recreational boating. Important needs are Publicly Supplied Water, Industrial Self-supplied Water, Commercial Navigation, Water Recreation, Fish and Wildlife, Water Quality Maintenance and Flood Damage Reduction. The key needs for Area 18's portion in the State is Water Quality Maintenance and Visual and Cultural. The important needs are Visual and Cultural and Water Quality Maintenance. Area 15 has the largest need levels with the exceptions of agriculture Irrigation Water, brackish withdrawal and consumption, hunting access, upstream and tidal and hurricane Flood Damage Reduction, Drainage Control, urban Erosion Control and unique natural and unique shoreline landscape maintenance.

Devices. Water quality control facilities are key devices in Area 15 mnd important devices in Area 15 and 18. Other important devices are storage facilities, withdrawal facilities, wells and temperature control facilities in Area 15 and land controls in Area 18. The largest device levels are in Mrea 18 except for storage facilities, fresh water intakes and pumping, potable water treatment plants, secondary (90%) and advanced waste treatment plants, zoning (mi.) and upstream flood control storage which are largest in Area 15.

Costs. The largest individual and total investments are in Area 15. Exceptions are wells, Industrial Self-supplied Water, agriculture Irrigation and Drainage Control which are largest in Area 18. The expenses which are significantly large in the State are for secondary waste treatment (2000-2020) and for Visual and Cultural (1980).

NEEDS-cumulative			STATE TOTAL			
			Pres.	1980	2000	2020
Publicly Supplied Water		(mgd)	58	74	105	151
Industrial Self-Supplied Water		(mgd)	25	48	101	184
Rural Water Supply		(mgd)	7.3	11.2	16.7	16.9
Irrigation Water:	agriculture	(1000 afy)	8.5	29.0	39.3	34.8
	non-agriculture	(1000 afy)	1.9	5.1	9.1	14.8
Power Plant Cooling:	withdrawal, saline	(cfs)	40	970	5340	11200
	brackish	(cfs)	600	390	1220	3170
	fresh	(cfs)	122	118	30	30
	consumption, brackish	(cfs)	1	1	7	16
	fresh	(cfs)	0	9	10	15
Hydroelectric Power Generation		(mw)				
Navigation:	commercial	(m. tons annually)	14	20	25	34
	recreational boating	(1000 boats)	35	43	65	108
Water Recreation:	visitor days	(m.)	x	11	18	33
	stream or river	(miles)	x	30	47	65
	water surface	(1000 acres)	x	7.5	11.4	17.1
	beach	(acres)	x	69	106	166
	pool	(m. sq. ft.)	x	1.3	2.1	3.2
	land facilities	(1000 acres)	x	4.8	5.7	8.9
Fish & Wildlife:	sport fishing man-days	(m.)	0.79	0.94	1.18	1.47
	surface area, lake	(acres)	x	1.1	4.3	8.1
	stream	(acres)	x	0	0.36	0.86
	access, fresh	(acres)	x	0.067	0.164	0.278
	salt	(acres)	x	0.072	0.191	0.332
	anadromous	(acres)	x	0.004	0.007	0.013
	piers	(1000 feet)	x	1.7	4.4	7.5
	hunting, man-days	(m.)	0.51	0.59	0.72	0.89
	access	(1000 sq. mi.)	x	0.20	0.35	0.59
	nature study, man-days	(m.)	0.64	0.76	0.96	1.19
	access	(1000 ac.)	x	4.0	11.0	19.9
Water Quality Maint.:	non-industrial	(m. PEs)	470	590	740	930
	industrial	(m. PEs)	380	1010	2570	5950
Flood Damage Reduction:						
avg. ann. damage,	upstream	(m. $)	3.1	4.2	6.2	9.7
	mainstream	(m. $)	0.49	0.78	1.51	3.08
	tidal and hurricane	(m. $)	0.63	1.05	2.01	3.99
Drainage Control:	cropland	(1000 acres)	54	80	109	111
	forest land	(1000 acres)	0	0	2.3	9.1
	wet land	(1000 acres)				
Erosion Control:	agriculture	(1000 acres)	150	240	300	310
	urban	(1000 acres)	140	290	380	550
	stream bank	(mi.)	0	8.1	24.3	40.5
	coastal shoreline	(mi.)	0	23	50	57
Health: vector control and pollution control			x	x	x	x
Visual & Cultural:						
landscape maintenance,	unique natural	(sq. mi.)	x	35	35	35
	unique shoreline	(mi.)	x	29	29	29
	high quality	(sq. mi.)				
	diversity	(sq. mi.)	x	220	440	660
	agriculture	(sq. mi.)				
landscape development,	quality	(sq. mi.)				
	diversity	(sq. mi.)				
	metro. amenities	(mi.)				
	"	(sq. mi.)				

	AREA 15				AREA 18				AREA				AREA			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	48	60	85	122	10	14	20	29								
	20	39	81	150	5	9	20	34								
	4.0	6.2	9.0	8.3	3.3	5.0	7.7	8.6								
	5.6	15.7	18.5	14.0	2.9	13.3	20.8	20.8								
	1.2	3.3	5.9	9.5	0.7	1.8	3.2	5.3								
	0	930	3400	6120	40	40	1940	5090								
	460	270	500	1100	140	120	720	2070								
	122	118	30	30												
					1	1	7	16								
	0	9	10	15												
	14	20	24	32	1	1	1	1								
	35	43	64	107	0.3	0.4	1	1								
	x	10	18	32	x	0.5	1	1								
	x	26	41	57	x	4	6	8								
	x	6.8	10.4	15.5	x	0.7	1.1	1.5								
	x	63	97	152	x	6	9	14								
	x	1.2	1.9	3.0	x	0.1	0.1	0.2								
	x	4.4	5.1	7.9	x	0.4	0.6	0.9								
	0.55	0.66	0.84	1.05	0.25	0.28	0.34	0.42								
	x	0.9	3.9	7.6	x	0.3	0.4	0.5								
	x	0	0.35	0.85	x	0	0.01	0.01								
	x	0.064	0.160	0.273	x	0.003	0.004	0.005								
	x	0.058	0.148	0.255	x	0.014	0.043	0.077								
	x	0.004	0.007	0.013												
	x	1.7	4.3	7.3	x	0.04	0.1	0.2								
	0.44	0.51	0.63	0.78	0.07	0.08	0.09	0.11								
	x	0.05	0.16	0.27	x	0.14	0.19	0.32								
	0.53	0.63	0.80	1.00	0.11	0.13	0.16	0.19								
	x	3.1	8.0	14.3	x	0.8	3.0	5.6								
	380	480	610	760	90	110	140	170								
	350	950	2430	5640	30	60	140	310								
	1.2	1.7	2.8	5.0	1.9	2.6	3.4	4.7								
	0.37	0.57	1.11	2.28	0.12	0.21	0.40	0.80								
					0.63	1.05	2.01	3.99								
	9	11	18	20	46	68	91	91								
	0	0	0.5	2.0	0	0	1.8	7.1								
	90	130	150	160	60	110	150	150								
	80	120	160	210	60	180	220	350								
	0	5.4	16.2	27.0	0	2.7	8.1	13.5								
	0	22	47	52	0	1	3	6								
	x	x	x	x	x	x	x	x								
					x	35	35	35								
	x	8	8	8	x	21	21	21								
	x	120	240	360	x	100	200	300								

