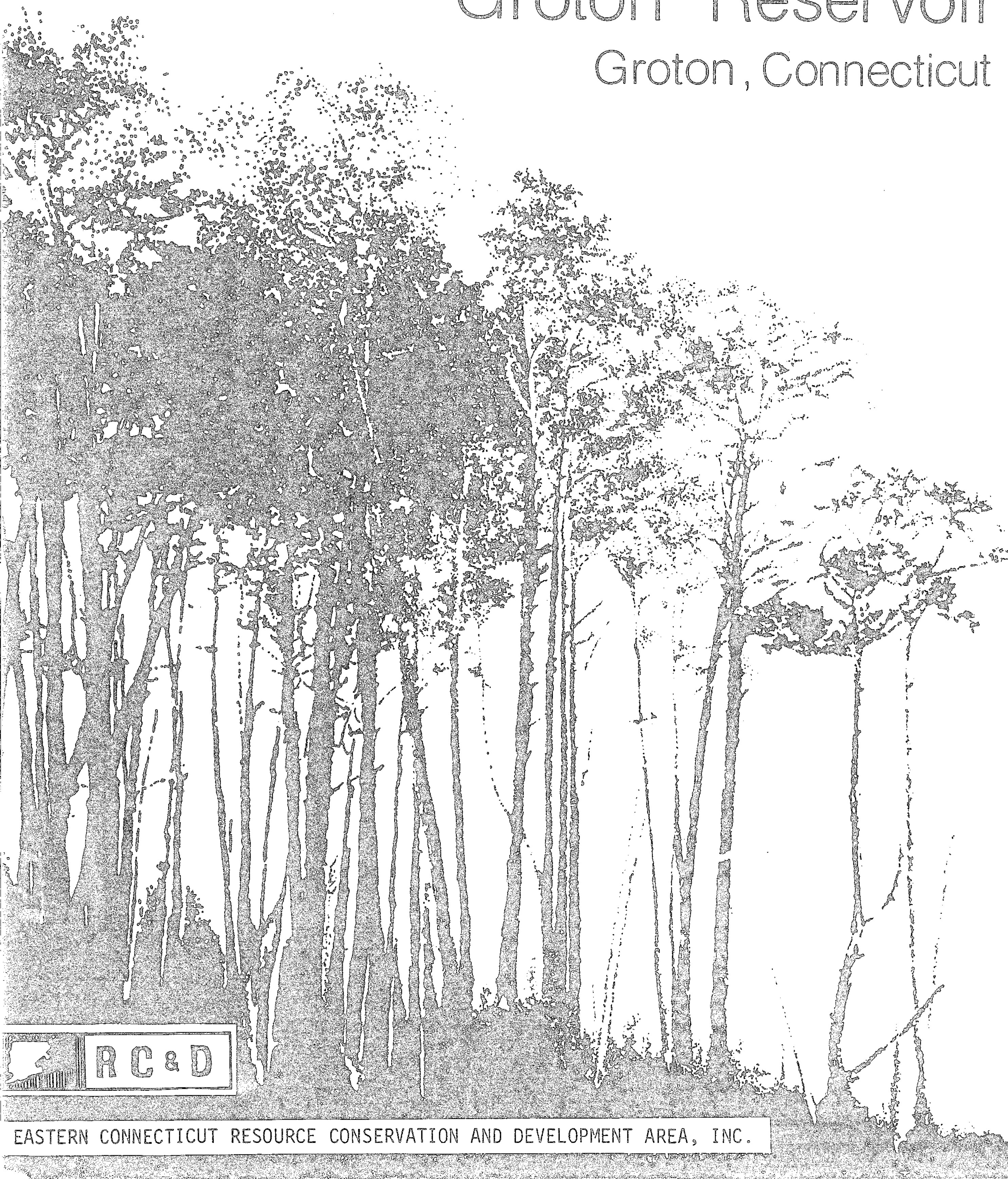
Environmental Review Team Report

Groton Reservoir

Groton, Connecticut



RC&D

EASTERN CONNECTICUT RESOURCE CONSERVATION AND DEVELOPMENT AREA, INC.

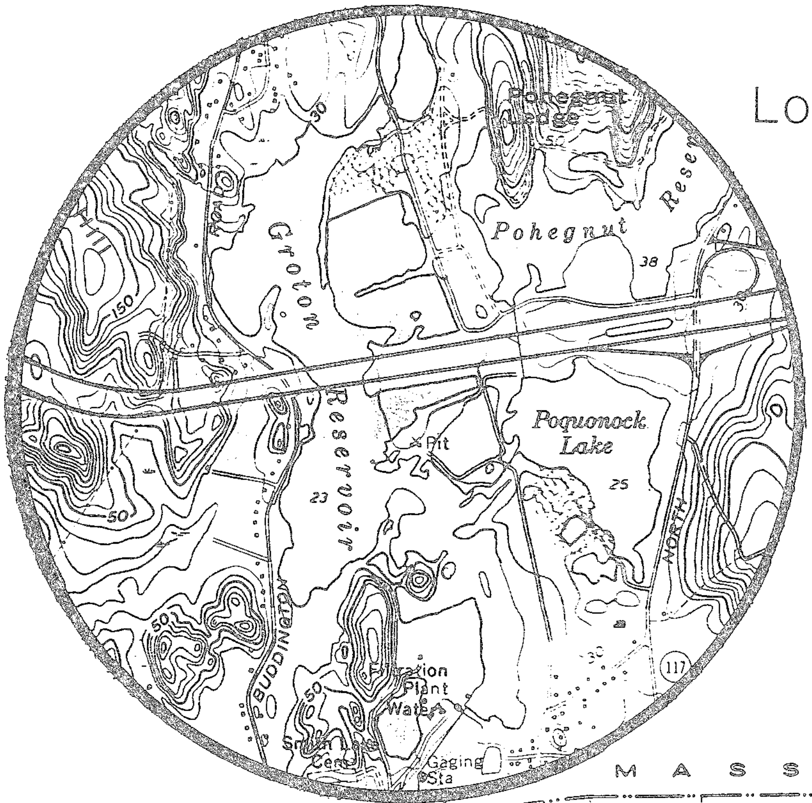
Environmental Review Team Report
on
Groton Reservoir
Groton, Connecticut

May, 1982

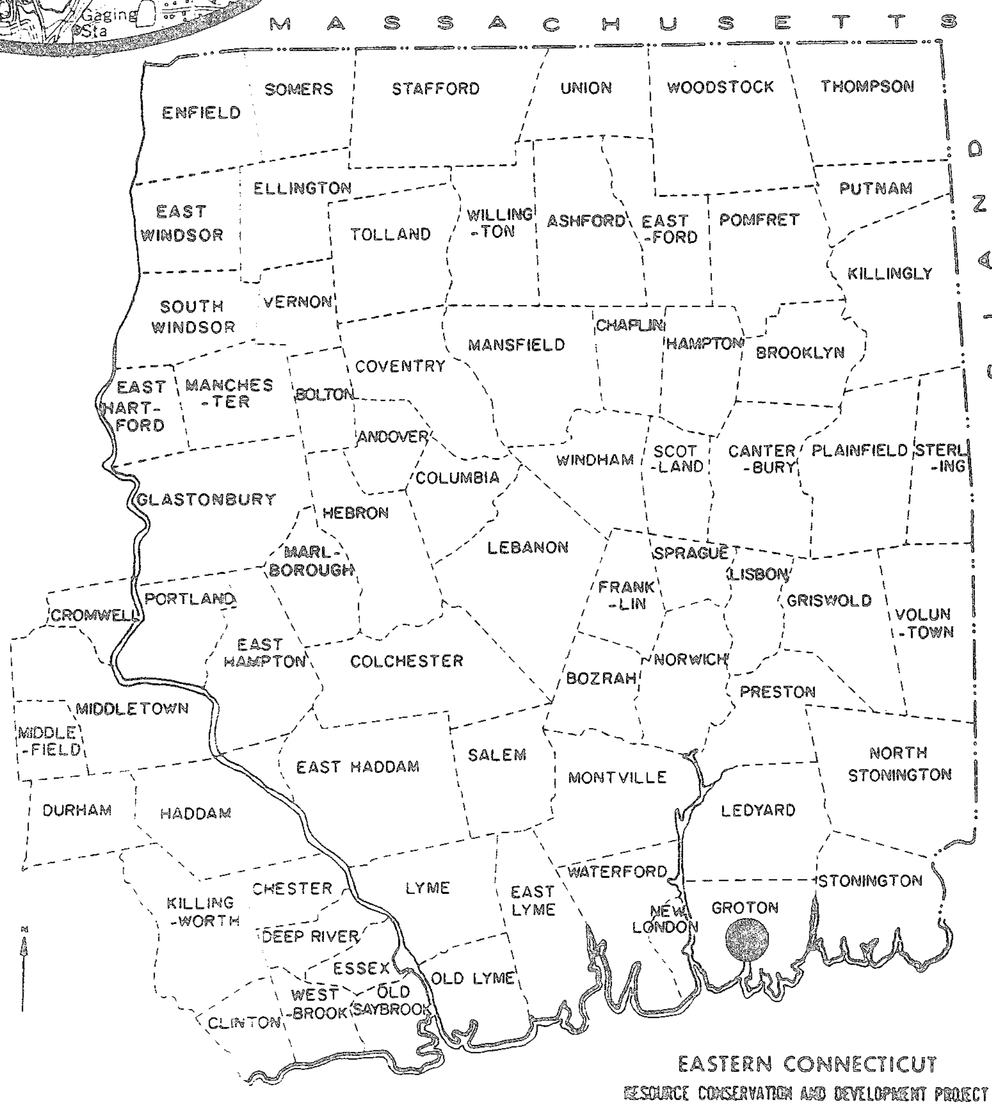
eastern connecticut resource conservation & development area

