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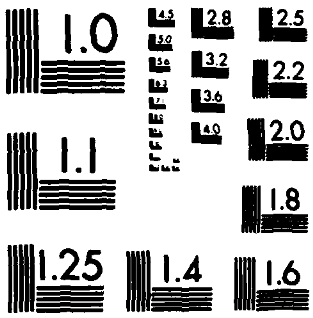

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Report provides a drought contingency plan for Mansfield Hallow Lake that would be responsive to public needs during drought situations. This plan provides for a 90 percent chance of dependable water supply yield of about 5.8 cfs. (3.7 MGD) while maintaining downstream release of 15 cfs or permit encroachment on flood control storage to elevation 213 feet NGVD, providing a maximum emergency water supply reserve of about 3,480 acre-feet (1,134 million gallons).

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THAMES RIVER BASIN

NATCHAUG RIVER WATERSHED

DROUGHT CONTINGENCY PLAN
MANSFIELD HOLLOW LAKE
MANSFIELD HOLLOW, CONNECTICUT

MARCH 1983

NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

DROUGHT CONTINGENCY PLAN

MANSFIELD HOLLOW LAKE

TABLE OF CONTENTS

Paragraph	Subject	Page
1	PURPOSE AND SCOPE	1
2	AUTHORIZATION	1
3	PROJECT AUTHORIZATION CONDITIONS	1
4	PROJECT DESCRIPTION	1
5	PRESENT OPERATING REGULATIONS	
a	Normal Periods	2
b	Flood Periods	2
c	Operating Constraints	
	(1) Minimum Releases	2
	(2) Maximum Releases	2
d	Downstream Non-Federal Project	2
6	DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS	
a	General	2
b	Water Supply Systems	11
c	Eastern Connecticut Water Suppliers	11
d	Population Projections	11
7	POTENTIAL FOR WATER SUPPLY REALLOCATION	
a	General	11
b	Drought Contingency Storage	12
8	WATER QUALITY EVALUATION	
a	Water Quality Classification	12
b	Existing Water Quality	13
c	Stratification Patterns	13
d	Water Quality Requirements for Drought Storage	14
e	Effects of Drought Storage	14
f	Conclusion	14

TABLE OF CONTENTS

Paragraph	Subject	Page
9	DISCUSSION OF IMPACTS	
a	General	15
b	Flood Control	15
c	Recreation	15
d	Sedimentation	15
10	POTENTIAL ENVIRONMENTAL IMPACTS	
a	Project Operation	15
b	Effects on the Aquatic Environment	16
c	Effects on the Terrestrial Environment	17
11	HISTORIC AND ARCHAEOLOGICAL RESOURCES	17
12	SUMMARY AND CONCLUSIONS	17

LIST OF TABLES

Table	Title	Page
1	Major Water Suppliers - Eastern Connecticut	3-6
2	Population Projections	7-10

LIST OF PLATES

Plate	Title
1	Thames River Basin Map
2	Mansfield Hollow Reservoir - Area-Capacity
3	Drought Contingency Storage Versus Flow Duration

DROUGHT CONTINGENCY PLAN

MANSFIELD HOLLOW LAKE

1. PURPOSE AND SCOPE

The purpose of this study report was to develop and set forth a possible drought contingency plan of operation for the Mansfield Hollow Lake Project that would be responsive to public needs during drought periods, and identify possible modifications to project regulation within current administrative and legislative constraints. The scope of this drought contingency plan includes an assessment of current water supply needs in the region, the possibility of reallocation of reservoir storage within specified limits, description of existing water supply conditions, water quality evaluation, discussion of impacts on other project purposes, and summary and conclusions.

2. AUTHORIZATION

The authority for drought contingency plans is contained in ER 1110-2-1941 which provides that water control managers will continually review and, when appropriate, adjust water control plans in response to changing public needs. Drought contingency plans will be developed on a regional, basinwide and project basis as an integral part of water control management activities.

3. PROJECT AUTHORIZATION CONDITIONS

Mansfield Hollow Lake was authorized by the Flood Control Act of 18 August 1941 (Public Law 228, 77th Congress). In addition, Section 4 of the Flood Control Act of 22 December 1944 (Public Law 534, 78th Congress) authorized the development and use of a recreational pool.

4. PROJECT DESCRIPTION

Mansfield Hollow Dam, completed in 1952, at Mansfield Hollow, Connecticut, is located on the Natchaug River about 5.3 miles upstream from its confluence with the Shetucket River at Willimantic, Connecticut (see plate 1). Normal elevation of the permanent pool at Mansfield Hollow is 206.5 feet NGVD (11.5-foot stage). A recreation pool is also maintained during summer months at elevation 211.5 (16.5-foot stage), with a surface area of 450 acres and storage of 2,800 acre-feet of water (0.33 inch of storage). An additional 49,200 acre-feet are available for flood control storage up to spillway crest (elevation 257), amounting to 5.8 inches of runoff from the 159-square mile drainage area. An area capacity table is shown on plate 2.

The outlet works consist of five 5'-6" wide x 7'-0" high conduits in the concrete spillway section. Conduits 3 and 4 have inverts at elevation 195, and conduits 1, 2 and 5 have inverts at elevation 199. Each conduit is provided with one hydraulically operated service gate with individual controls.

5. PRESENT OPERATING REGULATIONS

a. Normal Periods. During the nonfreezing season, a recreation pool, approximately 16.5 feet deep is maintained by a concrete weir and stoplog structure located upstream of gate 1. This pool is maintained from May to November. During the winter season, a pool approximately 11.5 feet deep is maintained by a concrete weir and stoplog structure located upstream of gate 2. Throughout normal periods the flood control gates are positioned to allow all inflow to pass through the dam.

b. Flood Periods. Regulation of flows from Mansfield Hollow is initiated for heavy rainfall over the Shetucket River watershed and for specific river stages at key index stations along the river. Regulation may be considered in three phases: Phase I - appraisal of storm and river conditions during development of a flood, Phase II - regulation of the project while the Shetucket and/or Quinebaug River floodflows crest and move downstream, and Phase III - emptying the reservoir following downstream recession of the flood.

c. Operating Constraints

(1) Minimum Releases. A minimum release of about 15 cfs is maintained only during periods of flood control regulation in order to sustain downstream fish life.

(2) Maximum Releases. The maximum nondamaging discharge capacity immediately downstream of Mansfield Hollow is about 2,900 cfs. Releases at or near this rate can be expected whenever peak inflows have exceeded this value and climatologic and hydrologic conditions permit such releases.

d. Downstream Non-Federal Project. The Willimantic Reservoir, owned by the city of Willimantic, is located about 2 miles downstream of Mansfield Hollow Lake. The reservoir impounds water from the Natchaug River for the water supply system for the city of Willimantic and has a total capacity of about 1,670 acre-feet. The average demand for water from the reservoir is about 2.5 million gallons per day (MGD).

