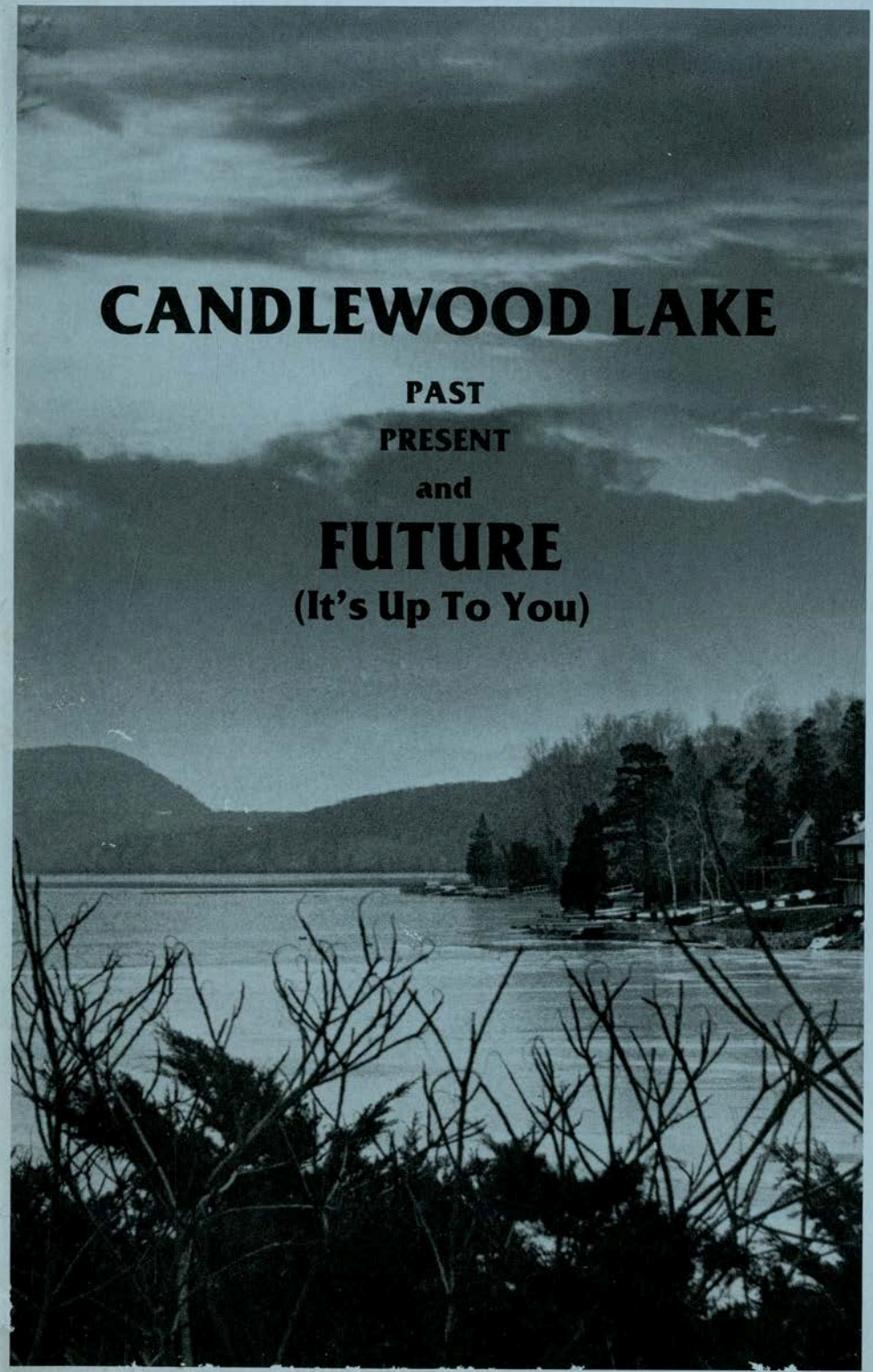
CANDLEWOOD LAKE
PAST
PRESENT
and
FUTURE
(It's Up To You)

A.C.W.A.

AFFILIATED CANDLEWOOD WATERSHED ASSOCIATIONS

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WATER CYCLE

When the earth was formed a fixed volume of water was present; no new water has been added since that time. This water, in its various forms of ice, water and vapor circulates in a never-ending cycle known as the hydrologic cycle.

Text prepared by
Helen Sullivan

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FORWARD

We who live in the Candlewood Lake area are fortunate in having the opportunity to enjoy the largest, and one of the most beautiful lakes in Connecticut. Candlewood Lake is not only an economic asset and a source of hydroelectric power, but more importantly, is a source of beauty and solace where we can enjoy swimming, boating, fishing, or just contemplation.

Unfortunately, the condition of our Lake has rapidly deteriorated over the last fifty years, and as a recent Department of Environmental Protection (DEP) study indicates, it is in advanced stages of eutrophication.