environmental review team
139 boswell avenue
norwich, connecticut 06360

Location of Study Site



GROTON RESERVOIR
GROTON, CONNECTICUT



EASTERN CONNECTICUT
RESOURCE CONSERVATION AND DEVELOPMENT PROJECT

ENVIRONMENTAL REVIEW TEAM REPORT
ON
GROTON RESERVOIR
GROTON, CONNECTICUT

This report is an outgrowth of a request from the Groton Planning and Zoning Commission to the New London County Soil and Water Conservation District (S&WCD). The S&WCD referred this request to the Eastern Connecticut Resource Conservation and Development (RC&D) Area Executive Committee for their consideration and approval as a project measure. The request was approved and the measure reviewed by the Eastern Connecticut Environmental Review Team (ERT).

The soils of the site were mapped by a soil scientist of the United States Department of Agriculture (USDA), Soil Conservation Service (SCS). Reproductions of the soil survey map as well as a topographic map of the site were distributed to all ERT participants prior to their field review of the site.

The ERT that field checked the site consisted of the following personnel: Gary Domian, District Conservationist, Soil Conservation Service (SCS); Mike Zizka, Geologist, Department of Environmental Protection (DEP); Rob Rocks, Forester, (DEP); Tom Seidel, Regional Planner, Southeastern Connecticut Regional Planning Agency; Doug Cooper, Water Resource Planner, (DEP); Don Capellaro, Sanitarian, State Department of Health; and Jeanne Shelburn, ERT Coordinator, Eastern Connecticut RC&D Area.

The Team met and field checked the site on Tuesday, December 22, 1981. Reports from each Team member were sent to the ERT Coordinator for review and summarization for the final report.

This report is not meant to compete with private consultants by supplying site designs or detailed solutions to development problems. This report identifies the existing resource base and evaluates its significance to the proposed development and also suggests considerations that should be of concern to the developer and the Town of Groton. The results of this Team action are oriented toward the development of a better environmental quality and the long-term economics of the land use.

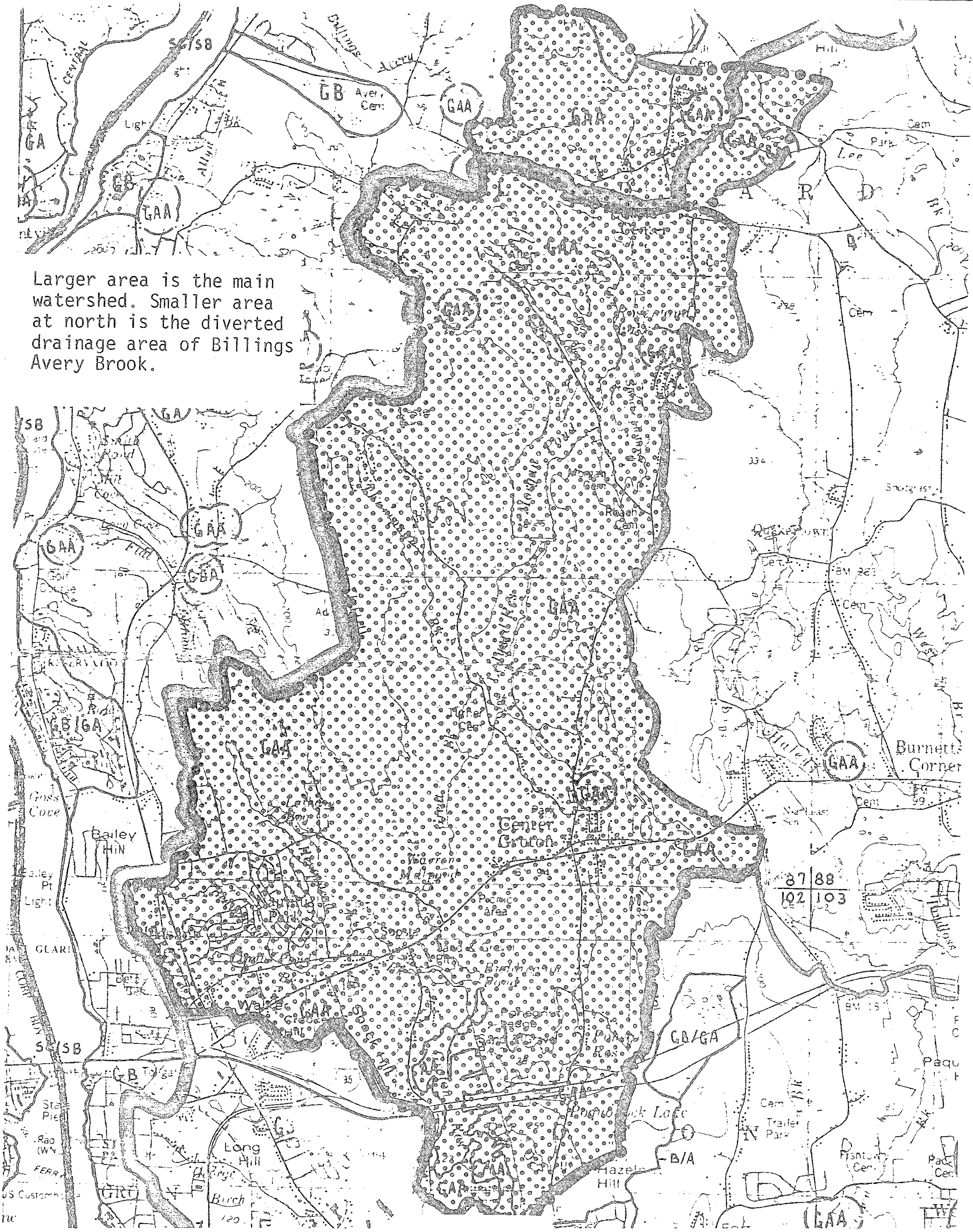
The Eastern Connecticut RC&D Project Committee hopes you will find this report of value and assistance in making your decisions on this particular site.

If you require any additional information, please contact: Ms. Jeanne Shelburn, Environmental Review Team Coordinator, Eastern Connecticut RC&D Area, 139 Boswell Avenue, Norwich, Connecticut 06360, 889-2324.

Topography

0 1000'
scale

N



Larger area is the main watershed. Smaller area at north is the diverted drainage area of Billings Avery Brook.

INTRODUCTION

The Eastern Connecticut Environmental Review Team was asked to prepare a natural resource inventory and analysis of the Groton Water Supply watershed. The City of Groton and the eastern half of the Town of Groton derives its water from the 15.7 square-mile watershed of Great Brook and the headwaters of the Billings Avery Brook, which drain the southerly portion of Ledyard and the central part of Groton. The flow from this watershed is collected in a system of impounding reservoirs: Buddington Pond, Pohegnut Reservoir, Smith Lake, Ledyard Reservoir and Morgan Pond Reservoir, all of which are interconnected component sources of supply and finally discharged into Groton Reservoir, the lowest in the system. The combined storage capacity is 2,242 million gallons.

The City of Groton Public Utilities Department owns a portion of the watershed acreage, which is maintained in open space. The remainder of the watershed land which is in the Town is zoned for moderate density residential development (20,000 square foot lots) and moderate density industrial development. The Town is concerned about the future potential for development in this area, and its effect on the water quality, as well as the potential for toxic waste spills within the watershed.

The Team has examined the resource base of the watershed and reviewed current Town controls over development. A water quality analysis has been provided in this report and various recommendations for maintaining or improving this water quality level are also discussed.

ENVIRONMENTAL ASSESSMENT

GEOLOGY

The public water-supply watershed land is encompassed by the Uncasville and New London topographic quadrangles. Bedrock geologic maps (respectively, Map GQ-576 and Map GQ-574) and surficial geologic maps (respectively, Map GQ-138 and Map GQ-176) of those quadrangles were prepared by Richard Goldsmith and published by the U.S. Geological Survey. The bedrock geology of the watershed is not believed to be a significant consideration with regard to potential pollution problems in the watershed, and bedrock is therefore not described in detail in this report.