DEVICES - incremental	STATE TOTAL				
	Purposes	1980	2000	2020	
I. Resource Management					
A. Water					
Storage Facilities ¢					
reservoirs, upstream (1000 af)	Rec,FW,VC*	2.3	3.9	39.0	
mainstream (1000 af)					
Withdrawal Facilities					
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	21	46	82	
brackish (mgd)	Ind	42	89	133	
wells (mgd)	*	6.2	30.0	12.4	
Conveyance Facilities					
interbasin diversions, into (mgd)					
out of (mgd)					
Quality Control Facilities					
chemical/biological					
potable water treat. plants (mgd)	PS	5.3	15.1	17.2	
waste treatment plants					
secondary (85%) (m. PEs removed)	WQ,WC,Rec	150	0	0	
secondary (90%) (m. PEs removed)	WQ,VC	1300	3000	6200	
advanced (95%) (m. PEs removed)	WQ,VC	71	152	344	
Desalting Facilities					
B. Water/Land					
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC,FW,Rec	144	174	19	
Local Flood Protection					
ocean (projects)	FDR	1	0	0	
river (projects)	FDR	1.0	6.0	0	
flood control channels (miles)	FDR	0	450	0	
Watershed Management (1000 acres)	FDR,VC,Drn,Rec	49	93	0	
C. Land					
Controls					
fee simple purchase (buying)(sq.mi.)	VC,Rec,FW	108	90	90	
fee simple purchase (buying) (mi.)	VC,Rec,FW	19	0	0	
purchase lease (sq.mi.)					
easements (sq.mi.)	VC,Rec,FW	90	90	90	
deed restrictions (sq.mi.)	VC,FW	x	x	x	
tax incentive subsidy (sq.mi.)					
zoning (sq.mi.)	VC,FW,Rec	18	0	0	
zoning (mi.)	VC,FW,Rec	11	0	0	
zoning and/or tax inc. subs.(sq.mi.)	VC,FW	40	40	40	
zoning and/or tax inc. subs. (mi.)					
V. Others					
Upstream Flood Control Storage (1000 af)	FDR	0	23	0	
Waste Water (mgd)	Ind	4	12	25	

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
¢ Flood control storage not included.

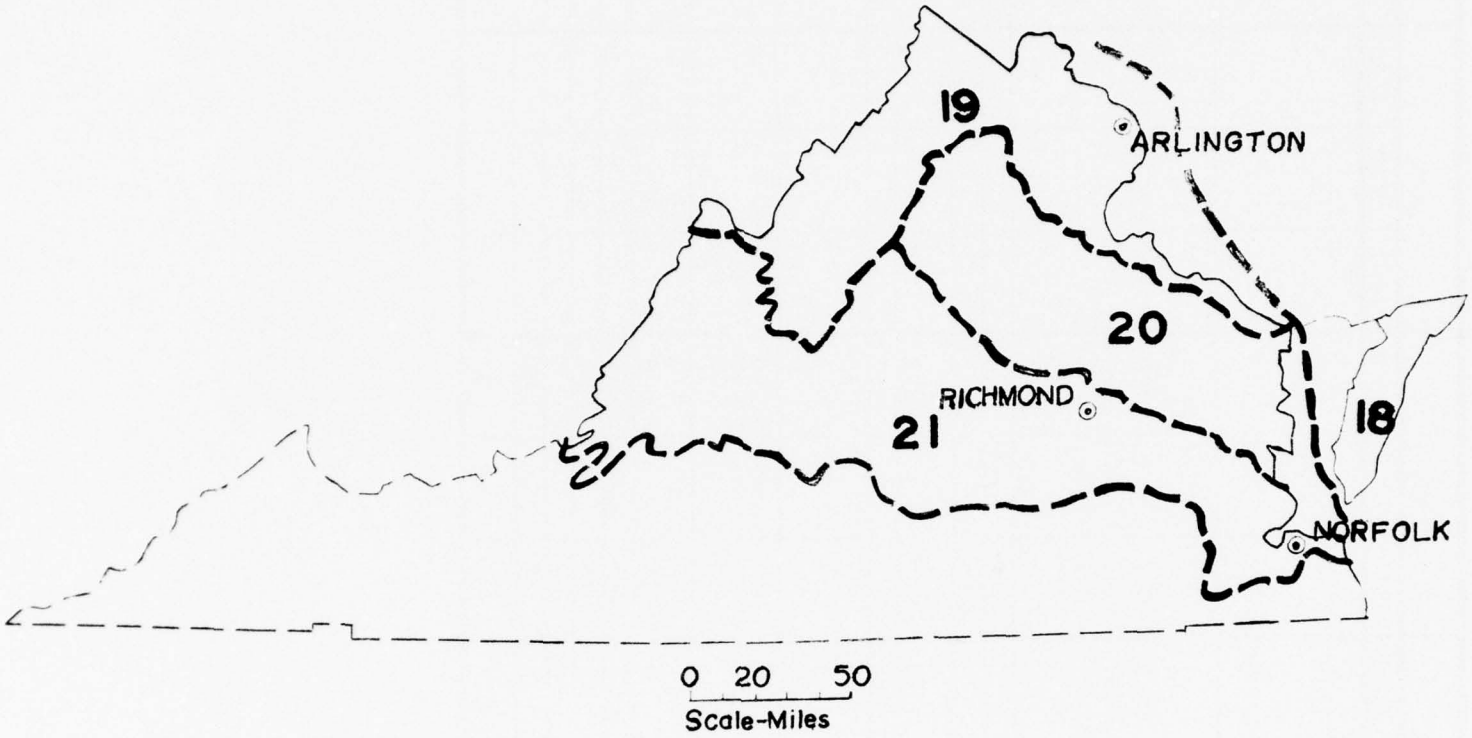
	AREA 15			AREA 18			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	2.2	2.9	39.0	0.1	1.0	0						
	17	38	70	4	8	12						
	16	29	45	26	60	88						
	3.1	2.7	12.4	3.1	27.3	0						
	5.2	14.8	14.8	0.1	0.3	2.4						
				150	0	0						
	1300	2700	5800	0	300	400						
	71	152	320	0	0	24						
	70	0	19	74	174	0						
				1	0	0						
	1.0	6.0	0									
	0	350	0	0	100	0						
	1	28	0	48	65	0						
	40	40	40	68	50	50						
	8	0	0	11	0	0						
	40	40	40	50	50	50						
	x	x	x									
				18	0	0						
				11	0	0						
	40	40	40									
	0	23	0									
				4	12	25						

