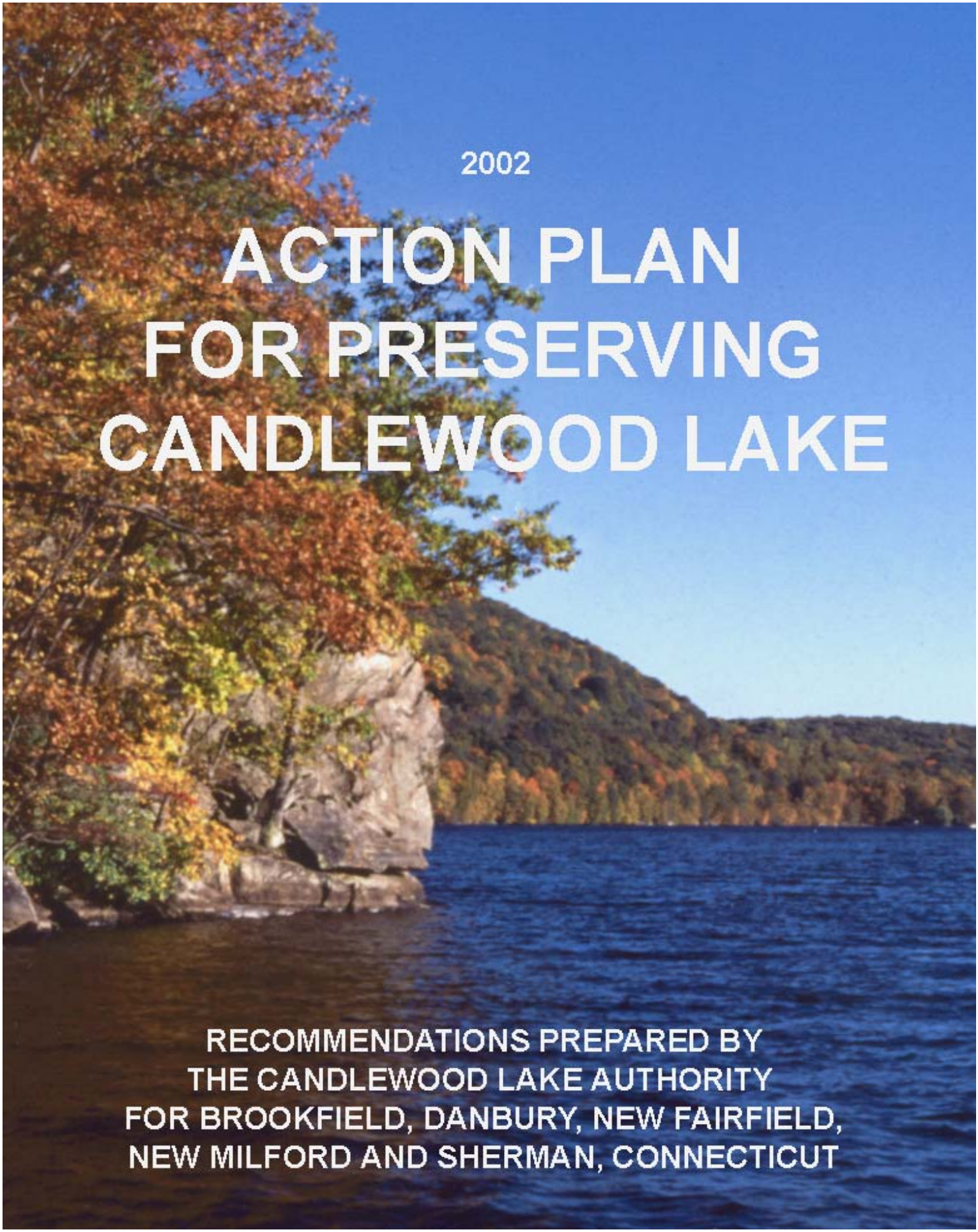
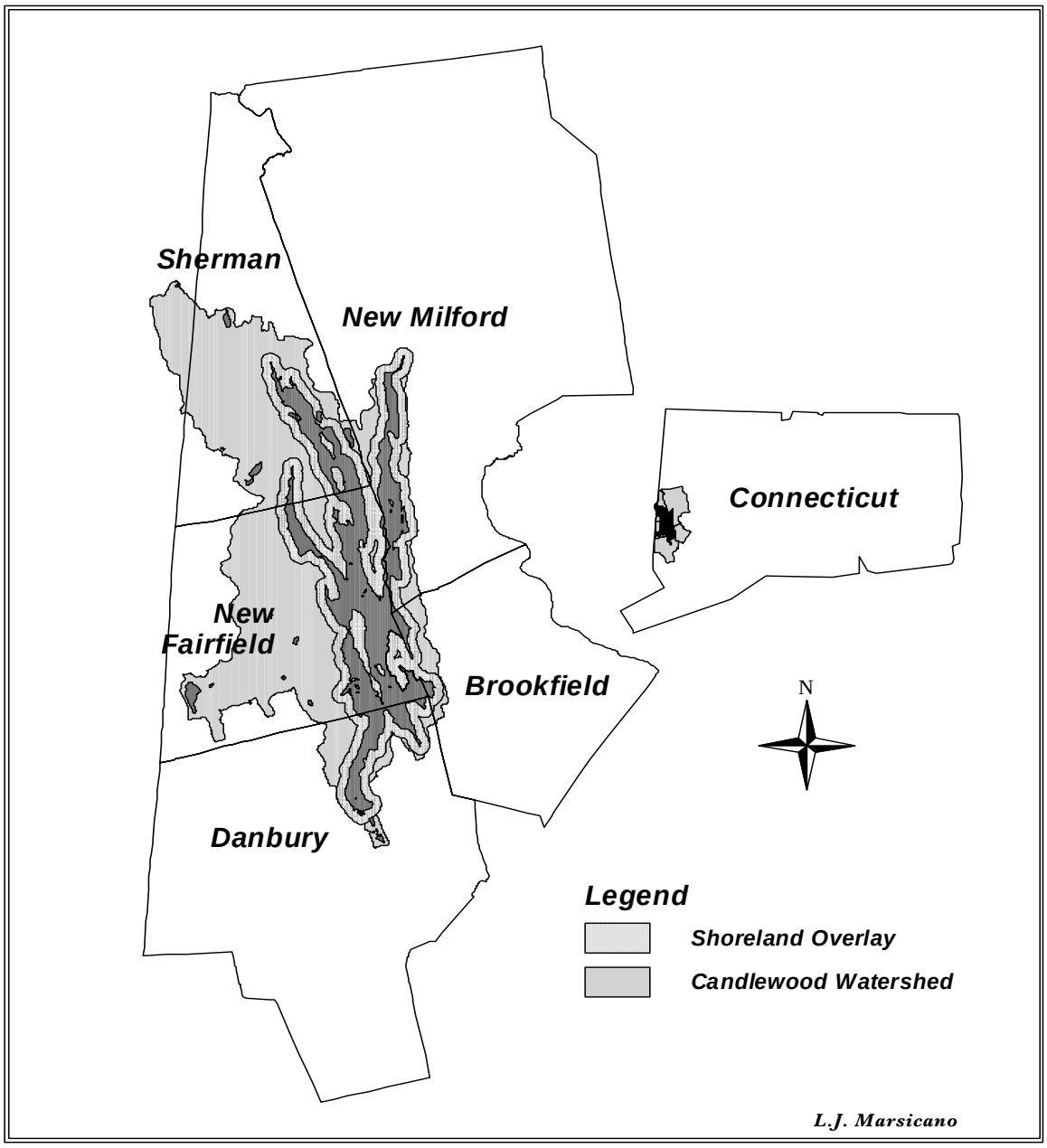


2002

ACTION PLAN FOR PRESERVING CANDLEWOOD LAKE

RECOMMENDATIONS PREPARED BY
THE CANDLEWOOD LAKE AUTHORITY
FOR BROOKFIELD, DANBURY, NEW FAIRFIELD,
NEW MILFORD AND SHERMAN, CONNECTICUT

Action Plan For Preserving Water Quality In Candlewood Lake



Recommendations Prepared by the Candlewood Lake Authority
For Brookfield, Danbury, New Fairfield, New Milford, and Sherman, Connecticut

2002

ACTION PLAN FOR

PRESERVING CANDLEWOOD LAKE

Recommendations Prepared by the Candlewood Lake Authority
For Brookfield, Danbury, New Fairfield, New Milford and Sherman

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Land Use and Lake Preservation Subcommittee
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The *Connecticut Department of Environmental Protection* and the *United States Environmental Protection Agency* through a Clean Water Act §604(b) Grant and the *Housatonic Valley Council of Elected Officials*

Table of Contents

LIST OF ACRONYMS

CGS	Connecticut General Statutes
CGSESC	Connecticut Guidelines for Soil Erosion and Sediment Control
CLA	Candlewood Lake Authority
CT DEP	Connecticut Department of Environmental Protection
CWP	Center for Watershed Protection
EPA	Environmental Protection Agency (US)
HHW	Household Hazardous Waste
HVCEO	Housatonic Valley Council of Elected Officials
IWC	Inland Wetlands and Watercourse Commission
IWW	Inland Wetlands and Watercourses
LI	Light Industrial
LRPC	Lakes Region Planning Commission
MF	Multiple Family
MWCOG	Metropolitan Washington Council of Governments
NEMO	Nonpoint Education of Municipal Officials
NHOSP	New Hampshire Office of State Planning
NPDES	National Pollutant Discharge Elimination System
NRWIC	Norwalk River Watershed Initiative Committee
PC&D	Plan of Conservation and Development
TRBPIC	Thames River Basin Partnership Initiative Committee
UCONN	University of Connecticut
UST	Underground Storage Tank
WDNR	Wisconsin Department of Natural Resources

EXECUTIVE SUMMARY

Candlewood Lake (the Lake) is the State's largest lake and one of its most important inland water resources. Historically, the Lake's water quality has gradually deteriorated since about 1950. Although modest improvements were observed from the mid 1980's to early 1990's, trends over the last 3 to 4 years have revealed further degradation, and conditions have returned to those observed in the late 1970's and early 1980's when the Lake was considered at an all time water quality low.

In 1998, the municipalities bordering the Lake (Brookfield, Danbury, New Fairfield, New Milford and Sherman) appointed a "Special Advisory Committee" (the Committee) to assist the Land Use and Lake Preservation Committee of the Candlewood Lake Authority (CLA) in addressing the question, "*Is Candlewood Lake at risk from non-point source pollution and, if so, how can we improve our land use regulations to better protect the Lake*?"

The Committee needed very little time to reach consensus on the first part of the question. The watershed of Candlewood has incurred considerable development over the years. This continued growth results in more areas of impervious surface and less ground water infiltration or recharge areas. Greater areas of impervious surfaces increase the volumes of stormwater and the velocity it moves through the watershed, thus increasing the non-point source pollutant load to the Lake.

With consensus reached regarding risk, the Committee then began the task of determining the areas of local land use regulations that could affect the water quality of the Lake and identified absent or substandard environmental policies and controls in the regulations as "Risk Factors". The next task was to identify those risk factors that posed the greatest or most immediate threat to the Lake. To facilitate the establishment of an attainable goal, the Committee limited the number of risk factors to ten. The initial purpose of this report is to identify those ten risk factors (see table below) and provide the reader the essential understanding of how each one impacts the water quality of the Lake.

Another important purpose of this study is to provide our communities with regulatory measures that could be implemented at the local level to preserve water quality in the Lake. Some recommendations for regulatory change to improve upon each community's ability to maintain and even improve upon water quality in the Lake are provided in this report. Additional specific recommendations for each municipality are forthcoming in a follow-up report. A cornerstone recommendation is the creation of a Candlewood Lake Protection Overlay Zone that will provide a framework for implementation of many of the proposed regulatory modifications. The objective is to protect Candlewood, and other inland water features if so desired, by providing the communities surrounding the Lake better regulatory tools.

Areas of local land use regulations in the communities surrounding Candlewood Lake Watershed that can pose a risk to water quality in Candlewood Lake if not addressed properly or lacking altogether. These are termed “Risk Factors” for the remainder of this report.

1. Plan of Conservation and Development
2. Preambles of Zoning Regulations in Addressing the Protection of Candlewood Lake
3. Buffers Adjacent to Wetlands and Waterbodies
4. Floodplain Management
5. Soil Erosion and Sediment Control Standards
6. Clear Cutting and Grading Standards
7. Septic Tank Cleaning and Inspections
8. Stormwater Runoff and Impervious Surfaces
9. Residential In-Ground Oil Storage Tanks
10. Household Chemical Storage

As a requirement of the CT DEP 604B Grant received to fund this effort, recommendations are to be presented, not only in this report, but also at meetings of the local land use commissions. The NEMO (Nonpoint Education for Municipal Officials) Project of the University of Connecticut Cooperative Extension Service agreed to assist the CLA in the outreach component of this effort.

The following research and recommendations were based on the growing body of scientific research, regulatory literature, design criteria and field experience that addresses these critical land use and water resource issues.

A. INTRODUCTION

The value a community places on a water resource is closely related to that resource's water quality. Good water quality is characteristic of a healthy lake, pond or watercourse, which provide greater ecological, recreational, economic and aesthetic values than does an unhealthy body of water. Many lakes provide additional important values as public water supplies, or as potential public water supplies. Candlewood Lake has and still provides many values to the communities of Danbury, Brookfield, New Fairfield, New Milford and Sherman, including that of providing a potential public water supply. Although not currently meeting CT DEP standards as a public water supply, the Housatonic Valley Council of Elected Officials' (HVCEO) views Candlewood Lake as a potential public water supply (see Appendix 1).

As Candlewood's health deteriorates, so too does the value it provides to the community. Based on economic research conducted here (DeLoughy and Marsicano, 2001) and elsewhere (Fishman et al., 1998; Michael, et al., 1996) and on the historical water quality history of Candlewood Lake, it is logically argued that a portion of Candlewood's value has already been lost. Even more alarming is the specter of continued community loss as water quality continues to deteriorate.

WATER QUALITY DETERIORATION

The deterioration of water quality in many Connecticut lakes is well documented (Deevey, 1940; Frink and Norvell, 1980; Canavan and Siver, 1994; Siver et al., 1995, 1999). In this area alone, Candlewood Lake and Squantz Pond, as well as the nearby Lake Kenosia and Ball Pond, have all experienced measurable deterioration within the last century. Water quality in Candlewood began declining about midway through the 20th century and the trend continued up until the mid 1980's (Marsicano et al., 1995; Fig. 1a). Afterwards, the Lake experienced a modest recovery and was seemingly stable up through the mid 1990's as reported from the Candlewood Lake Authority's (CLA) season water quality program. However, data collected in recent years by the CLA indicates that the Lake is neither improving nor stable and, in fact, deteriorating once again (Marsicano, 2000; Fig. 1b).

WATERSHEDS

The condition and uses of shoreline areas and upland areas draining into a lake (along with the surface area of the lake itself is collectively referred to as the *watershed*) are critically important to the health of the Lake. This relationship has been studied extensively, with numerous scientific publications documenting the decline in numerous lakes worldwide, including here in Connecticut. Generally speaking, lakes that have a high percentage of urban or residential areas in the watershed are typically in poorer heath than lakes with less development.

Similarly, lakes with watersheds that are comprised mostly of natural land uses (forests, wetlands, etc.) are generally in better health. In recent research from Connecticut, it was revealed that lakes with watersheds that were 25% or more developed were at high risk of water quality impairment (Siver et al. 1999). Similar findings were reported in other Connecticut-based research that used percent impervious cover to estimate changes in water quality (Arnold and Gibbons, 1996).

Many methods are used to assess watershed land use change. In Candlewood's case, historical population growth in the five lake municipalities was originally used. Population growth infers residential development occurring at the expense of lands in their natural states (forests, wetlands, etc.) and farmlands. Accelerated population growth around Candlewood closely paralleled the Lake's water quality deterioration, particularly between the 1950's through the mid-1980's (Fig. 1a). This deterioration was characterized by increased nutrient enrichment (eutrophication) and sedimentation (filling in of the lake bottom).

Estimates of land use change in the watershed of Candlewood corroborate the changes observed in population, with residential/developed areas in the watershed increasing from approximately 12% in 1970 (Norvell et al., 1979) to approximately 20% by 1977 (CT DEP, 1983) to 29% in 1990 (Marsicano et al., 1995).

PRINCIPAL CAUSES OF DETERIORATION

Two reasons why the health of a lake is inherently tied to watershed land use are stormwater runoff and the cultural practices associated with different land use. Land is often characterized based on its ability to slow down stormwater, thereby providing more groundwater recharge and attenuation of pollutants before they enter the lake. Natural land cover (e.g., forests and wetland) is the most effective land use at slowing down stormwater runoff and absorbing harmful pollutants.

Agricultural lands are less effective and are associated with practices that can impact lakes, i.e., unmanaged manure piles. Industrial, commercial and residential land cover (development) generally have the worst impact on lakes since these lands typically have greater percentages of impervious ground covers, and resultantly, greater volumes of stormwater runoff capable of transporting greater amounts of pollution to the Lake.

Developed areas also tend to sustain a greater occurrence of cultural practices that have negative impacts on lake water quality, e.g., misuse of fertilizers and pesticides, failing septic system, inadequate soil erosion controls, etc. Additionally, stormwater is collected, concentrated and conveyed through curbs and gutter systems. This results in decreased infiltration and increased flooding, erosion and transport of pollutants to lakes, ponds and other water features.

The pollutants described above are considered nonpoint source pollution and the principal cause of lake water quality decline in Connecticut and throughout the

U.S. The US EPA (1994) established nonpoint source pollution as the nation's number one cause of water quality impairment. The undisputable relationship between watersheds, land use and development, impervious surfaces, nonpoint source pollution, and water quality degradation has been clearly identified in Candlewood, in Connecticut and throughout the Nation.

Impervious surface has gained considerable attention in recent years, particularly as it pertains to lake water resource management. Studies have identified relationships between the percentage of impervious cover in an area and lot size, with smaller lots generally containing a higher percentage of impervious surfaces than larger lots (Arnold and Gibbons, 1996). Regardless of lot size, as the percentage of impervious surfaces in the watershed increases, so to does the impairment of water quality.

SPECIAL ADVISORY COMMITTEE

This document represents the efforts of a Special Advisory Committee (Committee) created to protect local communities from losses due to further degradation of water quality in Candlewood Lake and associated watercourses in the watershed. The Committee is comprised of appointees from each municipality surrounding the Lake (Brookfield, Danbury, New Fairfield, New Milford and Sherman), the Housatonic Valley Council of Elected Officials (HVCEO), and the Candlewood Lake Authority (CLA). Initially formed in July of 1998, the committee's focus has been on evaluating land use practices and procedures falling within jurisdictions of local land use commissions.

PROJECT FUNDING

In December of 1998, a grant application was submitted by the CLA to the Connecticut Department of Environmental Protection (CT DEP) for funding to review the land use ordinances of the five municipalities surrounding Candlewood Lake that pertain to the protection of inland water resources. The CT DEP funded the project $15,250 in January of 2000. The HVCEO also provided $5,250 on behalf of the local communities. Terms of the grant included the research, this document, and presentation to the land use boards surrounding the Lake.

MODELS AND LOCAL RECOMMENDATIONS

Regulatory recommendations provided for Brookfield, Danbury, New Fairfield, New Milford and Sherman were based on the review of current regulations and developed to assist these communities in better protecting Candlewood. The review also included researching how other lakeside communities address the protection of important lake resources and the critical watershed areas. One such way, common in the regulatory literature in many lake regions, was through *Shoreland Protection Zones or Overlay Zones*. Connecticut also implements overlays to protect critical lands and natural resources.

By extension of the well established overlay technique or through other available regulatory mechanisms, it is imperative that the Candlewood Lake communities

recognize the vulnerability of the Lake and strive to do what it can to protect it from further deterioration. This document provides a clear and efficient way for the land use commissions to upgrade regulations around Candlewood Lake, ultimately improving our communities' abilities to protect this valuable resource.

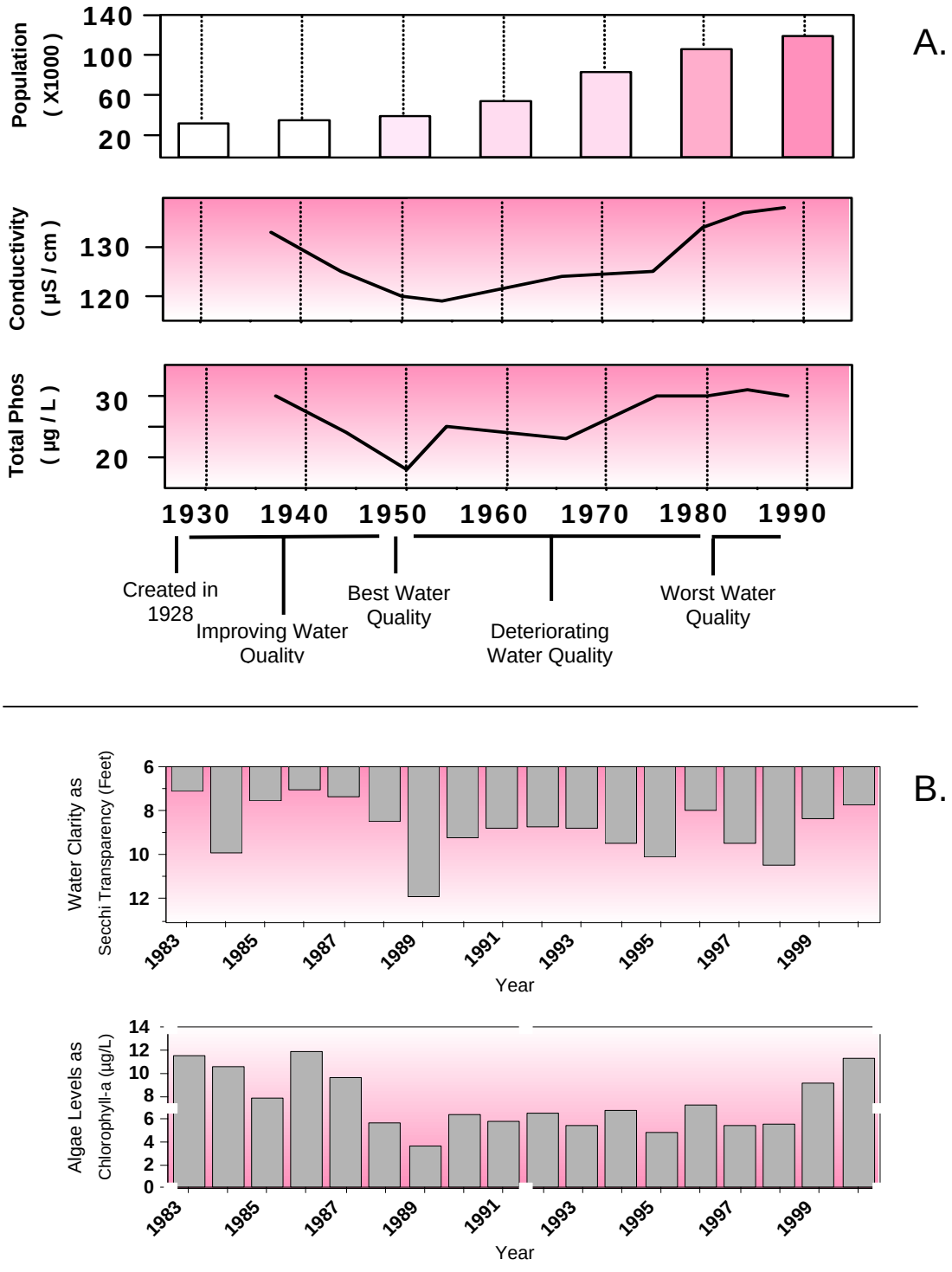

Figure 1. Historical water quality changes in Candlewood Lake between 1930 and 1990 (A) and after 1983 (B). The top half of the figure (A) presents results from paleolimnological research used to infer historical water quality. Note the negative shifts in the water quality features of increasing nutrient and dissolved salt levels after 1950, and how they closely they mirror the growth in population of the five municipalities surrounding the lake (Marsicano et al., 1995). This evidence supports the idea that land use practices in the watershed contributed to the deterioration in water quality. The bottom half of the figure (B) shows trends in Candlewood Lake since 1983 based on the seasonal monitoring program (Marsicano, 2000). Secchi disk transparency characterizes the clarity of the lake water, while chlorophyll-*a* concentrations provided a measure for algae levels in the water. Note the decline in both water quality features (increasing chlorophyll and reduced Secchi transparency) in recent years.