This booklet is designed to assist concerned citizens in understanding the process of eutrophication and its control through the management of the Lake's surrounding watershed. In it we will cover a brief but fascinating history of the Lake, its present condition, and finally, what we can do individually and collectively to restore and protect our lake's future. We hope that this booklet will serve to inform and motivate everyone to do what (s)he can to help save our Lake.

First, let us look at the unique way in which our Lake was formed...

HISTORY: From a Valley to Candlewood Lake

At the beginning of July, 1926, there was a rural valley stretching 10 miles between the rolling hills of Brookfield and New Fairfield to the east and west and bounded by Danbury, New Milford and Sherman to the south and north. Dirt roads wound through the valley, passing 35 farmhouses, fording the Rocky River and encircling five ponds whose shores were dotted with summer cottages. An apple orchard and nearby mill were nestled in the south end of the valley.

On July 15, 1926, Connecticut Light and Power Company's (CL&P's) board of directors approved a plan. It would be unique: The first (large-scale) operation of pumped storage facilities in the United States. By creating the lake and pumping it full of water from the Housatonic River, then letting the water pour down an immense pipe called a penstock and into a turbine, the utility could produce electricity.

The plan went into effect almost immediately after the July 15 meeting. Within weeks, an army of 50 surveyors swarmed into the valley, and lawyers were hired to process the deeds transferring land held by some families since before the American Revolution into the hands of CL&P. The utility had the power of public domain and so the farmers sold their land - $2,356 for 53 acres, $3,000 for 34 acres, $100 for 3¼ acres.

It took only 26 months to turn the valley into the lake. Starting in late July, 1926, nearly 1,400 men labored to create Connecticut's largest body of water. About 500 of those men, imported from Maine and Canada, hand-felled 4,500 acres of woodland, burning the lumber in massive bonfires - reminiscent of Indian campfires that once burned in the valley centuries earlier. Several dams were built, the largest at the north end of the valley, which upon completion measured 952 feet wide and 100 feet high.

On February 25, 1928, the first pumping operation began pouring water into the valley from the Housatonic. Engineers had planned on the Rocky River and its tributaries filling the valley one-fourth of the way, with the generating plant pumping the remaining three-forths of the water out of the Housatonic. The valley filled quickly and only 7 months later, on September 29, 1928, the water reached an elevation of 429 feet above sea level and Candlewood was considered complete.

Even before the lake's filling was completed, it became apparent it would become something more than the engineers had planned for - a lake of such beauty it would draw summer vacationers from as far away as New York City to gossip the lake's charms around the Northeast. Land prices on what would become the shoreline had already jumped to an unbelievable $1,000 an acre and summer developments sprang up almost immediately. Soon the area would be known for three things: Hats, the Danbury Fair and Candlewood Lake.

Although it was almost called Lake Danbury, Candlewood Lake ultimately got its name from New Milford's Candlewood Mountain - which was named after Candlewood trees, whose sapling branches were sometimes used as candles by early settlers.

STATISTICS - Candlewood Lake

Watershed Area	(acres)	25,860
Lake Area	(acres)	5,420
Length	(miles)	11
Width - Widest	(miles)	2
- Narrowest	(feet)	500
Shoreline	(miles)	60+
Maximum Depth	(feet)	85
Average Depth	(feet)	29-30
Volume	(million cubic feet)	7,500

EUTROPHICATION - What is it?

1. Eutrophication is the process of lake aging, caused by enrichment of the lake with nutrients from its surrounding watershed. During the aging process many lake characteristics undergo dramatic changes. Algae blooms increase; beds of aquatic weeds become dense and more extensive in coverage; sediment deposits accumulate and shoal areas develop; the lake becomes shallower; and the oxygen level in the bottom waters declines. As these conditions become more pronounced, recreational opportunities become seriously impaired. Ultimately the lake is transformed by eutrophication into a wetland - a swamp, marsh, or bog.

The Rate of Eutrophication

The rate at which eutrophication advances is determined by the rate at which the lake is fertilized by its watershed. Under natural conditions, nutrient inputs from a forested watershed are minimal and it may take centuries for a lake to change in appearance. However, man's development and use of the watershed (cultural eutrophication) inevitably results in a greater nutrient input. If man's activities are not controlled, severe eutrophication can occur in a matter of decades. It is this unnatural, accelerated eutrophication which can and must be slowed down and controlled.

2. Phosphorus - The Limiting Nutrient (The key to controlling eutrophication). In order for any form of life to grow and multiply, nutrients (the basic building blocks of life) must be available in the environment. In a lake, algae and aquatic plants depend on the nutrients - carbon, nitrogen and phosphorus - in the water column in order to grow. Phosphorus is the nutrient that is there in the shortest supply. Therefore, it is the nutrient which will first become depleted as the plants grow. When the

phosphorus is totally depleted, the growth of the plants will stop even though other nutrients are still available in surplus. Phosphorus, therefore, is referred to as the "limiting nutrient", for as we limit the amount of phosphorus we simultaneously limit the amount of plant and algae growth. The key to controlling the eutrophication process, therefore, is to limit the amount of phosphorus entering our lake.