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	0.6	1.6	10.2
mainstream			
wells	2.1	4.5	1.0
desalting			
Water Withdrawal and Conveyance Costs:			
inter-basin transfers			
public water supply	4.9	10.6	14.6
industrial self-supplied water	0.36	0.74	1.27
rural water supply	x	x	x
irrigation, agriculture	3.4	3.1	0
non-agriculture	2.7	2.9	3.8
Power Plant Cooling Water	0	2.0	20.0
Hydroelectric Power Generation			
Navigation: commercial			
recreational boating	0.85	1.18	2.06
Water Recreation	28	42	70
Fish and Wildlife: fishing	0.44	0.52	0.61
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	49	230	481
advanced	2.2	31.1	59.3
other /			
Flood Damage Reduction: upstream			
mainstream	13	12	0
Drainage Control	1.63	2.05	0.38
Erosion Control	52	54	27
Health	x	x	x
Visual and Cultural	178	47	47
Summation of Available Estimated Costs	340	450	740

* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

	AREA 15			AREA 18			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	0.6	1.5	10.2	0	0.1	0						
	0.9	0.8	1.0	1.2	3.7	0						
	4.7	10.3	13.9	0.2	0.3	0.7						
	0.16	0.32	0.58	0.20	0.42	0.69						
	x	x	x	x	x	x						
	1.2	.8	0	2.2	2.3	0						
	1.8	1.9	2.5	0.9	1.0	1.3						
	0	2.0	12.0	0	0	8.0						
	0.73	1.04	1.90	0.12	0.14	0.16						
	26	41	68	2	1	2						
	0.25	0.36	0.43	0.19	0.16	0.18						
	x	x	x	x	x	x						
	x	x	x	x	x	x						
	33	203	435	16	27	46						
	2.2	31.1	54.4	0	0	4.9						
	2	12	0	11	0	0						
	0.20	0.57	0.21	1.43	1.48	0.16						
	37	43	14	15	11	14						
	x	x	x	x	x	x						
	140	28	28	39	20	20						
	250	380	640	89	69	98						

VIRGINIA



VIRGINIA

The Commonwealth of Virginia covers 23,237 square miles in the NAR including all of Area 20, all but a tiny amount of Area 21, much of Area 19, and the lower portion of the Delmarva Peninsula section of Area 18. The major drainages of the State are the basins of the Potomac, James, Rappahannock and York Rivers. The topography ranges through all classifications from beach to mountain, but the major characteristic is undulating land. Three-quarters of the State is classified as medial visual quality while the remainder is low. Water is plentiful in Virginia but uneven population distribution may necessitate diversions downstream in the near future. Serious pollution exists in the northern drainages and on most downstream portions of rivers, but some good supplies exist in central and southern upstream reaches.

The population of this section of Virginia is concentrated around Richmond, Norfolk-Virginia Beach, and the Washington, D.C., suburban areas. The population totalled over 3.4 million in 1970 and should reach 7.6 million by 2020. Per capita income was 6 percent below the nation average in 1970, but it should be at the average by the end of the Study period. Employment in 1970 was highest for services and related industries, which is expected to increase by more than 150 percent by 2020. Increases are also projected for food and kindred products, paper and allied products, chemicals and allied products and primary metals. Decreases have been projected for textile mill products and agriculture, forestry and fisheries.

Needs to be Satisfied. Water Quality Maintenance is a key need in the portions of Areas 18, 19 and 21 that are located in the State, while Visual and Cultural needs are key in Areas 18 and 19. The important needs in Area 18 are Water Quality Maintenance and Visual and Cultural. In Area 19 they are Publicly Supplied Water, Water Quality Maintenance, Erosion Control, and Visual and Cultural, while in Area 20 the important needs are Publicly Supplied Water, Industrial Self-supplied Water, Rural Water Supply, Water Recreation and Fish and Wildlife. Important needs in Area 21 are Industrial Self-supplied Water, Power Plant Cooling and Commercial Navigation. In general the needs are all largest in Area 21. The needs in Area 18 are largest for coastal shoreline Erosion Control and unique shoreline landscape maintenance. Agricultural Irrigation Water, land facilities, lake surface area, fresh access, nature study access, agricultural landscape and metropolitan amenties development are largest in Area 19. Only cropland and forest land Drainage Control and unique natural and diversity landscape maintenance are largest in Area 20. The remaining needs have the highest levels in Area 21.

Devices. The important devices are quality control facilities in Area 18 and 19, and land controls in Area 18. The device, zoning for land control, is highest in Area 18. Upstream storage facilities, purchase

leases, and mainstream flood control devices are largest in Area 19. Fee simple purchases (sq. mi.), easements, and zoning and/or tax incentive subsidies are the devices which are largest in Area 20. All of the other devices have the highest level of implementation in Area 21.

Costs. The significantly large investments in the State will be for desalting (2000-2020), Publicly Supplied Water (2020), Water Recreation (2020) advanced waste treatement (200-2020), Erosion Control (1980-2000) and Visual and Cultural (1980). The expenditures for commercial navigation and secondary waste treatment will also be large in all time periods. These costs are incurred primarily in Area 21 which has the largest total cost in the State as well as most of the largest individual need costs. Area 19 has the largest costs for storage, wells, agricultural Irrigation, Water Recreation and Visual and Cultural The investments in the other Areas will be relatively small.

NEEDS-cumulative			STATE TOTAL			
			Pres.	1980	2000	2020
Publicly Supplied Water		(mgd)	320	450	680	1040
Industrial Self-Supplied Water		(mgd)	510	970	1640	2230
Rural Water Supply		(mgd)	54	85	125	146
Irrigation Water:	agriculture	(1000 afy)	12	50	71	68
	non-agriculture	(1000 afy)	5.7	21.5	38.5	62.0
Power Plant Cooling:	withdrawal, saline	(cfs)	1200	1100	9600	27700
	brackish	(cfs)	800	4700	6000	4200
	fresh	(cfs)	2300	2200	4200	5900
	consumption, brackish	(cfs)	8	43	56	40
	fresh	(cfs)	24	108	210	357
Hydroelectric Power Generation		(mw)	44	1510	2100	4100
Navigation:	commercial	(m. tons annually)	91	91	128	203
	recreational boating	(1000 boats)	81	94	151	224
Water Recreation:	visitor days	(m.)	x	57	95	160
	stream or river	(miles)	x	220	310	530
	water surface	(1000 acres)	x	44	68	107
	beach	(acres)	x	520	800	1130
	pool	(m. sq. ft.)	x	9.1	13.9	19.7
	land facilities	(1000 acres)	x	19	31	48
Fish & Wildlife:	sport fishing man-days	(m.)	7.5	9.2	12.2	15.8
	surface area, lake	(acres)	x	23	38	59
	stream	(acres)	x	8.3	8.6	8.6
	access, fresh	(acres)	x	0.34	0.57	0.86
	salt	(acres)	x	0.82	2.20	3.87
	anadromous	(acres)	x	0.086	0.128	0.178
	piers	(1000 feet)	x	24	64	111
	hunting, man-days	(m.)	4.5	5.0	6.6	8.5
	access	(1000 sq. mi.)	x	0.34	3.04	4.05
	nature study, man-days	(m.)	4.1	5.0	6.7	8.7
	access	(1000 ac.)	x	11	39	75
Water Quality Maint.:	non-industrial	(m. PEs)	1900	3800	5100	6600
	industrial	(m. PEs)	2900	7600	19400	45600
Flood Damage Reduction:						
avg. ann. damage,	upstream	(m. $)	5.7	9.0	16.4	31.7
	mainstream	(m. $)	4.8	8.4	17.4	37.4
	tidal and hurricane	(m. $)	3.0	5.2	10.4	21.7
Drainage Control:	cropland	(1000 acres)	160	230	310	310
	forest land	(1000 acres)	0	0	34	135
	wet land	(1000 acres)				
Erosion Control:	agriculture	(1000 acres)	3800	4600	5200	5300
	urban	(1000 acres)	840	1040	1460	2100
	stream bank	(mi.)	0	100	320	530
	coastal shoreline	(mi.)	0	100	220	270
Health: vector control and pollution control			x	x	x	x
Visual & Cultural:						
landscape maintenance,	unique natural	(sq. mi.)	x	1600	1600	1600
	unique shoreline	(mi.)	x	300	300	300
	high quality	(sq. mi.)				
	diversity	(sq. mi.)	x	600	1100	1200
	agriculture	(sq. mi.)	x	1400	1400	1400
landscape development,	quality	(sq. mi.)				
	diversity	(sq. mi.)				
	metro. amenities	(mi.)				
	" "	(sq. mi.)	x	26	26	26