B. CURRENT ZONING IN THE CANDLEWOOD LAKE WATERSHED

A watershed is the sum total of surface area that collects and drains water to the lake, including the surface area of the lake and other water features in the basin. Candlewood's watershed sits almost entirely within the municipal borders of Brookfield, Danbury, New Milford, New Fairfield and Sherman, with the latter two occupying the majority (Table B-1). Three percent of the watershed lies just over the State boundary in Dutchess County, New York.

The vast majority of the watershed surrounding Candlewood Lake is residentially zoned but also includes small pockets of commercial waterfront service, commercial restricted retail/service, commercial neighborhood retail/service, multifamily housing and low-density office/research/light industrial zones. Minimum lot sizes vary from one-sixth of an acre to two acres.

Residential zoning in the Candlewood watershed (Table B-2) is primarily R(A)-40 to R(A)-80, particularly in New Fairfield and Sherman. Greater percentages of higher-density residential areas (e.g. lot sizes $\leq$ ½ acre) are found in the remaining three municipalities. The densest zoning in the watershed occurs closest to the lake with the largest R-7 or R-8 areas comprising the small lakeside communities in New Milford and the large Candlewood Shores community in Brookfield.

Table B-1. Measures of the watershed of Candlewood Lake in each municipality (CT DEP, 1983).

Town	Acres of Watershed	% Of watershed within municipal boundary	% Of municipality within watershed boundary
Brookfield	1,177	4	9
Danbury	2,726	10	10
New Fairfield	12,197	46	72
New Milford	2,629	10	6
Sherman	7,132	27	51
New York State	600	3	
Total	26,461		

Table B-2. Classification of land uses within the Candlewood Lake watershed. Listed in "Other" are commercial neighborhood retail service in Danbury, low-density office/research/light industry and multifamily in New Fairfield, (Adapted a report by John Hayes for HVCEO and based on Zoning Regulations and maps).

	Residential Zoning				Commercial		Other
Classification	2-Acre 80,000 – 100,00 ft^2	1-Acre 40,000 – 60,000 ft^2	½-Acre 20,000 – 30,000 ft^2	1/6-Acre 7,000 – 9,000 ft^2	Water-front Service	Restricted Retail/ Service	
Brookfield	R-100 R-80	R-60 R-40	---	R-7	RS-40	RC-41	---
Danbury	R-80	RA-40	R-20	---	RR-10	---	CN-20
New Fairfield	R-88	RA-44	---	---	---	BC	LI MF
New Milford	R-80	R-60 R40	R-20	R-8	B-3	B-1	---
Sherman	A B	---	---	---	---	C	---

Commercial zoning and business districts are also found within the watershed. Small pockets lie along the perimeter of the Lake along Candlewood Lake Road South in New Milford and Brookfield, comprised mostly of small retail stores, convenience stores and restaurants. Other commercially zoned areas are occupied by marinas and gas stations. An undeveloped Lake Business Zone (B-3) exists in New Milford along the west side of New Milford Bay at the narrowest point on the lake. The largest business or commercial zones in the watershed are the municipal centers of the Sherman and New Fairfield.

Brookfield's Current Zoning in Candlewood Watershed

Five different residential zones and two commercial zones were located within the Lake's watershed located in Brookfield. Nearly half of those lands are zoned R-40. The second largest zone is R-7 occupying the Candlewood Shores community. A minute portion of the Candlewood Shores is zoned R-100. Brookfield's portion of the watershed also has commercially zoned areas (RS-40, RC-41), located on Candlewood Lake Road South, where a variety of small retail stores, restaurants, lodging, a gas station and marinas reside.

A number of provisions and uses associated with all districts in Brookfield have the potential to affect water quality in Candlewood Lake. These include, but are not limited to natural resource removal; excavation, filling and grading;

woodcutting, lumbering and forestry operations; setbacks from waterbodies; and conservation subdivisions. Many of the permitted uses and requirements specific to residential areas present risks to water quality as well, including accessory uses; livestock poultry farming; minimum lot area and building coverage. Components of commercially zoned areas that present potential exposures include setback and buffer requirements and percent coverage.

Danbury's Current Zoning in Candlewood Watershed

Danbury possesses a variety of residential zoning types within the watershed. A large portion is zoned RA-80, most of which lies west of Danbury Bay. Areas east of Danbury Bay and west of Latin's Landing are primarily RA-20. East of Latin's Landing lies RA-20 zoning on the shore with the remainder mostly zoned as RA-80. The area at the southern most tip of the lake in Danbury is zoned RR-10, which was created to provide residential, recreational and commercial uses that would take advantage of the area's unique location at the southern end of Lake Candlewood.

A number of the general use regulations including maximum building coverage and setbacks are of importance to water quality protection. Residential zoning also allows, by grant of special exception, cluster development to promote environmental protection and preservation of open space. Uses and regulations within the RR-10 expose the lake to potential risk including the special exception uses (e.g. hotel or motel, parking area or parking garage, general regulations (e.g. percent building cover) and landscaping requirements.

New Fairfield's Current Zoning in Candlewood Watershed

The vast majority of the Lake's watershed within New Fairfield is zoned R-88. However, the vast majority of lands nearest the Lake are zoned R-44, including the undeveloped Vaughn's Neck, the southern half of the long peninsula extending down from the north in New Milford into New Fairfield town borders, nearly half the length of the lake. Also within New Fairfield's portion of the Candlewood watershed is the business/commercial area occupying the town's center.

Landscaping standards are included in general provisions here and in general provision sections of the other municipalities. If utilized in an environmentally effective way, these provisions could provide additional protective measures from nonpoint source pollution. Each individual zoning district provides specific minimum lot sizes, setbacks and maximum lot coverage requirements that may be pertinent to water quality. Special permit uses that could provide risks include country clubs and conversions of single-family structures.

New Milford's Current Zoning in Candlewood Watershed

New Milford also has a wide range of zone types lying within the drainage basin of the lake. Residential (single family districts) zones include R-80, R-60, R40, R-20 and R-8. Business zones include the undeveloped B-3 located on the

northwestern shore of the New Milford Bay and small B-1 zones about midway down on the eastern shore. R-80 zoning covers a majority of the watershed lands in New Milford, with the largest contiguous and still undeveloped portion located on the west side of the New Milford arm of the lake on what is locally referred to as Candlewood Mountain.

An important feature to New Milford's zoning is its focus on minimum lot area requirements. Areas consisting of wetlands, watercourses, natural slopes in excess of 25%, portions of the lot less than 25 feet wide, or the private right-of-way leading to the rear lot are not included in establishing the lot size.

Numerous permitted or special permit uses are listed for the single-family districts. Some of these, including horses and livestock and golf courses, have the potential to impact surface waters. The same holds true for the B-1 and B-3 zones along the shore of the lake. Other risk areas include the lack of maximum lot coverage standards in the lot and area standards for residential districts.

Sherman's Current Zoning

Sherman is the most rural of the five lake communities. Areas of this community within the watershed are predominantly farm-residence zones (A) and residence zones (B). Both have minimum lot requirements of two acres. A business-residence zone (C) acts as the center of town and lies at the very northwest tip of the lake. Minimum lot sizes in this zone are one acre.

A number of the general zoning regulations in Sherman can be important with respect to water quality including the sections "Parts of Lot Not Counted Toward Minimum Area Requirements" and "Additions or Structural Alterations." Components of the individual zones, including permitted principal and accessory uses, minimum setback requirements and maximum building coverage should be considered a risk if not set at an appropriate standard.

C. THE OVERLAY ZONE TECHNIQUE USAGE AND METHOD TO ACHIEVE GOAL

The designation of environmentally critical areas for the protection of water resources is becoming more and more common as the health of those resources continues to decline. States, including New Hampshire, Vermont, Maine, Wisconsin Minnesota and Maryland have created models and/or mandatory shoreland protection zoning ordinances for their municipalities who often later go beyond the state's regulatory standards for even greater local protections.

In New Hampshire, for example, state statutes authorize municipalities to adopt innovative land use controls to protect water resources, including environmental characteristics zoning, which have resulted in the creation of protective overlay zoning districts with high environmental standards.

A number of regulatory models developed by federal, state, and conservation agencies use an overlay approach in the protection of lakes and other watercourses (Appendix 2). An overlay zone is a geographically defined area that has specified restrictions and/or prohibitions of development practices that is adopted as an enforceable land use regulation. Three of the five Lake zoning commissions exercise this regulatory power (Table C-1).

Table C-1. Overlay zones in the municipalities surrounding Candlewood Lake. An "X" denotes an overlay related to ground or surface water protection.

Municipality	Overlay Zone or District	Water Resource
Brookfield	Aquifer Protection District	X
	Floodplain District	X
Danbury	Airport Protection Zone	
	Floodplain Protection Zone	X
	Public Water Supply Watershed Protection Zone	X
New Fairfield	No overlay zones	
New Milford	Government Service District	
	Town Landmark District	
	Housatonic River District	X
	Driveway and Access Management Overlay Zone	
Sherman	No overlay zones	

Closer to the Candlewood, a number of communities utilize lake and pond overlay districts, including Kent, Warren and Washington, the municipalities surrounding Lake Waramaug, the State's second largest natural lake, and Stockbridge in Massachusetts. Amendments to the Salisbury, CT Zoning Regulations have been adopted to create a Lake Protection Overlay Zone. These communities have or are in the process of creating overlay zones specifically to protect and preserve special land attributes and natural resources. These kinds of overlay zones or special districts are already used in the communities surrounding Candlewood to protect public ground water and surface water like the Housatonic River.

Brookfield's Overlay Zones

Brookfield lists two districts in zoning regulation that are specific to water resources. The first is the Aquifer Protection District that was created to protect public health by preventing contamination of ground and surface water resources providing water supply or potential water supply to the Town of Brookfield. Prohibited uses in this district are listed in Table C-2. An important requirement for permit applications in this overlay is a stormwater runoff plan.

Table C-2. Prohibited uses in Brookfield's Aquifer Protection District

- Road salt storage and loading facilities
- Generation, manufacture, use, transportation or storage of toxic or hazardous materials in quantities greater than those associated with normal household use as determined by the Commission
- Disposal of toxic and/or hazardous waste
- Truck terminals
- Sanitary landfills, junkyards, salvage yards and other solid waste disposal
- Contractor's yard
- Motor vehicle service or washing stations of a commercial nature
- Disposal of snow from outside of the district
- On-site disposal of industrial wastes
- Uses of processes whereby other than standard domestic wastes generated on the site are discharged into the groundwaters of the Town of Brookfield

The second water resource affiliated zone is the Floodplain District. This is an overlay superimposed over other zoning districts. The intent here, as in most floodplain restrictions, is to protect the community in the case of flooding. The close proximity of this zone to watercourses also makes it regulated by the Inland

Wetland and Watercourse Commissions (IWC). Floodplains will be covered in detail in a later section of this study.

Danbury's Overlay Zones

Section 7 of Danbury's Zoning Regulations lists three overlay zones, two of which are related to water and the other being an airport protection zone. The Floodplain Protection Zone is intended to provide for the safety of citizens in case of flooding and will be covered in a later section of this report.

A Public Water Supply Watershed Protection Zone also exists in the City of Danbury and resulted from studies commissioned and reported by HVCEO in *HVCEO Bulletin 59: Danbury Watershed Protection Plan*. The intents of this zone are to facilitate adequate provision of potable water; to protect existing and potential public surface and ground water drinking water supplies from sources of contamination which contribute to the degradation of water quality; to promote public health and general welfare of the community; and to promote environmental protection. Components of the overlay include a watershed classification system (which are identified early on in the Definitions section of the regulations); uses and prohibitions for each class of watershed land; and procedures for submitting applications for development within the defined areas.

New Fairfield's Overlay Zones

No specified zones or overlays zones were found within the Zoning Regulation of New Fairfield.

New Milford's Overlay Zones

Article III of New Milford's Zoning Regulations sets standards and use regulations for several different overlay districts, one of which is related to water resources. Chapter 95 of Article III is entitled *Housatonic River District*. The purpose of this overlay is to protect a carefully defined area along the Housatonic River. New Milford along with five other towns on the Housatonic River has adopted this River District in a cooperative program for several reasons including the fact that the river is flood prone; is environmentally sensitive; and possessing of many natural resources. The overlay zone consists of an Inner and Outer Corridor and the overlay regulation provides permit procedures, requirements and standards.

New Milford does not list a floodplain protection district or overlay, as do Brookfield and Danbury. Instead, New Milford includes Floodplain Management Regulations in *Article V, Regulations Applying to all Districts*. These regulations act as an overlay in that they pertain to all of New Milford that lies within special flood hazard areas as identified by the Federal Emergency Management Agency (FEMA).

Sherman's Overlay Zones

No specified zones or overlays zones were found within the Zoning Regulation of Sherman.

Shoreland Protection Overlay Zone

Many of the overlays or special districts listed above were created to protect water resources by protecting specific and/or environmentally sensitive lands surrounding those resources. They improve the health and well being of the community by protecting the environmental asset. The Housatonic River District and Danbury's Public Water Supply Watershed Protection Zone also specifically acknowledge the purposes of protecting natural resources and promoting environmental protection.

As stated earlier, similar methods are frequently used in other parts of the country to specifically protect lake resources. The creation of a special lake district or overlay zone, often referred to as a Lake Shoreland Protection District, has been successfully utilized to regulate uses of watershed land, or portions of the watershed closest to the lake and set standards for those uses. Also mentioned earlier, the communities surrounding Lake Waramaug have coordinated regulations in an attempt to protect the State's second largest lake.

As will be detailed in a later section of this report, the Committee recommends that the municipalities surrounding Candlewood Lake create and utilize a protection zone as a structure for regulatory changes to better protect the Lake. The overlay or protection zone technique already has precedent locally (and elsewhere) as a means of protecting water recourses. A Candlewood Lake Protection Zone contiguous around the Lake would provide an environmentally protective, minimum standard for all five municipalities surrounding the lake and act as a cornerstone for this effort.

D. EVALUATING MUNICIPAL PROTECTIONS BY THE USE OF RISK FACTOR ANALYSIS

The goal of this effort is to strengthen local land use regulations to better protect Candlewood Lake and other water resources in the lake's drainage basin. Land use planning and regulatory mechanisms, if not properly designed, will result in negative impacts to water quality.

The Committee's first task was to identify planning and other regulatory mechanisms, which if insufficient or lacking, put our lakes, streams, ponds and wetlands at risk of degradation. These regulatory mechanisms were termed "risk factors" in that they could create an environmental exposure leading to water quality deterioration. These risk factors were used to compare local regulatory effectiveness in protecting the Lake. Strategies among the municipalities that were considered effective or more progressive in protecting lakes were also identified.

A transmittal letter accompanied a list of risk factors and was sent to the Chairmen of all land use commissions, asking that they prioritize the list. This step engaged the local community experts who were in the best position to represent individual local community needs. Commissions were asked to suggest other risk factors or indicate if something on the list was insignificant to their community. Mr. Thomas McGowen, a consultant with expertise in planning, lake management and the regulatory review process, was also retained to review the list.

A final set of risk factors was then used for comparative purposes within land use regulations in the municipalities of Brookfield, Danbury, New Fairfield, New Milford and Sherman. Since the regulatory needs and conditions differed from municipality to municipality, it was impractical to prioritize the risk factors. Instead, differences and similarities in how each town addressed each risk factor were determined. Attempts were made to document both positive qualities and shortcomings in regulatory measures in each municipality so they could be used later in forming model ordinances.

Another component of this analysis was the assemblage and review of in-use and model regulations found elsewhere. These included the inland wetland and watercourse regulations of all municipalities in CT, regulations used in other watershed communities particularly from New England, New York and the Great Lakes region, and models developed by regulatory and environmental organizations (Appendix 2). These more protective regulations were used for comparative purposes or as references for model ordinances to be presented to the communities surrounding Candlewood.

Once the regulatory recommendations were drafted for each municipality they were compiled in this document and will be formally presented at local land use commissions meetings. Recommendations were based on their projected positive impact on water quality and their capacity to be adapted to current regulations.

Precedents

The identification of municipal risk factors that impact natural resources has much precedent. Reviews of land use regulations in Connecticut have been conducted to gauge local and state efforts in protecting public water supplies (Doenges et al., 1993) and larger river systems (e.g.; NRWIC, 1998; TRBPIC, 1998).

Reviews for the protection of water resources are also becoming much more commonplace at federal, state, regional and local levels (e.g. NHOSP, 1992; WDNR, 1997; CWP, 1998), as the protection of natural resources becomes a more difficult and complex task. Such a review in 1989 resulted in a zoning overlay in Danbury to protect public water supplies (HVCEO, 1989).

A leading environmental planning group recently listed 22 areas of potential improvement in local land use regulations (CWP 1998). In Wisconsin, a state agency listed and addressed 16 risk factors (WDNR, 1997). Other notable efforts in Connecticut have used 11 to 12 land use components in multi-municipal comparative analyses (NRWIC, 1998; TRBPIC, 1998).

To promote the feasibility of improving measures here, our Committee limited the number of risk factors to ten, which were determined by the Committee. Important selection criteria for risk factors were that they be scientifically based and related to water quality protection.

E. Risk Factors in Local Regulations

1. The Plan of Conservation and Development

The local Plan of Conservation and Development (PC&D) sets policy for development coordination and specifies where local regulations relating to growth and development should be strengthened. Since PC&Ds provide the local authority for addressing land use issues and amending policies for the community at large, it is logically here where review of local regulatory protections of the Lake begins.

Proper provision in the PC&D assists local government agencies in modifying their regulations and is an important component of the protection of water resources (Doenges et al., 1993). Insuring that local PC&D's addressed the importance of Candlewood Lake to our communities, the developmental stresses facing the lake, and the need to protect it through land based measures was a logical starting point for this effort.

At the start of this project, the PC&D's of the five member municipalities of the CLA ranged from existing and thorough to lacking and deficient relative to recognizing the land use pressures on Candlewood and other water resources within the municipal boundaries. Since that time, recommendations have been made to planning commissions where necessary and amendments are pending in some towns (Table E-1). To date, all five municipalities are on course to have, or already have, strong language in their Plans to that recognize the importance of improving or maintaining water quality in the Lake and watershed based measures of attaining that.

There are currently large tracts of undeveloped lands adjacent to the lake and currently owned by Connecticut Light & Power shareholders. These are Candlewood Mountain / Vaughn's Neck (New Milford and New Fairfield, respectively), Green and Deer Islands (Sherman), property adjacent to the New Fairfield Town Beach area (New Fairfield) and property in Danbury in close proximity of Bear Mountain Park. It is the Committee's recommendation that all municipalities develop open space plans with the aforementioned properties earmarked in municipal PC&D's for open space protection.

Brookfield's 1990 Plan

- Identifies the lake as the town's most notable surface water resource, "beautiful", and "the primary tourist attraction in the area."
- Identifies recent deterioration in water quality due, in part, to failing septic systems, dry well laundry, lawn fertilizers and oily boats.
- Recognizes that the eutrophication of Candlewood Lake "would be a disaster for the community and the Region as a whole."
- Recommends specific steps that can be taken to prevent further deterioration of the water quality" including regulation of lawn fertilizer

usage adjacent to the lake and strategies to limit discharges of phosphorus and insecticides.

Table E-1. Comparison of selected Candlewood Lake related concepts found in the Plans of Conservation and Development in the five lake communities. The "+" sign signifies that Plan adequately addresses the issue while "P" signifies that there are changes pending, which would adequately addresses the issue. A "-" sign signifies that issue is not addressed in the Plan.

Issues	Brookfield	Danbury	New Fairfield	New Milford	Sherman
Recognize need to protect Candlewood	+	+	P	+	+
Recognize nonpoint source pollution in watershed					
Need to investigate protective measures	+	+	P	+	+
Recognize watershed	+	+	P	-	+
Recognize water quality/ watershed relationship	+	+	P	-	-
Recognize past deterioration	+	-	-	-	-
Recognize potential loss	+	-	-	-	-
Suggest "Lake District"	-	+	-	+	-
Suggest Open Space Conservation	+	+	+	+	-

Danbury's 2001 Plan

- Identifies the lake as a major recreational resource and a potential future public water supply.
- Identifies the relationship between development activities in the watershed and the Lake's water quality.
- Identifies the activities and supports ongoing efforts to strengthen the regulatory framework that protects the Lake.
- Identifies many of the areas of concern within the framework and also lists many of the recommendations stemming from this study including a Shoreland Protection Overlay District and standards for shoreland vegetated buffers.

New Fairfield's 1992 Plan (currently in review)

- Was recently amended to reference the watershed of Candlewood Lake under the section entitled "*The Protection of Sensitive Lands*."

- The amendment read, "*The relationship between land development activities in the watershed of Candlewood Lake and the water quality of Candlewood Lake, itself, is recognized. Watershed regulatory strategies for insuring the maintenance of good water quality in Candlewood Lake should be evaluated for implementation."*

New Milford's 1997 Plan

- Contains specific language in support for specialized protection of the lake saying *"As a major natural asset, Candlewood Lake should be protected from negative impacts resulting from the development of surrounding areas."*
- Recommends creating a Candlewood Lake District and addressing issues including ridgeline protection, restrictions on clear cutting, erosion control and other applicable provisions to protect the health of the lake.

Sherman's 2001 Plan

- Recognizes that development guidelines should vary on a watershed-by-watershed basis and states, *"Whenever significant development activities are proposed within two major watersheds present in the Town of Sherman, the development guidelines of the authorities responsible for those watersheds shall be taken into account at public hearings of the appropriate land use agencies…"*
- Recognizes that *"the land use agencies of the Town shall implement regulations or guidelines for cutting, planting, chemical use and other development activities on or near the shoreline of the Town's primary lakes and rivers."*

2. Zoning Preambles Addressing the Protection of Candlewood Lake

Zoning Commissions or Planning and Zoning Commissions are in the best position to affect land based measures protective of water resources, since they set limits for the location and uses of lands as authorized by State Statute (Zizka, 1997). They have both regulatory and prohibitory powers, and thus are able to provide strong protective measures. In local zoning ordinances definitions and delineations of land districts, overlays, uses and prohibitions are established in accordance with what is in the best interests of the community.

In Connecticut, part of the regulatory protections set forth for watercourses are done so through Inland Wetlands and Watercourse Commissions (IWC), which operate under the State's supervision through the CT DEP (Tondro, 1996). Effective water resource protection must take into account the entire watershed, which most often extends well past the 100 or 200 feet from the edge of the water feature designated as "regulated area" by IWC's.

Chapter 1 (also found as Article 1 or Section 1) of local zoning ordinances contains language listing the purposes, intents and objectives for those regulations. It is an important section in that it sets an early and important tone for the remainder of the regulations. There are common elements including the provision and protection of public health, safety and general welfare; guidance for future growth and development in accordance with the municipalities Plan of Conservation and Development; provision of basic infrastructure needs; and determining appropriate uses of lands.

Some local zoning commissions incorporated environmental objectives into their regulations by including language specific to environmental issues. Having environmentally protective language in this section can be particularly useful if there are important environmental resources the community wishes to protect and if there is a desire by the community to improve upon regulations for better protection of those natural resources.

Brookfield's Current Water Resource-Related Zoning Objectives

It is ironic that of the five municipalities surrounding Candlewood Lake, the one with the smallest part of the watershed has perhaps the best language in their zoning ordinance's Statement of Purpose. Components that interpretively have meaning with regards to Candlewood include the provision *to protect and conserve the character and the environment of all parts of the Town, and to encourage the orderly and beneficial development of the Town*. Definitive language addressing protection of water resources includes the provision *to prevent the pollution of watercourses and wetlands, safeguard the water table, avoid hazardous conditions and excessive damage resulting from storm water runoff throughout the Town, and conserve the Town's natural beauty and topography in such a way as to preserve the integrity, stability and value of land and buildings.*

Danbury's Current Water Resource-Related Zoning Objectives
Danbury is much less specific with regards to environmental concerns. Component that may have significance with regards to Candlewood include *facilitating adequate provision for water and encouraging the most appropriate use of land throughout the City*.