3. Stages of Eutrophication - There are three basic stages of eutrophication used to describe the age of a lake.

A. Oligotrophic: Early stage of aging - (deep clear water - limited nutrients, plants and sedimentation)

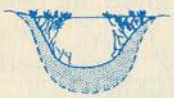

OLIGOTROPHIC LAKE

B. Mesotrophic: Middle aged lake - (increased organic + nutrient content + sedimentation, increased weed and algae growth)


MESOTROPHIC LAKE

(1) early-mesotrophic
(2) mid-mesotrophic
(3) late-mesotrophic

C. Eutrophic: Final stage of a lake before its death (high plant nutrients, excessive algae, oxygen depletion in bottom waters + fish kills).


EUTROPHIC LAKE

The above stages are also referred to as Trophic States. These trophic states are not rigid and a lake for example, may be classified eutrophic in some areas and mesotrophic in others.

Let's now take a look at the findings of some recent scientific studies indicating Candlewood Lake's stage of eutrophication...

SCIENTIFIC WATER QUALITY TESTING

1. Findings of Recent Studies on Candlewood lake:

   - Connecticut Department of Environmental Protection - Phase I Diagnostic/Feasibility Study - 1983 of Candlewood Lake (samples taken 1979-1981) indicates lake was in mid-mesotrophic to late mesotrophic state.
   - Western Connecticut State University (WCSU) - Dr. Peter Siver, Candlewood Lake Project - May 1983-May 1984 indicates lake is in late mesotrophic bordering on early eutrophic state.

Dr. Siver's 1983-84 study revealed that: Phosphorus levels in surface water at the bay sites were about 1.5 to 2 times greater than those from open water sites and represented lakes in late mesotrophic bordering on early eutrophic conditions. Phosphorus levels at the open water sites were similar throughout the summer and were indicative of mesotrophic lakes. Increased phosphorus levels generally indicate an increase in the eutrophication process.

In all instances where sites from the present study could be compared to ones sampled in 1981 by the DEP, it was found that mean phosphorus concentrations had significantly increased. Dr. Siver feels that the enhanced phosphorus levels in the bays are a result of inputs of nutrients from the watershed. Additional studies are needed to

broaden our knowledge of nutrient sources so that appropriate control measures can be undertaken.

2. The purpose of a scientific water quality testing program is to describe and evaluate a lake's physical, chemical and biological condition and trophic status, and to determine to the extent possible, the causes and sources of a lake's water quality problems. The data results from this testing must be compiled over a series of years in order to be an accurate and effective indication of the status of the lake and its rate of change.

   Such a data base is essential to a long range study of Candlewood Lake because it will be used to:

   A. Observe seasonal trends
   B. Flag potential problems
   C. Plan future research programs
   D. Plan and evaluate the effectiveness of lake management practices.

In May, 1984, the Limnology Lab at Western Connecticut State University (WCSU) successfully completed the first year of data collection from Candlewood Lake. It is essential that an ongoing monitoring program be continued without interruption since an up-to-date data base is the first step toward the successful control of eutrophication.

Your support is needed for the continuation of this important project. It's especially important, since the DEP isn't planning any further studies of its own in the forseeable future.

THE FUTURE - What can be done?

Control Techniques - There are two basic categories of control measures for lake problems: Treating the symptoms and treating the causes.

There has been much discussion and perhaps criticism about the value of treating symptoms (weeds and algae) since they bring only temporary "cosmetic" results. For example, if you eliminate the weeds without reducing phosphorus levels it is likely that increased algae growth will result. However, short-term actions (on weeds and algae) coupled with a long-term program to treat the causes constitute a valid lake management plan.

Watershed management practices to control erosion, sediment and nutrient runoff into the lake would be an example of a long-term approach to treat the cause. As with any illness, the symptoms and the causes should be treated simultaneously. However, let's begin with the most important of the two and look at the control techniques for treating the causes of our lake's problems. The following recommendations are taken primarily from Connecticut DEP's "Watershed Management Recommendations" of the 1983 Diagnostic/Feasibility study of Candlewood Lake.

A. TREATING THE CAUSES

The key to controlling the eutrophication process is to control the amount of phosphorus entering our lake. Therefore, the following are ways we can all help to limit the amount of phosphorus (and other nutrients) and sediments entering our lake.

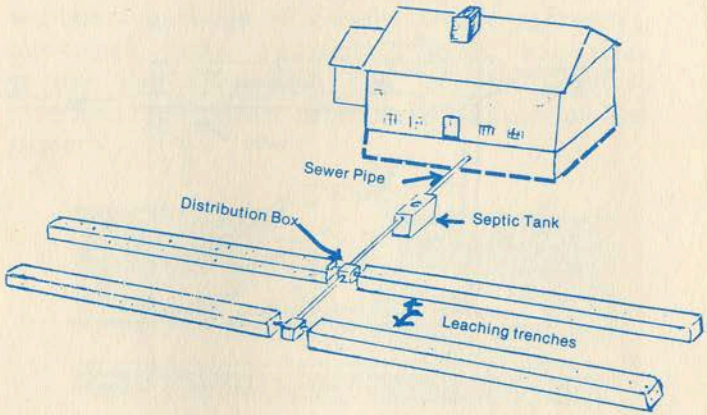
1. **Residential Land** - Things YOU can do to help save our lake.