	AREA 18				AREA 19				AREA 20				AREA 21			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	10	10	10	20	110	160	270	430	20	30	40	70	190	250	360	520
	1	1	2	4	60	110	200	300	50	80	120	130	400	770	1320	1790
	3	4	6	7	18	31	45	45	11	16	23	35	22	34	51	59
	5	24	37	37	3	17	24	21	1	3	3	3	2	8	8	8
	0.4	1.1	2.0	3.2	2.5	8.2	14.0	21.8	0.4	2.3	4.7	8.3	2.4	9.9	17.8	28.7
					0	0	2000	5800	400	400	3800	7900	800	700	3800	14000
					800	1300	700	1200					0	3400	5300	3000
					400	400	900	1000	0	100	200	100	1800	1700	3100	4800
					8	8	7	10					0	35	49	30
					5	9	24	55	0	82	90	58	19	17	96	244
					13	10	0	1000	0	0	100	100	31	1500	2000	3000
					1	1	1	1	5	8	12	18	85	83	116	185
	4	5	9	12	25	28	49	66	8	10	15	21	44	51	78	125
	x	0.2	0.3	0.5	x	12	22	45	x	11	19	33	x	34	54	82
	x	2	3	4	x	80	100	230	x	30	50	70	x	110	160	220
	x	0.3	0.5	0.6	x	15	27	48	x	5	8	13	x	23	33	46
	x	3	4	6	x	120	210	360	x	50	80	110	x	350	510	660
	x	0.04	0.1	0.1	x	2.1	3.6	6.2	x	0.9	1.5	2.1	x	6.0	8.8	11.3
	x	0.2	0.3	0.4	x	9	15	26	x	2	3	4	x	9	13	17
	0.1	0.1	0.2	0.2	2.2	2.8	4.1	5.6	1.0	1.2	1.6	2.1	4.1	5.0	6.4	8.0
	x	8	11	15	x	11	17	26	x	0	1	4	x	4	9	14
	x	0	0.3	0.3	x	2.1	2.1	2.1	x	0.7	0.7	0.7	x	5.4	5.4	5.4
	x	0.08	0.12	0.17	x	0.15	0.27	0.41	x	0.03	0.05	0.08	x	0.07	0.13	0.20
	x	0.10	0.30	0.54	x	0.29	0.87	1.58	x	0.04	0.11	0.20	x	0.39	0.92	1.56
	x	0.001	0.004	0.007	x	0.019	0.028	0.039	x	0.004	0.012	0.022	x	0.062	0.084	0.110
	x	3	9	17	x	8	25	45	x	1	3	5	x	11	26	44
	0.04	0.04	0.05	0.1	1.2	1.3	1.9	2.6	1.0	1.1	1.4	1.8	2.3	2.6	3.3	4.1
	x	0.06	0.08	0.14	x	0.07	0.61	0.91	x	0.10	1.25	1.60	x	0.10	1.10	1.40
	0.1	0.1	0.1	0.1	1.3	1.7	2.4	3.3	0.5	0.6	0.7	0.9	2.2	2.7	3.4	4.3
	x	2	7	13	x	9	29	55	x	1	3	6	x	0.2	0.8	1.5
	40	100	100	100	600	1300	1900	2600	100	400	500	700	1100	2100	2600	3200
	4	10	30	50	100	200	500	1000	200	600	1500	4600	2600	6800	17400	40000
	0.2	0.3	0.4	0.6	2.0	3.2	6.1	12.1	1.0	1.4	2.5	4.6	2.5	4.0	7.4	14.4
					1.3	2.5	5.4	12.1	0.3	0.5	1.1	2.3	3.2	5.4	11.0	23.0
	0.8	1.4	2.6	5.2					0.5	0.8	1.7	3.5	1.8	3.1	6.2	13.0
	30	40	50	50	40	50	80	80	50	70	90	90	40	70	90	90
	0	0	1	4	0	0	2	7	0	0	16	64	0	0	15	59
	30	100	100	100	1000	1300	1600	1600	1100	1200	1300	1300	1600	2000	2200	2300
	40	100	120	180	210	340	520	720	160	170	200	260	430	440	620	940
	0	2	5	10	0	40	110	190	0	10	30	40	0	60	180	290
	0	50	130	160	0	20	40	40	0	1	3	5	0	30	60	60
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	x	200	200	200	x	300	300	300	x	1000	1000	1000	x	100	100	100
	x	110	110	110	x	50	50	50	x	60	60	60	x	80	80	80
					x	100	200	300	x	500	900	900				
					x	1400	1400	1400								
					x	15	15	15					x	11	11	11