A surficial geologic map of the watershed, adapted from the quadrangle maps mentioned above, is included in this report. Several types of surficial materials are depicted in the accompanying map. These are described briefly below.

Till is the most abundant surficial material in the watershed. Till is a glacial sediment that was deposited directly from an ice sheet more than 14,000 years ago. Because the ice was indiscriminate in collecting, transporting, and redepositing rock particles and fragments, the till contains a

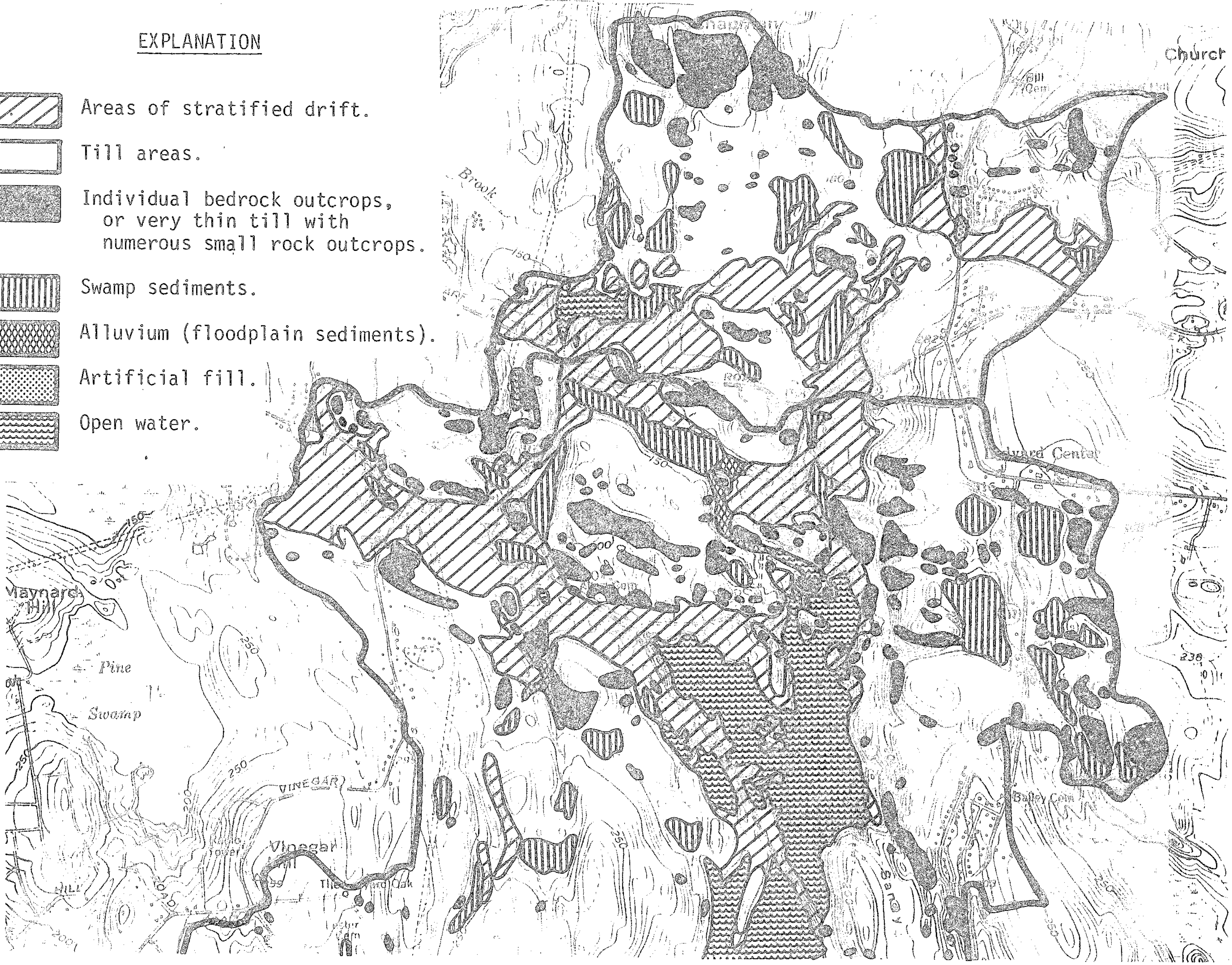
Surficial Geology (Northern portion of site)