In addition to supplying potable water to the city, water is drawn from the reservoir to power the vertical turbine pump which serves as the high-head water supply pump for Willimantic. Water for both purposes is drawn on demand.

6. DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS

a. General. Tables 1 and 2 present information concerning the

TABLE 1

Major Water Suppliers - Easter[n]

Company	Towns Served	Est. Population Served	Source of Supply Surface	Ground
Northern Div., Conn. Water Co.	East Windsor	2849	x	x
	Enfield	21689		
	South Windsor	6591		
	Stafford	2622		
	Suffield	5317		
	Vernon	171		
	Windsor Locks	12365		
Rockville Div., Conn. Water Co.	Ellington	749	x	
	Tolland	161		
	Vernon	14081		
Mystic Valley DS, CT-AM Water Co.	Groton	4321	x	x
	Stonington	5259		
Crystal Water Co. of Danielson	Killingly	7500	x	x
	Brooklyn	1700		
Jewett City Water Co.	Griswold	5650	x	x
	Lisbon	102		
Lifetime Homes Inc. Water Div.	Ledyard	3200		x
Thompson Water Co.	Thompson	3600		x
Groton Utilities Dept.	Groton	33200	x	
Manchester Water Dept.	Manchester	49500	x	x
New London Water Dept.	New London	-	x	
	Waterford	-		
	Montville	-		
Norwich Public Utilities Dept.	Bozrah	390	x	
	Lebanon	20		
	Montville	275		
	Norwich	43500		
	Preston	1000		
Putnam Water Dept.	Putnam	6710	x	x
	Thompson	70		
	Woodstock	138		
Vernon Water Dept.	Vernon	3400		x

TABLE 1

r Suppliers - Eastern Connecticut

urce of Supply		Water Production 1980 - MG		Est. Safe Yield MGD			
urface	Ground	Surface	Ground	Surface	Ground (Active)	Ground (Inactive)
x	x	165.9	1361.7	0.600	-	
x		1121.5		13.000		
x	x	378.9	76.5	-	-	1.080
x	x	204.4	179.0	0.800	-	
x	x	179.7	57.8	0.500	0.432	
	x		57.9		0.259	0.097
	x		99.6		-	
x		4416.6		-		
x	x	955.7	968.0	1.920	-	
x		1967.5		-		
x		1552.5		3.850	1.200	
x	x	468.7	136.7	-	-	
	x		98.9		.918	

Major Water Suppliers - Eastern

Company	Towns Served	Est. Population Served	Source of Supply Surface	Ground
Willimantic Water Dept.	Mansfield	1000	x	
	Windham	15400		
Ellington Acres Inc.	Ellington	1850		x
Elm Water Co.	Coventry	344		x
	Tolland	756		
Gallup Water Service Co.	Plainfield	1700		x
Plainfield Water Co.	Plainfield	1200		x
Colchester Water Dept.	Colchester	3500		x
Spragne Water And Sewer Auth.	Sprague	3100	x	
Amston & Beseck Water Co.	Hebron	500		x
	Lebanon	500		
	Middlefield	500		
Cedar Ridge Water Assn.	N. Stonington	450		x
Country Squire Water Co.	Preston	275		x
Ellington Water Co.	Ellington	365		x
General Water Service Co.	Coventry	464		x
Kittemaug Orchard Assn.	Montville	480		x
Lake Hoyward Water Co.	East Haddam	2800		x
Helms, Inc.	Coventry	530		x
Lakewood Heights Water Supply	Coventry	210		x
Lebanon Water Co.	Lebanon	228		x
Llynwood, Inc.	Bolton	184		x
Moosup Water Works	Plainfield	500		x
Waterford Village Water Co.	Waterford	440		x

TABLE 1 (Continued)

ater Suppliers - Eastern Connecticut

Source of Supply Surface	Source of Supply Ground	Water Production 1980 - MG Surface	Water Production 1980 - MG Ground	Est. Safe Yield MGD Surface	Est. Safe Yield MGD Ground (Active)	Est. Safe Yield MGD Ground (Inactive)
x		874.5		6.000		
	x		56.9		.154	.119
	x		-		-	
	x		257.0		1.620	.700
	x		120.6		-	
	x		115.8		.565	
x		42.8		.211		
	x		5.5		-	
	x		10.0		.214	
	x		8.1		.041	
	x		-		.043	
	x		-		.076	
	x		7.5		.075	
	x		5.4		.108	
	x		-		-	
	x		4.0		.029	
	x		5.0		.022	
	x		1.7		.032	.018
	x		7.5		.039	.032
	x		10.2		.056	.024

2

TABLE 1 (Continued)

Major Water Suppliers - Easter

Company	Towns Served	Est. Population Served	Source of Supply Surface	Ground
Oakdale Heights Assoc.	Montville	860		x
Occum Water Co.	Norwich	396		x
P & A. Memorial Water Supply Co.	Killingly	332		x
South Coventry Water Supply Co.	Coventry	600		x
Sterling Water Co.	Sterling	200		x
Tolland Aqueduct Co.	Tolland	375		x
Tolland Summit Com. Water Assoc.	Tolland	257		x
Trask Artesian Well Co.	Norwich	160		x
	Plainfield	220		
Williamsville Water Co.	Killingly	530		x
Woodland Summit Com. Water Assoc.	Tolland	250		x
Heritage Woods Water Co.	Tolland	275		x
Westerly Water Dep. Pawcatuck Sec.	Stonington	7400		x
University of Conn.	Mansfield	21700		x
Barrelt Div. SCWA	Ledyard	270		x
Ferry View Heights Div. SCWA	Ledyard	300		x
Gray Farms Div., SCWA	Ledyard	180		x
Lantern Hill Div., SCWA	Stonington	84		x
Mohegan Div., SCWA	Montville	1300		x
Montville Div., SCWA	Montville	1700		x

TABLE 1 (Continued)

Suppliers - Eastern Connecticut

Source of Supply		Water Production 1980 - MG		Est. Safe Yield MGD		
Surface	Ground	Surface	Ground	Surface	Ground (Active)	Ground (Inactive)
	x		23.6		.205	.043
	x		6.0		.070	
	x		-		.076	
	x		-		.075	
	x		-		-	
	x		6.4		.130	
	x		5.0		.016	.034
	x		-		-	
	x		-		-	
	x		5.6		-	
	x		4.9		.076	
	x		-		5.250	
	x		-		2.052	
	x		4.7		.043	.016
	x		6.1		.067	
	x		3.2		-	
	x		1.4		.084	
	x		23.8		.173	
	x		36.0		.130	.99

2

TABLE 1 (Continued)