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	Rec,FW,VC*	26.4	18.5	1.8
mainstream (1000 af)	PW,VC,Rec,WQ*	60	322	425
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	490	740	700
brackish (mgd)	Ind	84	163	255
wells (mgd)	*	110	110	330
Conveyance Facilities				
interbasin diversions, into (mgd)	*	25	0	0
out of (mgd)				
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	85	235	380
waste treatment plants				
secondary (85%) (m. PEs removed)	WQ,VC,Rec	7600	0	0
secondary (90%) (m. PEs removed)	WQ,VC	2300	22100	47000
advanced (95%) (m. PEs removed)	WQ,VC	130	1220	2610
Desalting Facilities	*	12	85	119
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC,Rec	110	310	50
Local Flood Protection				
ocean (projects)	FDR	0	1	0
river (projects)	FDR	35	29	28
flood control channels (miles)	FDR	72	207	246
Watershed Management (1000 acres)	FDR,VC,Drn,Rec	1200	1500	1800
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,Rec,FW	1000	0	0
fee simple purchase (buying) (mi.)	VC,Rec,FW	210	0	0
purchase lease (sq.mi.)	VC,FW	1400	0	0
easements (sq.mi.)	VC,FW	340	300	100
deed restrictions (sq.mi.)				
tax incentive subsidy (sq.mi.)	VC,FW	x	x	x
zoning (sq.mi.)	VC,FW,Rec	88	0	0
zoning (mi.)	VC,FW,Rec	56	0	0
zoning and/or tax inc. subs.(sq.mi.)	VC,FW	750	200	0
zoning and/or tax inc. subs. (mi.)	VC,FW	32	0	0
V. Others				
Upstream Flood Control Storage (1000 af)	FDR	380	300	370
Mainstream Flood Control Storage (1000 af)	FDR	0	500	460
Waste Water (mgd)	Ind	1	1	3

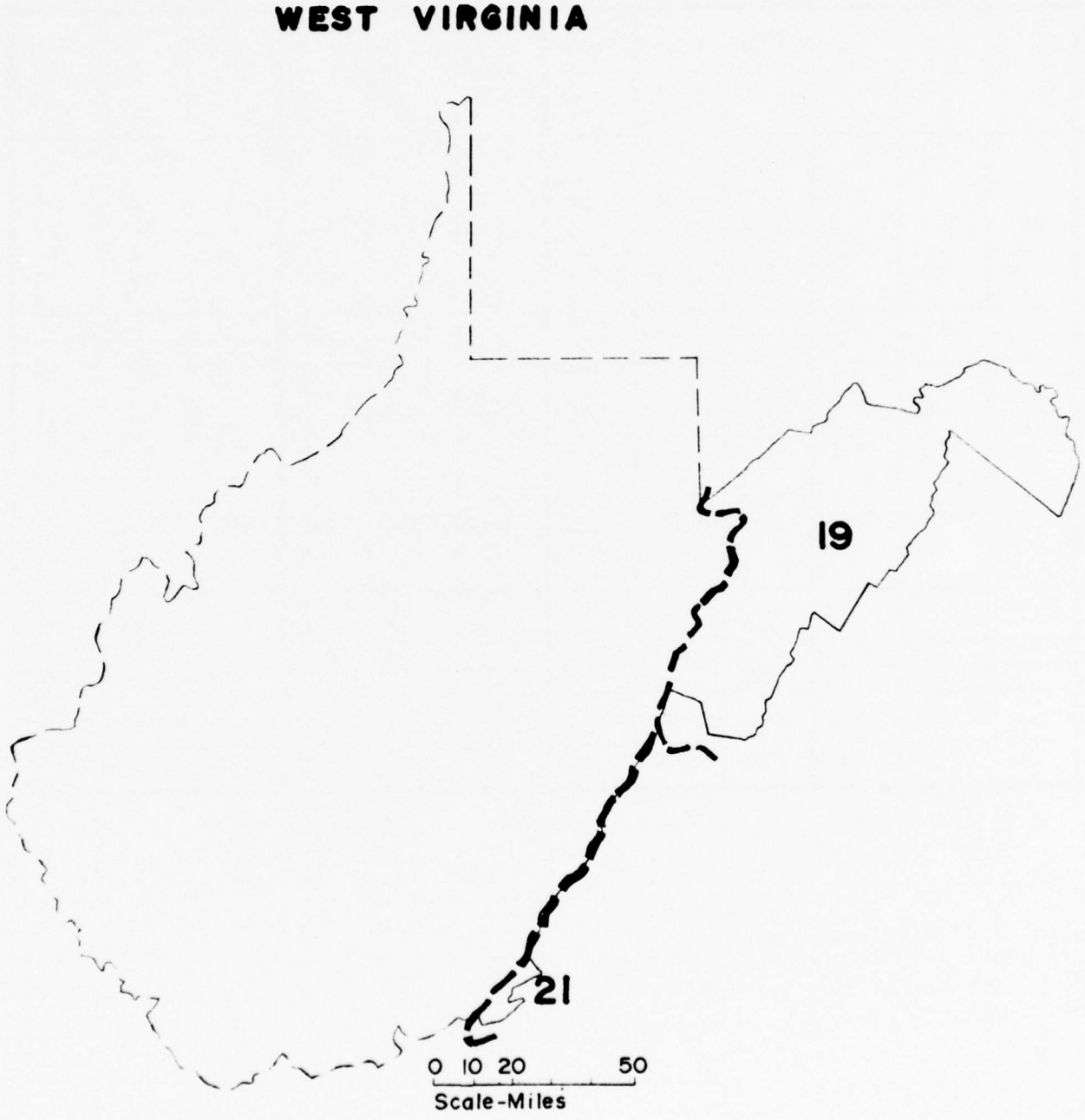
* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

	AREA 18			AREA 19			AREA 20			AREA 21		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
				14.4	13.2	1.8	1.3	3.9	0	10.7	1.4	0
				17	104	162	35	26	7	8	191	255
	1	1	2	70	120	160	30	30	10	390	580	530
	3	6	10	3	4	5	56	115	204	22	38	36
	3	20	0	80	20	50	10	10	10	20	50	260
										25	0	0
	0.1	0.2	1	37	106	170	5	14	18	43	116	191
	50	0	0							7500	0	0
	0	100	100	1400	2100	3200	900	1800	4800	0	18000	38900
	0	0	10	80	120	180	50	100	270	0	1000	2160
										12	85	119
	10	20	0	30	80	20	20	90	20	50	130	10
										0	1	0
				7	7	0	1	0	8	27	22	20
	0	50	0						90	72	157	156
	40	100		500	100	0	10	0	500	700	1400	1400
	100	0	0	300	0	0	500	0	0	100	0	0
	60	0	0	50	0	0	30	0	0	80	0	0
				1400	0	0						
				90	100	100	250	200	0			
										x	x	x
	88	0	0									
	56	0	0									
							750	200	0			
							32	0	0			
				100	60	0	40	0	130	240	240	240
				0	0	460	0	260	0	0	240	0
	1	1	3									

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	7.4	10.5	0.8
mainstream	44	60	87
wells	21	21	25
desalting	38	253	290
Water Withdrawal and Conveyance Costs:			
inter-basin transfers	1.9	0	0
public water supply	72	148	222
industrial self-supplied water	2.8	4.4	4.5
rural water supply	x	x	x
irrigation, agriculture	6.9	6.0	0
non-agriculture	13	12	16
Power Plant Cooling Water	0	20	38
Hydroelectric Power Generation	x	x	x
Navigation: commercial	170	360	180
recreational boating	8.4	14.3	17.4
Water Recreation	60	108	231
Fish and Wildlife: fishing	7.0	6.7	8.2
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	1100	2400	5100
advanced	26	251	536
other /			
Flood Damage Reduction: upstream	57	39	40
mainstream	17	71	0
Drainage Control	5.3	8.5	4.5
Erosion Control	180	200	140
Health	x	x	x
Visual and Cultural	899	48	24
Summation of Available Estimated Costs	2700	4000	7000

* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

	AREA 18			AREA 19			AREA 20			AREA 21		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
				5.8	5.5	0.8	0.2	5.0	0	1.4	0	0
				18	23	42	23	7	2	4	30	43
	1	3	0	13	7	8	3	5	5	4	6	13
										38	253	290
										1.9	0	0
	0.1	0.1	0.4	29	64	92	2	5	6	41	79	124
	0.02	0.1	0.1	0.3	0.5	0.6	0.5	0.8	1.2	2.1	3.1	2.6
	x	x	x	x	x	x	x	x	x	x	x	x
	3.8	4.1	0	2.3	1.7	0	0.1	0	0	0.6	0.2	0
	1	1	1	5	4	6	1	2	2	6	5	7
				0	4	10				0	16	28
						x		x		x	x	x
							20	0	0	150	360	180
	0.5	0.5	0.6	4.2	5.4	5.9	0.8	2.4	3.6	2.9	6.0	7.3
	1	0.4	1	46	69	126	3	2	4	10	37	101
	0.1	0.1	0.1	3.0	3.0	3.7	0.6	0.5	0.8	3.2	3.1	3.6
	x	x	x	x	x	x	x	x	x	x	x	x
	x	x	x	x	x	x	x	x	x	x	x	x
	10	10	10	200	200	300	100	200	600	800	1900	4100
	0	0	1	16	24	37	10	21	55	0	205	443
				11	8	0	8	0	14	38	31	26
				17	0	0	0	20	0	0	51	0
	0.9	0.9	0.1	1.1	2.0	0.2	1.3	3.0	2.2	2.0	2.6	2.0
	40	40	30	60	50	40	10	10	10	80	100	60
	x	x	x	x	x	x	x	x	x	x	x	x
	37	0	0	718	24	24	114	24	0	30	0	0
	95	60	44	1100	500	700	300	310	710	1200	3100	5400


WEST VIRGINIA
19
21
0 10 20 50
Scale-Miles

WEST VIRGINIA

Two sections of West Virginia lie within the NAR and cover 3,535 square miles mostly in Area 19, with a very small part in Area 21. The drainage in Area 19 is the South Branch Potomac River. The topography is mostly heavily forested mountains and rolling foothills. The overall visual quality is low to medial but the free-flowing streams are of importance esthetically where they are not polluted. Water is abundant in this corner of the Region, but much of it has been degraded by acid mine pollution.

The population of this small sector was just over 123,000 in 1970 and should increase to over 150,000 by 2020. Per capita income was 22 percent below the national average but is projected to rise significantly to only 5 percent below that average by 2020. Employment is largest in services and related industries which is expected to increase along with food and kindred products, paper and allied products and chemicals and allied products. Declines are expected for textile mill products and agriculture, forestry and fisheries.

Needs to be Satisfied. The key needs in the State are Water Quality Maintenance and Visual and Cultural in Area 19. The important needs are Publicly Supplied Water, Water Quality Maintenance, Erosion Control and Visual and Cultural in Area 19. All the needs are largest for the State in the portion of Area 19 found within the state.

Devices. The important devices are water quality control facilities in Area 19 and all devices levels are largest in the portion of Area 19 found in the State.

Costs. All of the costs in the State are incurred primarily in Area 19 where they are the largest. The only expenditure that is significant in size is for Visual and Cultural in 1970.

NEEDS-cumulative		STATE TOTAL			
		Pres.	1980	2000	2020
Publicly Supplied Water	(mgd)	14	22	36	58
Industrial Self-Supplied Water	(mgd)	8	17	29	46
Rural Water Supply	(mgd)	5.5	9.2	13.5	13.4
Irrigation Water: agriculture	(1000 afy)	1.0	5.0	7.2	6.3
non-agriculture	(1000 afy)	1.5	5.1	8.8	13.7
Power Plant Cooling: withdrawal, saline	(cfs)				
brackish	(cfs)				
fresh	(cfs)	79	49	1092	1478
consumption, brackish	(cfs)				
fresh	(cfs)	18	23	44	50
Hydroelectric Power Generation	(mw)	0	0	500	2000
Navigation: commercial	(m. tons annually)				
recreational boating	(1000 boats)	1.7	2.0	3.0	4.0
Water Recreation: visitor days	(m.)	x	0.44	0.69	1.04
stream or river	(miles)	x	3	4	6
water surface	(1000 acres)	x	0.58	0.84	1.18
beach	(acres)	x	5	7	9
pool	(m. sq. ft.)	x	0.079	0.114	0.155
land facilities	(1000 acres)	x	0.33	0.49	0.67
Fish & Wildlife: sport fishing man-days	(m.)	0.30	0.38	0.54	0.75
surface area, lake	(acres)	x	3.2	5.0	7.6
stream	(acres)	x	0.62	0.62	0.62
access, fresh	(acres)	x	0.043	0.079	0.120
salt	(acres)				
anadromous	(acres)	x	0.006	0.008	0.011
piers	(1000 feet)				
hunting, man-days	(m.)	0.16	0.18	0.25	0.34
access	(1000 sq. mi.)	x	0.052	0.429	0.637
nature study, man-days	(m.)	0.18	0.23	0.32	0.44
access	(1000 ac.)	x	1.2	4.2	7.8
Water Quality Maint.: non-industrial	(m. PEs)	86	177	254	345
industrial	(m. PEs)	39	101	253	535
Flood Damage Reduction:					
avg. ann. damage, upstream	(m. $)	3.7	6.1	11.4	22.7
mainstream	(m. $)	1.6	3.1	6.8	15.1
tidal and hurricane	(m. $)				
Drainage Control: cropland	(1000 acres)	26	34	47	47
forest land	(1000 acres)	0	0	1.4	5.2
wet land	(1000 acres)				
Erosion Control: agriculture	(1000 acres)	620	830	980	1010
urban	(1000 acres)	140	220	330	450
stream bank	(mi.)	0	23	70	117
coastal shoreline	(mi.)				
Health: vector control and pollution control		x	x	x	x
Visual & Cultural:					
landscape maintenance, unique natural	(sq. mi.)	x	700	700	700
unique shoreline	(mi.)				
high quality	(sq. mi.)				
diversity	(sq. mi.)	x	100	200	300
agriculture	(sq. mi.)	x	200	200	200
landscape development, quality	(sq. mi.)				
diversity	(sq. mi.)				
metro. amenities	(mi.)				
" "	(sq. mi.)				