New Fairfield's Current Water Resource-Related Zoning Objectives
Like language found in Brookfield's regulations, the "Objectives" section (Chapter 1) of New Fairfield's Zoning Regulations provides language that is clearly geared towards water quality with the provision *to control soil erosion and sedimentation*. Other language that could have relevance to Candlewood included the provision *to protect the existing and potential sources of potable water, to protect and maintain property values and to promote the historic character of the community*.

New Milford's Zoning Objectives
There is little in terms of language addressing New Milford's environmental concerns in the Statement of Intent and Purpose of their Zoning Regulations. Broad language pertaining to *the protection and conservation of the existing or planned character of all parts of the town to aid in maintaining their stability and value and to encourage the orderly development of all parts of the town* may have some relevance to Candlewood Lake.

Sherman's Current Water Resource-Related Zoning Objectives
The language found in Sherman's Statement of Purpose was similar to that found in Brookfield's and New Fairfield's in that specific environmental issues were addressed, as well as concerns regarding the more generic protection of the character of the Town. This more generic land-related language included provisions *to protect the character and stability of all parts of the Town, and ensure that all development shall be orderly and beneficial and to protect and conserve the value of land throughout the Town.*

Environmentally specific language included the provisions *to prevent the pollution of ponds and streams and encourage the wise use and sound management of natural resources throughout the Town in order to preserve the integrity, stability and beauty of the community and the value of the land.*

3. Buffers Adjacent to Wetlands and Waterbodies

For water quality protection purposes, *buffers* are vegetated upland areas adjacent to watercourses (wetland, stream, river, pond, lake, etc.) that function to reduce the input of nonpoint source pollutants. *Vegetated* means uncut or undisturbed forest or meadows, minimally disturbed or managed forest or meadows, or modestly managed vegetated areas that closely mimic natural design and function. It is critical that the distinction be made between these environmentally protective buffers and those more commonly referred to in zoning regulations, which function to create a visual screen.

The effectiveness of vegetated buffers to protect water quality is well documented. Vegetated buffers, in association with the leaf litter and organic soils that develops underneath them, significantly slow down water moving down from upland areas allowing for the sedimentation and attenuation of nonpoint source pollutants like soil sediments, fertilizers and pesticides before they enter a watercourse.

Buffers of 50 to 100 feet in width have been shown to remove from 45% to 93% of incoming sediments, and upwards of 80% of total suspended solids, nitrogen and phosphorus (Chase et al., 1995 and references therein). Many recent regulatory reviews and model regulations developed to protect water quality emphasize vegetated buffers and provide guidelines for widths, maximum levels of vegetation removal and other activities within set boundaries. Many states have mandatory provisions for minimum buffer standards (Table E-2), which are often enhanced at the county and/or local level to improve protection.

There is no mandatory state minimum standard in Connecticut. However, the Connecticut State Policies Plan for Conservation and Development (1998 – 2002) does contains language encouraging the use of setbacks and buffers along surface waters to prohibit clearing of vegetation and promote the vegetation of scenic areas which have been denuded, or disturbed in some manner (Doenges et al. 1993).

The New Hampshire Office of State Planning and the Audubon Society of New Hampshire recommended (Chase et al., 1995) that a discussion of the rationale behind buffers be found in a water resources component of the local PC&Ds. While our local PC&Ds identify water resources, none discuss the importance of vegetated buffers to protect them. A reasonable first step to minimize local risk and exposure from ineffective or missing vegetative buffer standards is the inclusion in local PC&Ds language that discusses the rationale behind vegetated buffers as a means of protecting water quality and provide a listing of wetland and surface water resources found within municipal boundaries.

Table E-2. Examples of minimum buffer requirements along waterbodies and watercourses in Wisconsin, Maine and New Hampshire.

Clear-cutting of trees and shrubs is prohibited in the strip of land from the ordinary high water mark to 35 feet inland with the exception of a 30-foot wide path, for every 100 feet of shoreline, down to the water. Limitations on cutting are also applied to the remaining shoreland area, which comprises another 965 feet back from the high water mark. - Wisconsin's Shoreland Minimum State Standards, s. 59.692 and NR115
Adjacent to great ponds and rivers flowing to great ponds, a buffer strip is required to extend 100 feet from the normal high-water line. "Clear-cut openings", defined as openings in the forest canopy greater than 250 ft., are prohibited although 40% of the volume of trees 4 inches in diameter, measured at 4½ feet above ground level, can be removed in any 10-year period. -Maine's Mandatory Shoreland Zoning Act, Title 38-3-B §§ 435-449
Where existing, a natural wooded buffer shall be maintained in a 150 ft. of the public boundary line. This affects public water bodies 10 acres or larger, as well as fourth order or higher rivers and tidal waters[1]. Cutting limits within 150 feet of great ponds and fourth order streams and within 50 feet of all perennial streams, rivers and brooks are 50% of the pre-harvest basal area[2]. - New Hampshire's Comprehensive Shoreland Protection Act, RSA-483-B[1] - New Hampshire's Basal Area Law, RSA-227-J:9[2]

Local Overview

For the balance of this chapter, local buffers, including their use, design and purpose, are examined and compared in local IWW and zoning regulations. Considerable effort went into searching for language addressing buffers as water quality protective measures.

In summary, all local zoning regulations contain discussions of buffers, but these were in most cases vegetated areas used as a screen between two properties or between some element of one zone and an element of another (e.g. row of evergreen trees to screen an industrial complex from a residential area).

All local inland wetland regulations define a regulated area, which extends some set distance from a wetland or watercourse, in which activities are regulated in an attempt to protect inland water resources. Very little in way of minimum design and function standards were provided for these areas.

Brookfield's Buffers

Brookfield's Zoning Regulations defines "Buffer Strip" as "a suitable open space, unoccupied except for plant materials, left in its natural state (or) having additional landscaping provided at locations deemed appropriate by the Commission in order to screen a project from adjacent properties, such as

additional screening to produce within three years a visual barrier. A distance of seventy-five (75) feet from the limits of a watercourse is set in regulations for multifamily dwelling zones prohibiting sewerage facilities, except for designated reserve area(s).

While not using the term buffer, Section §242-501J provides landscaping requirements for Industrial, Commercial and Other Districts. This section provides useful details on landscaping definitions and its Purpose section lists some of the benefits, including preventing the erosion of soil, providing water recharge areas and improving the quality of the environment and the attractiveness of the Town of Brookfield.

In Brookfield's IWW Regulations a "Regulated Area" is defined as any geographical area of the Town of Brookfield consisting of wetlands or watercourses or other land in the Town situated within a floodplain or within two-hundred (200) feet of the mean waterline of Candlewood Lake, the Still River, Lake Lillinonah, or the Housatonic River, within one hundred (100) feet of such waterline of any other watercourse or within fifty (50) feet of any wetlands.

"Regulated activities" are defined as any operation or activity, or use of, a wetlands, watercourse, or regulated area, involving removal or deposition of materials, or any obstruction, construction, alteration or pollution of the wetlands or watercourses, or which operations or activity may disturb the natural and indigenous character of a wetlands or watercourse and any earth moving, filling, construction, or clear-cutting of trees.

Non-regulated uses within the regulated area existed, but were qualified by provisions that they do not disturb the natural and indigenous character of the wetlands or watercourse by removal or deposition of material, alteration or obstruction of water flow or pollution of the wetlands or watercourse.

Danbury's Buffers

"Environmentally sensitive areas" are defined in the zoning regulation as land located within a public water supply watershed protection zone which has one or more of the following characteristics: (1) areas located within two hundred fifty (250) feet of the high water mark of a reservoir; (2) areas located within one hundred (100) feet of any wetland or watercourse, as defined in Sections 2.32 and 2.33 of the "Inland Wetland and Watercourse Regulations of the City of Danbury, "which drain into a reservoir; (3) wetlands, watercourses, reservoirs, lakes, and ponds; and (4) areas with slopes 15% or greater which have a soil depth of twenty inches (20") or less to bedrock.

Danbury Zoning Regulations also define "Landscaped Buffers" as an open unoccupied area requiring a mixture of evergreen and deciduous trees, and other plant materials that will in five years produce a visual barrier between adjacent land uses of different types. Where landscaped buffers are required, a planting

plan and plant list with types and sizes shall be required as part of the site plan requiring approval. “Natural Buffers” are also defined as a suitable wooded open space, unoccupied except by plant materials, cleared of all rubbish, and waste materials, and left in a natural state with the land surface covered with a suitable ground cover.

A suitably landscaped buffer strip of not less than twenty (20) feet is required of all special exception uses in RR-10 zones between the street line and the balance of the lot.

In Class I Environmentally Sensitive Area of the Public Water Supply Watershed Protection Zone, some language is provided regarding maintenance agreements with respect to the maintenance and upkeep of soil and vegetation covers for the land.

Danbury’s IWW Regulations defines "Environmentally Sensitive Zone of the Watercourse" as the area encompassed by a distance of 100 feet outward from the edge of the stream channel of a watercourse during low flow conditions. The intent of the IWW Regulations is to preserve the ecological integrity and pollutant renovation functions within this area. A definition of “regulated activity” is also provided and is similar to those in other local IWW regulations.

Instead of “Regulated Area”, Danbury defines an “Upland Review Areas” as the area a) within 100 feet of the outer boundary of a wetland, b) within 200 feet of the mean high water line of Candlewood Lake, Lake Kenosia, Still River, and all public water supply reservoirs, and c) within 100 feet of the mean high water line of any other watercourse. Regulated activities include locating septic systems; clear cutting or grubbing of land; specified excavating, filling or stockpiling activities; and permanent outdoor or underground storage of petroleum-based products in the upland review area.

New Fairfield’s Buffers

In New Fairfield’s Zoning Regulations a “Buffer strip or area” was defined as an open landscaped area free of any buildings, structures, rubbish or waste material that provides a barrier between adjacent land uses of different types. Buffer areas may consist of existing vegetative cover or may be suitably landscaped as may be required by the regulations. As in other zoning regulation, the intent is to provide screening. A related term, “setback,” was also defined as the shortest distance between any part of a building or structure and the nearest property line.

In New Fairfield’s IWW Regulations, “Regulated activities” were defined as any operation within or use of a wetland or watercourse involving removal or deposition of material or any obstruction, construction, alteration or pollution of such wetland or watercourses including, but not limited to the location of any subsurface sewage disposal system within (a) two-hundred (200) feet of the mean water line of Lake Candlewood, Ball Pond, Margerie Lake reservoir, and

the mean water line of Ball Pond Brook; (b) 150 feet of such mean water line and/or terminal edge of all other watercourses and wetlands; (c) or as prescribed under Section 4.5 of the regulations; and (d) any activity which may have a significant impact or major effect on the wetland or watercourse.

The IWW Regulations in New Fairfield also contained language unique to the Candlewood area regarding minimum buffer areas in Section 4.5, Special Provisions. There it states *"no activity shall be conducted in non-wetland areas which are closer than seventy-five (75) feet from regulated wetlands or watercourses. The Agency may, by a majority vote of its members, reduce the depth of said buffers when, in its judgment, the reduced distance will not be detrimental nor will it endanger the adjacent wetland. In reviewing proposed reduction(s) the Agency shall consider vegetative cover, terrain slope and man-made features. Reduced buffer shall not be granted when the activity in non-wetland areas include the installation of subsurface sewage disposal systems in the buffer area associated with new development proposals. Repairs to existing septic systems within the buffer area may be allowed at the discretion of the Commission if no feasible and prudent alternatives exist."*

In New Fairfield, "Greenbelt Restrictive Covenants" were established for the Sail Harbour community, which theoretically established a sixty-five foot conservation buffer area running parallel along the lake. These covenants were established as part of the deed restrictions in waterfront properties, were to be self regulated by the community but failed to protect all of the buffer area.

New Milford's Buffers

Provisions were found in Zoning Regulations for the use of landscaped buffers in order to screen certain land uses. No landscaping standards or minimum separating distances for the protection of lake water quality were found in any section including Chapter 50, Lake Business Zone.

Chapter 95, Housatonic River Zone, does define a particular area adjacent to the river where land uses are limited. Within the "Inner Corridor" of this zone special permits will not be granted if a proposed land use creates water or air pollution, increase erosion or sedimentation, create danger of flood damage, obstruct flood flow, damage fish or wildlife habitat, or adversely affect any unique feature of natural resource. All of these conditions result from the loss of shoreland vegetated buffers.

The intentions of Chapter 130: Landscaping, Screening and Buffer Area Standards included, among other things, the prevention of the erosion of soil, excessive runoff of storm water, of the depletion of the ground water table and the pollution waterbodies and watercourses. Standards are provided for front landscape areas and buffer areas. Buffer areas in this case are to provide

privacy from noise, headlight glare and visual intrusions to any residential district. MInimum buffer standards for the prevention of water pollution were not found.

New Milford's IWW Regulations recently provided a unique and important definition that effectively targets both form and function in Section 2.3, which reads:

Buffer means a vegetated area inclusive of trees, shrubs and herbaceous vegetation that exists or is established to protect a wetland or watercourse.

New Milford's IWW regulations also defined *Regulated Areas* and *Regulated Activities*. Regulated areas was described as "*any wetland, watercourse or the adjacent upland area as follows: within two hundred (200) feet of the ordinary high waterline of Candlewood Lake, the east or west branch of the Aspetuck River, the Still River, the Housatonic River or watercourses within the West Aspetuck River watershed, within one hundred (100) feet of the ordinary high waterline of any other watercourse, or within one hundred (100) feet of any wetlands which ever is greater.*"

Regulated activities were *"any operation within or use of a wetland, watercourse or regulated area involving removal or deposition of material, or any obstruction, construction, alteration or pollution, of such wetlands, watercourses or regulated area, or any operation or use of land that may disturb the natural and indigenous character of a wetland, watercourse or regulated area."* Permitted uses and operations are listed in Section 4.

New Milford's IWW regulations also unique in defining "*Significant Activities*" as "*any activity, including, but not limited to, the following activities which may have a substantial adverse effect or impact on the inland wetlands and watercourses within or abutting the area for which an application has been filed or on another part of the inland wetlands or watercourse system:*

A. Any activity involving a deposition or removal of material which will or may have a substantial adverse effect or impact on the wetland or watercourse, or

B. Any activity which substantially changes the natural channel or may inhibit the natural dynamics of a watercourse system including potential effects to regulated areas from alterations of the natural drainage patterns in upland areas, or

C. Any activity which may substantially diminish the natural capacity of an inland wetlands or watercourse to support desirable fisheries, wildlife, or other biological life, prevent flooding, supply water, assimilate waste, facilitate drainage, provide recreation or open space or other functions, or

D. Any activity which is likely to cause or has the potential to cause substantial turbidity, siltation or sedimentation in a wetlands or watercourse, or

E. Any activity which may cause a substantial diminution of flow of a natural watercourse, or groundwater levels of the regulated area, or

F. Any activity which causes or has potential to cause pollution of a wetlands or watercourse, or alters or destroys unique wetlands or watercourse areas having demonstrable scientific or educational value.

Sherman's Buffers

Buffer areas were discussed in Section in Section 350 of Sherman's Zoning Regulations (Additional Standards and Requirements) as a means of screening activity on the lot from neighboring residential areas.

Sherman's IWW Regulations contained the standard definition for "Regulated Activity" and included the removal or deposition of material, discharge, clear cutting, obstruction, construction, grading, paving, excavating, alteration, pollution, grubbing, and discharging of storm water into wetlands or watercourses. The "Upland Review Area", where certain activities are regulated, was defined as the land within 100 feet measured horizontally from the boundary of any wetland or watercourse.

As in New Fairfield, "Greenbelt Restrictive Covenants" were established for the Sail Harbour community, which theoretically established a sixty-five foot conservation buffer area running parallel along the lake. These covenants were established as part of the deed restrictions in waterfront properties, were to be self regulated by the community but failed to protect all of the buffer area.

4. Floodplain Management

The area of floodplain management regulation is a very logical place to look for risks in the protection of inland water resources as exemplified in two recent reviews of municipal regulations in Connecticut (NRWIC, 1998; TRBPIC, 1998). Each review defined a floodplain as a relatively flat area adjoining rivers, streams and coastal areas that can flood and when built upon is a hazardous place for life and property.

In the two reviews, the regulatory language of fifteen municipalities was assessed based on the extent that the regulations protected flood plains for their natural functions. Floodplains receive floodwater and disperse its energy efficiently as to not harm other natural resources, with excessive stream channel erosion, for example. In a recent report to the CLA, stream channel erosion of the Saw Mill Brook system was determined to be the major source of sediments entering the Lake and impacting Allan's Cove in Sherman.

Effective floodplain protection provides compatible land uses for both economic potential and protection of natural resource. Floodplain management is a mandatory component of local regulations and designed to protect the health, welfare and properties of those living near potentially floodable areas. These areas are defined by FEMA maps and based upon 100-year flooding events.

Over half of the annual water budget for Candlewood evolves from stormwater in the watershed (CT DEP, 1983), most of which lies in the municipalities of New Fairfield and Sherman (Table E-3). Watercourses like Ball Pond Brook in New Fairfield and Saw Mill Brook in Sherman collect drainage from large areas of the watershed, funneling storm water to the lake. Natural floodplains exist for both of these systems, regardless of any community designations.

Floodplain protection provides an excellent opportunity to protect the Lake's water quality by protecting the lands that border the streams that enter the Lake. Pollutants carried in stormwater, flowing over the protected floodplains, will be greatly reduced by the "buffer zones" established in the protected area. The buffer will remove sediments, nutrients and other pollutants from storm water. In large storms, proper floodplain management also serves another very important community function: it reduces the risks to public health and property.

Brookfield's Floodplain Standards

Brookfield addresses floodplain management with a floodplain district. The provisions and permitted uses are applied to areas defined by flood insurance studies and provide for a permitting process. The limits of the regulated area include both a floodway and floodplain, each with separate sets of permitted uses. Many of the uses promote less impervious ground covers like low-value agricultural uses, wild crop harvesting, non-fertilized crops, parks, and wildlife and nature preserves. Others, particularly in the floodplain, create risk by

promoting more impervious surface such as drive-in theaters, parking areas, and storage sites.

Other permitted high-risk uses of the floodplain are listed in Section E and include natural resource removal, railroads, street and other utility infrastructure, and structures constructed on fill. These high-risk uses are permitted providing that they don't increase the flood elevations by one foot.

Brookfield's floodplain regulations are comprehensive and include sections on structures, storage, flood hazard reductions, and specific standards for residential and nonresidential construction.

Danbury's Floodplain Standards

Floodplain provisions are listed under Floodplain Zones, which is one of Danbury's Overlay Zones. There, a permit is required for all proposed construction and other development in the floodplain and shall be issued by the Planning Commission upon fulfilling the requirements of the zoning regulations.

The regulated area are Zones A and A1-30/AE as shown on the Flood Insurance rate Maps. Site plans for proposed construction within these areas are required to contain necessary data for determining if they are in conformance with floodplain requirements.

Standards are set for both the numbered and unnumbered A Zones. Criteria in A Zones, defined as those without elevation or floodways, may not impede flow of water in the watercourse during period of 100-year flooding. Standards for new or replacement water supply systems and sanitary sewage systems are set, as well as limits on location of leaching fields. In Zones A1-30/AE, which are those with base flood elevation, the same standards apply as found for the A Zone with additional standards provided for new construction or substantial improvements.

Floodways appear to receive the greatest protections with complete prohibitions without certifications by registered professional engineers demonstrating no increase in flood levels during occurrences of base flood discharge.

New Fairfield's Floodplain Standards

Language in Zoning Regulations regarding floodplain management in New Fairfield is standard including the objective of "*securing safety from flooding*". The New Fairfield Inland Wetlands and Watercourse Regulations also briefly list "*hydrological stability and control of flooding and erosion*" in the Intent Statement (Section 1.2).

In section 2.19.9 of the Zoning Regulations, flood prevention is addressed by excluding any building or structure with any part of its foundation closer than the minimum side yard distance for the district in which it is located plus thirty feet to the centerline of a normally running stream or its bed. Minimum side yard

lengths range from 20 to 50 feet (Section 3.0) thus making the floodplain 50 to 80 feet from the center of a stream channel.

New Milford's Floodplain Standards

New Milford floodplain regulations are provided in Article V, Regulations Applicable To All Districts. Purposes and objectives include danger due to water or erosion hazard, increasing flood heights and velocity. Other important objectives are the control of filling, grading, dredging and other development that may cause erosion or flood damage and control of alterations of natural floodplains, stream channels and natural protective barriers.

General Provisions identify hazard areas by FEMA flood insurance studies and appoints the Zoning Enforcement Officer to administer and implement the provisions of the regulation. Additionally, all proposed developments, structures and improvements in the special flood hazard area must meet requirements of floodplain management regulations. Rigorous provisions for the application process are provided, as are thorough provisions for flood hazard reductions and enforcement.

Sherman's Floodplain Standards

Floodplain management is not addressed in the zoning regulations of Sherman. Similar to the New Fairfield Inland Wetland Regulations, the Sherman Inland Wetlands and Watercourse Regulations discuss the importance of wetland protection for "hydrological stability and control of flooding and erosion." In addition, Section 10.2 lists prevention of flooding as one of the important considerations in decisions on applications to the Inland Wetland Commission.

Floodplain management is more elaborately addressed in the zoning regulations of Brookfield, Danbury, and New Milford (Table E-3). The approaches used by the three differ somewhat in that the regulations in Brookfield are for a floodplain district; in Danbury floodplains are addressed as an overlay zone; and (*Interesting to note that the Connecticut General Statutes provide for no use variances in the Floodplain District. Does that apply to an overlay zone or regulations applicable to all districts?*)

Table E-3. Comparison of floodplain management regulations within local Zoning Regulations. FIA = Federal Insurance Administration; FIRM = Flood Insurance Rate MapFEMA = Federal Emergency Management Agency

	Brookfield	Danbury	New Fairfield	New Milford	Sherman
Implementation vehicle	Separate district	Overlay Zone		Regulations applicable to all districts	
Delineation of Floodplain and Floodway	Both specified; FIA study for Brookfield (1978) specifying Zone A, A1-A30 and maps, other materials therein.	Floodway Boundary and Floodway Maps & as outlined in Flood Insurance Study and Floodway Data Table (1982); Zones A, A1-30, AE; base flood is 100 year storm		Both specified; special flood hazard area identified in FEMA study (1987); Zone A or AE on FIRM; base flood is 100 year storm	
Permitting process	Begins in IWC before going to Zoning	Planning Commission		Zoning Commission	
Administration / Implementation	Zoning Enforcement Officer	Permits issued by Planning upon satisfactory completion of requirements		Zoning Enforcement Officer	
General Provisions	Provisions listed for floodways, floodplains, other permitted uses, structures, storage; flood hazard reduction and specific standards	Provisions set forth for site plan, unnumbered A Zones, numbered A Zones with base flood elevations (A1-30/AE), floodways		Listed for flood hazard reduction, enforcement and miscellaneous	

Table E-3. Continued.

	Brookfield	Danbury	New Fairfield	New Milford	Sherman
Specifics: Flood Carrying Capacity		Any relocation or alteration to a watercourse shall maintain the carrying capacity of such watercourse		In any portion of a watercourse which is altered or relocated the flood carrying capacity shall be maintained	
Specifics: Lowest Floors at or above base flood level		Standard for most construction		Standard for most construction	
Specifics: Floodways		No encroachments without certification by a registered professional engineer … no increase in flood levels during a base flood discharge		No encroachments without certification by a registered professional engineer … no increase in flood levels during a base flood discharge	

5. Soil Erosion and Sedimentation Standards

Perhaps no risk factor merits more attention than soil erosion and sediment control standards and enforcement. Sediment is considered the single largest nonpoint source pollutant impacting water resources. Doenges et al. (1993) reported erosion as the single greatest cause of eutrophication in the State, and in conjunction with the impacts of sedimentation, the most commonly reported problem in reservoirs.

Lake bottom sedimentation is the obvious impact from upland soil erosion. The deposition of terrestrial sediments at the bottoms of lakes, ponds and watercourses accelerates the lake's succession or filling-in process. Larger littoral or shallow areas are created and provide suitable conditions for submergent and emergent aquatic plant species to proliferate and potentially impact recreational uses.

Less obvious, sediment also transports other pollutants by means of adsorptions. This chemical process results in temporary attachments by pollutants, including nutrients, trace metals and other toxic substances (LRPC, 1994) to soil particles. Once in the aquatic system, these pollutants increase eutrophication, increase toxicity levels, and accumulate in the tissues of the fauna and flora all while the sediments are slowly filling in the lake and reducing the spawning habitat for a number of fish populations. In summary, much of the ecological balance of the entire aquatic ecosystem is negatively impacted by soil erosion and sedimentation.