Major Water Suppliers - Eastern Conn

Company	Towns Served	Est. Population Served	Source of Supply Surface	Ground	Su
N. Stonington Div., SCWA	N. Stonington	808		x	
Tower Div., SCWA	Ledyard	2040		x	
Somers Sec., No. Div., CTWC	Somers	1246		x	
Stafford Sec., No. Div., CTWC	Stafford	2622	x		16
Country Hills, Elm Water Co.	Tolland	368		x	
Coventry Hills, Elm Water Co.	Coventry	400		x	
Pilgrim Hills, Elm Water Co.	Coventry	352		x	
Lake Amston Div., A & B Water Co.	Hebron Lebanon	500 500		x	
Lakeview Terr. WSC, Helms Inc.	Coventry	530		x	
Nathan Hale Hgt. WSC, Helms Inc.	Coventry	160		x	
Arpin CT., Trask Art. Well Co.	Norwich	60		x	
Lawler CT., Trask Art. Well Co.	Norwich	100		x	
Moosup Sup., Trask Art. Well Co.	Plainfield	220		x	

TABLE 1 (Continued)

ater Suppliers - Eastern Connecticut

Source of Supply Surface	Source of Supply Ground	Water Production 1980 - MG Surface	Water Production 1980 - MG Ground	Est. Safe Yield MGD Surface	Est. Safe Yield MGD Ground (Active)	Est. Safe Yield MGD Ground (Inactive)
	x		14.4		.140	
	x		45.0		.632	
	x		-		.194	
x		165.9	-		-	
	x		-		.229	.030
	x		-		.062	.033
	x		-		-	
	x		-		.118	
	x		-		.025	.016
	x		-		-	
	x		-		.022	
	x		-		.011	
	x		-		.035	

TABLE 2
Population Projections

	Census 1980	1985	1990	1995	2000	% Change
Tolland County						
Andover	2,144	2,290	2,440	2,590	2,740	27.8
Bolton	3,951	4,100	4,260	4,380	4,440	12.4
Columbia	3,386	3,570	3,720	3,870	3,970	17.2
Coventry	8,895	9,310	9,760	10,140	10,410	17.0
Ellington	9,711	10,360	10,980	11,410	11,710	20.6
Hebron	5,453	6,160	6,840	7,150	7,400	35.7
Mansfield	20,634	20,130	20,130	21,130	21,630	4.8
Somers	8,473	8,670	8,900	9,020	9,030	6.6
Stafford	9,268	9,570	9,720	9,970	10,170	9.7
Tolland	9,694	10,490	11,390	12,190	13,190	36.1
Union	546	600	700	750	850	60.1
Vernon	27,974	28,680	29,910	31,230	32,530	16.3
Willington	4,694	4,890	5,190	5,390	5,540	18.0
	114,832	118,820	123,940	129,220	133,340	16.1

Population Projections (Cont.)

	Census 1980	1985	1990	1995	2000	% Change
Windham County						
Ashford	3,221	3,370	3,520	3,670	3,820	18.6
Brooklyn	5,691	6,090	6,390	6,790	7,090	24.6
Canterbury	3,426	3,830	4,230	4,330	4,430	29.3
Chaplin	1,793	1,890	1,940	1,960	2,010	12.1
Eastford	1,028	1,130	1,180	1,230	1,270	23.5
Hampton	1,322	1,520	1,720	1,820	1,920	45.2
Killingly	14,519	15,090	15,690	16,240	16,700	15.0
Plainfield	12,774	13,220	13,780	14,250	14,650	14.7
Pomfret	2,775	2,980	3,180	3,380	3,530	27.2
Putnam	8,580	8,580	8,530	8,680	8,630	0.6
Scotland	1,072	1,140	1,210	1,280	1,320	23.1
Sterling	1,791	1,890	1,990	2,070	2,100	17.3
Thompson	8,141	8,150	8,400	8,690	8,890	9.2
Windham	4,694	4,890	5,190	5,390	5,540	18.0
Woodstock	5,117	5,370	5,620	5,870	6,120	19.6
	75,944	79,140	82,570	85,650	88,020	15.9

Population Projections (Cont.)

	Census 1980	1985	1990	1995	2000	% Change
New London County						
Bozrah	2,135	2,180	2,190	2,130	2,100	-1.5
Colchester	7,761	8,330	8,940	9,470	9,510	22.5
East Lyme	13,870	14,280	14,860	15,230	15,300	10.3
Franklin	1,592	1,650	1,690	1,700	1,680	5.5
Griswold	8,967	9,220	9,470	9,720	9,970	11.2
Groton	41,062	41,030	41,830	42,380	42,780	4.2
Lebanon	4,762	4,960	5,110	5,260	5,460	14.7
Ledyard	13,735	14,590	15,630	16,490	17,060	24.2
Lisbon	3,279	3,430	3,580	3,730	3,830	16.8
Lyme	1,822	1,960	2,090	2,220	2,320	27.3
Montville	16,455	17,110	17,960	18,650	19,170	16.5
New London	28,842	29,010	29,140	29,090	28,580	-0.8
North Stonington	4,219	4,170	4,120	4,070	4,020	-4.6
Norwich	38,074	38,660	39,440	40,230	40,950	7.6
Old Lyme	6,159	6,660	7,160	7,660	8,060	30.9

Population Projections (Cont.)

	Census 1980	1985	1990	1995	2000	% Change
Preston	4,644	4,800	5,000	5,160	5,280	13.7
Salem	2,335	2,540	2,740	2,990	3,240	38.8
Sprague	2,996	2,960	2,930	2,910	2,860	-4.4
Stonington	16,220	16,720	17,350	17,920	18,360	13.2
Voluntown	1,637	1,720	1,780	1,860	1,940	18.5
Waterford	17,843	18,290	18,550	18,510	18,200	2.0
	238,409	244,270	251,560	257,380	260,670	9.3

existing water supply systems within Tolland, Windham and New London counties in eastern Connecticut. The tables have been formulated using data provided by the State of Connecticut Department of Environmental Protection. Data provided from the major water suppliers included a computer printout of water utility records for 1980, a summary of surface water sources in the study area, and information on ground-water sources where available. The estimated safe yields of existing surface and ground-water supplies were essential data. For the smaller water supplies such as apartment complexes and schools, estimates of daily consumption and safe yields were provided at some locations. In many instances, particularly for the smaller water supplies, portions of the data are missing. No effort was made to develop and accumulate this missing information as it was considered beyond the level of detail required for this study.

b. Water Supply Systems. The primary objective of this analysis was to accumulate available data regarding water supply systems in the vicinity of Mansfield Hollow Lake that could benefit from storage in the lake and present it in a manner portraying existing water supply conditions. Projections of future demands were not developed because this study only addresses the effects of drought conditions which could occur at any time in the future. Modifications in the operational procedures at Mansfield Hollow Lake would provide storage for water supply purposes only when drought conditions exist and not to meet normal water supply demands at some future date.

c. Eastern Connecticut Water Suppliers. Information pertaining to the larger water suppliers in eastern Connecticut are presented in table 1. The data given for each water supplier includes: the communities served, estimated population served within each community, source of supply (ground or surface), water production in million gallons during 1980, and the estimated safe yield of each source. An analysis as to whether existing sources can provide adequate supplies during drought conditions was not performed. The information has been accumulated to present a summary of the existing water conditions pertaining to major water suppliers in the three eastern Connecticut counties.

d. Population Projections. Population projections for the three counties in eastern Connecticut are given in table 2 to show the populations in each community potentially affected by a prolonged dry period. The projections were taken from Population Projections for Connecticut Municipalities and Regions to the Year 2000, published by the State of Connecticut Office of Policy and Management. This information is presented to indicate potential future growth in eastern Connecticut.