	AREA 19				AREA 21				AREA				AREA			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	14	22	36	58												
	8	17	29	46												
	5.5	9.2	13.5	13.4												
	1.0	5.0	7.2	6.3												
	1.5	5.0	8.6	13.4	0	0.1	0.2	0.3								
	79	49	1092	1478												
	18	23	44	50												
	0	0	500	2000												
	1.7	2.0	3.0	4.0												
	x	0.44	0.69	1.04												
	x	3	4	6												
	x	0.58	0.84	1.18												
	x	5	7	9												
	x	0.079	0.114	0.155												
	x	0.33	0.49	0.67												
	0.30	0.38	0.54	0.75												
	x	3.2	5.0	7.6												
	x	0.62	0.62	0.62												
	x	0.043	0.079	0.120												
	x	0.006	0.008	0.011												
	0.16	0.18	0.25	0.34												
	x	0.052	0.429	0.637												
	0.18	0.23	0.32	0.44												
	x	1.2	4.2	7.8												
	86	177	254	345												
	39	101	253	535												
	3.7	6.1	11.4	22.7												
	1.6	3.1	6.8	15.1												
	26	34	47	47	0.5	1	1	1								
	0	0	1.2	4.6	0	0	0.2	0.6								
	610	810	950	990	20	20	20	20								
	130	210	320	440	10	10	10	10								
	0	23	68	114	0	1	2	3								
	x	x	x	x	x	x	x	x								
	x	700	700	700												
	x	100	200	300												
	x	200	200	200												

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)	Rec,FW,VC*	3.8	3.5	0.5
mainstream (1000 af)	FW,VC,Rec,WQ*	31	74	89
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	9.8	15.9	21.9
brackish (mgd)	Ind	0	1	1
wells (mgd)	*	53	15	37
Conveyance Facilities				
interbasin diversions, into (mgd)				
out of (mgd)				
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	4.9	14.1	22.7
waste treatment plants				
secondary (85%) (m. PEs removed)				
secondary (90%) (m. PEs removed)	WQ,VC	250	460	790
advanced (95%) (m. PEs removed)	WQ,VC	14	25	44
Desalting Facilities				
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)	FDR,VC	26	67	16
Local Flood Protection				
ocean (projects)				
river (projects)	FDR	5.5	4.5	0
flood control channels (miles)				
Watershed Management (1000 acres)	FDR,VC,Drn	465	76	0
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,FW	710	0	0
fee simple purchase (buying) (mi.)				
purchase lease (sq.mi.)	VC,FW	200	0	0
easements (sq.mi.)	VC,FW	88	100	100
deed restrictions (sq.mi.)				
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)				
zoning (mi.)				
zoning and/or tax inc. subs.(sq.mi.)				
zoning and/or tax inc. subs. (mi.)				
V. Others				
Upstream Flood Control Storage (1000 af)	FDR	70	54	0
Mainstream Flood Control Storage (1000 af)	FDR	0	90	0

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

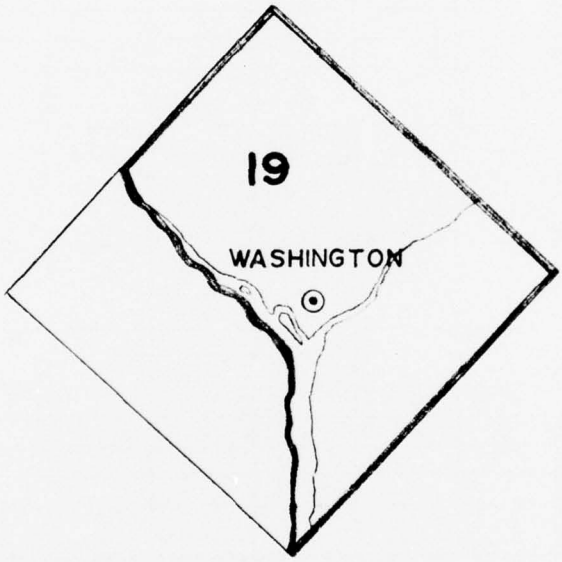
	AREA 19			AREA 21			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	3.8	3.5	0.5									
	31	74	89									
	9.8	15.9	21.9									
	0	1	1									
	53	14	34	0.2	1	3						
	4.9	14.1	22.7									
	250	460	790									
	14	25	44									
	26	67	16									
	5.5	4.5	0									
	465	76	0									
	710	0	0									
	200	0	0									
	88	100	100									
	70	54	0									
	0	90	0									

FIRST COSTS - incremental ($ million 1970)	STATE TOTAL		
	1980	2000	2020
Water Development Costs:			
storage, upstream	1.5	1.5	0.2
mainstream	20	11	22
wells	8.6	4.5	5.0
desalting			
Water Withdrawal and Conveyance Costs:			
inter-basin transfers			
public water supply	3.9	8.5	12.2
industrial self-supplied water	0.04	0.06	0.09
rural water supply	x	x	x
irrigation, agriculture	0.78	0.56	0
non-agriculture	3.0	2.8	3.6
Power Plant Cooling Water	0	10	20
Hydroelectric Power Generation		x	x
Navigation: commercial			
recreational boating	0.28	0.36	0.39
Water Recreation	1.7	1.5	2.0
Fish and Wildlife: fishing	0.40	0.40	0.49
hunting	x	x	x
nature study	x	x	x
Water Quality Maint.: waste treatment, secondary	28	49	84
advanced	2.9	5.1	9.0
other /			
Flood Damage Reduction: upstream	10.2	8.9	0
mainstream	0	7.0	0
Drainage Control	0.71	1.25	0.17
Erosion Control	29	28	22
Health	x	x	x
Visual and Cultural	281	24	24
Summation of Available Estimated Costs	390	160	210

* From the supply model and includes OMR costs.
/ Combined sewer overflows control and acid mine drainage control.

	AREA 19			AREA 21			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	1.5	1.5	0.2									
	20	11	22									
	8.6	4.4	4.9	0	0.1	0.1						
	3.9	8.5	12.2									
	0.04	0.06	0.09									
	x	x	x									
	0.78	0.56	0									
	2.9	2.7	3.5	0.1	0.1	0.1						
	0	10	20									
		x	x									
	0.28	0.36	0.39									
	1.7	1.5	2.0									
	0.40	0.40	0.49									
	x	x	x									
	x	x	x									
	28	49	84									
	2.9	5.1	9.0									
	10.2	8.9	0									
	0	7.0	0									
	0.69	1.22	0.15	0.02	0.03	0.02						
	29	28	21	0.4	1	1						
	x	x	x	x	x	x						
	281	24	24									
	390	160	200	0.52	1.23	1.22						

DISTRICT OF COLUMBIA



DISTRICT OF COLUMBIA

Washington, D.C., lies wholly within Area 19 and covers 69 square miles of totally metropolitan area. The major waterways are the Potomac River flowing past the District, and the Potomac tributaries of Rock Creek and the Anacostia River. The District's population, which totalled 850,000 in 1970, is projected to reach over 1.2 million by 2020. Per capita income stood at 30 percent above the national average in 1970 but should decline to 12 percent over that average by 2020.