Another lesser-recognized impact of soil erosion is the reduction in the terrestrial landscape's capability to support vegetation. As soils from uplands erode and become the sediments of the lake, the fertility of the uplands is also being lost to the lake. Lost soils and soil fertility will often be replaced with unstable topsoil and highly unwanted fertilizers and pesticides.

Like eutrophication, soil erosion is a natural process resulting from natural phenomenon like wind and rain. Many factors determine the erodibility of soils including its type and composition, the vegetation cover of the area, and existing or graded topography. The duration, frequency, and intensity of rainfall in an area also play a role. Combined with the percent and length of slope of the natural or finished topography these factors determine the velocity of stormwater runoff during a rain event.

Also like eutrophication, natural soil erosion is greatly accelerated by cultural land use practices. Human activities such as land clearing, building construction, mining, and construction of roads removes vegetation, exposes soil and smoothes the land surface. These changes in landscape result in changes in the hydrology and hydraulic nature of the land as pervious surfaces are replaced with impervious or less pervious surfaces. Increases in the volume and velocity of

stormwater in an area occur, which accelerated rates of erosion and sediment transport downstream. Erosion occurs not only on the surfaces modified by development, but also in the adjacent downslope areas, where stormwater is running to, and on the banks of the stream channels, themselves.

Because there exists such a strong market for housing and economic development in this area, erosion and sedimentation are one of the biggest threats to Candlewood and neighboring lakes, ponds and watercourses. New developments are rarer but still fairly common in the area. Rebuilds and additions to homes are becoming visible almost everywhere as new developments, particularly by the Lake, become scarce. Both new development and activities at pre-existing sites result in soil erosion and sedimentation since they increase impervious surfaces and gradually decrease groundwater recharge areas.

Non-constructions activities can also create considerable soil erosion and should be considered a potential source of nonpoint source pollution. Examples include landscaping, pools, patios and decks. As such, erosion controls should be a concern and responsibility of the owner of record and contractors during construction and the homeowner occupying the site afterwards.

A dramatic example of soil erosion and sedimentation can be witnessed at the mouth of the Saw Mill Brook in Sherman after most sizable rainfall events. At those times, sediment laden, chocolate brown waters can be observed flowing into Candlewood Lake with a plume extending into the lake for nearly a mile. Costly diagnostic feasibility studies have listed costly sedimentation basins and the dredging of Allen's Cove as potential restoration methods. Erosion of stream channel banks have been implicated.

The timing of the recent decline in Candlewood's health and the timing of the sedimentation problem occurring via the Sawmill Brook are more than coincidental. They provide a sobering message that land use problems and nonpoint source pollution are a serious threat to natural resources and emanate from all areas, even small New England towns like Sherman.

Communities are required to regulate and minimize impacts from soil erosion and sedimentation associated with construction activities. Measures such as silt fencing can minimize environmental impacts if correctly installed. But physical soil erosion controls are not enough. Permanent alteration in the landscape resulting from the construction activities also yields a permanent net increase in stormwater runoff. Therefore, controls must be supplemental to more preventative measures.

Because of the magnitude of the environmental impact from soil erosion, more than just the local regulatory agency approval is often required. Projects should also be consistent with Connecticut Guidelines for Soil Erosion and Sediment Control Handbook (CT DEP 1985, 1988), and are required to be consistent with

the US EPA's Stormwater Phase 1 and Phase 2 Guidelines, as well as the US Army Corp of Engineers requirements, if necessary. The Owner of Record for the project is, in all cases, the applicant for permits and is totally responsible to meet all of the above permitting responsibilities.

The use of the Connecticut Guidelines for Soil Erosion and Sediment Control (CGSESC) published in 1985, revised in 1988, and amended in 1995 and 1998, as a standard for the review process, was observed in the regulations of some of the communities around Candlewood. A more current edition of CGSESC is due to be released in the spring of 2002. It is recommended that the Candlewood municipalities include in their compliance requirements and permit process the most recent version of this important document upon publication. It is recommended that special attention be given to Chapter 4 of the new guidelines focusing on phasing, sequence and methods for building sites, roads and utility installations. By doing so, land disturbance can be minimized during each phase and sequence with each day of an earth moving activity.

State Standards

Municipalities are authorized by C.G.S § 22a-329 to require erosion and sediment control plans for development applications where the disturbed area is greater than one-half acre, with the exception of one single family house. Tondro (1992) suggests that the statute is "ambitious" but "treated more as a consciousness-raising exercise than obligatory regulations." The statute technically exempts numerous projects around the lake and in lake communities where disturbances may be one-half acre or less. This clearly poses an environmental threat to the lake. The cumulative soil erosion impacts from numerous small-scale projects is no less a threat than the impacts from a few large-scale projects.

Brookfield's Soil Erosion and Sediment Control Standards

In Brookfield, language providing for soil erosion and sedimentation control plans was found in various earth moving-related sections of the zoning regulations, and was requirement of the design review process.

Brookfield provides zoning language under "General Provisions Applicable in all Districts." There, a soil erosion and sedimentation control plan, as well as a map with soil-type classification boundaries, is listed as a data requirement for design review approval and as an environmental approval consideration. Erosion and sediment control measures are also to be located on a map and discussed in an application for a permit to remove natural resources (§242-302) and for woodcutting, lumbering and forestry operations (§ 242-304)." Soil erosion and sedimentation control plans were not discussed in the section entitled "Excavation, Fill and Grading." Brookfield also has in Article VI, Land Use Standards and Design Criteria, a section on erosion and sedimentation controls.

Brookfield has recently improved compliance with erosion and sedimentation controls, as well as excavation, fill and grading standards in areas of Brookfield closest to the lake. This was accomplished by providing the Zoning Enforcement Officer the authority to use his discretion in determining if all conditions of the regulations are fulfilled or if further measures need to be taken. Other measures Brookfield is investigating include authorizing the Zoning Commission to require the posting of a bond in an amount in accordance with Section 242-705 of their regulations.

Brookfield also recently improved land use standards and design criteria by applying them to all new or modified development projects, rather than apply to all commercial, industrial, multifamily or other permitted uses. The standards and criteria shall be uniformly applied to all applications for Zoning Approval, a Certificate of Zoning Compliance or a Design Review Approval.

Danbury's Soil Erosion and Sediment Control Standards

Of the three municipalities with specific erosion and sedimentation control sections in the Zoning regulations (Danbury, New Milford and Sherman), only Danbury had language describing the purpose of these controls that included preventing silt deposits in lakes and streams. Language regarding permit requirements is strong, prohibiting "any grading, stripping, excavating or filling or undertaking any earth change unless a valid grading permit is received from the Environmental Inspector with exceptions. These exceptions, including agricultural use, disturbance not exceeding ½ acre, and alterations and additions where disturbed area will not exceed 5,000 square feet, are a risk to water quality. Those disturbances have the potential to be substantial and should necessitate soil erosion and sediment controls, particularly near the Lake and tributaries.

When required, site plan requirements are comprehensive, and include a timing schedule indicating construction sequence, time of year of construction and estimated quantities of excavation and fill required. Performance bonding may be used to insure compliance and circumstances pertaining to Cease and Desist Orders are clearly spelled out.

A Restriction and Specification Section is comprehensive but could benefit by incorporating specifications from the most recent version of CGSESC.

New Fairfield's Soil Erosion and Sediment Control Standards

New Fairfield does not have a stand alone Soil Erosion and Sediment Control Ordinance within their zoning regulations. New Fairfield provides some language in Section 2.10, Excavation, Removal, Filling and Grading of Earth Material. There one of the purposes of the regulation is listed as "*minimizing any unnecessary accelerated erosion and sedimentation.*" General requirements here prohibit excavation or removal of earth materials or grading of land except as provided by and in compliance with this section. Removal of materials is also prohibited with exceptions.

A number of exceptions are provided, which in close proximities to the Lake, are risks. For example, "*excavation or filling of earth materials in connection with and clearly incidental to construction or alteration*" still creates soil erosion that will bring pollutants and sediments to waterbodies. Many of the exceptions are qualified by having obtained approvals elsewhere including erosion and sedimentation control plan approval as part of the subdivision approval or Special Permit.

Standard data requirements were listed for Special Permit applications. Not listed was a timing schedule indicating construction sequence. The Commission may impose time limitations, as well as performance and/or maintenance bonding.

New Milford's Soil Erosion and Sediment Control Standards

New Milford has a comprehensive, stand alone Soil Erosion and Sediment Control Ordinance within their zoning regulations. However, within its Purpose Section lies the watershed-wide risk of limiting these standards to developments cumulatively over a ½ acre with the exception of a single-family dwelling.

Requirements for erosion and sediment control plans are comprehensive and specify that CGSESC (1985) be used for methods and practices necessary for certification. This should be updated to CGSESC (2001). A scheduling and sequencing narrative, as well as a map, is a progressive requirement. Requirements for design criteria, construction detail, installation/application procedures and operation and maintenance programs are also clearly provided and strengthen the plan.

New Milford's regulations also provide for additional requirements, if necessary, including performance bonding and progress reports from the permittee. With the exception of the standard exemptions from requiring approval, the New Milford Plan is exemplary.

Sherman's Soil Erosion and Sediment Control Standards

Sherman does have a comprehensive and stand alone Soil Erosion and Sediment Control Regulations for Land Development attached at the end of their Zoning regulations. No purpose or intent section was provided.

As is the case elsewhere, activities requiring a certified erosion and sediment control plan do not include subdivisions, or any other permitted uses, where disturbance is cumulatively ½ acre or less or single family dwellings not part of a subdivision. However, plans shall can be required by the Planning and Zoning, Commission, Inland Wetlands and Water Courses Commission or Sherman Department of Health. These requirements shall be made only following a finding of either *a) the existence of a condition of accelerated erosion on such parcel of land, or b) the likelihood that a proposed activity on such parcel of land*

will lead to a condition of accelerated erosion. This provides an element of local regulatory discretion in establishing what activities should provide preventative erosion and sedimentation measures.

When required, plans "*shall contain proper provisions to adequately control accelerated erosion and sedimentation and to reduce the danger from storm water runoff on the proposed site*." CGSESC (1985) is listed as the source for principles, methods and practices necessary for certification. This should be amended to the most recent version of the CGSESC. Site plan requirements include a narrative describing start and completion dates, sequencing for grading and construction activities, design criteria, construction details, installation and/or application procedures, and operation and maintenance programs.

The site plan map is required to provide standard site plan data. A map data requirement found elsewhere near the Lake, but not in Sherman, is the sequence of grading and construction activities. Although it is required in a narrative form, its visual provision as a map or series of maps provides for more detail and accountability.

The Sherman language lists as a condition of approval letters of credit or savings passbooks with two signed withdrawal forms in the amount equal to 100% of the estimated cost of compliance. Inspections are also provided for in the regulations, as are the conditions for cease and desist orders.

6: Septic Tank Cleaning and Inspections

On-site sewage disposal or septic systems are by far the primary means of treating human waste and wastewater in the Candlewood Lake watershed. The only area within the approximately 26,000-acre watershed that is connected to municipal sewers is a small section of Danbury running along a small watercourse that drains into the lake. The reason behind this connection to Danbury's municipal sewer system was because on-site septic systems had been failing at a rapid rate, polluting Candlewood Lake, and resulted in the closing of the Danbury Town Beach during most of the summer in 1992.

On-site septic systems provide communities cost and ecologically effective means of treating or "recycling" human waste and wastewater. However, they can and do incur failures. Failing septic systems are considered a primary source of non-point source pollution to lakes, other watercourses, groundwater and wells. Impacts on lakes from septic derived pollutants have been quantified (e.g., Dillon et al., 1994); are recognized as having damaged important inland water resources (e.g., LRPC, 1994); and therefore, are still a threat to the Lake's water quality. Pollutants from failing systems include nutrients (nitrogen and phosphorus), pathogens (disease-causing bacteria, viruses and parasites), and household chemicals, many of which are carcinogenic. Septic pollutants are a detriment to the environment, to human health and to existing and potential public water supplies.

The closing of the Danbury Town Beach in 1992 was a public safety response by Danbury's Department of Health and Environmental Services to the high bacteria levels at the Town Beach. Bacterial monitoring of public swimming areas was and still is conducted regularly by each municipality within their beach area and also by the CLA beyond swim areas at the beaches and other locations on the Lake. Bacterial levels have been known to exceed the state minimum safety requirements from time to time.

The failure rate or efficiency of a septic system largely depends upon four issues: design, installation, operation and maintenance. Design and installation are considerations during the construction of a home and must follow certain standards within each municipality. Conversions from seasonal to year-round use, as well as expansions of existing construction puts increased burdens on existing systems and should also be addressed in regulations. The size of the septic system and/or size of leaching fields may require change if home usage changes. This trend of converting from seasonal to year-round use has and continues to characterize much of the development around the Lake. Additions and alterations to existing construction and the pressures they place upon communities and the environment are quickly becoming a major concern in the tri-state area (Foderaro, 2001).

Septic systems operate by removing solid waste and containing it in a tank and funneling the wastewater out to a leaching field were natural processes in the soils remove pollutants before the water leaves the system. Limitations on the disposal of septic effluent are due to soil permeability; the depth to a water table, a compact layer or bedrock; slope; the degree of stoniness; the number of rock outcrops; and frequency of flooding. The CT DEP (1983) characterized the majority of soils within the Lake's watershed as severely limited for on-site sewage disposal systems, with many of these areas immediately adjacent to the lakeshore and already extensively developed.

The degree of the impact from failing septic systems on Candlewood's and the public's health has never been fully determined. Likewise, the contribution from failing septic systems to the nutrient budget of the Lake and cultural eutrophication is largely unknown although it has been estimated in other lakes (Dillon, et al., 1994). However, the 1992 incident at the Danbury Town Beach, regular bacteria monitoring at town beaches and elsewhere and septic inspection data (discussed below) points to a need for stronger municipal language in local regulations to minimize the effects of failing systems.

Two of the municipalities surrounding Candlewood have incorporated into their regulations a sewer avoidance ordinance. The goals of sewer avoidance programs are to reduce the number of failing septic systems and the length in which they go uncorrected. This type of program is common in Connecticut since it has the potential to save communities the enormous expenses associated with installing and operating municipal sewers. Most programs incorporate regularly scheduled on-site inspections where staff from the health and sanitation departments visually inspects the areas above the leaching fields, looking for visible signs of failure. Table E-4 provides data from a number of Connecticut towns with inspection programs.

Evaluation of the data in Table E-4 requires some special considerations. Brookfield and New Fairfield use a two to four year cycle to complete examinations for all septic fields in the town. Seasonal differences in rate of failure may be related to spring precipitation levels or the particular area of the town where most of the exams are conducted that year (e.g., old home vs. new homes). A more statistically accurate way of characterizing the rate failure may be to analyze failures within a given cycle. Based on data from the Department of Health in New Fairfield, failure rates for the first (May 1991 to July 1994), second (August 1994 to July 1996) and third cycle of the program (August 1996 to July 97) were 2.8, 2.6 and 2.2%, respectively.

There are an estimated 8,000 homes in the watershed of Candlewood Lake and an untold number of municipal and commercial buildings with septic systems. Using an average failure rate based on the three New Fairfield inspection cycles and an assumption that conditions such as soil type, depth to bedrock, and

slope, are similar to those observed in New Fairfield, the number of septic systems polluting the watershed and ultimately the Lake is approximately 200.

Table E-4. Number of inspections and failures detected from four Connecticut Towns including New Fairfield and Brookfield.

Municipality	Year(s)	No. of Inspections	No. of failures detected	%
Torrington	1979 – 1990	116	20	17.2
New Hartford	1979 – 1990	2,662	232	8.7
Brookfield	1998	2825	N/A	N/A
	1999	362	16	2.5
	2000	944	9	1.0
New Fairfield	1991	809	19	2.4
	1992	1927	78	4.1
	1993	615	16	2.6
	1994	2791	58	2.1
	1995	1933	92	4.8
	1996	2380	39	1.6
	1997	2095	58	2.8
	1998	1853	50	2.7
	1999	2081	25	1.2
	2000	1772	54	3.1

The impact of 200 hypothetically failing systems will depend greatly on how badly the system is failing and possibly how far that system is from a watercourse. This looming risk is clearly a cause for great concern; speaks volumes to the current and historical water quality of the lake; substantiates the need for monitoring water quality and bacteria levels lake wide; and necessitates that our communities are adhering to the strictest standards for septic system maintenance and inspection requirements.

Municipal Standards
Of the five Candlewood Lake municipalities, only New Milford does not have standards regarding on-site septic systems beyond those listed in the Public Health Code for the State of Connecticut. Brookfield and New Fairfield have an On-site Sewage Disposal System or Septic Management Ordinances. Sherman has a Sanitary Code. Danbury's septic standards are located in their Public Health Ordinance. Of the four, only New Fairfield and Brookfield's regulations include regularly scheduled septic system inspections and pump-outs.

Brookfield's Septic Standards
Brookfield's standards are found in their On-Site Sewage Disposal System Ordinance and include regularly scheduled septic system inspections and pump-outs. In Brookfield, owners or occupants of residential dwellings shall have the septic tank inspected and pumped by a licensed septic tank pumper as a condition of the renewal of operating permits, which are valid for a period of four years. Field inspections are also a condition of permit renewal in Brookfield. Noteworthy is the fact that these requirements apply only to residential properties and that the scope of Brookfield's ordinance does not include commercial property. Septic Management / Sewer Avoidance in New Fairfield, discussed below, applies to residential and commercial buildings.

Design, construction and operation standards are also addressed to various degrees in the local regulations. Brookfield relies heavily on the Public Health Code of Connecticut.

Danbury's Septic Standard
Contained within Chapter 9, Health and Sanitation, of Danbury's Public Health Ordinance is language regarding septic tank notices, discharge permits and test hole requirements. There is also a permit process for subsurface sewage disposal systems. Plans submitted for approval *"shall be based upon a plan prepared by a professional engineer."* Danbury's Septic Code standards do not include language on cleaning, pump-out, or inspection programs.

In addition to the Septic Code, Danbury addresses septic installations in the Public Water Supply Watershed Protection Zones in Zoning regulations. Section 7.C.3 c(2) states that *where individual sewage disposal systems are proposed, the design and installation of such systems shall be in accordance with Health Department regulations and shall use seepage rates which do not exceed that of soils existing on the site prior to the deposition of any fill. Seepage rates of fill sections shall not be used in the system design, unless the system is approved by the Department of Environmental Protection and the Health and Housing Department.* Later in Section 7.C.4. a(2), provisions for environmental analysis requirements are provided with one option being *a map illustrating the soils units between the proposed leachfield and the nearest downgradient watercourse.* Results from this map may necessitate other environmental analysis including a *seepage analysis, using on-site soil permeability data.*

New Fairfield's Septic Standard

New Fairfield's Sanitary Code is the most comprehensive and generally goes the farthest in providing protections to public health and the environment from septic systems. New Fairfield regulations include regularly scheduled septic system inspections and pump-outs. Table E-5 compares components found in New Fairfield's Sanitary Code that pertain to septic systems to those in other communities with Sanitary Codes or On-site Sewage Disposal System Ordinances.

In New Fairfield's Sanitary Code, Section 4.3, it states that septic tanks shall be cleaned and inspected not less frequently than every three years by a licensed subsurface sewage disposal system cleaner. Some exceptions do exist. Additionally, the Management / Sewer Avoidance section states that, "*Properties shall be subject to inspection no less than once every three years*."

Of particular importance is the language specifically addressing conversion or alterations of seasonal to year-round buildings. Due to the decline of availability of undeveloped lots, alterations of existing buildings and conversions from seasonal to year round are a considerable component of land use changes around Candlewood Lake.

New Milford's Septic Standards

New Milford does not have any specific local standard for septic systems and relies solely on the Public Health Code for the State of Connecticut for its powers and authorities in this area of community and environmental health.

Shermans Septic Standards

Sherman's standards are set forth in their Sanitary Code. There a number of design and construction criteria are provided, including those for areas of special concern. Other language addressed garbage grinders associated with septic systems, soil testing and the use of fill. There was no language, however, addressing cleaning, pump-out, or inspection programs.

The strictest slope requirement was found in Sherman where leaching systems are not permitted on slopes greater than 20 percent. Sherman additionally requires that for leaching systems placed on slopes greater than 10%, a minimum of 66 inches of original soil shall be required for construction.

Table E-5. Comparison of components in sanitary or on-site septic regulations in the five communities surrounding Candlewood Lake

Component	DB	NM	NF	BR	SH
Inclusion of State's Public Health Code	X	X	X	X	X
Inclusion of additional Standards [1]			X		
Health Director approval for sanitation facilities for structures or improvements			X	X	X
Language specifically addressing seasonal conversions or alterations to year round buildings			X		
Language for buildings that reduce lot area availability for subsurface sewage disposal			X		
Conditions for septic modifications or requirements based on additions of living spaces			X		
Language addressing repairs			X		
Language addressing accessibility of scavenger vehicles			X		
Language addressing accessibility of manholes over the clean out hole			X		
Requirement of regular cleaning and inspection of septic tank by a licensed subsurface sewage disposal system cleaner (with exceptions)			3 years	4 years	
Defined Heath Department authorities and actions if a property is in violation			X	X	
Prohibitions of garbage disposal grinders			X		X
Minimum separating distance of 75 feet from the top of a bank of a watercourse (includes Candlewood?)			X		
Minimum separating distance of 50 feet from wetlands			X		
Setback for previously approved lots (50 and 25 feet for watercourses and wetlands, respectively)			X		
Requirements for testing, approval and construction of all systems including special concern designs			X		X
Certification of new construction by professional engineer to include septic system			X		
Minimum separation distance of 30 inches between high groundwater and/or hardpan and the bottom of the leaching structure			X		X[2]
Specification for systems built on hillsides or slopes >25% to be notched in a minimum of 6 inches into original soil			X		

Table E-5. Continued

Component	DB	NM	NF	BR	SH
Conditions where Health Director can require additional studies including areas exceeding 25% slope or location of system <100 feet up-gradient of a watercourse			X		
Prohibition of new system construction on slopes greater than a set percentage			40%		20%
Conditions for other hydrological modifications to the property including potential relocation of drainage fields; discharge beyond 25 feet; and final grading, seeding and other structures			X		
Requirements for absorption areas			X		
Conditions for deep hole percolation tests			X		X
Prohibition of system siting based on percolation rates are			X[3]		X[3]
Conditions pertaining to curtain drains			X		X
Conditions pertaining to the use of fill			X		X
Administrative guidelines			X		
Language specifically addressing septic management and sewer avoidance programs			X		
Requirement of physical inspections of property			X[4]	X[4]	
Specifics provisions for properties found in compliance and those not in compliance			X		

[1] Includes Technical Standards for Subsurface Sewage Disposal Systems, and Parts 1 and 2 of the Design of Subsurface Sewage Disposal Systems for Household and Small Commercial Buildings, for the State of Connecticut.
[2] Sixty-six inches required in Sherman when slope is > 10%.
[3] In New Fairfield, when rate < 1 inch in 40 minutes; in Sherman, when rate is < 1 inch in 40 minutes for lots pre-existing August 29, 1979 and < 1 inch in 30 minutes after August 29, 1979.
[4] Every 4 years in Brookfield; every 3 years in New Fairfield.

7. Stormwater Management and Impervious Surface Standards in Zoning Regulations

There are several possible fates for stormwater once it has fallen on land. Terrestrial fauna and flora will utilize some of it; some will evaporate back into the atmosphere; and some will infiltrate into the soil and the surficial materials below to recharge groundwater supplies. The remaining stormwater is going to flow over the surface of the land as surface runoff. The stormwater runoff will flow from higher to lower elevations in the watershed before reaching natural containment areas like wetlands, pond, lakes and other waterbodies.

While not a pollutant itself, stormwater is a key component in the nonpoint source pollution of lakes. Pollutants such as fertilizers, pesticides, sediments, salts, oil, litter and other debris are generally transported from their points of origin into watercourses by stormwater runoff. Elevated levels of stormwater can also raise the water table in the ground and cause effluent from older septic leaching systems to break the surface before adequate treatment. Once above ground, the inadequately treated effluent and associated pollutants (see Risk Factor 6) will be transported by surface flow of stormwater to receiving waterbodies.