7. POTENTIAL FOR WATER SUPPLY REALLOCATION

a. General. According to provisions contained in the Water Supply Act of 1958 (Public Law 500, 85th Congress, Title III), as amended, municipal and industrial water supply storage space may be recommended for inclusion in Corps of Engineers reservoirs. The law provides that up to 15 percent of total storage capacity allocated to all authorized Federal purposes or 50,000 acre-feet, whichever is less, may be allocated from the storage serving authorized purposes to storage serving municipal or industrial water supply within the Corps discretionary authority. Guidance contained in ER 1110-2-1941 directs field offices to determine the short term water supply capability of existing Corps reservoirs that would be functional under existing authorities.

b. Drought Contingency Storage. At Mansfield Hollow it has been estimated that a small amount of the existing storage can be put to multiple use for drought contingency as well as flood control. This infringement would result in a maximum pool elevation of about 213 feet (18-foot stage), representing a total volume of about 3,480 acre-feet, or about 680 acre-feet over the normal summer season recreation level and 2,680 acre-feet over the permanent pool storage level. The total volume of 3,480 acre-feet constitutes about 7 percent of the total reservoir storage. It was concluded that this was the maximum infringement for drought purposes without seriously impacting on one of the reservoir's authorized purposes, flood control. Additionally, further infringement may kill timber and vegetation in the uncleared reservoir areas impacting water quality and aesthetics.

Based on an all season low flow duration analysis, using the 51 years of flow records for the Natchaug River at Willimantic, Connecticut, it was determined that during a 10-year frequency drought there would be sufficient riverflow to either provide a water supply yield of about 13 cfs (8.4 MGD) or to fill the reservoir from 211.5 to 213 (680 acre-feet) in a 26-day period, provided no releases were made downstream. If a release of 15 cfs (0.1 cfs/sq mi) were maintained then either a water supply yield of 5.8 cfs (3.7 MGD) could be maintained or the project filled to the 213-foot NGVD level over a 58-day period. It was further concluded that in the event of a severe drought emergency all water in storage could be made available for water supply, providing 3,480 acre-feet (1134 million gallons) of water supply if the storage were initially at elevation 213 feet NGVD. The available drought storage could be drawn from the reservoir pool or transported downstream. Drought contingency storage versus flow duration at Mansfield Hollow is shown graphically on plate 3.

8. WATER QUALITY EVALUATION

a. Water Quality Classification. The Mount Hope, Fenton and Natchaug Rivers above Mansfield Hollow Lake are rated class AA by the Connecticut Department of Environmental Protection (DEP). Class AA ratings are for existing or proposed drinking water supply impoundments and tributary surface waters. Technical requirements for class AA waters include: a minimum dissolved oxygen (DO) concentration of 5 mg/l; fecal coliform bacteria not to exceed a mean of 20 per 100 ml nor more than 100 per 100 ml in more than 10 percent of the samples;

sodium not to exceed 20 mg/l; no color, turbidity, pH, phosphorus, taste, or odor except as naturally occurs; and no chemical constituents in concentrations or combination which would be harmful to human, animal or aquatic life.

b. Existing Water Quality. The New England Division has collected water quality data at Mansfield Hollow Lake inflow and discharge stations since 1971. The results of the NED water quality program shows that the waters of Mansfield Hollow Lake are of good quality and usually meet or exceed the requirements of their Connecticut class AA designation. Areas of concern include high levels of coliform bacteria and heavy metals.

The good quality of the waters of Mansfield Hollow Lake is evidenced by dissolved oxygen (DO) levels which are usually above 8 mg/l and virtually always above the minimum required by Connecticut class AA standards, generally very low turbidity levels, low to moderate color levels, pH levels usually within the limits set by Connecticut class AA standards, and nutrient levels that are generally below the threshold level to sustain algae blooms in an impoundment.

Some high coliform counts have been measured at this project in the past; however, a shortage of recent data precludes a definite description of existing conditions. There are no significant point sources of discharge upstream from the lake and coliform levels are expected to be low except when runoff events wash debris into the rivers.

Data collected by the NED Laboratory indicate that high levels of zinc and mercury may occasionally be found at Mansfield Hollow Lake. These metals are not in concentrations high enough to be a health hazard to humans, but might be harmful to fish. The data on these metals are not complete.

Levels of iron and manganese are higher than the recommended limits in the National Secondary Drinking Water Regulations for a treated water. However, these limits are established to prevent taste and laundry staining problems; iron and manganese levels at Mansfield Hollow Lake are not a health hazard for humans or aquatic life.

c. Stratification Patterns. Although lake profiling data have not been collected at Mansfield Hollow Lake, a typical summer stratification pattern can be estimated from what is known about other NED reservoir impoundments. Stratification begins in late April or early May and is pronounced by June. Peak stratification occurs in July. By late October or early November, the surface waters of the lake cool off enough for the fall overturn to occur.

Because of the shallow depth of Mansfield Hollow Lake, stratification is expected to be generally weak with a maximum surface to bottom temperature difference of 5 to 10 Fahrenheit degrees. Anaerobic conditions in the depths of the lake would be expected to develop during the peak stratification period.

d. Water Quality Requirements for Drought Storage. There are two requirements to be met. The waters must meet State standards for surface waters and must be of a quality suitable for domestic water supply use. A water which meets State standards will in most ways be good for public water supply. However, there are some parameters such as iron and manganese which are not covered by State standards but are undesirable in a public water supply. These substances can be removed by conventional treatment processes, but if their levels are kept low, it will reduce the amount of treatment required to make the water usable. Additional monitoring by the Corps of Engineers would be conducted during the drought storage period.

e. Effects of Drought Storage. The principal water quality change that will occur as a result of drought storage at Mansfield Hollow Lake will be an increase in the temperature of the lake and the discharges from the lake. Other possible changes include localized algae blooms; and increases in color, turbidity, and metal levels in the lake and the discharge.