0 — 660'
scale

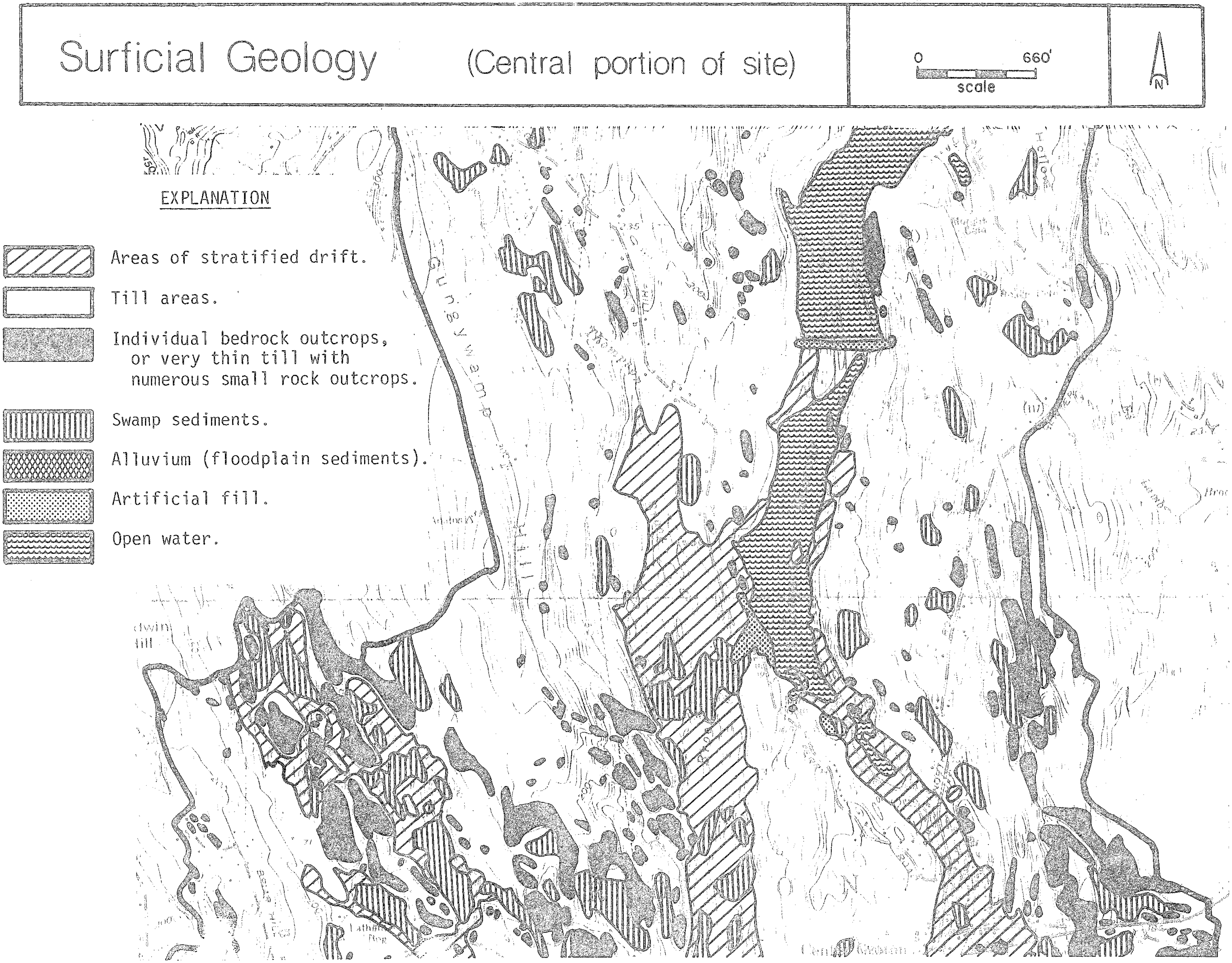
N

EXPLANATION

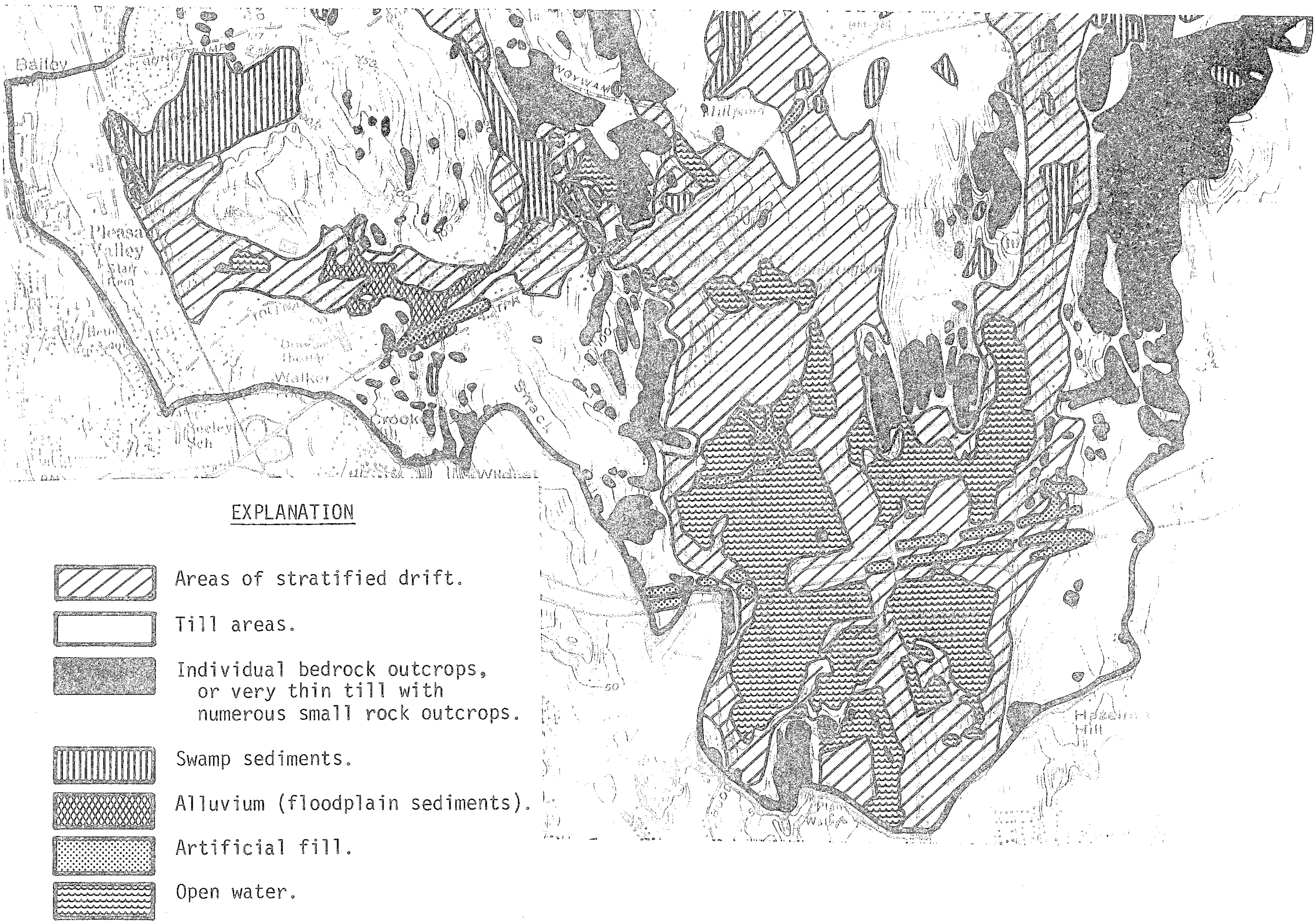
- Areas of stratified drift.
- Till areas.
- Individual bedrock outcrops, or very thin till with numerous small rock outcrops.
- Swamp sediments.
- Alluvium (floodplain sediments).
- Artificial fill.
- Open water.



Surficial Geology (Central portion of site)



Surficial Geology (Southern portion of site)



variable mix of clay, silt, sand, gravel, and boulders. In places where the till is deep (over five feet thick on the average), a loose, sandy variety may overlie a compact, somewhat siltier variety. The looser till is generally only a few feet thick. Where the till is thin, the texture of the till is usually loose, sandy, and very stony.

The second most abundant surficial material is stratified drift. Stratified drift is a glacial sediment which was formed by the deposition of rock debris that had been transported away from an ice sheet by meltwater streams. The streams sorted the rock particles by size and deposited them in more-or-less regular layers. Normally, sand and gravel are the major size components in a stratified drift deposit, but layers of silt, clay, or even boulders may be present in some deposits. The coarse sandy and gravelly stratified drift deposits are typically the most favorable sources of groundwater supplies, but inadequate thickness or locally poor groundwater quality may make the installation of high-yielding wells impractical.

Swamp sediments are the next most abundant type of overburden. These deposits contain a high percentage of decayed organic materials, mixed with lesser amounts of silt, sand, and clay. The sediments are usually less than ten feet thick, but they may be thicker in some of the largest swamps on the watershed.

Alluvium consists of silt, sand, and gravel that were deposited on floodplains in post-glacial times. These are generally less than five feet thick in the watershed. Artificial fill consists of mineral material, and occasionally some rubbish or other waste materials, that were deposited by man.

The various surficial geologic materials in the watershed differ in their abilities to transmit and purify water. These differences relate directly to the potential for pollution from certain types of activities within the watershed. The Hydrology section of this report further discusses these aspects.

HYDROLOGY

The City of Groton Department of Public Utilities has compiled substantial information about its public water-supply watershed. Data from numerous wells, test holes, etc., are included in the Department's files. Much of this information is more recent than the data available to the Team. For this reason, the Team suggests that the Town of Groton coordinate its anti-pollution efforts more closely with the Department. The Team will not attempt to duplicate the Department's data in this report for reasons of time and space, but some basic information and considerations are offered in the materials that follow.

Before discussing the hydrology of the watershed, certain terms need to be cleared up. The reservoir identified as Groton Reservoir on the U.S.G.S. topographic maps is also apparently known as Poquonnock Reservoir. The reservoir identified as Poquonock Lake on the topographic map is now called Smith Lake. In order to avoid confusion, the Team will use the terms "Groton Reservoir" and "Poquonock Lake" as in the topographic maps, since the maps serve as basic data in this report.

Groton Reservoir is the withdrawal site for the water for the public-supply system. The reservoir has a natural drainage area of about 14.1 square miles.

Approximately 1.4 square miles of the drainage area of Billings Avery Brook in Ledyard can be diverted by a low dam into the public-supply watershed.

Several reservoirs are located along the course of Great Brook, the principal inflowing stream to Groton Reservoir. These other reservoirs are Rosemond Lake, with a drainage area of about 1.29 square miles; Morgan Pond, with a drainage area of about 5.11 square miles; and Buddington Pond, with a drainage area of about 10.8 square miles. Pohegnut Reservoir, which drains about 1.79 square miles, and Poquonock (Smith) Lake, which drains about 2.29 square miles, are located at the downstream end of Hatching House Brook, a smaller tributary to Groton Reservoir.

The principal streams in the watershed are Great Brook, Hatching House Brook, Hempstead Brook, Beaverdam Brook, and Thompson Brook. There are many smaller streams, as well as several small ponds.

Three groundwater-supply wells are used to augment the inflow to Groton Reservoir. One well, near the southern tip of Poquonock (Smith) Lake is reportedly capable of yielding two million gallons per day. This well is pumped into Poquonock Lake, from which the water is transmitted to Groton Reservoir. The other two wells, which have an estimated yield of one million gallons per day, are located along, and are pumped directly into, Groton Reservoir.

In many instances, the pumping of a well placed in coarse-grained sediments near a water body can cause "induced infiltration." This occurs when water from the water body flows back through the ground, a reversal of the natural pattern, and into the well. If the public supply wells in Groton caused induced infiltration from the adjoining reservoirs, no net gain to the public supply would result from the infiltration since the well water is merely pumped into the reservoirs. The City's Department of Public Utilities has conducted studies to investigate whether induced infiltration was, in fact, a significant source of the well supplies. The studies involved the monitoring of reservoir water levels during well pumping. No significant decline in those levels was noted. The Department concluded that fine-grained sediment layers on the bottoms of the reservoirs were preventing most induced infiltration.

Connecticut Water Resources Bulletin No. 15, which was published by the U.S. Geological Survey, discusses and evaluates the water resources of much of southeastern Connecticut. The report identifies the stratified drift deposits in the vicinity of Groton and Pohegnut Reservoirs and Poquonock (Smith) Lake, and also in the valley of Great Brook south of Ledyard Reservoir, as being particularly favorable for groundwater withdrawal. The report estimates the total sustainable capacity of those deposits (i.e., the average daily yield for the year, exceeded seven years out of ten) as 4.4 million gallons per day. The three presently existing public-supply wells, if pumped simultaneously, would account for most of that capacity. In view of the proximity of the three wells, it seems reasonable to conclude that simultaneous pumping would result in at least some interference among the wells and at least some induced infiltration from the reservoirs.

Apart from the question of how much induced infiltration may occur between a well and a surface water body, there is no doubt that groundwater and surface water are hydrologically connected. For this reason, both types of water must be protected in a public water-supply watershed in order to guarantee an adequate quality of supply. Individual sources of potentially serious water pollution are generally easy to identify and control. Examples are landfills, salt storage areas, industrial discharges, and septage disposal areas. None of these types of pollution sources presently exist in the watershed (a salt storage pile along Route 117 has been moved). The Department of Environmental Protection has broad powers to regulate discharges that may affect water quality. In the event a source of potentially serious contamination becomes established within the watershed, the basic need is for regular monitoring. Town health officials may need to shoulder much of this monitoring burden, since DEP's personnel resources are spread thinly throughout the state.