   An acre of residential land will contribute much more phosphorus to a lake than an acre of woodland in the same location. A recent DEP report indicated that inadequate septic systems are probably the leading source of phosphorus enrichment from the watershed.

HOW THEY WORK:

Most lakeside residents have a septic system to dispose of their waste water. The septic system is usually a two part treatment method which uses physical + biological processes to reduce the waste to a harmless liquid which then enters the ground. Buried in the ground, the system is connected to

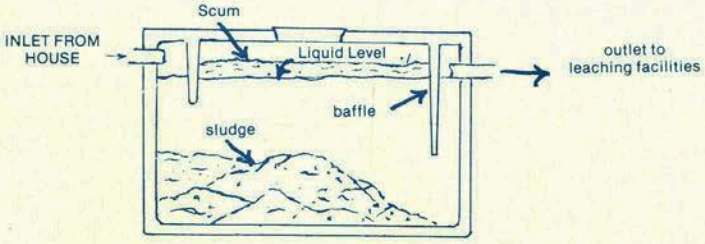
TYPICAL SEPTIC SYSTEM



the residence by a pipe a minimum of fifteen feet long which then enters a septic tank the size of which is determined by the size of the home and the soil conditions as determined by a percolation test. This solid walled tank is connected to a leaching field or perforated tank which permits the liquid part of the waste to enter the soil. The septic tank is a sealed unit which collects

the sludge or solid wastes while a layer of grease and fats or scum collects on the top. All these layers must be removed by periodic pumping. Bacteria living in the septic tank help reduce the sludge by breaking down some organic solids into liquid components, which then run off into the leaching fields.

Septic Tank



WHY SYSTEMS FAIL:

- If the sewage effluent cannot soak into the soil the waste water backs up into the home, or, more frequently, overflows over the top of the leaching field. If a system is not pumped out frequently, the scum or sludge from the system can overflow into the leaching field. When this happens the soil surrounding the leaching area becomes clogged and water will not run off.

- High ground water can also affect the failure rate of septic systems. During rainy seasons the water table or level of water in the ground rises. If this water reaches the

septic system the ground water fills in the leaching field and finally the septic tank. This may be corrected by the installation of underground water diversion drains called "curtain drains" to keep water out of the system.

- A system that was designed inadequately, without consideration for the number of residents in the household or of soil conditions, can fail prematurely. It should be noted that there are now state approved "non-flush" toilets which cut water usage almost in half, allowing marginal septic systems to function properly due to reduced loading.

- High water usage which may include dishwashers, garbage disposals, water softeners, backwash from swimming pools, excessive grease and frequent use of the washing machine can cause premature failure of the system.

Tree roots may also block the effluent pipes. Prudent landscaping can prevent this problem. First a root hair may enter the pipe to obtain water. As the root hair becomes larger, great pressure can be exerted upon the pipe until it breaks. This upsets the effective elimination of waste water into the soil.

Failing systems, in effect, do not allow the soil to retain phosphorus (remove phosphorus from the sewage) and therefore contribute more phosphorus to the lake, in addition to bacteria, which is a public health hazard.

INDICATIONS OF SYSTEM FAILURE:

- Sewage odor near the installation site.
- Slow-running or backed-up drains.
- Areas of lush vegetation over the septic system.
- Time...normally three years or more since the last pumping.

Before you panic . . .

Since there are many possible reasons for a septic system failure, it is important to determine the exact cause of a particular failure in order to avoid the useless expense of a repair attempt which does not address the problem. The first step, which the homeowner can do, is to uncover the septic tank and distribution boxes. In the tank: are the baffles in place? Are there cracks or tree roots? Can water be heard pouring in even when all fixtures are turned off? (This indicates a leaking fixture, a surprisingly common problem.) Lift the distribution box lid; is the box filled with sludge? Does liquid flow into all the outlet pipes? Is a pipe clogged with tree roots or crushed? If none of these are the problem, then it is time to call a septic system installer.

PROPER MAINTENANCE

Good maintenance of septic systems cannot be over emphasized. Not only is it environmentally sound, but it is also economically sound. A replacement of your present system will cost thousands of dollars, while a typical pump-out costs less than $100. Testing and repair of faulty septic systems should be done promptly on indication of any problem. The design and construction of new septic systems within the watershed should be in compliance with local sanitary codes, especially on sites near the lake.

Local health officials should also evaluate septic systems in summer cottages converting to all year-round systems.

PREVENTIVE MAINTENANCE INCLUDED:

- Schedule pumping normally at least every 3 years - older systems should be pumped and inspected more frequently.

- Don't dispose of grease, fats, solvents, chemicals or medicines into the system. They can cause clogging or interfere with the biological treatment process.

-Avoid the use of garbage disposals and water softeners (especially with backwash systems).