The temporary increase in the size of the permanent pool at Mansfield Hollow Lake will increase the hydraulic detention time in the lake and flood lands which are normally not under water. The increase in detention time will cause a warming of the lake waters, a strengthening of thermal stratification patterns, and an increase in the duration and size of the anaerobic zone in the bottom of the lake. Because nutrients and metals can be released from sediments under anaerobic conditions, an increase in the duration of anaerobic conditions could increase nutrient levels in the lake enough to allow minor algae blooms to occur, particularly when the lake turns over in the fall. Algae blooms can cause color, turbidity, taste, and odor problems in a public water supply. On the positive side, an increase in hydrauic detention time will allow a reduction in turbidity and coliform levels through settling and natural die-off.

The inundation of vegetated lands when the pool is raised will affect water quality by causing a decay of plant material and a release of nutrients to the overlying waters. This could also lead to the formation of localized algae blooms in the lake. Raising the pool stage from 16.5 to 18.0 feet will increase the pool surface area from 450 to 490 acres. Because this increase is small relative to the total pool area, the effects on water quality of the inundation of vegetation should be minor and localized. However, it is possible that the combined effect of increased hydraulic detention time and decaying submerged vegetation will produce nuisance algae problems. This could require lowering the pool, removing organic material, and then refilling the pool.

f. Conclusion. Raising the pool at Mansfield Hollow Lake to elevation 213 feet NGVD most likely will cause no more than minor water quality problems. The stored water should be of a basically good quality that will be usable for public water supply.

9. DISCUSSION OF IMPACTS

a. General. Any action resulting in a temporary change of reservoir storage volumes will have impacts on other project purposes which must be evaluated before a storage reallocation plan can be implemented. At Mansfield Hollow Lake, an evaluation has been made of the impacts resulting from drought contingency storage on the flood control and recreation purposes of the project. Effects on sedimentation and the aquatic and terrestrial environments as well as the historic and archaeological resources have also been addressed.

b. Flood Control. A review of the regulation procedures at Mansfield Hollow Lake was undertaken to determine the volume of water that could be made available for drought contingency purposes. The water would be stored by temporarily utilizing existing flood control or recreation storage. It is recognized that major floods occur in every season of the year, and any use of flood control storage would be continually monitored to insure there would be no adverse impacts on downstream flood protection.

At Mansfield Hollow Lake the maximum pool elevation for drought contingency storage has been estimated to be elevation 213 feet, representing an infringement on the flood control storage of about 0.1 inch of runoff from the upstream 159-square mile drainage area. This level indicates the approximate elevation to which water could be stored without significantly affecting regulation activities.

c. Recreation. No adverse impact. The culvert under Basset Bridge Road that separates the lake into two parts will still allow boats to pass through at a stage of 18 feet. Recreational use during the drought storage period may be restricted if so requested by the users.

d. Sedimentation. Little or no impact. No slumping or shore erosion is anticipated at a stage of 18 feet.

10. POTENTIAL ENVIRONMENTAL IMPACTS

a. Project Operation. The proposed plan involves raising the recreational pool level 1.5 feet above its 211.5 foot elevation. This increased storage would later be drawndown for potential water supply use to the 195 foot elevation which is the level of the gate sill. Based on a 10-year event, the anticipated rate of pool increase would be about 0.3 inch/day over a 58-day period. To accomplish this, the downstream releases would be restricted to 15 cfs during the storage period. The storage would be drawndown as needed but may be held for a 3 to 4-month period.

b. Effects on the Aquatic Environment. The aquatic environment of the project area consists of the reservoir and downstream riverine habitats. The reservoir provides good habitat for warm water fish species of which large-mouth bass is the most important. Also, three major streams which feed into the reservoir, the Natchaug, Fenton and Mount Hope Rivers are annually stocked with trout by the State of Connecticut. These rivers and reservoirs provide suitable cold water habitat until early summer when water temperatures rise above 70° Fahrenheit. Impacts to the reservoir fishery are mainly concerned with the self-sustaining large-mouth bass population. This species generally nests in sand or gravel covered shallow areas around the lake perimeter during May and early June. Impacts would be generally related to the extent, frequency and timing of the pool fluctuations.

The small, slow and one time rise in pool elevation during the critical spawning period should not inhibit the reproduction of bass. However, the anticipated localized water quality changes may affect fish reproductive success and survival of fry depending on the degree of change. Further study would be required to assess impacts to the fish community. If the proposed drawdown occurs during the spawning season, established shoreline nests may be isolated or dewatered; thereby, reducing the occurrence of that year class. If such conditions occur over several years, the natural population may be severely affected in the long term. However, if drawdown occurred after the newly hatched fry have left the confines of their nest (by mid to late July), which is more likely, the impact could be negligible. There is evidence that previous drawdowns at the reservoir have actually stimulated growth in the lake's predatory fish populations possibly by concentrating the forage fish. However, if the existing storage were to be entirely removed, as would be the case during a severe drought, the aquatic community would be removed from the reservoir. Repopulation would probably occur in the following seasons, but management efforts would probably be required to restore the water quality sport fishery.

The other affected aquatic habitat consists of the one-half mile reach of the Natchaug River downstream of Mansfield Hollow Dam which leads directly to the upper reaches of Willimantic Reservoir. In addition to the stream-associated warm water species of this reach, the reach is also annually stocked with trout. As with the upstream habitat, the reach is also a seasonal cold water habitat.

Impacts would be generally related to the downstream low flows imposed by the storage on the stocked trout population. It is not known whether spawning or nursery areas occur in this reach of the river. However, the maintenance of this area as a healthy stream community and a seasonal adult holding area would depend on adequate streamflows. Further study would be required to determine the impacts on the downstream stocked trout population during periods of minimum release rates of 0.1 csm or 15 cfs. The State of Connecticut has also stated its concern about the necessary maintenance of flows to the downstream Shetucket River which supports a year-round cold water fishery. Because of potential conflicts with the existing uses of the flows which feed the Shetucket River, a basin-wide approach has been suggested should this plan proceed to more detailed study.

c. Effects on the Terrestrial Environment. The habitat surrounding the reservoir is primarily made up of upland forest, open field and forested wetland vegetative cover types. Roughly 50 percent of the area is wooded. Common upland species are primarily red and white oak and white pine; whereas, the wooded swamp areas include such species as red maple, gray birch, red oak, elm and sugar maple. Forestry management practices maximize forest edge to provide a variety of habitats for the area's wildlife species. Common and/or important species include mammals such as deer, rabbit, fox, mink and a variety of rodents; birds, such as waterfowl, wading birds, raptors, shore birds, and songbirds; reptiles/amphibians such as turtles, snakes, frogs, salamanders and newts. Pheasants are stocked in an upland field area by the State on a put-and-take basis. The impacts of the increase in pool elevation would be to inundate an additional 40 acres of shoreline habitat. Because storage in the current and recent years has been above the existing recreational pool, the actual area of inundated upland would be considerably less. Also, most of the shoreline for 2 vertical feet above the 211.5 foot pool is stone or sand-faced; thus, the impacts on the existing shoreline vegetation should not be significant. A previous storage for a 4-month period during the 1980 growing season did not cause any significant problems. Since most of the affected shoreline is armored with stone or sand, there should not be any significant impacts to wildlife species. However, the proposed increased pool would inundate some shoreline vegetation that may be useful to wildlife as food or nesting habitat. As with the large-mouth bass, the degree of impact is essentially dependent on the timing of inundation. If storage took place during the nesting season, the nest and its contents may be inundated. Eggs and recently hatched juveniles would be particularly susceptible. However, the conditions subjected to resident species by the proposed storage have previously occurred during normal flood control operations without significant impact.