Other sources of substantial pollution are harder to control. These are the accidental sources, such as a leak in a fuel-storage tank or an accident involving a chemical tank truck. The public reservoirs in Groton seem particularly vulnerable to this type of pollution since they are essentially boxed in by roads, including I-95. The basic need in the event of accidental pollution is to assure that the communications procedures for obtaining the proper emergency personnel and equipment are well-established. Oil and chemical spills should be reported promptly to the Department of Environmental Protection at 566-4633.

Perhaps the most serious cause for concern is pollution from sources that are spread throughout the watershed. These sources may be insignificant in themselves, but the cumulative effects may be severe. Among these sources are septic systems, urban runoff, agricultural runoff, and improper disposal of water-softener wastes. The City's Public Utilities Department presently has an inspection program under which every home in the watershed is checked annually for signs of septic system troubles. Any failures discovered during the check are reported first to the homeowner, and then to the Town Sanitarian. If the problem isn't corrected within fifteen days, the State Department of Health Services is notified.

Different geological materials have different capacities for renovating, i.e., removing contaminants from, wastewater. Coarse-grained materials, such as gravelly stratified drift, allow rapid percolation of groundwater and are not as effective at removing suspended and dissolved contaminants as finer grained materials, such as till. Till, on the other hand, may be too compact to allow a mechanically adequate percolation rate. Shallowness to bedrock, high water tables, periodic flooding, stoniness, excessive slopes, and other factors may also limit the natural ability of the land to serve as an effective filter for wastewater.

Hydrogeologist Thomas L. Holzer* analyzed the need to maintain minimum lot size requirements in areas which are underlain by till and which are served by both on-site septic systems and on-site wells. Using the Town of Mansfield, Connecticut, as a base for the study, he concluded that residential development should not occur at densities greater than an average of one residence per acre. This requirement was necessary to assure that the nitrates produced by septic systems received adequate dilution from infiltrating precipitation. The Town of Groton's geologic and hydrologic conditions are sufficiently similar to those of Mansfield that a one-acre minimum lot size would also seem to be reasonable for sections of Groton that do not have access to public water and sewer facilities.

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* Holzer, T.L., 1975, "Limits to Groth and Septic Tanks." in <u>Water Pollution Control in Low Density Areas</u>, W.J. Jewell and R. Swan, editors, University Press of New England.

In the areas in which public water will be available to users within the watershed, it probably is not necessary to establish or maintain one-acre maximum residential densities. However, soil conditions suggest that it is impractical to allow half-acre development in all of those areas. The technical requirements for subsurface sewage disposal will limit such development. The Town may wish to consider a more flexible zoning arrangement that would allow higher density development in favorable soil areas but would restrict development in marginal areas. The Town should also make a concerted effort to preserve its remaining wetlands. The wetlands are among the best available resources for purifying surface water that has been degraded by pollution from urban sources.

The Town should also take special care to protect the sand and gravel (stratified drift) deposits adjacent to the reservoirs. Contaminated surface or groundwater runoff in those deposits is very likely to affect either the reservoirs themselves or the new water-supply wells.

WATER QUALITY EVALUATION

It has been demonstrated that runoff from urban and suburban areas can be a significant factor in surface water quality within any watershed area. Of particular interest in this case are those lands contributing surface water flow to the Groton water supply reservoirs which are not owned by the water utility and, thus, may be developed in the future. The quantitative effects of future development can be calculated (for comparative purposes only) by utilizing non-point source pollution modeling techniques as found in the Connecticut "208" Areawide Waste Treatment Management Planning Board report authored by the Center For the Environment and Man (CEM). The CEM methodology establishes factors for pollution from urban and rural land surfaces which can approximate pollution yield from these land surfaces. The equations for computation of non point source pollution take into account soils, slopes, land use, climate, land management techniques, traffic and other salient environmental factors, by comparing existing (undeveloped) conditions in the above mentioned privately owned lands with the potential (developed) conditions as allowed under current zoning constraints, a general estimate of the effects of development may be seen. Inasmuch as there can be inaccuracies in any model analysis, the precise loading of pollutants and their effects on water quality will be subject to the same variations described in the CEM manual. Suffice to say that the comparison (i.e., when expressed as a percentage increase in pollution) may well be meaningful. In addition, if there exist marginal conditions within the watershed at present, or problems in maintenance of water quality (i.e., on a seasonal basis), the results of such a "modeling" exercise will demonstrate if these conditions will be exacerbated.

For the purposes of this exercise, the following assumptions are made:

1. The total area of privately held (non-water company) undeveloped land within the watershed but within the corporate limits of the Town of Groton is approximately 2,540 acres.

2. Of that total, 2,211 acres are zoned RU-20; 329 acres are zoned IP-200.

3. These undeveloped lands will be analyzed as woodland having no significant erosive sites, roadways, landfills, agricultural activities, livestock, or construction areas.

4. The "future" condition of full development as permitted by zoning will be as follows: 20,000 square feet single-family residential lots in the RU-20 zone lands and 200,000 square feet per industrial lot site density in the IP-200 zone. All of the above mentioned areas will be assumed to have municipal sewers and separate storm sewers.

5. There will be (assumed) a total of twenty miles of paved roadway built to serve "future" development. This is exclusive of driveways and parking areas.

6. Loading of pollutants will be calculated on a yearly basis for purposes of this exercise. (In actuality, the distribution of non-point pollution in runoff throughout the year is important in analyzing the impact of this runoff).

7. Annual precipitation will be assumed as 48 inches per year.

8. Street sweeping will be conducted once yearly under "future" conditions.

9. De-icing salts will be applied at a rate of #3.5 tons/mile road (courtesy of Groton Public Works Department). Three hundred and fifteen tons were used in the last four years at a 1-salt to 6-sand ratio over ninety miles of existing town roads.

10. RU-20 will be considered to be a "moderate" density of urban development according to the CEM methodology.

11. IP-200 will be assumed to be a "moderate" density of urban development according to the CEM methodology.

12. No wetlands will be committed for future development calculations.

13. Heavy metals, oil and grease will not be calculated in this exercise. These constituents will undoubtedly increase with urbanization, however.

The following data has been compiled in tabular form for both existing and future conditions in the watershed. Remember this is only for the portion of the watershed which is within Groton's Corporate limits which is currently undeveloped.

LAND USE DATA

Present Land Use	Acres	Future Land Use	Acres
Urban Areas	0	Urban Residential (Moderate Density)	2,000
Wetlands (Approximately 10% of the total)	250	Urban Industrial (Moderate Density)	300
Forest	2,300	Forest	0
		Wetland	250
TOTAL:	2,550		2,550

Road Length: 20 mi. med. duty local
Salt application: 3.5 T/mi./yr.

Calculations for Tables

1. Population function = (a) .142 + .218 x (population density) .54 = .142 + .218 x 10.54 = .122

   (b) .142 + .218 x 4.54 = .142 + .218 x 2.11 = .75

2. Pollutant from Land Use: = constant a x rainfall x pop. function x street sweeping effectiveness factor

Residential:									
(28.7) BOD#ac/yr 46.8	=	.799	x	48	x	1.22(or .75)	x	1
(586.8)SS#ac/yr 954.5	=	16.3	x	48	x	1.22(or .75)	x	1
(2.7)PO4#ac/yr 4.4	=	.0757	x	48	x	1.22(or .75)	x	1
(4.2) N#ac/yr 7.6	=	.131	x	48	x	1.22(or .75)	x	1
Industrial:								
BOD 8.24	=	1.21	x	48	x	.142	x	1
SS 198.3	=	29.1						
PO4 .48	=	.0705						
N 1.54	=	.227						

3. Coliform Loadings

MPN = 1.03 x 106 x rainfall x Coeff of Runoff x Area x conclusion
ml/ac in in C MPN/100ml
= 1.03 x 106 x 48 x .6 x Area x 3x.05

4. Road Salting
Loading of Salt per year - 2,000 #/ton x attenuation factor x salt (#yr)
= 2,000 x .6x315 = 378,000 #/salt/year

5. Pollution from Roadways

Pollutant (#/yr)		=	deposition rate	x	roadway length	x	Traffic density #/da	x	avg#axles/vehicle
74.8	BOD	=	5.43x10-6	x	20	x	900 x 2.1	x	365 days/year
5.5	N	=	.4x10-6	x	20	x	900 x 2.1	x	365 days/year
19.8	PO4	=	1.44x10-6	x	20	x	900 x 2.1	x	365 days/year
4.1	Cu	=	.3x10-6	x	20	x	900 x 2.1	x	365 days/year
2.7	Cr	=	.2x10-6	x	20	x	900 x 2.1	x	365 days/year
386.1	Pb	=	28x10-6	x	20	x	900 x 2.1	x	365 days/year
5.5	N	=	.4x10-6	x	20	x	900 x 2.1	x	365 days/year
48.2	Zn	=	35x10-6	x	20	x	900 x 2.1	x	365 days/year

Runoff from undeveloped land contains pollutants which are calculated as a portion of the sediment yield from these areas. The Universal Soil Loss Equation (USLE) is used to calculate the sediment which may be generated from the undeveloped watershed. Factors are provided by the CEM manual for the concentration of pollutants common in Connecticut sediment. The equation for soil loss is:

Average Annual Soil Loss Tons/Acre	=	Rainfall Runoff Erosion Index	x	Soil Erodibility Factor	x	Slope Length Steepness Factor

x	Cropping and Management factor	x	Supporting Conservation Practices Factor		OR

A	=	R	x	K	x	LS	x	C	x	P
1.4T/ac	=	150	x	.35	x	13.6x.	x	002	x	1

LS = 1 1/2 x (.0076 + .0053 (10%) + .00076 (102)

Annual Sediment Yield = 1.4T/ac. x 2300 ac.x12sd = 386 Tons/year sediment for undeveloped watershed.