Historically, communities have attempted to mitigate the impacts of increased stormwater runoff levels by collecting, concentrating and conveying it through road ditches, storm sewers, and other drainage measures. These measures result in an increase in the speed at which the runoff moves, and a decrease in the time it takes for the runoff to move through the watershed. Higher peak discharges (or maximum rate of flow during a storm) are a result of increased runoff speed and reduced runoff time.

The greater peak discharge rate, coupled with the increased volume, accelerates the erosion of stream channels (LRPC, 1994) bringing additional unwanted sediments to catchments. A recent diagnostic feasibility study submitted to the CLA (Land-Tech., 2001) describes erosion in the Saw Mill Brook stream channel, which has led to the undesirable accelerated sedimentation of Allen's Cove in the Sherman arm of Candlewood Lake.

Impervious surfaces are land surfaces that inhibit or prevent the infiltration of stormwater into the ground. Examples include rooftops, streets, sidewalks and paved parking lots. The amount of impervious surface in an area has a profound impact on the volume of stormwater runoff generated in that area. As the percentage of impervious surfaces increases, so too does the volume of the stormwater surface runoff since less stormwater will infiltrate into the ground and recharge groundwater resources in an area. Additionally, an increase in impervious surfaces will accelerate the transport of nitrogen that is dissolved in precipitation and deposited on the watershed to surface waters. This occurs because increase in impervious surfaces eliminates the soil and vegetative cover that would normally absorb the nitrogen from precipitation washout and prevent it from reaching the surface water.

The relationship between impervious surface in a watershed and water quality in receiving waterbodies is well documented. Prisloe et al. (2000) used GIS technology to model the impacts on water quality in Connecticut resulting from impervious surfaces. A similar study looked at general land use patterns (residential/commercial, agriculture or forest) in 23 lake watersheds in Connecticut and their impact on water quality (Siver et al., 1999).

Common to these types of studies is the premise that cultural activities generating more impervious surfaces are generally associated with activities that generate more nonpoint source pollutants (e.g., earthmoving and construction, use of fertilizers and pesticides, release of other toxic substances, etc.). The increased volume of stormwater and higher peak discharge rates, both resulting from more impervious surfaces, expedites the transport of the nonpoint source pollutants. Both phosphorus and nitrogen exports to water resources in an area are known to increase as the percentage of impervious surface increases in that area (CWP, 1998).

Ultimately, the elevated loads of nonpoint source pollutants cause the degradation of water quality including accelerated eutrophication and sedimentation. However, it is important to note that increased stormwater runoff and impervious surfaces can impact communities in ways not necessarily associated with water quality degradation. As mentioned earlier, greater amounts of impervious surface cover reduces groundwater recharge areas, thus impacting public water supply resources. Greater peak discharge coupled with greater volumes of stormwater runoff also increases the potential of flooding in an area.

The severity of impacts from stormwater has recently propelled the Environmental Protection Agency (EPA) to enhance federal measures for protecting water resources. In 1999, EPA announced Storm Water Phase II Final Rule, which upgraded the original 1990 Phase I. Phase II requires municipalities to develop stormwater management programs that include the following measures:

1. *Public Education and Outreach*
2. *Public Participation / Involvement*
3. *Illicit Discharge Detection and Elimination*
4. *Construction Site Runoff Control*
5. *Post-construction Runoff Control*
6. *Pollution Prevention / Good Housekeeping*

All measures will cause municipalities in Candlewood Lake's watershed to change their behaviors with respect to stormwater management (see www.epa.gov/owm/sw/phase2/factshts.htm). For example, Measure #4 will require "*construction activities that result in a land disturbance of greater than or*

equal to one acre" to obtain a permit. This is more stringent than the Phase I requirement of permits for areas of disturbance of five or more acres.

Measure #6 covers areas undergoing new and redevelopment and calls for planning and design practices to minimize impacts from stormwater. Best management practices that are encouraged to satisfy this measure include:

- Guiding or restricting growth in certain areas through Plans of Conservation, Watershed Management Plans and regulations that support these planning exercise.
- Utilizing buffers, riparian zone preservation, minimization of disturbance and imperviousness and maximization of open space.
- Infiltration practices like infiltration basins/trenches, dry wells, and porous pavement.
- Vegetative practices including grassy swales, filter strips, artificial wetlands, and rain gardens.

Mindful of EPA and CT DEP's promulgation of these measures to improve the health of our nation's water resources, the Committee advocates the incorporation of the suggested management practices where feasible.

It should be noted that advanced contemporary treatment technologies exist that effectively remove stormwater pollutants from developed areas. This, along with monitoring and maintenance provisions, can greatly ameliorate the loading of stormwater pollutants if properly enforced. For example, a standard practice for large developments in Danbury that are approved for construction in wetland areas, is to stipulate the following measures as conditions of approval:

1. Required stormwater treatment technology that meet performance standards of 80% or greater (based upon peer review studies);
2. Require additional treatment technologies to be proposed as a "contingency" (analogous to the septic requirement of having a "reserve area");
3. Require the owner of record to institute a 2-3 year monitoring of stormwater during major precipitation events from at least seven storms;
4. Analyze the results of the entire record of the monitoring period to determine if the actual pollutant removal met the performance standard;
5. Require the installation of the additional contingency measures, if these standards were not met in the monitoring period.

Site Plan Review

A common component of zoning and subdivision regulations is the site plan review process. An initial step in the process is for applicants to provide site plan design and other data as part of their permit application. The local land use commission and enforcement officer reviews the components of site plans.

Requirements should, but do not always adequately address stormwater management.

Language in the site plan requirements of the five Candlewood municipalities varies in its emphasis in managing and minimizing increased stormwater runoff (Table E-6). Danbury's zoning regulations provided the most detailed language regarding stormwater management requirements in the site plan approval process.

An innovative site plan review requirement found only in the Danbury zoning regulations was a construction limit line, identifying all areas to remained undisturbed and in their natural state in a lot. This requirement aids in reducing the effects of stormwater runoff by maintaining natural ground cover that serves as both an infiltration area and as a filter for runoff.

Table E-6. Inclusions of a stormwater management language in the site plan review and/or subdivision regulations.

Municipality	Contents of Zoning Regulations
Brookfield	Nothing required in data for design review of residential development; when building development is >50% of the lot, the application must indicate methods of onsite water resource generation and "shall utilize proven pollution control to avoid contamination of the Town's water resources…" For major shopping centers an environmental impact study is required in the design review application.
Danbury	Site Plan Contents include, "provisions for storm drainage, including catch basins, retention ponds, detention ponds, drywells, energy dissipaters, manholes, culverts, and similar facilities" as well as "proposed drainage rights." A separate Stormwater Drainage section provides greater detail for provisions for a management plan including the use of a State licensed engineer, sealed certification, and certified record drawings. Site plan approval of projects yielding one or more acres of impervious surface require still more specifications and illustrations.
New Fairfield	Nothing noted in Site Plan requirements. "Proposed drainage plans and details" required in site plans in applications for special permits.
New Milford	"Storm drainage… shall be adequate for the proposed development. All storm drainage proposals shall be reviewed by the New Milford Department of Public Works prior to application."
Sherman	Zoning commission may require on the site plan map location, size and design of storm drainage.

Site plan review requirements can be written to reduce water quality impacts associated with stormwater runoff and other aspects of nonpoint source pollution such as soil erosion and sediment control. The importance of adequate site plan review to environmental assets prompted the New Hampshire Office of State

Planning to create a set of guidelines for municipalities (NHOSP, 1999). These guidelines may prove useful in a review of local requirements. Recommendations and a discussion of local site plan review requirements have been provided in a Memorandum by Jack Deering, Consultant to HVCEO, and in the NEMO Project's "Technical Paper #1", provided in Appendix 3 and 4, respectively.

General Provisions

Some municipalities address activities such as excavation, removal, filling and grading of earth material separately in the general provisions of zoning regulations. Consideration of stormwater management varies in the provisions (Table E-7). These regulations act as additional protections since many of the activities are components of residential development. Activities such as mining or quarrying also fall under these kinds of regulations. Nonetheless, any applicant involved in a significant earthmoving activity should be responsible for appropriate stormwater management as required by local ordinance.

Table E-7. Stormwater management plans for earth moving operations.

Municipality	Contents of Zoning Regulations
Brookfield	Existing and proposed drainage on map submitted for an excavation permit. "Altered drainage flows" were mentioned as a consideration of the Commission in regards to excavation, filling and grading.
Danbury	Danbury does not specifically address earth moving operations in their Zoning Regulations.
New Fairfield	Nothing specific to stormwater management in earth moving operations found in Zoning Regulations.
New Milford	Contents of Erosion and Sediment Control Plans include design criteria, installation and/or application procedures, and operation and maintenance programs for stormwater management facilities. Location and design details are required on the site plan map.
Sherman	Nothing specifically addressing stormwater in Earth Moving Operations in Zoning regulations but defers to SESC Regulations for Land Development. There, as part of the contents of the Erosion and Sediment Control Plan, is design criteria for storm water management facilities.

Maximum Building Coverage

Maximum building coverage essentially defines the extent of the building structures and boundaries of most, but not all, of the impervious surface on a lot. Ideally, both maximum building coverage and total impervious surface in a lot should be regulated to ensure minimum impact from stormwater runoff.

New Milford did not have a maximum lot coverage standard in their zoning regulations. In the zoning regulations of the other four municipalities, maximum

building coverage in residential zoning districts in the watershed ranged from 10 to 30%, dependant upon the type of zoning (Table E-8). Typically, smaller lots had greater maximum allowable building areas. As discussed in previous sections, smaller lot size characterizes the areas closest to the lake with larger lots further away from the Lake. This means that higher percentages of impervious surfaces per lot are found closest to the lake.

Table E-8. Maximum building of the zoning districts within the Candlewood watershed.

Municipality	Contents of Zoning Regulations
Brookfield	10% in all residential zones with the exception of R-7 where it is 25%. For industrial, commercial or other districts, total allowable imperious of 75%.
Danbury	RA-8 is 30%; RA-20 is 20%; RA-40 and 80 is 15%; RR-10 is 25%; CN-20 is 33.3%. A Site Plan requirement of a "construction limit line, identifying all areas to remained undisturbed and in their natural state" was noted.
New Fairfield	R-88 is 15%; R-44 is 20%; BC is 25%; LI is 15% for building and structures and 65% for parking areas and drives; MF is 25% for building and structures and 50% parking areas and drives.
New Milford	"There is no maximum lot coverage" (pg. 20 of Zoning Regulations).
Sherman	Farm/Residence Zone and Residence Zone is 15%; Business/Residence Zone is 10%.

Commercial and other zones ranged from 25% to up past 75% of the lot for building coverage. New Fairfield provided maximums for building structures and for parking areas and drives in LI and MF zones, which collectively totaled or exceeded 75%.

Total Impervious Surfaces

In addition to maximum building coverage, total impervious cover in a lot should be included by definition to be "any ground cover where precipitation cannot be effectively absorbed before moving laterally as surface runoff. This may include roads, parking lots, patios, tennis courts, driveways, compact earth or pipe. Ideally, total impervious surface in a lot should be kept to a minimum to minimize increased stormwater runoff.

As reported in NEMO's Technical Paper 1, some communities have established impervious coverage limitations. However, care must be taken in the development of limits. Impervious surface limits are best used where:

- There is a firm relationship between the regulated area and an identified priority natural resource;
- The regulated area is well-defined (special overlay zone or watershed);
- Flexibility is built in to allow the developer to reach town goals through design considerations.

The adverse effects of imperviousness can be minimized by stopping the pollutant generator, reducing the size of impervious coverage, or replacing impervious coverage with more porous surfaces and draining off runoff from impervious to open areas.

Minimum Lot Size

A natural but often controversial progression of the maximum building coverage discussion is minimum lot size. In 2001, the Town of New Milford attempted to increase minimum lot size from two to four acres in undeveloped areas around Candlewood, namely the Candlewood Mountain area north of Vaughn's Neck. The proposal was highly contested by landowners and ultimately denied by the Zoning Commission. Vaughn's Neck, which lies south of Candlewood Mountain in New Fairfield, is currently one acre zoning.

The University of Connecticut Cooperative Extension System has conducted research investigating the relationship between lot size and percentage of impervious surface (Prisloe et al., 2000). Their data shows that smaller lot sizes contain greater areas of impervious surfaces (Figure 2). Based on these findings, it is recommended that where possible, undeveloped areas near the lake (e.g. Vaughn's Neck and Candlewood Mountain) be zoned at a minimum of two to three acres (see Appendix 5, NEMO Team Memorandum on Upzoning).

Other Considerations

Another approach to minimizing the impacts of stormwater runoff is to reduce the amounts of nonpoint source pollution available for transport. While essential for the winter driving safety, sand and salts can also become a source of nonpoint source pollution if not managed in an appropriate and timely fashion. Prioritization for the removal of winter sands from roads and cleaning of stormwater catchments along roadways in the spring should begin with critical watershed areas, particularly those closest to the waterbody.

However, this can be complicated in some of the private lake communities since many of their roads are private and not maintained by municipal facilities. Nonetheless, municipalities should instruct road maintenance authorities to develop policies that will minimize the amounts of sands that can be transported to the lake by early sweeping and maintenance of stormwater catchments in sensitive areas.

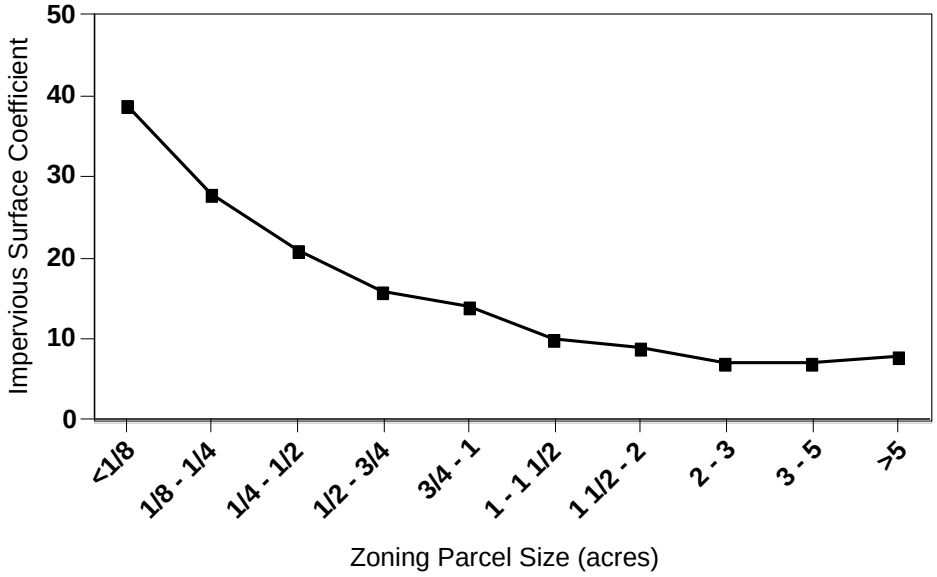

Figure 2. Impervious surface coefficients for zoning parcels in Connecticut. Coefficients were determined from analyses of land use – land cover GIS data, digital planimetric data, and parcel and zoning maps for four towns in Connecticut (from Prisloe et al., 2000)

8. Clear-cutting, Excavation and Grading Standards

The construction practices of lot clearing, excavation and grading clearly create exposures to the water quality. These practices, which in the past have occurred down on the water's edge, damage the natural systems ability to filter out pollutants from stormwater. The replacement of the natural riparian or buffer zone with turf lawn or even more impervious kinds of surfaces is a serious issue in need of addressing. The same holds true in floodplains where the change in surface type not only potentially increases nonpoint source pollution, it also reduces the storage capacity during storm events.

Forest practices regulations, such as those implemented in Newtown, CT, address another type of mass vegetation clearing. These kinds of regulations aim to preserve forested areas and regulate their cutting for a wide variety of reasons, including the improvement of water quality. The publication *Timber Harvesting and Water Quality in Connecticut: A Practical Guide for Protecting Water Quality While Harvesting Forest Products* (CT RC&D Forestry Committee, 1990) discusses the importance of forests to ground and surface waters, the impacts from forest harvesting on water quality, and best management procedures for logging and timber harvesting. Forest practices regulations in the communities surrounding Candlewood should be reviewed in the future for the risks they create to water quality.

Clearing, excavation and grading are common components of construction, subdivision and lot development and are closely associated with soil erosion, sedimentation and other risks linked with stormwater runoff. It is in this construction context that they are addressed here as a local regulatory risks. The Vermont Agency of Natural Resources (1990) described clearing and grading for building sites, roads and utilities as removing vegetation, exposing soils, smoothing land surface and compacting soils. The hydrological changes in an area resulting from those landscape alterations are increased runoff, which in turn increases erosion and soil loss, as well as sediment and other pollutant transport to lakes.

The native New England flora has as much or more to do with the development and preservation of our soils as does the geology of the inorganic parent materials of that soil. The vegetation provides the majority of the organic components of the soil and protects the organic – inorganic mixture from the forces of erosion. The removal of vegetation from a site exposes soils to extreme temperatures, wind and direct precipitation, the agents of erosion.

Soil type, slope or percent grade, and length of slope or grade are important factors determining the erodibility of soils. Slope length and percent grade influence the amount and rate of runoff, with increases in the former resulting in increases in the later. These geological features also contribute to the natural selection process that determines the vegetation community type thriving in an area. Once established, the vegetation provides protection from temperature,

wind and precipitation. In absence of a vegetated cover, the agents of erosion work in conjunction with the soil type, slope and length of slope resulting in erosion, soil loss and sedimentation of waterbodies.

Models

The Metropolitan Washington Council of Governments (MWCOG) provides an excellent resource for municipal clearing and grading strategies and model regulations. Their publication, *Clearing and Grading Strategies for Urban Watersheds* (Corish, 1995) used as its basis a national survey of jurisdictions with existing clearing and grading programs, most of which were found in the contents of local soil erosion and sedimentation control standards. Key recommendations based on their survey include the preservation of existing vegetation and sequencing and phasing of construction operations. Another is site fingerprinting, described by MWCOG as an increasingly recognized means of minimizing clearing and grading. It refers to the restriction of ground disturbance to areas where structures, roads and right of way will exist after construction is completed.

The MWCOG points out that the purpose behind clearing and grading standards is to prevent erosion and sedimentation and should not be construed with the purposes or results of physical soil erosion and sedimentation control devices, which act to minimize impacts. Soil erosion and sedimentation devices primarily control and contain erosion and sediment, rather than prevent it. Prevention is best attained if site clearing, excavation and grading are kept to a minimum. Clearing should be enough for the access road or drive and for working around the building site itself. Current practices often result in far more area cleared than necessary. Site grades should be as close to the natural topography as possible. Current practices occasionally include complete alteration of the slope particularly when bedrock is shallow. Grades should not be established until the conceptual view for the finished floor elevation for the building has been established.

The Maryland Department of Natural Resources suggested a limit of disturbance around a structure of five to ten feet outward from the building pad (CWP, 1998). CWP adds that this distance may need to be increased in areas where potential wildfires are a concern. Other concerns with this distance may arise from conflicts with OSHA standards for a “Clean and Safe Site.” A number of advisors to the Committee have described the five to ten feet limitation as impractical and have suggested distances of 20 to 30 feet. Whatever the distance, the principal benefit from minimizing disturbance is that, left intact, the surrounding vegetation acts as a soil erosion and sediment control device. This natural control device is considered a cost effective method of controlling erosion, flooding and managing stormwater runoff from nonpoint sources such as development sites, streets and parking lots.

A model ordinance for the Candlewood region should seek to minimize the loss of natural vegetation and natural topography and to protect specimen trees, significant forest types, and the most valuable wildlife habitat when developing a site. Incorporated into the ordinance should be the requirement of development by work zones with phasing, sequencing and methods clearly defined. Along with the description of the sequence and methods within each phase, soil erosion and sediment controls and measures for each phase should be listed. All of these issues need to be addressed and incorporated into the bonding and financing of the project. Defining phases within a work zone is a critical component of minimizing disturbance.

Regulatory Review

Text defining grading or some term related to earth disturbances was common to the zoning regulations of the five Candlewood municipalities. Danbury, New Milford and Sherman specifically define grading with language such as "stripping, excavation, filling or stockpiling". Other terms such as "earth change", "disturbed area", "earth disturbing activity" are described as "man-made changes to the natural cover or topography of the land." Although generally not noted with the terminology, inherent to all is the change in the topography, land cover and the hydraulic character of the lot, which lies at the center of most stormwater issues.

Important characteristics of local clearing and grading programs from the Corish (1995) survey were summarized by CWP (1998) and are listed in Table E-9. In addition to the individual characteristics, the percent occurrence from the national survey is provided, as well as the occurrence of the program feature in the Candlewood communities based on this research.

As stated earlier, clearing and grading standards existed in a community's regulations, more times than not, within the contents of a soil erosion and sediment control ordinance (Corish, 1995). The municipalities of Danbury, New Milford and Sherman have such ordinances that were developed beyond referencing the past editions of the Connecticut Guidelines for Soil Erosion and Sedimentation Control.

In addition to an applicable definition, all the Candlewood municipalities had mechanisms for establishing performance bonding and enforcement procedures, both considered important features in clearing and grading standards (Table E-9). The financial, bonding and enforcement issues are clearly critical features of an economically and environmentally successful project.

An important feature of all five community's site plan review requirements were mapping of the existing and proposed topography at two-foot contours, which provides a measure of the extent of grading to be performed. This information defines the percent grades and the length of grades on a project. Other local features potentially pertaining to clearing and grading practices are provided in Table E-10. The site plan review requirements are an early and critical

component to minimizing impacts to natural resources. Due to their importance, a memorandum and technical paper have been included in the Appendix section of this document that address requirements in site plans.

As noted earlier, exemptions from requiring Soil Erosion and Sediment Control plans do create risks. Exemptions from requiring grading permits also exist in local zoning regulations and increase risk. These included:

- Agricultural use of land (DB, SH)
- Minor land disturbing activities that include individual home landscaping and minor repairs and maintenance work not exceeding one-half acre (DB, NM).
- Preparation of one family dwelling sites that are not part of a subdivision plan approved by Planning (DB, NM, SH).
- Alterations or additions to existing structures where disturbed areas will not exceed 5,000, square feet (DB).

Table E-9. Characteristics of local clearing and grading programs with Erosion and Sediment Control Programs and how the five Candlewood communities compared against those characteristics (Adapted from CWP, 1998 and Corish, 1995)

Items	% Respondents from survey	BR	DB	NF	NM	SH
Existence of Soil Erosion and Sediment Control Programs[1]	88%		X		X	X
Specific clearing and grading requirements	77%					
Steep slope requirements	65%					
Established tree preservation requirements	65%					
Provisions for enforcing compliance during the construction phase	63%		X		X	X
Provisions for site inspection to confirm clearing/grading requirements prior to the start of construction	40%		X			
Provisions for bond or other measure of assurance before construction	40%		X		X	X
Regulations that specify percent of the site that can be cleared	17%					

[1] Brookfield and New Fairfield zoning regulations contain components of soil erosion and sedimentation control programs in provisions for *Natural Resource Removal* and/or *Excavation, Fill and Grading* sections.

Requirements for designations of natural areas to be protected are generally absent in the Candlewood communities with exceptions found in language from Brookfield and Danbury. In Danbury's site plan requirements, there is a construction limit line, identifying all areas to remained undisturbed and in their natural condition. In Brookfield, site plans require the mapping of existing trees and shrubs to be retained, proposed trees and shrubs to be located in the project, including type, name, height and caliper, and the precise location of the plantings. Location of existing trees greater than twelve-inch caliper is also to be identified. In either case, no limits on the extent of clearing were established.

Defined limitations on the amount of grading at a site were also generally not apparent in the regulations of all five communities. Neither the importance of maintaining the natural topography nor ordinances nor guidelines to that effect were observed in local regulations. This may explain why site preparations on the many steep sided properties near the lake often include considerable grading and sometimes even blasting of ledge.

Table E-10. Other important provisions in the zoning regulations of the five Candlewood municipalities pertaining to clearing and grading practices.