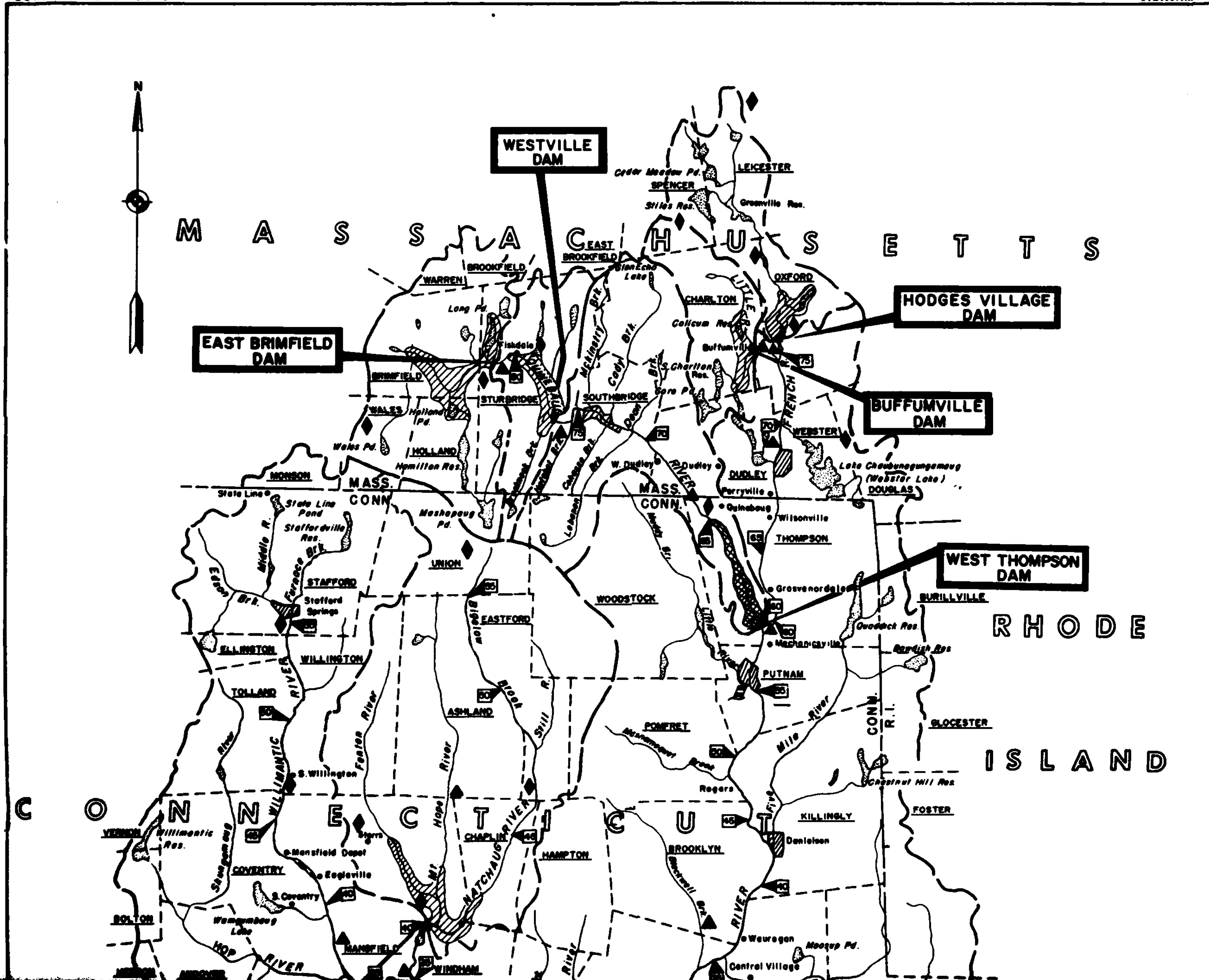
11. HISTORIC AND ARCHAEOLOGICAL RESOURCES

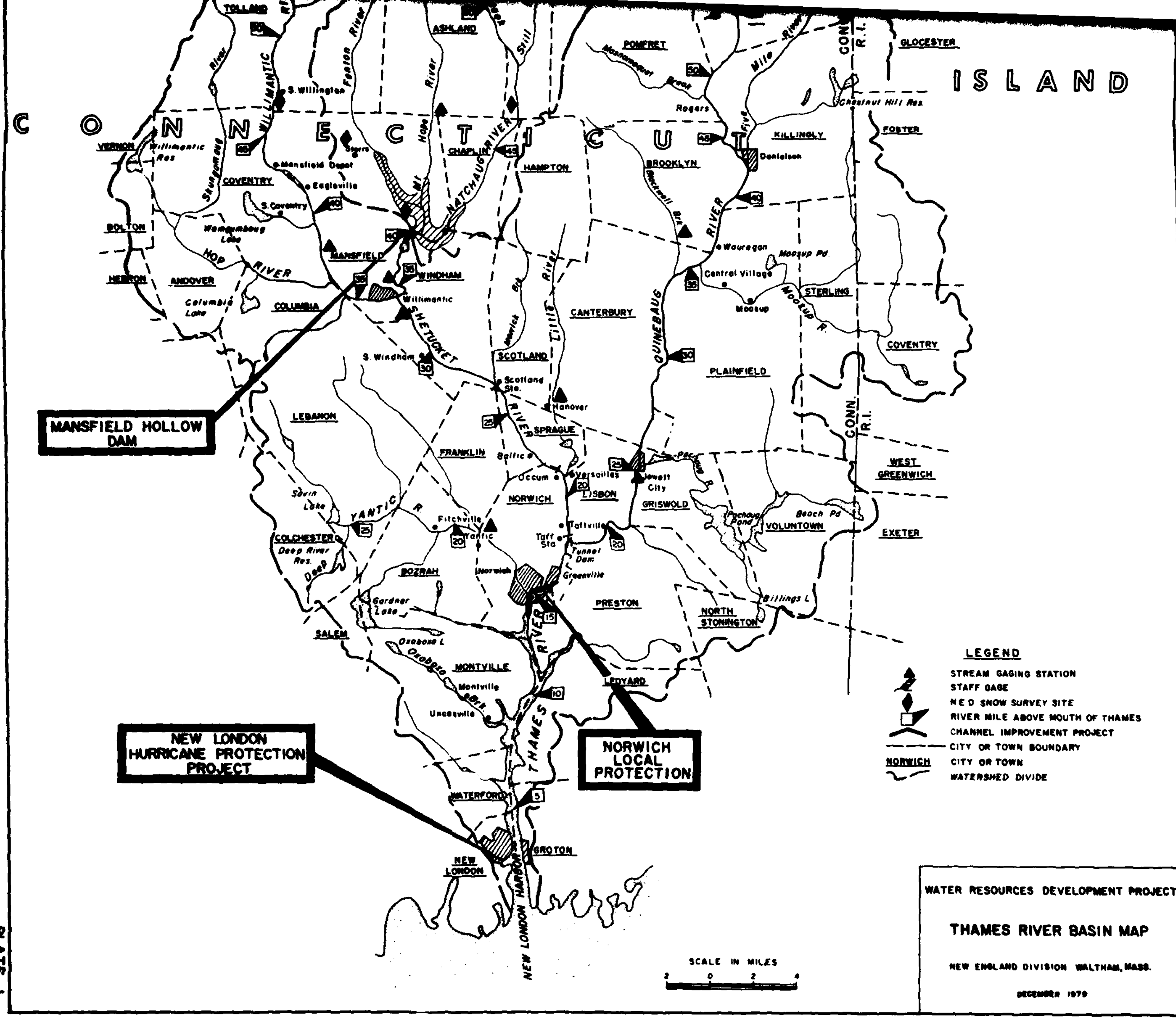
Examination of mid-19th century maps reveals no recorded historic period resources below elevation 213 feet NGVD, and no prehistoric resources are recorded within the project. However, as the project has never been subjected to an archaeological survey, unrecorded prehistoric or historic resources may exist within the area affected by this drought contingency plan. Therefore, should this plan proceed to more detailed study, an archaeological reconnaissance survey of the impact area will be necessary to determine what, if any, resources are affected and the severity of any impacts upon them.