- Practice water conservation in the home - excessive quantities of water will reduce the effectiveness of the septic system and lead to flooding of the leaching area.

The bottom line to all this is to show that there are many steps the homeowner can take to prevent his septic system from failing and many steps he can take to repair it if it does fail. It should also be realized that the Health Department understands the plight of the average homeowner with a failing septic system and will allow homeowners to try inexpensive repair techniques before requiring any large expenditure for a large-scale septic system replacement.

b. WATER CONSERVATION - BEGINS AT HOME

40%. . . . Toilet use accounts for forty percent of household water.

Here are some tips for cutting down on waste of toilet water: (a normal flush uses 5 gallons of water).

1. Don't use the toilet as a trash disposal.
2. Instruct children not to flush toilet just for fun.
3. Check for leakage. Add some food coloring to the tank and note if any appears in the bowl without flushing.
4. Consider water saving toilets or devices:
   - The simplest way is to fill two half gallon plastic bottles with stones and place them in the tank; you'll save one gallon per flush.
   - Bending the floating arm down will lower the water level.
   - Toilet Dams fit around tank exit hole and hold back one to two gallons per flush. Cost is approximately $15.
   - A new device provides a "half flush" for urine. If full flush is needed you merely hold the lever down for a complete cycle. Cost is approximately $15.

30% . . . . Bathroom - Sink + Shower

A bath often uses 50 gallons of water. A shower uses approximately 5 gallons per minute, depending on water pressure.

Some simple ways to reduce water use without sacrificing cleanliness or comfort are:

1. Checking all faucets for possible leakage. Most leaks can be repaired by simple replacement of washers or gaskets.
2. In filling a tub, close the stopper at once. Use the minimal amount of water necessary
3. Installing a flow reducing shower head can reduce water flow by one half.
4. Try reducing the length of your shower to 3-5 minutes.
5. Adding aerators to sink faucets will reduce water flow by one-half. Cost $2.
6. While shaving and brushing teeth, don't let water run needlessly.

15% . . . . Laundry use: 30 to 60 gallons per load.

1. Most important in cutting down water use is to make sure you are really washing dirty clothes.
2. Always run full loads.

10% . . . . Kitchen use.

1. Dishwashers use 12-17 gallons per load,
   - Run full loads only;
   - Scraping and wiping dishes can eliminate use of pre-wash cycle;
   - Phosphorus is contained in most dishwashing detergents - use sparingly and read labels.
2. Hand washing dishes - use minimum amount of water. Stack in a drain rack and using boiling water rinse all at once rather than individually.
3. A garbage disposal uses a great deal of unnecessary water. They also pose a serious problem for septic systems by adding the largest amounts of solid waste. Most experts recommend disposals should not be used with septic systems.

5%....Outside house use.

- Check for faucet and hose leaks.

c. NON-PHOSPHATE CLEANING PRODUCTS

The average person contributes about 4 pounds of phosphorus into the water each year, including the phosphate in human sewage. Phosphorus can generate 500 times its own weight in algae and aquatic plants. Thus, four pounds from one person can produce a ton of plant growth. Although the relative contribution from septic systems cannot be accurately measured, relatively poor soil conditions around Candlewood Lake do favor the travel of nutrients from septic systems into the lake. While human waste will always contain phosphate, we **can** however control the type of cleaning materials we use, thereby reducing the excessive phosphorus we presently find in our lake.

It was estimated at one time that half of the phosphates in municipal sewage came from detergents. Recent publicity regarding the amount and effects of phosphates in detergents has caused some changes in formulas. Most clothes washer detergents are now free of phosphate, as are detergents for hand washables and dishpan use. However, measurable amounts of phosphates are found in all detergents for automatic dishwashers although some do contain less/per load than others. Please read package labels carefully. The following recent 1985 listing may be of help. The most important figures to note are the "grams of Phosphorus Used/Per Load".

PHOSPHORUS CONTENT OF SOME COMMON DETERGENTS

Attention: Phosphorus content may may vary from store to store. **Please** read all labels carefully.

DETERGENT	PHOSPHORUS CONTENT - %	GRAMS OF PHOSPHORUS USED/PER LOAD
* Ajax	2.5%	2.0 gm/1 cup
All (Liquid)	0	0
* All (Powder)	trace	trace
* Amway SA8 Phos. Free	0	0
* Amway SA* Limited Phos.	8.1%	4.5 gm/per ¼c used
* Arm & Hammer	0	0
* Bold-3	6.1%	6.0 gm/1 cup
* Cheer	8.2%	6.1 gm/3/4 cup
* Cold Power	2.5%	2.0 gm/1 cup
* Dash	8.0%	5.8 gm/½ cup
* Dreft with Borox	8.2%	7.0 gm per 1¼ cup
* Dynamo	0	0
* Era	0	0
* Fab	6.0%	6.0 gm/1 cup
Fresh Start	14.7	5.7 gm/per ¼ Cup used
* Ivory Snow	0	0
* Purex	0	0
* Shaklee Basic L	0	0
* Rinso	trace	trace
Solo	0	0
* Tide	8.4%	6.3 gm/3/4 cup
* Trend	0	0
* Wisk	trace	trace
* Yes	0	0

Trace amounts contain less than 0.5% phosphorus. These formulas are made without phosphorus, however, the manufacturing equipment still has some residual phosphorus remaining from past use.