The work force totalled almost 390,000 in 1970, over 330,000 of which were employed in services and related industries, and this total is projected to increase to more than half a million by 2020. There is some employment in food and kindred products, which is expected to decrease; some in primary metals and chemicals and allied products which are projected to rise; and a significant number of armed services personnel whose total should remain constant.

The District of Columbia is unique in that it is the only "state" in the NAR located entirely within a tiny part of a single river basin, and the only one completely urban in nature.

Needs to be Satisfied. The need for Water Quality Maintenance is important and key to the fulfillment of the Visual and Cultural need, which is also key and important. Other important needs include Publicly Supplied Water and Erosion Control.

Devices. The important devices for meeting the needs of the District are water quality control facilities.

Costs. The only expenditures of significant size in the District will be for secondary waste treatment in all time periods.

NEEDS-cumulative			STATE TOTAL			
			Pres.	1980	2000	2020
Publicly Supplied Water		(mgd)	90	140	230	380
Industrial Self-Supplied Water		(mgd)	80	150	260	400
Rural Water Supply		(mgd)				
Irrigation Water:	agriculture	(1000 afy)				
	non-agriculture	(1000 afy)	0.7	2.3	4.0	6.2
Power Plant Cooling:	withdrawal, saline	(cfs)				
	brackish	(cfs)				
	fresh	(cfs)				
	consumption, brackish	(cfs)				
	fresh	(cfs)				
Hydroelectric Power Generation		(mw)				
Navigation:	commercial	(m. tons annually)	0.70	0.70	0.70	0.80
	recreational boating	(1000 boats)	12	14	24	33
Water Recreation:	visitor days	(m.)				
	stream or river	(miles)				
	water surface	(1000 acres)				
	beach	(acres)				
	pool	(m. sq. ft.)				
	land facilities	(1000 acres)				
Fish & Wildlife:	sport fishing man-days	(m.)	1.9	2.5	3.5	4.8
	surface area, lake	(acres)				
	stream	(acres)				
	access, fresh	(acres)				
	salt	(acres)				
	anadromous	(acres)				
	piers	(1000 feet)				
	hunting, man-days	(m.)	1.0	1.1	1.6	2.2
	access	(1000 sq. mi.)				
	nature study, man-days	(m.)	1.2	1.5	2.1	2.9
	access	(1000 ac.)	x	0.6	2.1	3.9
Water Quality Maint.:	non-industrial	(m. PEs)	560	1150	1650	2240
	industrial	(m. PEs)	120	300	760	1610
Flood Damage Reduction:						
avg. ann. damage,	upstream	(m. $)				
	mainstream	(m. $)	0.06	0.13	0.27	0.60
	tidal and hurricane	(m. $)				
Drainage Control:	cropland	(1000 acres)				
	forest land	(1000 acres)				
	wet land	(1000 acres)				
Erosion Control:	agriculture	(1000 acres)				
	urban	(1000 acres)	21	34	51	71
	stream bank	(mi.)				
	coastal shoreline	(mi.)				
Health: vector control and pollution control			x	x	x	x
Visual & Cultural:						
landscape maintenance,	unique natural	(sq. mi.)				
	unique shoreline	(mi.)				
	high quality	(sq. mi.)				
	diversity	(sq. mi.)				
	agriculture	(sq. mi.)				
landscape development,	quality	(sq. mi.)				
	diversity	(sq. mi.)				
	metro. amenities	(mi.)				
	" "	(sq. mi.)	x	5	5	5

	AREA 19				AREA				AREA				AREA			
	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020	Pres	1980	2000	2020
	90	140	230	380												
	80	150	260	400												
	0.7	2.3	4.0	6.2												
	0.70	0.70	0.70	0.80												
	12	14	24	33												
	1.9	2.5	3.5	4.8												
	1.0	1.1	1.6	2.2												
	1.2	1.5	2.1	2.9												
	x	0.6	2.1	3.9												
	560	1150	1650	2240												
	120	300	760	1610												
	0.06	0.13	0.27	0.60												
	21	34	51	71												
	x	x	x	x												
	x	5	5	5												

DEVICES - incremental	STATE TOTAL			
	Purposes	1980	2000	2020
I. Resource Management				
A. Water				
Storage Facilities ϕ				
reservoirs, upstream (1000 af)				
mainstream (1000 af)				
Withdrawal Facilities				
intakes & pumping, fresh (mgd)	PS,Ind,Pow,Irrig	85	144	186
brackish (mgd)	Ind	3	5	7
wells (mgd)	*	0.3	0.1	0.2
Conveyance Facilities				
interbasin diversions, into (mgd)				
out of (mgd)				
Quality Control Facilities				
chemical/biological				
potable water treat. plants (mgd)	PS	32	91	147
waste treatment plants				
secondary (85%) (m. PEs removed)				
secondary (90%) (m. PEs removed)	WQ,VC	1300	2200	3500
advanced (95%) (m. PEs removed)	WQ,VC	73	120	192
Desalting Facilities				
B. Water/Land				
Upstream Flood Plain Mgmt.(1000 acres)				
Local Flood Protection				
ocean (projects)				
river (projects)				
flood control channels (miles)				
Watershed Management (1000 acres)				
C. Land				
Controls				
fee simple purchase (buying)(sq.mi.)	VC,FW	5	0	0
fee simple purchase (buying) (mi.)				
purchase lease (sq.mi.)				
easements (sq.mi.)				
deed restrictions (sq.mi.)				
tax incentive subsidy (sq.mi.)				
zoning (sq.mi.)				
zoning (mi.)				
zoning and/or tax inc. subs.(sq.mi.)				
zoning and/or tax inc. subs. (mi.)				
V. Others				

* From the supply model for the following purposes: PS, Ind, Rur, Irrig, Pow.
ϕ Flood control storage not included.

	AREA 19			AREA			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	85	144	186									
	3	5	7									
	0.3	0.1	0.2									
	32	91	147									
	1300	2200	3500									
	73	120	192									
	5	0	0									

Water Development Costs: storage, upstream mainstream wells desalting
Water Withdrawal and Conveyance Costs: inter-basin transfers public water supply industrial self-supplied water rural water supply irrigation, agriculture non-agriculture
Power Plant Cooling Water
Hydroelectric Power Generation
Navigation: commercial recreational boating
Water Recreation
Fish and Wildlife: fishing hunting nature study
Water Quality Maint.: waste treatment, secondary advanced other /
Flood Damage Reduction: upstream mainstream
Drainage Control
Erosion Control
Health
Visual and Cultural
Summation of Available Estimated Costs

	AREA 19			AREA			AREA			AREA		
	1980	2000	2020	1980	2000	2020	1980	2000	2020	1980	2000	2020
	25	55	79									
	0.37	0.61	0.76									
	1.5	1.4	1.8									
	2.1	2.7	2.9									
	2.6	2.6	3.1									
	x	x	x									
	x	x	x									
	150	230	370									
	15	25	39									
	4.6	6.0	7.0									
	x	x	x									
	3.0	0	0									
	200	320	500									