12. SUMMARY AND CONCLUSIONS

A drought contingency plan was developed for Mansfield Hollow

Lake that would be responsive to public needs during drought situations. The plan would provide a 90 percent chance of dependable water supply yield of about 5.8 cfs (3.7 MGD) while maintaining a downstream release of 15 cfs or permit encroachment on flood control storage to elevation 213 feet NGVD, providing a maximum emergency water supply reserve of about 3,480 acre-feet (1,134 million gallons). An evaluation of the effects of this drought contingency plan on the various project features, as well as on certain environmental aspects, has revealed no significant impacts. This evaluation was based on preliminary studies utilizing readily available information. Should this plan proceed to more detailed studies, further evaluation would be required to fully assess the significance of environmental impacts.


N
MASSACHUSETTS
CONNECTICUT
RHODE ISLAND
WESTVILLE DAM
EAST BRIMFIELD DAM
HODGES VILLAGE DAM
BUFFUMVILLE DAM
WEST THOMPSON DAM
LEICESTER
SPENCER
OXFORD
CHARLTON
EAST BROOKFIELD
BROOKFIELD
WARREN
BRIMFIELD
STURBRIDGE
SOUTHBRIDGE
WALES
HOLLAND
WEBSTER
DUDLEY
DOUGLAS
MONSON
UNION
STAFFORD
WOODSTOCK
THOMPSON
BURRILLVILLE
EASTFORD
PUTNAM
ELLINGTON
WILLINGTON
TOLLAND
ASHLAND
POMFRET
GLOCESTER
VERNON
COVENTRY
CHAPLIN
HAMPTON
BROOKLYN
KILLINGLY
FOSTER
BOLTON
MANSFIELD
WINDHAM
MASS.
CONN.
R.I.
FRENCH
RIVER
Quinebaug
Fiskdale
Buffumville
W. Dudley
Dudley
Perryville
Wilsonville
Grosvenordale
Mechanicsville
Stafford Springs
S. Willington
Storrs
Mansfield Depot
Eagleville
S. Coventry
Danielson
Rogers
Wauregan
Central Village
State Line
Long Pd.
Holland Pd.
Wales Pd.
Hamilton Res.
Mashapaug Pd.
Cedar Meadow Pd.
Stiles Res.
Greenville Res.
Glen Echo Lake
Cohcum Res.
S. Charlton Res.
Lake Chaubunagungamaug (Webster Lake)
State Line Pond
Staffordville Res.
Quaddick Res.
Bowdish Res.
Chestnut Hill Res.
Moosup Pd.
Willimantic Res.
Wamgumbaug Lake
WILLIMANTIC RIVER
NATCHAUG RIVER
HOP RIVER
Mt. Hope River
Fenton River
Still R.
Bigelow Brook
Five Mile River
Blackwell Brk.
Mashamoquet Brook
Muddy Br.
Little River
McKinstry Brk.
Cady Brk.
Middle R.
Edson Brk.
Furnace Brk.
Skungamaug River