The following assumptions were made for calculating the values of soil loss (on an annual basis) using the USLE.

1. Rainfall - runoff erosion index R = 150 (from CEM manual)

2. Soil Erodibility K = .35 was an average by area using SCS soil maps and K values.

3. LS factor calculated using average slope length of 500 feet and average steepness of 10%.

4. Management practices factor C = 1 (from CEM manual) for forest land.

5. Conservation practices factor P = .002 (from CEM manual) for forest land.

6. Sediment delivery ratio of 12% = Sd will be used for computing the delivery of soil to watercourses in this watershed (from CEM manual pg. 4-14).

7. Wetlands areas were excluded from sediment yield calculations.

Computation of Pollutant Loadings

The general formula for estimating pollutant loading is:

Pollutant #/yr	=	20	x	% pollutant in soil	x	Enrichment ratio	x	Sediment Yield T/yr.
For Nitrogen: (#.yr) 3474	=	20	x	.15	x	3.0	x	386
For PO_4: (#/yr) 1154	=	20	x	.065	x	2.3	x	386
For BOD_5: (#/yr) 5790	=	20	x	.3	x	2.5	x	386

For Coliform MPN/ac for forest land = $.4x10^9$
MPN/yr = $.4x10^9$ x 2300 ac = $.920x10^{12}$

TABLE 1

UNDEVELOPED NON-POINT SOURCE POLLUTION
(Present)

Land Use Category:	Residential Medium Density	Industrial Medium Density	Woodland	Wetland	Total
Area	0ac	0ac	2300	250	2550
BOD					
#/yr			5790		
Suspended Solids					
#/yr					
Total Nitrogen					
#/yr			3474		
Total Phosphorus					
#/yr			1154		
Coliform					
MPN/$x10^{12}$			.92		

TABLE 2

URBAN NON-POINT SOURCE POLLUTION
(Future)

Pollution From Roadways = 0

Land Use Category:	Residential Medium	L	Industrial Medium	Woodland	Wetland	Total
Area	2000	2000	300	0	250	2550
Pop. Density	10	4	-	-	-	
Pop. Function	1.22	.75	.142			
BOD						
#/ac/yr	46.8	28.7	8.24			
#/yr	93,600#	57,400	2472			
Suspended Solids						
#/ac/yr	954.5	586.8	198.3			
#/yr	1,909,000	1,173,600	59,490			
Total Nitrogen						
#/ac/yr	7.6	4.7	1.54			
#/yr	15,200	9400	462			
Total Phosphorus						
#/ac/yr	4.4	2.7	.48			
#/yr	8800	5400	144			
Coliform						
MPN/$x10^{12}$	$11,865x10^{12}$	5932	$2669x10^{12}$			

Pollution From Roadways = Road Salts + Other Vehicular Deposited Pollutants
for future 20 miles of roadway

Salt:	189 Tons/year	Cr:	2.7#/year
BOD:	74.8 #/year	Pb:	386.1 #/year
N:	5.5 #/year	Ni:	5.5 #/year
PO^4:	19.8 #/year	Nn:	48.2 #/year

TABLE 3

Comparison Table

Pollutant	Existing (1982)	Post Development (as zoned)	% Increased Over Existing	Post Development If Up Zoned	% Less Than Denser Zone	% Increase Over Existing
BOD	5790#/yr	96,072#/yr	93%	59,872#/yr	38%	90%
N	3474#/yr	15,662#/yr	77%	9,862#/yr	38%	64%
PO^4	1154#/yr	8,944#/yr	87%	5,544#/yr	37%	79%
Salt	-	189 T/yr	-	141T/yr[1]	25%	
Cu	-	4.1#/yr	-	3#/yr[1]	25%	
Cr	-	2.7#/yr	-	2.0#/yr[1]	25%	
Pb	-	386.1#/yr	-	289#/yr[1]	25%	
Ni	-	5.5#/yr	-	4.1#/yr[1]	25%	
Zn	-	48.2#/yr	-	36#/yr[1]	25%	
Coliform	$.92 \times 10^{12}$MPN	14534×10^{12}MPN	99.99%	8601×10^{12}	41%	99.98%
S.S	-	984T/yr	-	616T/yr	38%	

1 Assumed 25% reduction in roadway length under less dense residential zone.

As can be seen in Table 3, there will be increases of all non-point source pollution constituents if the undeveloped lands within this watershed are developed under current zoning. The increases of certain pollutants (BOD, PO^4, N, Coliforms) range from 77% to 90% over that which occurs naturally. Some pollutants (Salt, Metals, Suspended Solids) will be introduced to the watershed new and are not shed from undeveloped land surfaces in significant amounts. These increases can be reduced by 25%-41% if the minimum lot density in the residential area was reduced (i.e., to 1.5 to 2.0 acre minimum lot sizes).

The pollution yield given on Tables 1 - 3 are for comparison purposes only. Specific conditions existing in the watershed and treatment and management techniques can make significant differences in the loads of pollutants which could conceivably reach a drinking water supply. The assumption made for this study that no wetlands would be developed is an important one. Approximately 10% of the watershed is wetland. These areas function in nutrient and sediment uptake. As much as 40% of the total sediment generated in the watershed may be retained in these wetlands. Yields shown on Tables 1 - 3 would be significantly higher should these wetland values be removed.

The impact of the pollutant loads may be estimated using various means which are beyond the scope of this exercise. Detailed data on hydraulics, physical characteristics of stream and reservoirs within the watershed, existing water quality and other factors would be necessary to determine if a particular water quality will be met on any particular occasion. Some of the generalizations made for comparative purposes in this exercise do not lend themselves particularly well to such analyses.

Recommendations

To maintain water quality within this watershed, the following concepts should be considered:

1. Reducing residential density permitted for the undeveloped lands within the watershed.

2. Preservation of the wetlands with strict limitations on developmental uses which would reduce nutrient and sediment retention functions.

3. Strict sediment and erosion control for all activities within the watershed.

4. Water utility acquisition of key private lands which may directly affect water quality.

5. Careful scrutiny of industrial proposals for lands zoned IP-200. Encourage natural park type development maximizing greenbelts, buffers, and minimizing sediment runoff.

6. Adoption of frequent street sweeping program in watershed areas. Reduce road salting or change to alternate de-icing techniques.

7. Adoption of emergency spill contingency plan for watershed land (if none exists now).

SOILS

The Soil Conservation Service, in cooperation with the New London County Soil and Water Conservation District can provide technical assistance to the Groton Planning and Zoning Commission in preparing a watershed analysis based primarily on soils. The Team recommends that the Groton Planning and Zoning Commission wait until the New London County Soil Survey is published before spending more time and dollars on map preparation. The published soil survey is on a later photo base and is far easier to use and read than the existing soil map reproductions. Publication of the survey is expected to be accomplished by January of 1983.

During the interim, the Team suggests that critical areas within the watershed, such as those that are eroding, or those planned for development, be reviewed in the field cooperatively with a soil conservationist and a representative from the Commission in Groton and Ledyard. The soil conservationist will make recommendations for stabilizing critical areas and can develop plans for erosion control on developing areas. The Hydrologic Soil groups can also be defined in the watershed because this grouping is an indication of infiltration rates and can be used to identify water recharge areas. The soils can also be evaluated as per the limitations they may exhibit, such as slow permeability or seasonal high water tables, which are limitations to the proper functioning of septic systems.

Other planning information, such as runoff control plans for developing areas can be reviewed by the District and Soil Conservation Service. The Soil Conservation Service has its own method of calculating storm water runoff and runoff control structures. The potential of other areas for various intensities of recreation can also be evaluated based on soils. Passive recreation, such as hiking, can be instituted on much of the watershed area, however, recreation such as camping would require a more detailed analysis. Forestry plans should be coordinated with a Department of Environmental Protection (DEP) forester. The Soil Conservation Service can provide soils data relative to potential growth rates of certain forest species and to the management needed to prevent erosion in logging areas.