Item	BR	DB	NF	NM	SH
Definition of grading and/or earth disturbing activity	X	X	X	X	X
Reference to the protection of soil surfaces during and after construction	X	X	X		
Prohibition on grading and stripping without a valid grading permit (with exceptions)	X	X	X	X	X
Reference to the principals in the CT Guidelines for Soil Erosion and Sediment Control	X	X		X	X
Applications requirements					
Specifications and timing/sequencing schedules,	X	X		X	X
Quantities of excavation and filling involved,		X	X		
Existing and proposed topography at a maximum of two foot contours	X	X	X	X	X
Location of existing and proposed structures	X	X	X	X	X

The most definitive prohibition for earth changes was found in the provisions for Class I Environmentally Sensitive Areas from Danbury's Public Water Supply Watershed Protection Zones Ordinance. There it states:

Earth changes shall be prohibited on slopes greater than twenty-five percent (25%) unless the Planning Commission receives a report from the Department of Health and Housing of the City of Danbury which documents that erosion control measures provided with the plan are adequate to meet the purpose and intent of these regulations and to protect health, safety and welfare.

In summary, local regulations do provide precursors for establishing effective clearing and grading programs; but otherwise provide very little on how much clearing is allowable; how much natural vegetation is to be preserved; and provide very few restrictions for modifying the natural topography of the land or preserving it.

9. Residential Underground Storage Tanks for Fuel Oil

Organizations such as the Litchfield County Soil and Water Conservation District, and the Conservation Commission of the Town of Washington, concur that underground storage tanks (USTs) for heating oil pose one of the greatest and most costly environmental risks to water resources, citizens and communities of Connecticut in the near future.

There are many statistics quantifying the gravity of the problem. It was estimated from data collected between 1984 and 1985 in New England that out of every 1000 customers with an UST, 1.7 customers have a tank that leaks and 2.5 customers have a leaking UST fuel line. The life expectancy of USTs ranges from ten to fifteen years (Doenges et. al., 1993; Friedman, 1992). Tanks that are over 25 years old have a higher probability of incurring a leak, either from the tank or from the fuel lines. In New York, the Department of Environmental Conservation estimates that as many as 50% of the bare steel oil USTs installed in the 1950's and 1960's are leaking into the environment (Friedman, 1992).

Contaminants leaking from a UST system clearly put individual, community and environmental health at risk. Many of the compounds in home heating oil are listed by the State as volatile and are carcinogenic including benzene, ethyl benzene, and toluene. Accordingly, health-related agencies such as the Connecticut State Department of Health Services and the Chesprocott Health District advise against or provided some level of regulation for the use of USTs to protect human health and ground water resources.

Small levels of contaminants leaking from USTs can cause significant taste and odor problems in public water supplies. Higher levels will also impact the fauna and flora along shoreline communities of lakes, as well as public recreational use at State, local and community beaches.

There are few regulatory controls for residential USTs even though a leak or spill from one is considered a discharge to public waters and, therefore, illegal. The EPA federally regulates USTs that are over 1,100 gallons, such as those found at gas stations, marinas and airports, but not smaller tanks used in residential developments. While the CT DEP is not authorized to regulate the use of residential USTs, it does provide programs aimed at minimizing the impacts of leaking USTs. For example, there is statutory authorization for requiring reporting by environmental professionals of significant environmental hazards including those that threaten ground or surface waters.

The CT DEP also instituted a program for homeowner amnesty, contractor registration and reimbursement of remediation costs for homeowners who remove their residential heating oil storage tank between July 1, 1999 and January 1, 2002. Information on the CT DEP's residential UST programs is available through the Internet at www.dep.state.ct.us/wst/ust/indexust.htm.

There are at least 36 towns in Connecticut that restrict or in some way regulate USTs (Doenges et al., 1993). For example, the Town of Granby prohibits the installation of UST for fuel oil in new home lots. The Chesprocott Health District, which has regulatory authority in the Towns of Cheshire, Prospect and Wolcott also enforces regulations regarding USTs. In this District, existing USTs are required to be registered with the local Director of Health; all USTs must be tested within 33 to 36 months prior to age 15 years and tested every three years thereafter; and it is recommended that USTs be removed while still intact and prior to failure. In addition, all leaking underground fuel oil tanks and/or transmission lines must be reported to the Health District immediately.

There are no provisions aimed specifically at USTs in the zoning regulations of the five municipalities surrounding Candlewood Lake. HVCEO (1989) did recommend in their *Danbury Watershed Protection Plan* measures for new and existing USTs including:

- The registration of new and existing tanks;
- The development of design standards;
- The prohibition of new subsurface tanks within the watershed.
- A statement defining leaks and spills as illegal discharges in order to be consistent with State Statutes.

HVCEO recommended that these measures be integrated into existing zoning and subdivision regulations or through adoption of a new ordinance.

Danbury zoning regulations for the Public Water Supply Watershed Protection Zone currently prohibit manufacture, use, storage or disposal of hazardous materials in any watershed area without an emergency response plan approved by the Health and Housing Department. There are also provisions for the use of Class I Environmentally Sensitive Areas prohibiting manufacture, use, storage or disposal of hazardous material.

Although no language specific to USTs was located in the zoning regulations of the five Candlewood communities, some communities provide provisions for hazardous materials (see Risk Factor 10). For example, in New Milford's Housatonic River Zone there are zoning regulations that address to some degree the polluting of water resources with materials, which may include home heating fuel. There it states:

"No activity shall locate, store, discharge or permit the discharge of any treated, untreated or inadequately treated liquid, gaseous or solid materials of such nature, quantity, obnoxiousness, toxicity or temperature, that runoff, seep, percolate or wash into surface, stream or ground waters so as to contaminate, pollute or harm such waters or cause nuisances, such as objectionable shore deposits, floating or submerged debris, oil or scum, color, odor, taste or unsightliness or be harmful to human, animal, plant or aquatic life."

Brookfield's zoning regulations provide similar language concerning toxic or hazardous materials within the provisions for their Aquifer Protection District. In addition, there exists a special section on spill protection, control and containment. The provisions specify that within the district a Spill, Control and Containment Plan accompany an application for design review for approval by the Commission. Included in this plan are a schedule for the inspection and maintenance of equipment and containers; a method and plan for the detection of spills or leak; and structural and nonstructural measures to be implemented in order to prevent contamination.

The looming imminence of environmental problems related to residential USTs was recently demonstrated in New Fairfield where approximately 450 gallons from a 60-year-old UST leaked into the environment. A number of private wells were contaminated and very little of the fuel oil was ever recovered.

10. Household Hazardous Waste

The Connecticut based Metropolitan District estimates that the average household stores almost ten gallons of hazardous waste. The US EPA estimates that the average U.S. household generates more than 20 pounds of household hazardous waste (HHW) per year; that as much as 100 pounds can accumulate in a home over time; and that the average household disposes of one pound of hazardous waste per year. Based on the last statistic and the number of residences in the Candlewood watershed, approximately 8,000 pounds of HHW has the potential of polluting the Lake per year if not disposed of properly.

Many common household products (see Table E-11) contain hazardous chemicals. The US EPA defines as hazardous any chemical that is highly flammable, reactive, corrosive and/or toxic. Paints, preservatives, thinners, brush cleaners or other solvents, for example, contain suspected carcinogens methylene chloride and toluene, among others. Oven, drain and toilet cleaners contain the caustic base sodium hydroxide. Laundry detergents, abrasive cleansers and mildew removers contain bleach (sodium hydrochlorite). Cleaners that dissolve hard water scale deposits contain sulfamic and hydroacetic acids. Many aerosols, automotive products, pesticides, polishes and floor care products are high in carbon-based organic compounds. When homeowners no longer regularly use these and similar products, they are then considered HHW.

As is the case with all nonpoint source pollutants, the problem is not the one household, but rather the many homes polluting the environment. While improper use and storage of HHW can jeopardize human health, surface and ground water contamination is generally a result of improper disposal. The improper disposal method of greatest concern is pouring HHW down the drain or toilet, on the ground or into a street or storm drain. Another common but environmentally harmful method of disposal is adding them to the solid waste main stream, resulting in the contaminated landfills and the ground water resources beneath them.

Pouring HHW into drains and toilets has a compounding affect. Corrosive chemicals can damage plumbing systems. Many HHW can adversely affect the efficiency of septic systems by destroying the beneficial bacteria. This increases the potential of untreated or under treated septic effluent polluting surface and ground waters. Many of the HHWs will then move through the leaching fields untreated or unchanged to contaminate water resources down slope.

Many HHWs are disposed of in storm drains. Nationwide, it is estimated that 250,000 gallons of waste oil is discarded directly into stormwater systems every year. Candlewood's potential as a backup water supply is clearly jeopardized since one gallon of oil can ruin one million gallons of water. Poisioning and bioaccumulations of toxins in the fauna and flora of lake ecosystems can also result and over time. Some lake and other communities use storm drain stenciling to warn against dumping wastes into systems.

Table E-11. Common household hazardous wastes.

Abrasive cleansers	Drain openers	Laundry detergents	Prescription drugs
Adhesives	Epoxy products	Lawn chemicals	Preservatives
Aerosols	Finishes	Lighter fluid	Rat poison
Ammonia	Fire extinguishers	Lye	Rust solvent
Antifreeze	Flea collars	Mercury thermometers	Shoe polish
Art supplies	Flea powder	Metal cleaner	Solvents
Automotive products	Flea sprays	Metal polish	Spot removers
Batteries	Floor care products	Mildew removers	Stain removers
Bleach	Floor polish	Mothballs	Stains
Brake fluid	Fuel injection cleaners	Nail polish	Strippers
Bug sprays	Fungicides	Nail polish remover	Thinners
Car wax	Furniture strippers	Oil based paint	Toilet cleaners
Carburetor cleaners	Gasoline	Old propane tanks	Transmission fluid
Charcoal lighter fluid	Glues	Oven cleaner	Treated scrap sawdust
Chemical strippers	Grease solvent	Paint solvents	Treated scrap shavings
Chlorine bleach	Hard water scale remover	Paint strippers	Treated scrap wood
Cleaners	Herbicide insect repellent	Paint supplies	Turpentine
Cleaning solvents	Herbicides	Paint thinners	Used motor oil
Contact cement	Household cleaners	Paints	Used oil filter
Cosmetics	Household polishes	Paints pesticides	Varnish
Crank case oil	Insecticides	Pesticides	Wood cleaner
Disinfectants	Kerosene	Photography chemicals	Wood preservatives
Drain cleaners	Latex paint	Pool chemicals	

Federal and State Regulatory Review

Household hazardous waste collection days have been successfully used in Connecticut ever since the first collection in Ridgefield in 1984. The CT DEP reported, for example, the collection of 1,118 lbs of thermometer mercury since the spring of 2001. Collection sites for Danbury and New Fairfield have historically been at the Danbury Public Works Facility while the site for New Milford and Sherman is at the parking lot adjacent to the train station in New Milford. For a HHW collection schedule, go to http://dep.state.ct.us/wst/recycle /hhwsched.htm on the Internet.

Technically, the substances listed in Table E-11 qualify as hazardous, but are not covered under current US EPA hazardous waste disposal regulation. Wastes generated by normal household activities are exempt since it would be impossible for the Federal Government to regulate every household in the nation. The US EPA also does not require households to separate HHW from non-hazardous waste. Some states do require separation. CT DEP addresses HHW with the collection programs on an individual volunteer basis.

Regulations regarding HHW were sparse in the zoning regulations of the Lake-bordering municipalities. When found, they were generally provisions designed to protect important water resources.

Brookfield's HHW Standards
Brookfield's Aquifer Protection ordinance specifically prohibits *generation, manufacture, use transportation or storage of toxic or hazardous materials in quantities greater that those associated with normal household use as determined by the Commission.*

Danbury's HHW Standards
The Danbury Public Water Supply Watershed Protection Zones regulations prohibit *manufacture, use, storage, or disposal of hazardous materials in any watershed area without an emergency response plan approved by the Health and Housing Department.*

New Fairfield's HHW Standards
While no hazardous materials management ordinance exists in New Fairfield (or any other Candlewood municipality) attempts to locally regulate have occurred. In the latter part of the 1980's, a subdivision application near the Short Woods Brook Aquifer had requirements for special hazardous material storage areas.

New Milford's HHW Standards
In July of 1999, New Milford included hazardous waste in their list of definitions characterizing them as posing a significant, present or potential hazard to water supplies or to human health if disposed into or on any land or water, including groundwater. Under Performance Standards of General Provisions language is found prohibiting the dumping of refuse or other waste materials and liquids shall on any lot or dumped or discharged into any river, stream, watercourse, storm drain, pond, lake or swamp so as to constitute a source of water pollution.

Provisions in the Housatonic Overlay Zone state that *there shall be no land use which would adversely affect air quality though the release of noxious fume, gases or other emissions, or through creation of significant amounts of dust or other particulate matter. No activity shall locate, store, discharge or permit the discharge of any treated, untreated or inadequately treated liquid, gaseous or solid material of such nature, quantity, obnoxiousness, toxicity or temperature, that runoff, seep percolate or wash into surface, stream or ground waters so as to contaminate, pollute or harm such waters or cause nuisances, such as objectionable shore deposits, floating or submerged debris, oil or scum, color, odor, taste or unsightliness or be harmful to human, animal, plant or aquatic life.*

Sherman's HHW Standards
There were no HHW standards found within the contents of the Sherman Zoning Regulations.

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G. APPENDICES

1. HVCEO Policy on Future Use of the Candlewood Lake Watershed for Water Supply Purposes

January 2001

Under the authority of State Statute Chapter 127, Section 8-35a, the Housatonic Valley Council of Elected Officials (HVCEO) is required to prepare a plan of development for the ten municipalities of the Housatonic Valley Region. The latest HVCEO Plan was adopted by the Council in 1997.

The 1997 HVCEO Plan, and the 1981 HVCEO Plan before it, viewed Candlewood Lake as a long range water supply resource. This is in addition to its ongoing role as a recreational resource. This designation necessitates a recommendation for conservative local land use policies to help preserve the Lake's watershed for this potential future environmentally sensitive purpose.

In making this water supply designation HVCEO was aware that the Lake receives water from the Housatonic River which is a waste water receiving stream, and that State policy prohibits water supplies from receiving such waters. HVCEO has developed a position on this point, as explained below:

First, any future use of Lake waters by the City of Danbury would be via withdrawal at the southern end of that water body. This would be preceded by division of the Lake into classifications of B (northern, waste water receiving) and AA (southern, suitable for public drinking supply) segments.

This step would be preceded by studies documenting that a combination of the factors of a) basin recharge from such major tributaries near Danbury as Ball Pond Brook, b) limited water supply withdrawal in Springtime only for nearby reservoir enhancement, and c) the fact that the only wastewater entering the 11 mile long Lake is at the northern most point, a dual classification with the boundary bisection the water body itself would be within existing state law.

Secondly, on the eastern side of our Region, the State Plan of Conservation and Development permits the Shepaug River and Watershed to be shown as a future water supply resource, even though wastewater is received from the Town of Litchfield sewer treatment plant. A similar hybrid policy is feasible for Candlewood Lake.

Issues concerning the viability of Candlewood Lake as a future water supply are outlined in the following factors and studies:

---PRIOR USE IN A SEVERE DROUGHT. Candlewood Lake has already been established as the "source of last resort" for the City of Danbury during an extreme drought. Such an emergency occurred in 1968 when state permission was granted for use of Candlewood Lake for water supply by Danbury.

---REGIONAL DEVELOPMENT PLAN OF 1981. The HVCEO Regional Plan of 1981 stated that "It is possible to divert waters from the Lake to other reservoirs during the Spring before the Lake is used intensively for recreation during the Summer. The Lake might serve as a feasible alternative for several municipalities concurrently.

Additionally, the Lake may be the only feasible alternative at a given future time if other proposed sources are not developed for water supply purposes. In any evaluation of the Lake as a water supply, local officials will want to see that existing recreational, environmental and aesthetic resources are protected."

---DANBURY WATER SUPPLY PLAN OF 1986. According to the City of Danbury's 2/1986 engineering report entitled "Investigation and Report on Lake Candlewood Diversion," the proposed diversion from Candlewood Lake would include a pump station and intake on the shore of the Lake, a discharge pipeline and an access road. Storage for the diverted water would be in Danbury's large Margerie Reservoir. The new pipeline would be about 4,750 feet in length. Its cost in 1986 dollars was estimated at $2,240,000.

---NEW FAIRFIELD LAKE USE POLICY OF 1987. The policy of the Town of New Fairfield towards use of Candlewood Basin waters for future public water supply purposes was released in 1987. A town meeting vote that year opposed diversion of Ball Pond Brook water the short distance from New Fairfield to Danbury's Margerie Reservoir.

Primary concerns were negative impact upon the aesthetics of the Brook, reduction of the quality of Lake water if Ball Pond Brook's highly oxygenated water was no longer allowed to enter and mix with that water body, and negative Lake fisheries impacts.

---1988 REGIONAL WATER UTILITY PLAN. The state created Housatonic Water Utility Coordination Committee for the Greater Danbury Area, operating under state statutory authority and funded by the CT Department of Health, in 1988 included a Candlewood Lake diversion in its plan as a "potential future water supply source."

---DANBURY WATER SUPPLY PLAN OF 1991. According to the City of Danbury's Comprehensive Water Supply Plan dated 2/1991, "Two surface water sources, Ball Pond Brook Diversion and Lake Candlewood Diversion, have been identified by the Danbury Water Department as future sources of supply which will be required to meet future demands of the City."

Concerning Candlewood Lake water quality, the Plan continues: "The water has been found to be of good quality, presently meets all raw water standards in the Public Health Code, and is capable of meeting Safe Drinking Water Act criteria after treatment in the Margerie Reservoir Water Filtration Plant." The 1991 Danbury Plan also notes the fact that Candlewood Lake was used as a raw water supply source by Danbury during the drought of the mid sixties.

Commenting upon the Class B status of Lake water, the Danbury Plan acknowledged that such sources are only authorized by the state for use in emergencies, but that state law does permit such sources to be included in water supply planning studies.

---REGIONAL PLAN OF 1997. HVCEO policy on this matter was last updated in April of 1997. It was voted to reaffirm the role of the Candlewood Basin as a potential future public water supply watershed, continuing the policy adopted by HVCEO in 1981 and supportive of Danbury's needs.

---1997 WATER QUALITY RECLASSIFICATION CONCEPT. In September of 1997 HVCEO proposed to the CT Office of Policy and Management, as part of testimony on the 1998-2003 Draft Conservation and Development Policies Plan for Connecticut, a conceptual water quality reclassification plan for the Lake that would allow the proposed Danbury diversion of Candlewood waters to operate within state water quality laws.

2. MODEL OR EXISTING REGULATORY LANGUAGE FOR PROTECTING WATER RESOURCES

Some of the references below are available at the office of the Candlewood Lake Authority.

BUFFERS

Rhode Island Coastal Zone Buffer Program, 1994
http://www.epa.gov/owow/nps/ordinance/rhdisland.htm

USEPA. Model Ordinances Language for Stream Buffers.
http://www.epa.gov/owow/nps/ordinance/mol1.htm

FLOODPLAINS

Portland Metro. Floodplain Preservation Management.
http://www.epa.gov/owow/nps/ordinance/portland.htm

GENERAL

Cape Cod Commission Model Bylaws and Regulation Project
http://www.cape.com/~cccom/bylaws/

City of Portland, Oregon. Title 33. Planning and Zoning. Chapter 33.430: Environmental Zones.
http://www.planning.ci.portland.or.us/zoning/ZCtest/400/430_Envir.pdf

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http://209.221.153.38/buildplan/planning/informat3.htm

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State of New York, Lake George Park Commission Regulations. Part 646-3: Wastewater Management and Part 646-4: Stormwater Management

Town of New Hartford, Connecticut, Planning and Zoning Regulations. Articles VI, Section 17 – "Farmington River Protection Overlay District"; Article VI, Section 18 – "Public Water Supply Watershed Zone"; and 1998 proposed amendment regarding change in lot sizes (Article III, Section 3)

Town of Newbury, New Hampshire. Zoning Ordinance.

Town of Sunapee, New Hampshire. Zoning Ordinance.

Vermont Agency of Natural Resources. 1990. Planning for Lake Water Quality Protection: A Manual for Vermont Communities. Waterbury, VT.

LOT SIZE

Litchfield Hills Council of Elected Officials, 1998. Memorandum, March 5, 1998, Re: Proposed Changes to Lot Size Requirements. Goshen, CT.

OVERLAY

Dane County (Wisconsin) Shoreland, Shoreland-wetland and Inland-wetland Regulations. http://www.co.dane.wi.us/ord/ord011.pdf

Lake Sunapee Protective Association. Lake Sunapee Zoning Regulations. http://www.lakesunapee.org/docu6pc.htm

Lakes Region Planning Commission. 1994. Lake Winnipesaukee Watershed Project Model Ordinance Manual. Meredith, NH

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New Hampshire Office of State Planning. Model Shoreland Protection Ordinance. http://www.state.nh.us/osp/planning/guide/docs/shorlnd.html

Sawyer County (Wisconsin) Zoning Ordinance. Section 4.4: Shoreland Regulations. http://sawyercounty/gov.org/zosec4.htm

Town of Kent, CT. Zoning Regulations. Sec. 10: Lake Waramaug Watershed District. Kent, CT.

Town of Stockbridge, MA. Zoning Bylaw of the Town of Stockbridge. Section 6.5: Lake and Pond Overlay District. Stockbridge, MA.

Town of Washington, CT. Zoning Regulations. Section 6. R-3, Lake Waramaug Residential District

Town of Woodbury, CT. Town Planners Office. 1998. Subdivision Regulations. Watershed / Viewshed Regulated Areas

Waupaca County (Wisconsin) Shoreland Zoning Ordinance http://www.co.waupaca.wi.us/zoning/index.htm

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SOIL EROSION AND SEDIMENT CONTROL

Metropolitan Washington Council of Governments. 1995. Clearing and Grading Strategies for Urban Watersheds. Washington, DC

3. MEMORANDUM ON SITE PLAN REVIEW REQUIREMENTS

Memorandum

From: John W. Deering
To: The Special Advisory Committee to the CLA
Date: December 5, 2001

Re: BUILDING SITE PLAN ITEM LIST FOR PROJETS 5 ACRES OF DISTURBANCE AND OVER: STORMWATER PHASE IAND FOR 5 TO 1 ACRE OF DISTURBANCE STORMWATER PHASE II NOTWITHSTANDING 1 ACRE AND UNDER

With reference to our meeting October 24th, I am submitting the following description of items that should be reviewed, considered and implemented as site plan permit requirements. The main issue is having total regulatory clarity in the permit process and responding to the existing Stormwater Phase I and the upcoming Stormwater Phase II construction permits.

As of this date it has not been stated in Connecticut who will administer the under 5 acre to 1 acre of disturbance permits that will be required by Stormwater Phase II. But, I would have to believe the authority would settle in with the cities and towns. Basically speaking cities and towns do not have acre of disturbance requirements. Why? They are required to meet the CT Guidelines for Soil Erosion and Sediment Control (1988) recommendation of ½ acre or more of construction. It is of the essence to meet the Stormwater Phase II requirement of 5 acre to 1 acre of disturbance. But simultaneously there should be no exclusions for 1 acre and under. The new CT Guidelines for Soil Erosion and Sediment Control Handbook (to be published in the spring of 2002) should be a must during the processing of permits, with special attention to Chapter's 1 and 4. Chapter 1 offers the opportunity to exceed the Guidelines and Chapter 4 offers suggested sequence for construction.

It is recommended that permit(s) should not be issued to Non-Owners, unless they have been designated by the Owner as an Agent of Record, with power of attorney to represent them. The strength of the permit is holding the Owner as the ultimate responsible person or party for the project. This would stay in line with the USEPA requirement for Delegate States (representative) for which Connecticut DEP is one.

When registering a project with the CT DEP for 10 acres and over of disturbance, it is also required that the Owner of Record who is the applicant, must make a full submittal of plans and specifications. Upon acceptance and approval, the daily operators (the design team and the contractor) would sign on as the co-permit-tee. This is a basic requirement for which the "operators" are acknowledging full acceptance of the permits and its stipulations. The same applies with 5 acres of disturbance not to exceed 10 acres and over. The exception here is that the submittal of the plans and specifications are not required under 10 acres of disturbance.