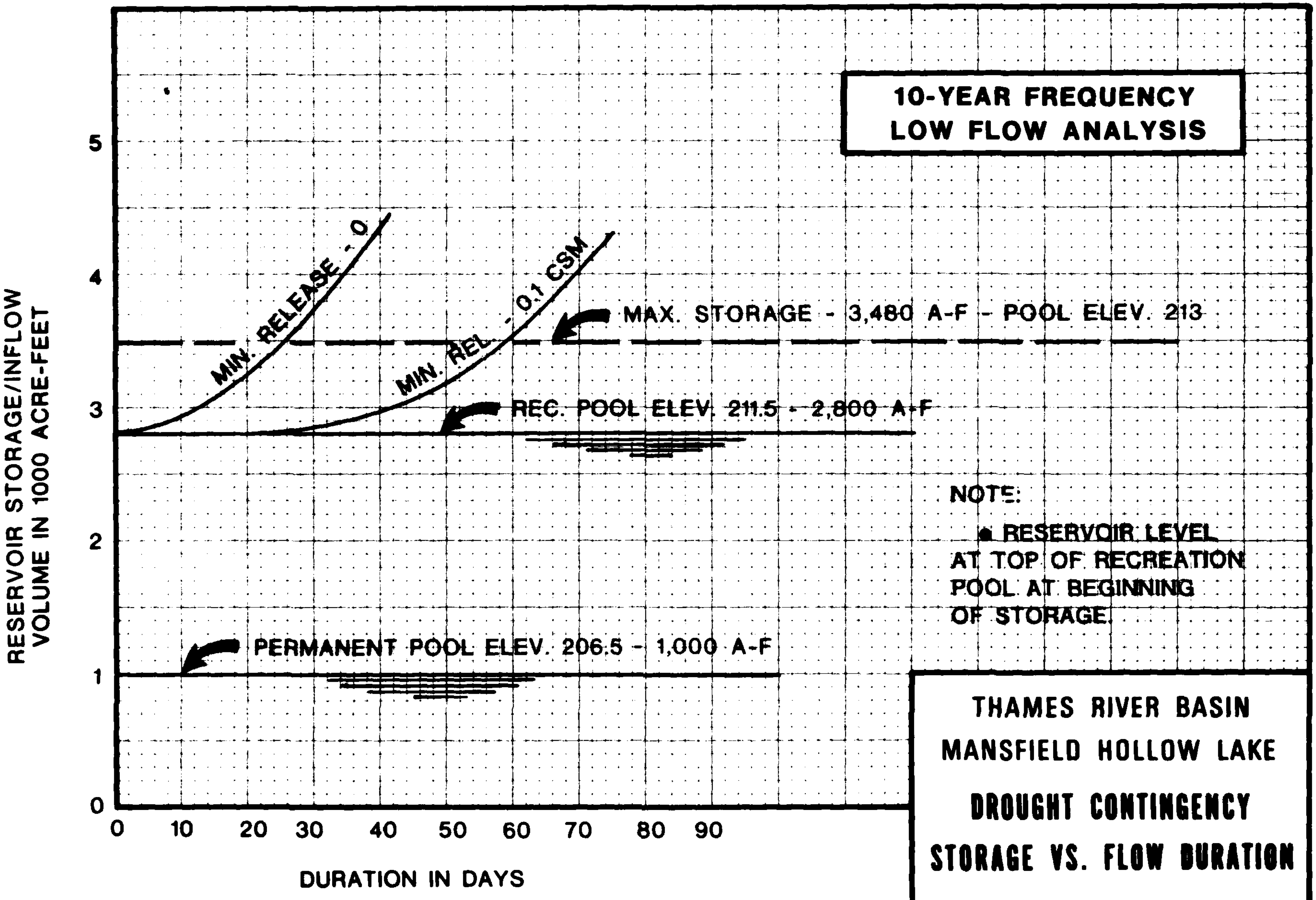
CONNECTICUT
ISLAND
MANSFIELD HOLLOW DAM
NEW LONDON HURRICANE PROTECTION PROJECT
NORWICH LOCAL PROTECTION
TOLLAND
ASHLAND
POMFRET
GLOCESTER
VERNON
COVENTRY
BOLTON
HEBRON
ANDOVER
COLUMBIA
MANSFIELD
WINDHAM
CHAPLIN
HAMPTON
BROOKLYN
KILLINGLY
FOSTER
STERLING
CANTERBURY
SCOTLAND
PLAINFIELD
LEBANON
FRANKLIN
SPRAGUE
NORWICH
LISBON
GRISWOLD
VOLUNTOWN
WEST GREENWICH
EXETER
COLCHESTER
BOZRAH
PRESTON
NORTH STONINGTON
SALEM
MONTVILLE
LEDYARD
WATERFORD
NEW LONDON
GROTON
CONN.
R.I.
WILLIMANTIC RIVER
NATCHAUG RIVER
SHETUCKET RIVER
QUINEBAUG RIVER
YANTIC R.
THAMES RIVER
HOP RIVER
NEW LONDON HARBOR
LEGEND
STREAM GAGING STATION
STAFF GAGE
N E D SNOW SURVEY SITE
RIVER MILE ABOVE MOUTH OF THAMES
CHANNEL IMPROVEMENT PROJECT
CITY OR TOWN BOUNDARY
NORWICH CITY OR TOWN
WATERSHED DIVIDE
SCALE IN MILES
2 0 2 4
WATER RESOURCES DEVELOPMENT PROJECT
THAMES RIVER BASIN MAP
NEW ENGLAND DIVISION WALTHAM, MASS.
DECEMBER 1979

PLATE 1

MANSFIELD HOLLOW RESERVOIR
AREA AND CAPACITY
DRAINAGE AREA: 159 SQ. MI.

Elev. (msl)	Stage (ft.)	Area (acres)	Capacity (ac.ft.)	Capacity (inches)
Recreation Storage				
195	0	0	0	0
196	1	0	0	0
197	2	5	0	0
198	3	8	0	0
199	4	18	0	0
200	5	25	20	0
201	6	70	55	0.01
202	7	100	135	0.02
203	8	130	250	0.03
204	9	165	400	0.05
205	10	200	580	0.07
206	11	240	800	0.09
207	12	280	1,060	0.12
208	13	325	1,365	0.16
209	14	370	1,715	0.20
210	15	415	2,120	0.25
211	16	440	2,545	0.30
211.5	16.5	450	2,800	0.33
Flood Control Storage				
211.5	16.5	450	0	0
212	17	465	200	0.02
213	18	490	680	0.08
214	19	515	1,180	0.14
215	20	540	1,710	0.20
216	21	565	2,200	0.26
217	22	595	2,840	0.33
218	23	620	3,450	0.41
219	24	650	4,080	0.48
220	25	675	4,750	0.56
221	26	690	5,430	0.64
222	27	710	6,130	0.72
223	28	740	6,850	0.81
224	29	760	7,600	0.90
225	30	785	8,400	0.99
Flood Control Storage (cont.)				
226	31	810	9,200	1.10
227	32	835	10,000	1.18
228	33	855	10,800	1.27
229	34	880	11,700	1.38
230	35	900	12,600	1.49
231	36	925	13,500	1.59
232	37	955	14,450	1.70
233	38	980	15,400	1.82
234	39	1,015	16,400	1.93
235	40	1,040	17,450	2.05
236	41	1,070	18,500	2.18
237	42	1,095	19,600	2.31
238	43	1,125	20,700	2.44
239	44	1,160	21,800	2.57
240	45	1,190	23,000	2.71
241	46	1,225	24,200	2.85
242	47	1,260	25,450	3.00
243	48	1,295	26,700	3.15
244	49	1,330	28,000	3.30
245	50	1,360	29,400	3.47
246	51	1,400	30,800	3.63
247	52	1,450	32,200	3.80
248	53	1,490	33,700	3.97
249	54	1,530	35,200	4.15
250	55	1,580	36,700	4.33
251	56	1,625	38,300	4.52
252	57	1,670	40,000	4.71
253	58	1,710	41,600	4.91
254	59	1,750	43,400	5.12
255	60	1,790	45,400	5.35
256	61	1,840	47,200	5.57
257	62	1,880	49,200	5.80

NOTES: Gate Sill Elevation = 195
Spillway Crest Elevation = 257
1" Runoff = 8,480 acre-feet



THAMES RIVER BASIN

MANSFIELD HOLLOW LAKE

DROUGHT CONTINGENCY

STORAGE VS. FLOW DURATION

PLATE 3