VEGETATION

The 9,856 acre "Groton Reservoir Watershed" is located partially within the Eastern Coastal ecoregion of the Coastal Hardwood Zone and partially within the Southeast Hills ecoregion of the Southern Hills-Central Hardwoods Zone.*

According to Dowhan and Craig (1976), "an <u>ecoregion</u> is an area characterized by a distinctive pattern of landscapes and regional climate as expressed by the vegetation composition and pattern and the presence or absence of certain indicator species and species groups. Ecoregion are thus natural divisions of land, climate, and biota."

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* Dowhan, J.J. and Craig, R.J., 1976, <u>Rare and Endangered Species of Connecticut and Their Habitats</u>. Connecticut Geological Natural History Survey Report Invest. #6.

The vegetation which is characteristic of the Eastern Coastal Ecoregion is dominated by red oak, white oak, black oak, mockernut hickory, black cherry, sassafras, red maple, eastern hemlock and eastern red cedar. The dominant understory species include witch hazel, maple-leaved viburnum, dogwood, sweet pepperbush and spice bush.

The vine species which are present include green brier, catgreen brier, poison ivy, Japanese honeysuckle and oriental bittersweet. Plants which may be considered rare in Connecticut and are found in this ecoregion include redroot, inkberry, large marsh pink, thread-leaved sundew and several species of panic grass.

The vegetation which dominates the Southeast Hills ecoregion in characterized by white oak, red oak, black oak, scarlet oak, chestnut oak, shagbark hickory, pignut hickory, mockernut hickory, tulip tree, black birch, white ash, red maple, yellow birch, eastern hemlock, eastern white pine, pitch pine and eastern red cedar. The understory is typically dominated by blue beech, witch hazel, maple-leaved viburnum, mountain laurel, hop hornbeam, spice bush, highbush blueberry and sweet pepperbush. Rare plants which may occur in this ecoregion include swamp cottonwood, Allegheny plum, rhododendron, showy aster, bur-marigold, Small's yellow-eyed grass, white milkweed and several species of panic grass.

Red and white pine plantations have been established along with eastern hemlock around most of the reservoir system within this watershed. These trees act as a barrier which stop deciduous tree leaves from reaching the various reservoirs.

General Management Considerations

The Forestry Unit of the Department of Environmental Protection encourages all woodland owners to manage their forest lands. When properly prescribed and executed, forest management practices will increase the production of forest products, improve wildlife habitat and enhance the overall condition of the woodland with minimum negative environmental impact.

To reach a healthy and productive state, individual forest stands should be periodically evaluated to determine present and future management needs. A public service forester from the Department of Environmental Protection may be contacted at 376-2513 to provide basic advice and technical assistance in woodland management. These services are provided free of charge. Services of a more intensive nature are available from private consulting foresters.

Forest Management and Water Quality

Healthy woodlands provide a protective influence on water quality: they stabilize soils, reduce the impact of precipitation and runoff, and moderate the effects of adverse weather conditions. By so doing, woodlands help to reduce erosion, sedimentation, siltation and flooding. Research has shown that soil protected by the cover of litter and humus associated with woodland areas contributes little or no sediment to streams.

Improper cultivation and harvesting of timber for commercial purposes may, however, lower water quality in several ways: 1) Erosion, siltation and sedimentation caused by improperly located and improperly constructed access road, skid trails, yarding areas and stream crossings; 2) Siltation and sedimentation caused by logging debris left in streams, interfering with natural flows; 3) Thermal pollution resulting from complete or partial harvesting of streambank vegetation, eliminating shade; 4) Chemical pollution caused by improper application of herbicides and insecticides (it should be noted, however, that in Connecticut, the widespread use of chemicals in forest management is not prevalent and therefore does not constitute a great threat to water quality at this time); 5) Influx of nutrients caused by the application of fertilizer, soil conditioners and wetting agents (used in forest fire control). Research has determined that nutrient loss from normal silvicultural practices (i.e., practices involving the cultivation and harvesting of timber) does not, for the most part, result in significant deterioration of water quality.

Despite the potential adverse impacts to water quality, the harvesting of trees is a major and necessary tool used in forest land management. Adverse impacts to water quality can be minimized through good planning and responsible implementation.

A pamphlet entitled "Logging and Water Quality in Connecticut: A Practical Guide for Harvesting Forest Products and Protecting Water Quality" has been published and made available through the Department of Environmental Protection's Forestry Unit. A series of Best Management Practices (BMP's), which are recommendations designed to minimize the negative impact of silvicultural activities on water quality, are presented in this pamphlet.

A "BMP" as defined in the pamphlet is "a practical, economical and effective management or control practice which will reduce or prevent the generation of pollution."

Examples of recommended BMP's for preventing or reducing degradation of water quality resulting from silvicultural activities include:

Phase I. Planning the Job.

a. Locate all streams, wetlands and poorly drained soils (sensitive areas) on USGS topographic maps and/or county soils maps.

b. Plan preliminary locations of access roads, skid roads and yarding areas to avoid the sensitive areas. Locate potential stream crossings.

c. Plan for the best time of year to implement individual silvicultural activities. Sensitive areas that cannot be avoided should be planned for winter when the ground is frozen and more stable.

d. Plan Stream Management Zones which are aimed at protecting stream beds and stream banks.

Phase II. Implementing the Job.

a. Locate logging roads and skid trails so that the slopes of these roads do not exceed 10% except for short distances.

b. Locate yarding areas on well drained soils with a slight slope, avoiding drainage discharge directly into access roads or streams.

c. Locate Stream Management Zones and avoid equipment operation in these areas to the greatest extent possible.

d. Provide undisturbed buffer strips between streams and roads or yarding areas. The width of these buffer strips is generally between 30 and 100 feet, but should depend on slope, soil erodability and the magnitude of road or yarding area drainage discharge.

e. Avoid, when possible, equipment operation on poorly drained soils, in swales and around or in stream channels.

f. Avoid complete clearing of vegetation in the Stream Management Zone.

g. Avoid disturbing understory vegetation within thirty feet of a stream channel.

h. Avoid reducing overstory crown cover below 50% within thirty feet of a stream channel.

i. Avoid felling trees in streams; if this occurs, remove debris as soon as possible.

j. Avoid stream crossings if possible, if not, consider building temporary bridges. Crossings should be made at right angles to the stream over stable rock or gravel bottoms, and should avoid steep or unstable banks.

Phase III. Completing the Job.

a. Install erosion control measures on access roads and primary skid trails, including properly placed waterbars and reconditioned cross drains, located at intervals which take into account road length, slope and common sense.

b. Remove all temporary bridges and culverts from streams.

c. Lime and seed specific critical areas, such as steeply sloped roads or problem areas.

d. Close roads to prevent continuing access.

Following these BMP's along with the use of common sense will help to avoid water quality degradation resulting from silvicultural operations.

The implementation of the recommended BMP's will most likely be of a voluntary nature, aided through an accelerated educational program and perhaps an incentive program, rather than through regulation. At this time, local regulation of forest product harvesting is contrary to State forestry policy.

Educational and incentive programs may be reinforced by the use of timber sale contracts which reflect the use of BMP's between landowners and loggers. A public or private professional forester can assist landowners in developing an effective timber sale contract. The posting of reasonable performance bonds by the logger may be necessary to help insure proper completion of the logging operation. Periodic on-site inspection may also be essential to see that the logging activities meet the contract terms. Proper education of the landowner and logger can be the key to successful use of BMP's in forest management.

Further guidelines to maintain water quality on managed woodlands may be found in the pamphlet "Timber Harvesting Guidelines" by the Wood Producer's Association of Connecticut. The principles set forth in this publication are aimed at protecting the forest ecosystem from thoughtless timber harvesting practices that may lower environmental quality in both the long and short run. Copies of this pamphlet are available from the Department of Environmental Protection's Forestry Unit and members of the Wood Producer's Association of Connecticut.

The City of Groton owns approximately 2,240 acres of land surrounding the Groton reservoir system. A forest management plan was completed for this area in April of 1973. Due to the fact that vegetative conditions and management opportunities can change significantly within a ten-year time period, it is recommended that this entire property be reinventoried and an up-to-date management plan be drafted.

DEP forestry personnel are available on a limited basis to assist the City of Groton with the establishment of proper inventory procedures, the evaluation of collected inventory sampling data and the development of a comprehensive management plan for the Groton reservoir property.

PLANNING CONCERNS

In order to address the problem of industrial pollution of surface and groundwaters, the Connecticut 208 Water Quality Planning Central Office and the Connecticut Department of Environmental Protection (DEP) in 1978 prepared an industrial site constraint matrix intended to serve as a tool for local officials and other agencies in formulating a "preliminary, first cut" analysis of the types of industries that a particular site's water environment can support. The matrix relates major industrial types by SIC code (Standard Industrial Classification) to the relative impact a particular industry's generated pollution might have if it were to discharge wastes in the following ways:

1. via a municipal sewerage system,

2. via subsurface disposal, or

3. via discharge to surface waters.