What needs to be considered at the City and Town level is to give the Owner of Record/Applicant a Pre-Construction No Disturbance Permit. What that means is that all of the design criteria and Stormwater NPDES has been met, along with a perimeter soil

erosion and sediment control plan and that no construction will begin until the Contractor has been chosen. This will give the applicant an opportunity to include the permit and its stipulations into the Contract Bid Documents. This will require the Contractor to submit in the bid document, the phasing, sequence, methods and schedule for each phase within each work zone, along with an engineered soil erosion and sediment control plan for each phase. This reduces the exposure greatly, controls the activities and increases the performance of the soil erosion and sediment control measures.

Upon the selection of the Contractor, the final plan would be submitted for the record and should not require a meeting for approval. It should be a letter of acceptance from an authorized engineer/agent. If a meeting is deemed necessary, then a special meeting should be called for the sole purpose to process the final plans and issue the permit(s) within 21 calendar days of receipt.

Please note that all of the above will be described in the Performance Bond and FYI the Owner's Construction Mortgage will basically require the same description for the project. This ties in all of the parties to be in compliance with the permit(s) issued. Then the project can begin. Again, bear in mind, over 5 acres and under 10 acres it only requires the Owner of Record to register the project with the CT DEP, 30 days prior to its start. These are critical path issues that need to be addressed as this initiative will assist greatly with all projects that are 10 acres and under of disturbance.

The regulatory process within a City or Town does not respond to the acre of disturbance category other than the ½ acre and over of construction stated in the 1988 CT Guideline Handbook for Soil Erosion and Sediment Control. With the upcoming Stormwater Phase II, March 10, 2003, this is an opportunity to bring forward a standard practice for site plan permit submittals. Please note this does not take away the individuality of each City or Town with specific issues relative to their geographic location. What this initiative proposes is to establish line item requirement(s) list for earth moving activities, which will meet the permit requirements and its stipulations. This does not mean that you will be telling the applicant how to operate their business. You will be asking through the permit requirements how will the items be executed and controlled.

Building Sites experience the most exposure to enforcement when the building construction is premature to the substantial completion of the site. This issue will be addressed in Recommended Line Items for a Building Site Plan.

Recommended Line Items for A Building Site Plan:

1. The obvious plan begins with an A-2 survey with 2 foot contours, vicinity plan describing the location and access, etc.
2. The initial submittal should be a fully designed project meeting all of the design criteria and permitting issues, to include the State and Federal requirements (NPDES), not withstanding the US Army Corps of Engineers Category I or II, General or Individual if applicable. The development of work zone(s) and a full description of all of the activities that will be taking place such as having typical sections for the areas of excavation and fill in place. They basically should be at fifty or one hundred feet intervals.

3. The Contractor of choice will respond with the development of the Phases, Sequence, Methods and Schedule, along with an engineered Soil Erosion and Sediment Control Plan and its measures for each Phase.
4. Special attention should be given to applications for filling in a flood plain and for pond restoration. These issues will be addressed in this presentation.

Please note: The recommended line item list for building sites for 5 acres and over are as follows:

Line Items to be considered for a Building Site Excavation and Grading Plan:

1. Establish the Work Zone(s) and Construction Limit(s) and Construction Access
2. Clear cutting and or selective cutting for tree clearing
3. Excavate and chip stumps on site or remove off-site to a legal dumpsite
4. Strip and stockpile topsoil (state cubic yards)
5. Excavation to approximate sub-grade (state cubic yards)
6. Fill in place compacted to the approximate sub-grade (state cubic yards)
7. Removal of material off site (state cubic yards)
8. Materials to be brought in from other locations (state cubic yards)
9. An engineered soil erosion and sediment control plan and its measures for each phase within each work zone will be submitted by the chosen contractor

For single building construction, one work zone and the necessary phases submitted by the Site Contractor should be shown on the site plan. The substantial completion of the site should take place prior to construction of the building.

Example: All tree clearing, excavation, fill in place, soil erosion measures, sub-surface utilities/drainage, road and access-ways, parking lots (process aggregate only – no paving) and sub-grade for the footprint of the building. Upon completion of the building construction, the balance of the site work would then be completed.

For a multi building site, the site would need to show multi work zones and the necessary phases of construction for substantial completion, prior to construction of the buildings in each phase.

- Refer to the tree clearing, excavation, fill in place, etc. on page 2
- Installation of sub-surface utilities to within five feet of the building footprint
- For multi building construction install all sub-surface utilities in road access and to within five feet of the building footprint
- Coordinate with sub-surface utilities and install all sub-surface drainage and structures
- Preparation of sub-base and slope(s) for building site, parking areas, access and roads
- Place and compact process aggregate base in roadway, access-ways and parking lot(s)
- Install and secure all erosion control measures for the above items as shown on plan in each phase of work

Upon completion of the items as stated on page 2 and 3, the building construction can begin. With the completion of the building in one work zone or the completion of the

buildings in a multi-work zone and the cleaning/removal of construction debris, the following list of items is recommended:

- Coordinate and complete all lighting, sidewalks, terraces, any other amenities that may be selected and final landscape of all disturbed areas with the placing of topsoil, rake, seed and mulch
- Fine-grade the process aggregate in the roads and parking areas
- Install the first course of bituminous concrete (asphalt) paving for roads and parking areas
- Install all bituminous concrete (asphalt) curbs and complete landscaping to curb prior to the second course of paving.
- Please note: Where concrete or granite curbs are required, their installation and back-filling to sub-grade precedes the first course of paving
- Final landscaping for all disturbed areas with the placing of topsoil, fine-grading, seed and mulch
- Designed signage and line painting

The focus within these four pages has been on large building sites. Why? They basically are the most exposure during a construction activity. Work Zone(s), Phasing, Sequence, Schedule, Bonding and Finance bring forward a coordination of all activities with the Environmental Permit(s) and their stipulations.

SPECIAL ITEM SECTION

Please note:

What has been presented in the previous four pages exceeds Chapter 4 (the new CT Guideline Handbook SE & SC, 2002) suggested sequence and applies the option in Chapter 1, page 1-6, of the Connecticut Guidelines for SE & SC Handbook, 1988.

Special Item 1: Reference to Chapter 1, 1988 and 2002

These guidelines are intended to serve as a technical guide in the effort to meet the requirements of Soil Erosion and Sediment Control Act and to assist in implementing the requirements of laws and statutes relating to water pollution control. The use of words such as “shall”, “will” and “must” within the design or implementation standards is meant to emphasize the direction which will ensure that the control measure or design procedure will serve its intended purpose. Innovative modifications to the control measures or design procedures are acceptable and encouraged, especially if they improve upon sediment-loss mitigation. However, designers and plan reviewers must be sure that the modified procedure will be successful. Designers must be present to plan reviewers sufficient technical data that shows that the proposed modification is at least as effective as the guidelines measure they are meant to replace.

With reference to the statement above “innovative modifications to the control measures or design procedures are acceptable and encouraged”, is a critical path statement.

Special Item 2: The filling of Floodplains

It is the opinion of this author, that floodplains are equal in priority to wetlands. The filling of wetlands over the past three decades certainly have been an unacceptable practice and have been seriously regulated and monitored. The same does not prevail for floodplains. When a floodplain is filled in, it displaces the water storage that was available during a flooding event and simultaneous changes the cubic foot per second of flow downstream when the flooding is taking place. How? It narrows the sheet flow that existed and raises the height of the water until the storm subsides. Can there be building construction in a floodplain? Yes, but the engineering and architectural design must meet the flood proofing construction required and does not interrupt the natural topography in the floodplain. It is recommended that construction in a floodplain should be as restrictive as any construction activity that is being proposed in the floodway. The displacing of water without question changes the hydraulic nature of the existing topography and the disposition of the downstream properties.

Special Item: Suggested Floodplain Site Plan Requirements

1. 100 year Storm history/flooding for the drainage basin the proposed development will take place in. Date and effect of last recorded 100-year storm.
2. Full disclosure of cubic yards of fill in place with typical sections.
3. Full disclosure of the gallons of water displaced. Plus the increase in height of water and the estimated cubic foot per second of water down stream.
4. What alternative flood proofing construction measures can take place to prevent the filling of the floodplain?

It should be noted that it is basically unacceptable in a wetland application to propose the filling of a wetland and not demonstrate that all alternatives have been reviewed and exhausted. It should also be noted that the filling of a wetland for 5,000 square feet and over is described in Category II, US Army Corps of Engineers and the Connecticut Department of Environmental Protection Water Quality Certification and requires a General Programmatic Permit or possibly an Individual Permit.

Special Item 3: Site Plan Requirements for 1 Acre and under

Can a site plan for 1 acre and under be as complicated as 5 acres and under or as 10 acres and over? Yes. It is recommended that when reviewing a site plan for 1 acre and under, all considerations should be made to stay within the recommended construction sequence of the Connecticut Guide Line Handbook, Chapter 4 (please note I am referencing the new Handbook as this initiative and the handbook should emerge around the same time). Also, depending on how complicated the site is, you might want to consider the more stringent issues described in work zone(s), phasing, sequence and methods section of this document.

Special Item 4: Pond Restoration and Enhancement

This is really a special item. To my knowledge, pond restoration is not basically addressed in the current theme of earth moving activities in most cities and towns. I just received a Department Of The Army Programmatic General Permit State of Connecticut and CT Department of Environmental Protection Water Quality Certification. To complete the above permitting process, I will be on the agenda at the Wetlands

Commission, Town of Newtown, December 12th and the Town of Newtown Planning & Zoning Commission, December 20th or January 4th, 2002. The pond is located in Newtown and my clients have agreed to allow me to write and produce an educational workshop for the permit process as well as film and present the pond restoration activities that will be taken place the summer of 2002.

If the Committee so chooses, I would be pleased to share the permitting information for Ponds, as they are the natural "catch-basins" (not by choice) for Lakes and Watercourses.

Also, it is most important that the applicant that stands before you understand that approval by your committee or commission is not total approval. They should be reminded that the State and Federal requirements remain their responsibility.

In Closing:

Thank you for the opportunity to be a member of this team. I look forward to your thoughts, comments and suggestions. Please respond to jwdeering@snet.net ASAP.

Respectfully submitted,

John W. Deering

4. NEMO MEMORADUM ON UPZONING

MEMORANDUM
To: Candlewood Lake Authority
From: UConn CES NEMO Project Team
Date: December 12, 2001

RE: Upzoning to Reduce Impacts from Imperviousness

The NEMO Project is not opposed to large lot zoning; however, we feel strongly that large lot zoning by itself may not effectively address impacts from imperviousness (IS). Please understand that, a 2-acre lot (depending on local zoning & subdivision provisions such as lot coverage, setbacks, etc.) can contain a smaller *percentage* of imperviousness then a 1 or ¼ acre lot but that percentage often translates into *more square feet* of imperviousness. Larger lots can accommodate decks, patios, swimming pools, basketball courts, sheds, paved parking areas or turnarounds, etc. adding to imperviousness. In addition, a typical 2-acre lot can generate 200' of road frontage and extensive lengths of paved driveway.

NEMO recommends that prior to developing any lot, consideration be given to the conditions of the lot (existing hydrology, soils, slopes, critical resources, etc) and its ability to support the proposed use (and associated potential pollutants). Once this is understood, the location of IS on the lot and the connectivity of the IS can be designed (if zoning & subdivision regulations allow!) to have minimal impacts.

To reduce impacts of imperviousness NEMO offers regulatory and planning techniques, utilization of porous materials and treatment of runoff (please visit "Reducing Runoff" on http://nemo.uconn.edu). Some examples include:

- Defining "imperviousness" in zoning regulations and insuring that lot coverage includes all impervious surfaces not just the building footprint.
- Utilizing Cluster development to preserve existing site features such as wetlands.
- Allowing alternative materials when building driveways, access roads, overflow parking, etc.
- Allowing alternatives to curb and gutter drainage where appropriate such as grassed swales.

See NEMO's Technical Paper #1 in this report for more detail.

5. NEMO Technical Paper #1

NEMO

NONPOINT EDUCATION
FOR MUNICIPAL OFFICIALS

TECHNICAL PAPER **NUMBER 1**

Addressing Imperviousness In Plans, Site Design and Land Use Regulations

By Jim Gibbons, *UConn Extension Land Use Educator, 1998*

Imperviousness As a Water Quality Barometer

Impervious surfaces are impenetrable materials that prevent water from percolating into the soil. Common impervious surfaces are asphalt, cement and roofing material, all associated with development. A ubiquitous modern landscape feature, impervious surfaces are accepted urbanization indicators. As two-thirds of all impervious cover is automobile related, imperviousness is a particularly good gauge of suburban sprawl with its extensive road and parking networks.

Impervious surfaces are also excellent barometers of development's impact on water quantity and quality. Hydrologists have long recognized that impervious surfaces affect water quantity by diverting subsurface flow to surface runoff, often resulting in increased flooding and stream bank erosion. In addition to imperviousness' adverse impacts on water quantity, numerous studies document its water quality impacts with evidence of stream impairment when watershed imperviousness approaches 10 Percent. Much of this damage is from polluted runoff.

Imperviousness As a Planning Tool

Land use planners interested in water resource protection will find imperviousness a practical tool for analyzing development's impact on water. As a planning tool, impervious coverage has several advantages. First, the relationship of impervious cover to water quantity and quality is well documented and can be used with confidence, even if the specific pollutants, sources, pathways and effects are unknown. Second, impervious cover is measurable. Whether estimated from "windshield" surveys, measured from site plans or digitized from aerial photos or satellite imagery, imperviousness can be documented with real numbers. Finally, impervious surfaces such as roads, rooftops, driveways, parking lots and sidewalks are easily recognized landscape features. They are not complex, invisible components of the polluted runoff stew, such as toxins and nitrates. The public sees impervious surfaces daily, and is more apt to grasp its use as a planning tool. (See Technical Paper 3, *"Methods for Measuring and Estimating Impervious Surface Coverage"* and Technical Paper 4, *"Do it Yourself! Impervious Surface Buildout Analysis".)*

Getting Down to Business

The NEMO Project offers the following suggestions on incorporating impervious coverage in land use plans and regulations. Each suggestion can be taken independently, but they are most effective if followed sequentially. As new information comes on line, additional runoff control options will emerge. And please, don't take ours as the last word. You might have your own creative ways of addressing this important issue.

1. Review and Revise Your Local Plan of Conservation and Development

As a blueprint for land use regulation, the municipal master plan should clearly state community goals and guidelines for conservation and development. It should specify areas to be developed and recommend permitted uses in each development area. The plan should also identify significant natural resources (based upon a natural resources inventory), such as water, and recommend areas worthy of conservation. As one of your community's most important documents, the plan should address the potential impact of development on water resources. Below, is a discussion of selected plan chapters that might address this issue, highlighting imperviousness' impact on water.

Introduction

Early in the plan, include a goal statement on the potential impact of various land uses on water resources. Consider as an example, "The community wishes to protect its water resources. As impervious surfaces can collect and convey polluted runoff to our waters, we seek to reduce their amount and impact." Once addressed in the introduction, there are several other plan

chapters where imperviousness might be discussed in greater detail, including:

Historical and Existing Land Use Trends - Include a discussion of past and use trends, highlighting the amount and type of impervious surfaces associated with each use. Conduct a survey of present land use and impervious coverage. Use actual impervious measurements or estimates based on the amount of imperviousness associated with various land uses. Present an overview of the impervious budget, highlighting the amount of imperviousness associated with transportation as compared to buildings. The plan might also include an analysis of where impervious surfaces are located within watersheds. For instance, impervious surfaces in headwater areas, near water bodies and over groundwater recharge areas can be particularly damaging to water quality. Rather than lumping all impervious surfaces together, the inventory might differentiate them as to their potential impact on water quality. For example, roads, parking lots and commercial/industrial rooftops often drain directly to stormwater sewers.

Runoff from these areas is not naturally filtered by soil and vegetation and moves rapidly in great volumes. In contrast, runoff from residential rooftops usually drains to lawns that promote infiltration, reduce runoff rates and filter pollutants. The general goal for impervious surfaces is to limit them when and wherever possible.

Topography - Use natural contours and watersheds for drainage system planning. As topographic lines and watersheds do not follow political boundaries, local officials need to address drainage in a regional context. A plan goal might be to utilize natural drainage systems where feasible and to recognize that certain development practices, such as site clearance and grading, change the landscape disrupting natural drainage patterns. Discuss the hydrologic cycle and the importance of infiltration in maintaining subsurface recharge and other natural functions. Establish goals of minimum site disturbance and maximum retention of existing topography while discouraging clear cutting of vegetation and extensive grade alterations. Emphasize the economic and environmental benefits of natural drainage over manufactured systems.

Watersheds - Local officials need to recognize ecosystems and land use's impact on them. A watershed is an ecosystem in which all surface water drains to a common outlet. The community plan should inventory and analyze land use and natural resources in local and regional watersheds. Local officials should know where water naturally drains and how development will affect those patterns. Applicants before local boards should delineate proposed uses within the watershed and report on the impact of their proposal on surface and subsurface water. Communities are recognizing the value of developing comprehensive watershed management plans to better understand land use impacts on drainage. Watershed management plans are highly recommended as important components of any community master plan. A recommended outline for a watershed master plan is included as Appendix A. The general goal for managing stormwater within a watershed is to manage it on-site using practices that closely mimic natural infiltration including, vegetative filters, grassed swales and bioretention areas and porous pavement.

Soils - Soils data can help delineate areas suitable for development and conservation. Soil surveys also identify areas with soils capable of supporting water management practices including; pond and reservoir areas, embankments, drainage, diversions and grassed waterways. Local officials can designate areas where natural drainage systems can be maintained or required by reviewing a site's soil properties including; slope, permeability, erodibility, wetness, depth to bedrock, hardpan and ability to support permanent vegetation. When development is directed to areas with soils suitable for urban uses, adverse impacts on fragile natural resources can be minimized. Soils can also be used to establish density limits. For example, some communities have adopted "net buildable areas" or soil based zoning, where permitted density is based the amount land suitable for development rather than total acres owned. This chapter should also address the importance of inland and tidal wetland soils as nature's sponges and filters. A key plan goal should be the protection and establishment of stream side or riparian buffer areas to offset the adverse impacts of development. While wetlands and riparian buffers can absorb floodwater and filter certain pollutants, policies should protect them from overloading and direct receipt of polluted runoff.

Open Space - Some plans analyze the various functions of open space including; recreation, resource protection and management, habitat conservation and open space's contribution to community character as well as it's economic benefits. Few however, discuss open space as a water resource protector. The soils and vegetation associated with open space are vital to stormwater management plans that emphasize infiltration. Hence, your plan should describe how open space could mitigate development's adverse impacts on water. For example, open areas can serve as filters buffers, swales, wet and dry ponds, as well as detention and retention areas. Open space obtained during development, such as subdivision and cluster dedications can be particularly protective of water resources. Urban open areas, such as vest pocket parks, plazas, playgrounds and vacant lots can be designed to filter polluted runoff from adjacent impervious areas.

Water Resources - This chapter addresses surface and subsurface water. Where available, water quality monitoring data as well as existing and proposed water quality standards should be used to help establish goals for the watershed. Discuss land use impacts on these standards, particularly known or inferred pollutant generators. Discuss the various pollutants found in stormwater runoff and relate them to existing and proposed land uses. Locate and classify watercourses and water bodies within their watershed and identify their drainage function. Present management strategies for each stream, river and pond. When

presenting water quality goals, include impervious surface reduction and infiltration as major objectives.

Community Design - Address the impacts of site design on the paving of your town by suggesting ways to reduce the imperviousness of streets, parking lots, sidewalks, driveways, structures and compacted earth. Encourage designs that direct runoff to open areas as opposed to more costly, and often less effective, structural "best management practices." The compatibility of clustering, neo-traditional development and traffic calming designs with naturalistic storm water management might be addressed. The contribution to "community character" of naturalistic stormwater management facilities such as swales, infiltration basins and wet ponds should be included. A discussion on how green areas are more pedestrian friendly than gray impervious surfaces designed for cars should also be included. Stress how porous materials such as crushed stone, porous pavers and porous asphalt mixtures might be substituted for more traditional impervious materials.

Community Character - This chapter should present strategies to reduce the social, economic and environmental impacts of sprawl and its associated features such as impervious surfaces. Address the compatibility of naturalistic landscaping and impervious coverage reduction with neo-traditional design and rural landscape protection. For example, roads serving low-density residential development need not be as wide as those serving more intense uses. Communities with a village center, might place porous parking spaces behind commercial structures to avoid the harsh visual impact of macadam seas flowing door to door. National studies indicate many communities require more parking than actually utilized. Conduct a local parking utilization survey and based on results, suggest revisions to existing parking regulations. Encourage landscaped parking lots with green areas used for infiltration. Review the many studies documenting the costs of sprawl with particular emphasis on property tax implications for communities relying on single-family homes as the major tax source. Discuss the importance of green areas in providing a sense of place and possible multiple uses of these areas including stormwater management.

Community Facilities - Municipal facilities with impervious surfaces including; buildings, parking lots, paved recreation and outdoor storage areas, should be analyzed for their potential contributions to polluted runoff. List ways to reduce the impervious surfaces associated with civic centers, schools, libraries, police and fire stations, garages, waste disposal areas, parks and other municipal sites. Consider replacing impervious surfaces with porous alternatives. Local government should serve as a model in water pollution prevention. Therefore, local policies must guarantee that public roads and parking areas are swept, storm drains vacuumed, storm sewers maintained, swales and other drainage systems cleaned and road runoff diverted from direct stream discharge. Care should be shown when washing municipal vehicles and planning sites for waste disposal and outdoor storage of materials such as sand and salt.

Public Utilities - Public utilities such as sewer and water lines are often constructed to correct water quality problems. However, public utility service areas can generally accommodate denser development than those served by on-site systems. Denser development may generate new water problems, such as polluted runoff from impervious surfaces. As a consequence, public utility impacts on water quality need to be addressed before committing to these expensive "public improvements." Even communities with sophisticated storm sewers can experience problems, such as broken pipes leaking polluted runoff into barren earth. In this situation, polluted water is quickly piped out of sight and often out of mind, yet the long-term effects are devastating. Storm sewers can also alter watershed hydraulics as runoff is directed to pipes preventing infiltration and base flow recharge. Any stormwater management facility requires maintenance yet, many are not properly maintained. For instance, storm drains should be vacuumed twice a year. Research shows few communities properly maintain storm drains. As a result they become literal petri dishes of accumulated pollutants waiting for the next rainfall to discharge their contaminated wastes upon the landscape.

Transportation - Rather than relying on a "one design fits all situations" approach to road construction, communities should develop road standards based on the function each road will serve. For instance, a cul-de-sac road serving a few residential lots need not be built to the same specifications as collector and arterial roads handling heavier traffic. Local standards regarding pavement type, sub-base specifications, road length and width, sidewalks, curbs, swales and street trees should be reviewed. Local roads can be constructed of porous materials, be fairly narrow, designed to follow natural contours and drain to swales rather than curbs. These design features not only produce functional roads, they also promote infiltration of runoff. Policies regarding sidewalks should also be reviewed. Sidewalks should only be required where needed. For instance, sidewalks may be needed only on one side of the road or, if not connected to municipal facilities, perhaps not at all. Review the impact of zoning requirements for front yard setbacks as they relate to driveway construction. Excessive front yard setbacks will generate long impervious driveways and research shows residential driveways to be "hot spots" of polluted runoff. Similarly large lot zoning will generate greater road lengths. A typical one-acre lot will require approximately 200' of road frontage. As alternatives to total reliance on automobiles, the plan should address mass transit as well as pedestrian and bike trails.

Parking utilization surveys should be conducted to determine whether present zoning requirements for parking are excessive. Many parking standards are based on peak utilization periods, such as the week before Christmas, and as a result many spaces are not utilized for most of the year. The benefits of landscaped and porous parking lots as natural filters and pleasant visual alternatives to seas of macadam and concrete should be promoted. Also review and comment on the water quality impact of local maintenance practices on roads and parking areas. Before

adopting the latest planning trends, analyze their potential impact on water. For instance in touring Disney's no-traditional town Celebration, it became evident that even though road lengths and widths were decreased, the use of alleys increased overall imperviousness. Of course, the alleys and the roads could have designed with more porous materials such as porous asphalt or paver stones.