Note: * indicates a product is biodegradable which means that the ingredients (surfactants) are broken down by natural biological action. This capability helps to eliminate foaming problems in our lake.

AUTOMATIC DISHWASHING DETERGENTS

DETERGENT	PHOSPHORUS CONTENT - %	GRAMS OF PHOSPHORUS USED/PER LOAD
All	8.7%	2.4 grams/2 Tbsp.
Amway-8.7 Phosphate	8.7%	1.3 grams/1 Tbsp.
Amway-Soft Water Formula	6.0%	.9 grams/1 Tbsp.
Cascade	8.7%	2.1 grams/2 Tbsp.
Electra Sol	7.1%	2.1 grams/2 Tbsp.
Finish	8.7%	2.6 grams/2 Tbsp.
Shaklee Basic-D	8.7%	.86 grams/2 Tsp.
Shop Rite	8.7%	2.1 grams/2 Tbsp.

d. LAWN AND GARDEN MAINTENANCE

1. Over-fertilization or fertilizing especially before a rain storm can allow many nutrients to flow into the lake. It is recommended that residents near Candlewood Lake have soils tested so that fertilizers can be matched to soil nutrient requirements. Soil testing kits for this purpose can be purchased for a $2 fee from Fairfield County Extension Service in Bethel. Soil samples are analyzed at the University of Connecticut Cooperative Extension Service within several weeks, and the results identify soil nutrient deficiencies. If you feel you must fertilize your lawn, do so sparingly.
2. Disposal of vegetation - Lakeside owners should dispose ot all materials from yard maintenance activities, such as leaves and grass clippings, at suitable sites away trom the lake and its water courses. This will prevent vegetation from becoming a source of nutrient enrichment of lake waters. (Grass clippings and leaves make an active compost pile providing free fertilizer for gardening.) The use of a "pooper scooper" or other devices to rid your lawn of animal waste is recommended - especially important on waterfront property.

e. SHORELINE EROSION CONTROL

Shoreline Erosion Control measures should be utilized to minimize the amount of sediment entering the lake. Natural vegetation and construction of seawalls are some ways this can be accomplished. Generally, construction of seawalls and other structures below the 440' contour requires permission from

the land owner CL&P. General guidance on these and other steps can be found in the **Erosion and Sediment Control Handbook for Connecticut.***

f. WATERFOWL CONTROL

Large flocks of migrating waterfowl which stop at our lake for many weeks can contribute appreciable amounts of phosphorus and nitrogen to lake waters through their excrement. Efforts should be taken to discourage large flocks from using the lake. Do not feed waterfowl! The Wildlife Unit of DEP should be consulted for information on methods which might be appropriate for Candlewood Lake. Another helpful source of information is U.S. Fish and Wildlife Service.

g. AGRICULTURAL PRACTICES

Agricultural practices which minimize runoff from fertilized fields and from manure should be used.

2. Erosion, Sediment and Runoff Controls

All of the items in this section are subject to control by local town agencies.

Erosion is a natural process whereby soil is worn away from the land by running water.

Sedimentation is the deposition of the eroded material into a body of water. Some erosion and sedimentation from a watershed is inevitable, but it can be greatly increased by activities of man which disturb the land, remove vegetation and expose soil to the direct forces of rainfall and surface runoff.

Erosion contributes to eutrophication in several ways. Soil particles containing phosphorus and other plant nutrients are added to the lake. Sedimentation reduces water depths creating shoals that encourage weed growth. Also, organic matter associated with the soil is decomposed by lake bacteria, contributing to the depletion of oxygen in the water.

a. **Construction Site Activities are a serious source of erosion** which can occur anywhere in the watershed and are considered a major causative factor in the lake eutrophication process. Some of the erosion control methods are site planning, vegetative control - seeding, sodding and tree planting. Other methods are hay bale checks, mulching, land grading and structural controls.

   Recent legislation mandates the adoption of municipal erosion and sediment control by July 1, 1985. Lake residents and lake users should urge their town to adopt and utilize erosion and sedimentation ordinances in their subdivision and zoning regulations.

b. **Roadway Runoff** (sand, leaves, topsoil) can be a significant source of sediments in lake watersheds. Some of the management techniques that should be taken by local towns are care in sanding operations and early spring street cleaning; the stabilization of road banks with vegetation and proper grading, and the grading and surfacing of unpaved roads. Another important factor is having properly designed and maintained roadway drainage systems. The towns should have a regular program of catch basin cleaning and maintenance. Additional catch basins should be installed if needed.

c. **Woodland and Timber Harvesting**

Harvesting of timber for firewood or lumber is a land disturbance activity which has the potential to cause serious erosion and sedimentation. Local towns should adopt policies on timber harvesting which utilize the best management practices to control erosion and sedimentation. A good source of information is **Logging & Water Quality in Connecticut*.**

d. **Wetlands**

Scientific research has shown that Wetlands in a lake watershed play a vital role in regulating the timing of transport of phosphorus to the lake. Wetlands also help control flooding which could cause erosion and sedimentation. Approximately 4% of the land area in our watershed consist of wetlands. It's critical that local inland/wetland agencies continue to maintain the existing wetlands in their present natural states since this will aid in protecting our Lake's water quality.