In addition, the matrix rates the potential impact of a particular industry on the environment from:

4. non-point source pollution, and

5. sludge or solid residuals.

In all instances, the ratings are based on a range of: 1) slight; 2) moderate; and 3) severe constraints.

The industrial site constraint matrix is included in Table 4 of this report.

In Groton, a portion of the Groton reservoir drainage basin extends east of Route 117 into an industrial park 200A zone north of I-95 and into an industrial park 200C zone south of I-95. Existing land uses are undeveloped forested and open lands, agriculture, and low density residential. Institutional uses are a church and medical clinic south of I-95. No industrial uses currently exist and no public water or sewer facilities are currently available.

No industrial zones currently exist in the Ledyard portion of the watershed, although the possibility exists of future industrial-commercial uses along the southern portion of Route 117 which is partially within and outside of the watershed.

The zoning commissions of Groton and Ledyard should plot the Groton reservoir drainage basin as an overlay to their zoning map in order to identify the areas of each town sensitive to intensive industrial or commercial development.

Any potential uses which will have any industrial and sanitary discharge should be evaluated by the State Departments of Environmental Protection and Health for suitability; the industrial site constraint matrix referred to above could be used to make a preliminary analysis. A potential industry should supply data and analysis on the exact type of activity, water usage, wastes generated, effects on stream and groundwater flows, and any non-point source pollution. The requirements of Section 19-13-B32 of the State Health Code concerning the sanitation of watersheds should be addressed. Only after a favorable review of this information by the above agencies should a zoning permit be considered by the zoning commissions in each town.

An erosion and sedimentation plan that includes provisions for a storm drainage system with an impervious catch basin system to provide for recovery of normal and accidental industrial spills should be prepared by the applicant. Currently, Ledyard has erosion and sedimentation provisions in both its zoning and subdivision regulations and Groton has them in its subdivision regulations. These recommendations are in addition to, and do not replace, other performance standards and requirements in the zoning regulations of either town.

BIBLIOGRAPHY

Watershed Boundaries - DEP Water Quality Maps by Drainage Basin.

Land Use Data - Groton Zoning Map; Groton Plan of Development.

Soils - USDA Advance Soil Sheets and Preliminary Soil Survey.

Wetlands - Groton Inland Wetland Map.

Soil Erodibility - Erosion and Sediment Control Handbook, SCS, Storrs, Ct.

Non-Point Sources Pollution Handbook - Connecticut 208 Areawide Waste.

Treatment Management Board - Center For the Environment and Man.

TABLE 4. INDUSTRIAL DEVELOPMENT - SITE CONSTRAINT MATRIX

SOURCE: The Industrial Site Constraint Manual prepared by the 208 Central Office and DEP

CONSTRAINT KEY
1. Slight
2. Moderate
3. Severe

STANDARD INDUSTRIAL CLASSIFICATION (SIC CODE)	WATER USAGE	SEWERAGE SYSTEM		SUBSURFACE DISPOSAL			SURFACE DISCHARGE				NON-POINT SOURCE POLLUTION					RESIDUALS					AIR QUALITY	
	Gal. Per Empl.	Capacity	Amenability	Major Aquifer	Pre-treat. requirements	Area Requirements	AA	A	B ELS	B WQS	AA	A	B ELS	B WQS	Major Aquifer	AA	A	B ELS	B WQS	Major Aquifer	AQMA	Other
19 ORDNANCE		3	3	2	2	2	NA	3	2	2	3	3	2	2	3	3	3	2	2	3		
20 FOOD		3	2	2	1	1	NA	3	2	3	2	2	1	1	2	3	3	2	2	3		
21 TOBACCO		3	3	2	2	3	NA	3	2	3	2	2	1	1	2	2	2	2	2	2		
22 TEXTILES		3	3	3	3	3	NA	3	2	3	2	2	1	1	2	3	3	2	2	3		
23 APPAREL		1	2	3	2	1	NA	3	1	2	2	2	1	1	2	1	1	1	1	1		
24 LUMBER AND WOOD		1	1	1	1	1	NA	3	1	1	3	3	2	2	1	2	2	2	2	2		
25 FURNITURE AND FIXTURES		1	1	1	1	1	NA	3	1	2	2	2	1	1	1	1	1	1	1	1		
26 PAPER		3	2	3	3	3	NA	3	2	3	3	2	2	2	2	3	3	2	2	3		
27 PRINTING AND PUBLISHING		1	2	3	2	1	NA	3	1	2	2	2	1	1	1	3	2	1	1	3		
28 CHEMICALS		3	2	3	3	3	NA	3	2	3	3	2	2	2	2	3	2	2	2	3		
29 PRODUCTS OF PETROLEUM AND COAL		2	3	3	1	2	NA	3	2	3	3	3	2	2	3	3	2	1	1	3		
30 RUBBER AND PLASTICS		2	2	3	2	2	NA	3	2	3	3	2	1	1	2	3	2	1	1	3		
31 LEATHER		1	2	3	2	2	NA	3	2	3	3	2	1	1	2	3	2	2	2	3		

TABLE 4.

STANDARD INDUSTRIAL CLASSIFICATION (SIC CODE)	WATER USAGE	SEWERAGE SYSTEM		SUBSURFACE DISPOSAL			SURFACE DISCHARGE				NON-POINT SOURCE POLLUTION					RESIDUALS					AIR QUALITY	
	Gal. Per Empl.	Capacity	Amenability	Major Aquifer	Pre-treat. requirements	Area Re-quirements	AA	A	B ELS	B WQS	AA	A	B ELS	B WQS	Major Aquifer	AA	A	B ELS	B WQS	Major Aquifer	AQMA	Othe
32 STONE, CLAY, GLASS & CONCRETE PROD.		3	2-3	3	2	2	NA	3	1	1	3	3	2	2	2	2-3	2	1	1	2-3		
33 PRIMARY METAL INDUSTRIES		3	3	3	3	3	NA	3	3	3	3	3	3	3	3	3	3	2	2	3		
34 FABRICATED METAL PROD.		2	1	1	1	2-3	NA	3	1	2	3	2	1	1	3	3	2	2	2	3		
35 MACHINERY		2	3	3	3	2	NA	3	1	2	3	2	1	1	3	3	2	2	2	3		
36 ELECTRICAL EQUIPMENT		1	3	3	3	1-2	NA	3	1	2	3	2	1	1	3	3	2	2	2	3		
37 TRANS. EQPMT		1	3	3	2-3	1-2	NA	3	1	2	3	2	1	1	3	3	2	1	1	3		
38 PROFESSIONAL SCIENTIFIC & CONTROLLING INSTRU., PHOTO & OPTICAL GOODS WATCHES AND CLOCKS		1	2	2	1-2	1	NA	3	1	2	2	2	1	1	2	2-3	3	1	1	2		
O MISC. MANUF. INDUS. (other)		1	2	2	1-2	1	NA	3	1	1-2	2	2	1	1	2	2	1	1	1	2		

About the Team

The Eastern Connecticut Environmental Review Team (ERT) is a group of professionals in environmental fields drawn together from a variety of federal, state, and regional agencies. Specialists on the Team include geologists, biologists, foresters, climatologists, soil scientists, landscape architects, archeologists, recreation specialists, engineers and planners. The ERT operates with state funding under the supervision of the Eastern Connecticut Resource Conservation and Development (RC&D) Area.

The Team is available as a public service at no cost to Connecticut towns.

PURPOSE OF THE TEAM

The Environmental Review Team is available to help towns and developers in the review of sites proposed for major land use activities. To date, the ERT has been involved in reviewing a wide range of projects including subdivisions, sanitary landfills, commercial and industrial developments, sand and gravel operations, elderly housing, recreation/open space projects, watershed studies and resource inventories.

Reviews are conducted in the interest of providing information and analysis that will assist towns and developers in environmentally sound decision-making. This is done through identifying the natural resource base of the project site and highlighting opportunities and limitations for the proposed land use.

REQUESTING A REVIEW

Environmental reviews may be requested by the chief elected officials of a municipality or the chairman of town commissions such as planning and zoning, conservation, inland wetlands, parks and recreation or economic development. Requests should be directed to the Chairman of your local Soil and Water Conservation District. This request letter should include a summary of the proposed project, a location map of the project site, written permission from the landowner allowing the Team to enter the property for purposes of review, and a statement identifying the specific areas of concern the Team should address. When this request is approved by the local Soil and Water Conservation District and the Eastern Connecticut RC&D Executive Council, the Team will undertake the review on a priority basis.

For additional information regarding the Environmental Review Team, please contact Jeanne Shelburn (889-2324), Environmental Review Team Coordinator, Eastern Connecticut RC&D Area, 139 Boswell Avenue, Norwich, Connecticut 06360.