Future Land Use and Build Out Scenarios - When projecting future land use, consider the imperviousness of various development types. Studies show commercial and industrial development can generate 70 Percent to 95 Percent impervious coverage, while residential areas vary from 15 Percent imperviousness in one-acre zones, to 65 Percent in one-eight acre zones. Build-out analyses, based on present zoning, should include impervious coverage projections. Growth management goals should encourage redevelopment of built areas served with public utilities as a practical alternative to costly sprawl. An Impervious Surface Reduction Study could suggest a full menu of techniques to reduce polluted runoff from existing and projected land use.

There are other chapters in your community's Master Plan that might address development's impact on water. The important point is, throughout your Plan, the community goal of reducing development's impact on water resources should be clearly stated.

2. Mirror Plan Goals in your Land Use Regulations

Your community's land use regulations should reference and repeat goals and recommendations regarding polluted runoff and impervious surfaces addressed in the Master Plan. While your Plan can broadly address these issues, the regulations should set specific standards each applicant must meet before the commission grants approval. Most communities rely on zoning, subdivision and wetland regulations to control land use. What follows are suggestions as to how those regulations might address development's impact on water with emphasis on imperviousness and runoff.

Review and Revise Zoning Regulations

Selected sections of zoning regulations that might address the impact of development on water quality include:

Definitions - When courts review zoning cases, they often reference the Definitions' Section to see how local officials define specific terms. Where local definitions are absent, the court will use it's own. Zoning regulations should include a comprehensive list of definitions for terms used in the zoning text, including those related to stormwater management. Definitions should be included for terms such as; impervious and porous surfaces, non-point and point source pollution, swales, lot coverage, best management practices, storm water runoff, infiltration, etc…

Permitted Uses - Zoning can permit uses by right, by special permit or prohibit them. Zoning can relegate certain uses to certain districts or prohibit uses judged to adversely impact public health or safety. For example, activities that might contaminate water because they involve the use, storage or disposal of hazardous materials might either be prohibited or permitted in certain locations provided the applicant can comply with certain performance standards mandated by the commission to protect natural resources. Most state environmental protection agencies compile lists of those businesses that might pose risks to water. Don't be afraid to prohibit uses state officials list as posing particular hazards to water quality. Carefully review permitted uses and be assured they pose no threat to water resources. Review site plan requirements for special permits paying particular attention to storm water runoff and impervious reduction standards.

Lot Size - Water resources may be protected, in part, by controlling the placement and density of structures and septic systems. Many local officials feel the best way to protect the environment and preserve rural character is to require large lots with expansive setbacks. However, these requirements generate extensive roads, driveways and sidewalks that, in turn, provide an efficient delivery system for polluted runoff. Zoning should encourage development in those areas that are capable of supporting growth and discourage development in areas with site characteristics posing limitations for development. An area's suitability for on-site utilities is a key factor for lot size determination particularly in those communities wishing to avoid public sewers or water. Requiring an applicant to perform an analysis of "net buildable area" will address these concepts.

Lot Coverage - Some regulations define lot coverage as the percentage of the lot covered by structures. A more comprehensive approach defines coverage as, the percentage of the lot covered by impervious surfaces including buildings, roads, sidewalks, parking areas, compacted earth or pipe. To calculate a site's impervious surface ratio, divide the area of impervious surfaces by the site's gross area. For example, in a 20-acre subdivision with 5 acres of impervious cover, the impervious surface ratio is .25 or 25 Percent. In residential areas, about 63 Percent of the impervious surface is related to paved areas while 37 Percent is attributed to roofs. Hence, if one wishes to reduce imperviousness in residential areas, the focus should be on roads, driveways, sidewalks and parking. In contrast, parking and roofs are the dominant impervious surfaces in commercial and industrial areas.

Some communities have established impervious coverage limitations. However, care must be taken in the development of limits. Impervious surface limits are best used where:

- there's a firm relationship between the regulated area and an identified priority natural resource;
- the regulated area is well-defined (special overlay zone; watershed);
- flexibility is built in to allow the developer to reach town goals through design considerations that reduce effective impervious surfaces (those that are collecting, conveying, and concentrating

polluted runoff). For example, Brunswick, Maine limits impervious coverage to 5 Percent in a watershed draining to fragile shellfish beds. The adverse effects of imperviousness can be minimized by stopping the pollutant generator, reducing the size of impervious coverage, or replacing impervious coverage with more porous surfaces and draining runoff from impervious to open areas.

Density - Zoning controls the density of development by regulating the number and type of structures permitted on various size lots, i.e., one dwelling unit per acre. Some regulations contain cluster or conservation development provisions that permit buildings to be "clustered" more densely than allowed by conventional zoning. In exchange, the undeveloped portion of the site is preserved as permanent open space. Open space may protect water by conserving sensitive aquatic habitat, preserving riparian buffers, as well as serving as detention and retention areas, ponds, swales and other drainage systems. Clustering not only provides direct open space and water protection, but if properly designed it can greatly reduce impervious surfaces such as sidewalks, driveways and road lengths. A review of several cluster designs shows imperviousness can be reduced anywhere from 15 Percent to 50 Percent compared to conventional designs.

Special Permits and Site Plan Review - Under zoning, uses are allowed either "by right" or as special permits. Special permits are uses the commission might allow, if the applicant complies with performance standards set forth in the regulations. Generally, the standards address the potential impact of the proposed use on the neighborhood and environment. Standards regarding the management and filtration of stormwater runoff should be included. The standards should guarantee that the proposed use would not generate runoff that will adversely impact receiving land or water. Special permits generally require that a site plan be submitted to help the commission determine if the proposed activity conforms to the regulations. The regulations must state what uses are subject to site plan review and list the standards each application must address. The commission acts in an administrative capacity when reviewing site plans, meaning applications complying with the regulations, must be approved. Regulations should require that site plans show the location of the proposed site within the local watershed, that post development runoff not exceed pre-development levels and proposed stormwater management practices are delineated and described (see stormwater management section below).

Proposed stormwater management techniques should reflect and respect watershed characteristics and comply with any approved watershed management plans. NEMO suggests that the management practice of choice be infiltration. There are only a few areas where infiltration should be avoided including: areas with steep unstable slopes; soil as impermeable as the pavement or buildings that will be placed upon it; areas close to water supply wells over known aquifers; areas close to septic systems; areas close to sensitive structural foundations; and contaminated sites that would leach with added flow.

Erosion and Sediment Controls - Erosion is soil removed from its place of origin by wind, rain or running water. Sediment is eroded soil transported to water. Erosion and sediment control regulations generally include the following principles; respect for and utilization of natural drainage systems, avoidance of development on steep slopes, keeping post development runoff equal to or less than pre development rates and minimized site disturbance and vegetation clearance. Zoning has traditionally addressed soil erosion more than other nonpoint pollutants. A potential problem with such emphasis is that local officials sometimes feel they have addressed the entire issue of polluted runoff by adopting erosion and sediment control regulations. Erosion, of course, is only one of many ingredients in the polluted stormwater bouillabaisse and based on water quality monitoring data, officials should make provisions to address the other pollutants of concern with the same rigor they have approached erosion control.

Stormwater Management - Zoning regulations should require that all development proposals contain stormwater management provisions that address the impact of development on both water quality and water quantity. Of particular concern, is the impact of the proposed use on the local watershed, not just the proposed site or adjacent parcels. Common stormwater management principles found in regulations include:

- no direct channeling to watercourses or wetlands;
- use of natural drainage systems;
- minimum site clearance and grading;
- maintenance of natural streams and riparian zones;
- development not creating downstream flooding or off-site erosion;
- no greater site runoff than existed prior to development;
- on-site retention and filtration of the first inch of runoff from impervious surfaces to on-site vegetative areas. NEMO suggests that the management practice of choice be infiltration. There are only a few areas where infiltration should be avoided including: areas with steep unstable slopes; soil as impermeable as the pavement or buildings that will be placed upon it; areas close to water supply wells over known aquifers; areas close to septic systems; areas close to sensitive structural foundations; and contaminated sites that would leach with added flow. Once again, these regulations can be most effective when developed and administered in conjunction with comprehensive watershed management plans.

Earth Removal - Zoning can regulate the removal of sand, gravel, rock, peat, top soil and other earth products, by restricting when, where, and how these products can be mined, if at all. As mining operations bare earth, they can generate erosion that might eventually find its way to water in the form of sediment. Site disturbance should be minimal and top soil stockpiled so it can be replaced on work areas. Gentle final grades and reseeding should be required once the operations are finished.

Aquifer Protection Zones - Zoning may reasonably provide for the protection of existing and potential surface and subsurface drinking water supplies by establishing standards to insure

proposed development will not have an adverse impact on these valuable resources. Many communities and states have mapped major known or inferred aquifers and the regulation might wish to reference those studies as "areas of particular concern." While NEMO promotes infiltration of stormwater, caution is needed when proposing infiltration on or near known aquifers, particularly in areas with excessively well-drained soils.

Floodplain Zoning - One of the statutory purposes of zoning is to secure safety from flooding. A floodplain is a flat or nearly flat land on the floor of a stream valley or tidal area that is covered by water during floods. That part of the floodplain subject to a 1 percent chance of flooding in any given year is designated as an "area of special flood hazard" by the Federal Insurance Administration, who delineates these areas on official maps for each community. The commission should protect the floodplain by regulating uses within it as well as those on higher elevations that drain to it. One of the great dangers of increased impervious surfaces is that stormwater moves rapidly over its surface and unless it is intercepted, can gain in volume and velocity often resulting in increased downstream flooding. Local officials must realize the contribution of upland development to the floodplain and develop land use regulations that mandate zero or minimal off-site runoff. In addition to the above sections found in most zoning regulations, there are other innovative ways zoning might address land use impacts on water quality, including:

Overlay Protection Zones - An overlay protection district or floating zone is the same as a conventional zone except it is not designated on the zoning map. It "floats" over the community until an application is approved and then is affixed to a particular parcel. The zoning text describes the conditions required for approval. The area protected by the overlay zone could be a water resource area. Generally uses will be permitted with restrictions beyond those in the underlying zone. However, bonuses such as increased density are often offered to encourage use of this protective tool. The underlying zone determines the permitted land use, while the overlay establishes the special restrictions and bonuses in place to meet the desired end, i.e., water resource protection. Impervious surface limits might be considered as a condition of approval. However, care must be taken in the development of limits. Impervious surface limits are best used where there's a firm relationship between the regulated area and an identified priority natural resource as outlined previously in the section of this paper on Lot Coverage.

Water Sheet Zoning - A new zoning technique of extending zoning districts onto water courses or water bodies. Under traditional zoning, areas of land are designated for various uses. Under Water Sheet Zoning certain areas of water are reserved for water dependent uses that will not have an adverse impact on the water quality.

Riparian Buffer Zones - A buffer zone is an area of open land separating two distinct land uses that acts to mitigate the adverse effects of one on the other. When used in water resource protection, buffers are usually strips of grass or other vegetation separating a waterway from adjacent land uses. Buffers are also referred to as filter strips, vegetated strips and grassed buffers. Buffer widths vary based on the sensitivity of the resource being protected and the land uses of concern. For example, to protect fragile areas such as trout hatcheries, buffers of 300' or more may be appropriate. When buffers are used as protective filter strips, required widths vary based on; the pollutant of concern, soil type, slope and vegetative cover. Buffers protect water by filtering pollutants, regulating water temperature and runoff, recharging groundwater, storing floodwater and protecting riparian habitat.

Slope Restrictions - As slope increases, runoff velocity, flooding, erosion and sediment transport increase. Some programs concerned with the impact of steep areas on water quality, such as Maryland's Chesapeake Bay Critical Areas Program, prohibit clearing on slopes greater than 25 Percent.

Transfer of Development Rights (TDR) - TDR is based on the concept that land has a bundle of different rights and a landowner can sell one of them, the right to develop, for use in another area. To implement a TDR program, a plan must be prepared to show sensitive areas to be protected, from which development rights may be sold, as well as developable areas which can receive those rights and be developed at a higher density than allowed in conventional zones. Several states including Connecticut, authorize zoning commissions to provide for the creation and permanent transfer of development rights.

Review and Revise Subdivision Regulations

Subdivision regulations provide standards for design of streets and public improvements associated with tracts of land to be divided into parcels for the purpose of development. The objectives of subdivision regulations are to promote orderly growth and protect natural resources by insuring land proposed for subdivision development is capable of supporting intended uses.

In Connecticut, a stated objective of subdivision review is to insure proposed development adequately provides for drainage and flood control. Selected sections of a subdivision regulation that might address drainage, flood control, stormwater management and impervious surfaces include:

Policy or Purpose - This section should clearly state that it is the policy of the municipality to assure that the land proposed for subdivision is of such character that it can be safely used toaccommodate the intended use without danger to the communal health, safety and welfare and that proper provision be made for drainage, flood control, stormwater management, protection of water resources and any required municipal improvements.

Definitions - It is important for subdivision regulations to include definitions for key words used in the text. Definitions for; best management practices, buffers, curbs, catch basins, channels, culverts, detention basin, ditches, drainage, drainage facility, drainage system, driveway, drop pipe, easement, erosion, grade,

ground cover, gutter, impervious surface, infiltration, open space, parking space, pervious surface, point and non-point pollutants, porous surfaces, retention basin, runoff peak rate of discharge, runoff volume, sedimentation, septic system, sidewalk, stormwater management plan, stormwater runoff, sub grade, swales, watershed, wet ponds, etc…

Site Location Map - show the location of the proposed subdivision within its local watershed and delineate streams, rivers, water bodies and wetlands within that watershed. Also show all areas in the watershed subject to a 100-year flood. Major known and inferred aquifers should also be delineated.

Stormwater Management Plan (As part of the Subdivision Site Plan) - As drainage and stormwater management are among the most critical public improvements within a subdivision, the applicant must show the planning commission that the proposed subdivision will have no adverse impact on existing drainage facilities and will protect or enhance the community's water resources. A critical area to be addressed is the ability of the proposed development to accommodate existing upstream drainage and prevent increases in downstream flooding. A sound stormwater management plan addresses not only quantity of water to be generated by the new development but also how that development will be protective of water quality. To adequately determine the impact a proposed subdivision might have on water quantity and water quality; the subdivision regulations should require the submission of a detailed Stormwater Management Plan. It is suggested that any stormwater management plan be based on the following principles:

- Encourage on-site infiltration of water rather than diversion by impervious roads, parking areas and drainage structures. Diverted storm water alters the natural hydrologic cycle producing increased runoff and flooding.
- Development should retain the natural landscape by minimizing grading and disturbance of existing vegetation. Storm water management systems should utilize natural drainage patterns.
- Compensate for development impacts by protecting and enhancing riparian buffers.
- Minimize impervious surfaces and encourage permeable paving.
- Permit flexible road designs to create narrow, gently curving, porous roads draining to grassed swales rather than wide, straight impervious roads draining to curbs and storm drains.
- Permit shared and porous paved driveways and sidewalks.
- Stormwater should be carried as sheet drainage, diffused over large surfaces such as the face of gentle slopes, as opposed to concentrated drainage directed to curbs, storm sewers or ditches.
- Where pipes are used, encourage perforated over closed pipes to allow leaching or filtration.
- Drainage from roads, parking and roofs should be carried on the surface in shallow, gently sloping swales. Swales regulate velocity, minimize erosion and maximize percolation.
- Curbs, catch basins, storm drains and imperviously lined ditches should be avoided in favor of open swales. In areas where curbs are necessary, their length should be shortened to minimize stormwater volume and velocity.
- Look at total watershed drainage patterns not just those at the project site. Closing or restricting natural drainage ways should not be allowed as uphill drainage problems could result.
- The applicant must assess watershed and site characteristics before suggesting detention and retention ponds. Before approving any structural drainage system the commission must be assured it is appropriate for the entire drainage basin, as well as the proposed site. For example, in many watersheds, regional rather than site specific detention ponds may have less adverse impact on receiving waters.
- Construction activities should be coordinated and conducted in staged or limited time frames, taking advantage of low flow seasons. The contractor may be required to do any major clearing during winter months when the ground is frozen to minimize erosion and sedimentation and to avoid wildlife nesting and breeding seasons.
- When the proposed subdivision is crossed by a watercourse or drainage way there should be a stormwater easement or drainage right-of-way provided of such width and construction as determined by the commission.
- Where public storm sewers are accessible, connections shall be made in accordance with applicable construction standards and specifications.

Review and Revise Road Standards - Generally one objective of subdivision regulations is to insure that the proposed subdivision is served by roads that meet local standards designed to safely provide for present and future traffic needs. In most instances, this means the developer must construct new roads that comply with locally adopted road construction specifications. In some communities these specifications are found in the subdivision regulations while in other they are found in local ordinances and cross-referenced in the subdivision regulations.

While traditionally the main objective of road design has been to move vehicular traffic as swiftly and safely as possible, there is growing concern that roads are being "over designed" and many communities rely on a "one design fits all occasions" approach to road building. There is also a heightened awareness of the impact of roads on sprawl, pedestrian safety and environmental protection. As one of the major sources of impervious coverage, how roads are designed and where they are placed can greatly influence the quality of a community's water resources. Roads should be designed based on the function they will serve. A local road serving access to a few homes need not be built to the same standards as a collector or arterial roads serving higher density mixed land uses and greater traffic volumes. One of the key design elements local officials should review is the recommended widths of local roads. Road width should be based on the following four variables; traffic volume, design speed, lot width and parking needs.

Traffic Volumes - When dealing with existing and projected traffic volumes a simple rule prevails, the fewer the vehicles, the narrower the road may be. Many communities call for all roads to be built with a minimum width of 32' or 34' of pavement, or

two, adjacent 16' or 17' travel lanes. Research shows that for most local roads all that is needed is 20' or 24' road widths composed of two 10' or 12' travel lanes. In some of the recent Neo-Traditional Neighborhood Design Manuals, specifications for local roads, suggest 18' widths composed of two 9' travel lanes

Design Speed - As design speed declines, road widths narrow. Research shows that long, wide, straight roads produce higher traffic speeds and higher accident counts particularly fatal accidents. Local residential roads should be designed to provide safe access to home sites and not as mini raceways. Research shows that narrow streets are the safest. For example, a study by Swift Associates and the City of Longmont, Colorado looked at 20,000 automobile accidents over an eightyear period and found, "The most significant casual relationships to injury and accident were found to be street width and street curvature." According to the Swift Report, "... as the street widens, accidents per mile per year increases exponentially, and that the safest residential street width is 24 feet."

Lot Size - Another planning variable that effects road design is the size of the lots the road will serve. As a general rule, large lots with long widths and long front yards require less on-street parking. Large lots by their very nature generally have enough area to accommodate on-site parking. Hence roads serving large lots do not have to designed with on-street parking lanes and thus can be quite narrow.

Parking - If the function of the road is to provide overflow parking from adjacent sites, an extra lane or two of roadway parking is required. However, one should not assume that every road needs to accommodate off-site parking. In neo-traditional design, on-street parking is only provided where densities exceed 4 dwelling units per acre. When on-street parking is needed lanes of 8' or 9' are provided.

One of the most common difficulties of gaining approval for narrow roads is objections from emergency vehicle operators such as policemen, firemen and ambulance drivers who predict awful consequences if proper access and adequate parking is not provided. The answer to such concerns is that the actual road right-of-way should still be the standard 50' or 60'. What is reduced is the paved portion of the right-of-way. If curbs are replaced with well-designed swales, those swales will more than adequately accommodate any squadron of emergency vehicles, including hook-and-ladder fire trucks. The swale to be effective as a stormwater filter must be designed with a sub-base equal to or exceeding that found under the best roads. The sub-base of the road extends to the swale. The only difference between how the road and swales are designed and built is that the road is covered with pavement while the swale is covered with grass. Many local officials confuse a ditch dug by a backhoe with a well-designed bio-retention swale and hence assume swales will not support heavy parking loads. A well-designed swale can serve as an efficient filter of polluted stormwater runoff as well as a safe parking area for cars and emergency vehicles.

When the four variables of traffic volume, design speed, lot size and parking needs are considered it becomes evident that road design, particularly road width will vary based of the function the road will serve. Reducing road widths from 32' to 20' will produce a 6 Percent reduction in impervious area. When this reduction is applied on all local roads, it can result in a substantial reduction of the impervious coverage in your town.

Review and Revise Wetland Regulations - (APPLICABLE ONLY TO CONNECTICUT)

Under Section 22a-42(c) of the Connecticut General Statutes, each municipality is required to establish an Inland-Wetlands and Watercourses Agency. Once established the Wetlands Agency must develop regulations to protect wetlands that conform to model regulations adopted by the Commissioner of the State Department of Environmental Protection. The Statutes state that, among other things, inland-wetland regulations must include criteria and procedures for application review. Section 7.5 of the DEP. Model Regulations entitled "Application Requirements" states that all applications will include information in writing or on maps regarding; the proposed activity, proposed erosion and sedimentation controls, other management practices and mitigation measures which may be considered as a condition of issuing a permit including measures to (1) prevent or minimize pollution, (2) maintain or enhance environmental quality or (3) restore, enhance and create productive wetlands.

Section 2 of the Model Regulations deals with Definitions and subsection 2.1 defines "Management Practice" as a procedure, activity, structure or facility designed to prevent or minimize pollution or other environmental damage or to maintain or enhance environmental quality. The Model Regulations list selected examples of such practices including; erosion and sedimentation controls, land use restrictions, setbacks, waste disposal, equipment maintenance to prevent fuel spillage, methods of construction to prevent flooding or damaging wetlands, maintenance of continual stream flow and time restrictions on in stream construction.

Wetlands Agencies thus have the legal right to ask applicants to address the issue of land use impacts on water quality and, if they so desire, may require specific information regarding the impacts of impervious surfaces on wetlands and watercourses. To this end, if the commission wishes to get more specific regarding stormwater management practices, Section 7.5 might include the following:

- As the Wetlands Agency is particularly concerned with the adverse impacts of polluted storm water runoff on wetlands and watercourses, applicants shall submit a detailed Stormwater Management Plan that indicates how the following principles will be addressed:

- Minimal site disturbance and retention of existing vegetation, especially native species.
- Retention of the natural landscape by avoided grading and regrading.
- Utilization of natural drainage patterns.
- Impervious surfaces kept to a minimum.
- Stormwater to be managed on-site with no greater runoff post development than existed prior to development
- Infiltration should be the primary method of stormwater management, where feasible
- Protect and enhance existing riparian buffers to offset adverse development impacts
- Minimize direct discharge of runoff to wetlands
- Proposed development is capable of receiving upstream drainage and will not contribute to downstream flooding
- The Plan shall address water quality as well as water quantity
- Investigate the applicability of regional stormwater facilities.

Appendix A

Recommended Outline for a Watershed Master Plan

1. Watershed Boundaries and Characteristics
A. Topography
B. Land Use and/or Land Cover
C. Wetlands
D. Watercourses
E. Soils
F. Impervious Cover

2. Watercourse Inventory
A. Hierarchy of Streams
B. Aquatic Habitat Quality
C. Bed and Bank Characteristics-Scour and Deposition Areas
D. Pools and Riffles
E. Direction of Flow and Discharge Points

3. Hydrology
A. Rainfall
B. Runoff Coefficients
C. Storage Capacities
D. TR-20 Computer Runoff Model Data
E. Low Flow Evaluations
Management Structures

4. Hydraulic Structures Location, Size and Condition of:
A. Culverts
B. Bridges
C. Dams
D. Storm Drains
E. Detention/Retention Ponds and other Storm Water

5. Water Quality Surveys
A. Known Point and Nonpoint Sources of Pollution
B. Water Quality Monitoring Test Results
C. Macro invertebrate Surveys
D. Base Flow and Runoff Sampling

6. Projected Quality Models
A. Impervious Surface Build-Out Analysis
B. Nutrient Load Analysis
C. Identify Potential Problem Areas

7. Management Alternatives
A. Land Use Planning-Areas To Be Developed and Preserved.
B. Site Design Review Standards to Reduce Impervious Coverage.
C. Best Management Practices
   1. Naturalistic-porous paving, bio-retention swales, buffers, infiltration into open space.
   2. Structural-pipes, storm drains, sewers, filters, trenches, dry and wet ponds.

8. Management Implementation
A. Revisions to Town Natural Resource Inventory, Town Plan and Open Space Plan.
B. Revisions to Zoning, Subdivision and Inland-Wetland Regulations.
C. Revisions to Town Road Standards.
D. Public Education for local officials and selected landowners.
E. Suggested Changes in Local Policies Regarding Maintenance of Roads, Parking Areas and Community Facilities.
F. Capital Improvements Plan-Who will do what, when, why and how much it will cost.

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