B. TREATING SYMPTOMS

Now let's take a look at some of the ways of treating symptoms (weeds & algae).

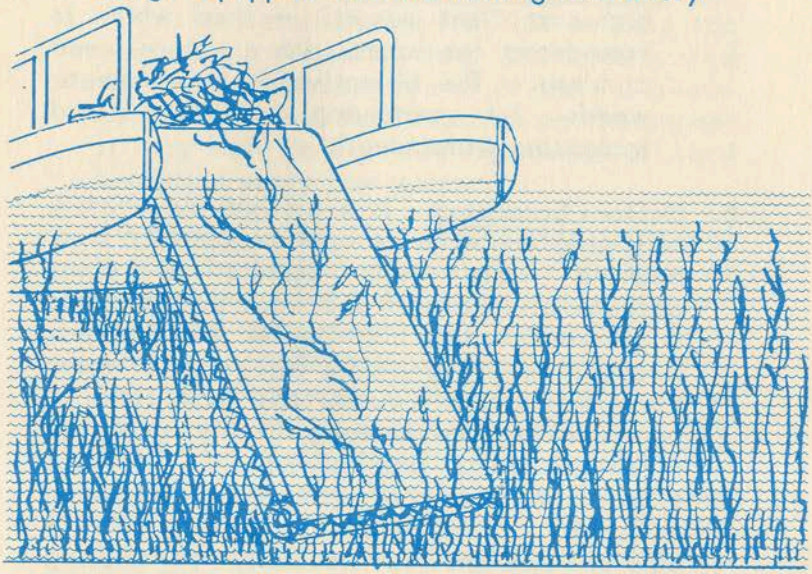
1. **Weed Control** - Aquatic plants (macrophytes) growing in our lake are a natural and normal occurrence. In moderation, aquatic plants are aesthetically pleasing and environmentally desirable. However, when a lake becomes nutrient rich, these plants occur in greater quantities and can interfere with recreational water use and may become a problem. (The weeds that need to be controlled in Candlewood Lake are primarily milfoil, and pondweeds).
   Because weeds are a necessary part of the ecological system of our lake any weed control program adopted should be based on the most thorough evaluation of its potential impact on the environment. The following are some ways in which these weeds may be controlled:

   a. **Harvesting** - is one method which physically removes plants from the lake. There are several advantages to this approach. Nutrients such as phosphorus in the water are taken up by the weeds during their growth process. Thus, when the weeds are harvested and removed from the lake, so are their nutrients (which would have stimulated algae growth.) If the weeds had been left to die either naturally or through chemical control, the nutrient levels would have increased. It is important that harvested weeds be removed from the water; as certain species such as Eurasion Water Milfoil propagate by fragmentation. That is, once cut, the cuttings float until water-logged, sink and become rooted to form new plants.

Harvesting may be done in several ways:

1. Hand Harvesting: This involves simply pulling or cutting the plant near the roots. This can be done by wading, from boats or from dockside. Scuba divers may be used in deeper water, (as was used most successfully at the New Fairfield Town Beach for the past few years). Rakes can be used to help pull up weeds or they may be cut easily by sweeping a three foot long $\frac{1}{4}$ inch fiberglass rod back and forth across the lake bottom. Weeds will float to the surface and should be gathered, dried and disposed of (away from the lake), preferably used as a good compost.

2. Mechanical Harvesting: This involves cutting the weeds below the water line but leaving the root system intact. This is done with the use of a specialized barge equipped with harvesting machinery

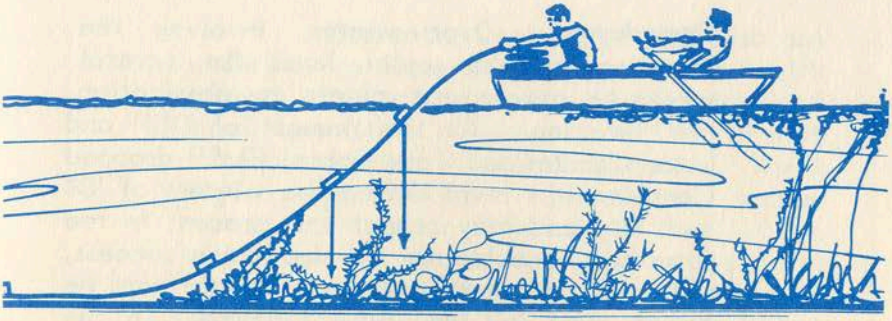


which gathers up the weeds. It is designed to control rather than eradicate weeds. Depending on weed regrowth, it may have to be repeated later in the season during the first few years. Several studies have shown however, that after the second or third year there is a noticable reduction in weed growth. This method may be competitive with the cost of chemical control. Harvesters may be rented by individuals or groups.

3. Hydro-Rake: Combines the best features of a dredge and mechanical harvester in that the roots of the aquatic plants are removed along with the stalks and foliage, thereby having longer lasting results. It is a specialized barge which works from the water. Danbury first used the hydro-rake successfully on their town beach in 1983.

4. Hydraulic Dredging: Is a complex, high-cost "last resort" method which is considered for lakes with a severe weed problem. The objective is to eliminate weeds by removing sediment and increasing water depth.

b. **Bottom Screening:** Is a method by which a screening material is applied directly over existing weeds and results in plant decomposition over a 2-3 week period. This is accomplished by blocking out the sunlight. Because decaying plants left in the water increase nutrient levels, the best time to apply the screen is early in the spring or after the weeds are harvested. The ideal type of material to use is a closely woven fiberglass screen which shuts out 50% to 60% of sunlight (a necessity for killing weeds) yet allows gases to escape during



decomposition. It is applied in sheets and is pinned or weighted down on edges. Some people have used heavy black plastic but it should be noted that because of gas build-up, many holes should be made in the plastic and it must be weighted down quite well. The advantages of bottom screening are that there is immediate control of existing weeds; it prevents new weed growth; solves the problem of disposing of harvested weeds and may be the best long-term solution in limited sized areas. Although the initial cost is high, in the long run it is relatively economical because the screening material is inert and is estimated to have a minimum life of at least 10 years. Because of sediment build-up on the screen it may have to be taken up, rinsed off, and reapplied every few years.

c. **Herbicides:** Provide for effective control of weeds by killing plants in local areas of application. The effects are temporary, and repeated treatments on an annual basis would be required to maintain control. Any use of chemicals in Candlewood's waters must be in accordance with the DEP Pesticides Unit Permit Process and DEP policy. However, in 1983, due to concern about their safety by the State Health Department, the use of the chemicals 2-4D and Diquat were prohibited.

d. **Drawdown:** Over winter, involves the lowering of the water level for several weeks to expose the plants to dessication and freezing. At the request of DEP and Lake Candlewood Task Force, CL&P dropped Candlewood's level during the winters of '84 and '85, and may repeat this process in the future. To evaluate the drawdown success, it is essential that new weed growth maps be drawn up in the later summer to be compared to those made in prior years. This is just another example of one of the important functions that on-going testing will accomplish.

e. **Excavation:** This method employs conventional earth moving equipment to remove dry sediments during drawdown in areas where a firm base underlies sediments. At Candlewood, authorization is required from CL&P which generally owns land below the 440' contour."

2. **Algae Control** - Algae are primitive plants that grow suspended in water or attached to the lake bottom. They contain chlorophyll, but lack roots, stems and leaves. Some areas of Candlewood lake have recently experienced late summer blooms of filamentous blue-green algae, which were aesthetically unpleasant and interfered with recreation in localized areas. The following are various methods of algae control:

Chemical Algicide Treatment: Is conducted for temporary, cosmetic relief from nuisance algae blooms. Copper sulfate is often used. Since the timing and amounts of the chemical to be introduced into the water are critical the dosage should be determined by professionals in order to avoid unwanted side effects.

Currently, scientific studies are underway to determine if any chronic health effects are produced by the ingestion of small quantities of copper. A DEP permit is required prior to each application. When algae are killed without a proper management system, the oxygen level of the water can be so reduced that animals can be significantly affected. Also toxicity to fish could result in fish kills if dose is not carefully controlled. When chemical treatment for algae control is used, the killed algae settle to the bottom sediment and increase the amount of phosphorus in the lake.

Other chemicals are also being experimentally used to precipitate soluable phosphorus from lake waters.

Artificial Aeration: Various pumping methods may be used to increase oxygen levels in the lake water column to prevent anoxic recycle of plant nutrients from the lake bottom sediments.

Hypolimnetic Withdrawal: Or "siphoning" is a method in which the bottom water (which contains most of the nutrients) is removed, treated and discharged back into the lake. This method was started at Lake Waramaug in 1983, and appears to have increased water clarity significantly.

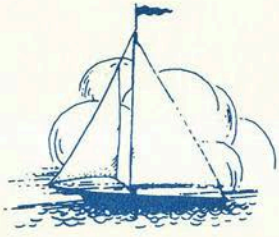
The last two restorative methods are high-cost measures which may not be required if we all become involved and support an effective watershed management program.

C. LOCAL TOWN'S ROLE

Our local town officials play a vital role in the future of Candlewood Lake. It is essential that they are informed on the subject of eutrophication and its control through proper watershed management, and are willing to take the appropriate steps necessary to restore and protect our Lake. All the towns on the Lake have been supportive of the 1983-1984 reorganization of Candlewood Lake Authority (CLA) which resulted in more emphasis being placed on water quality control and the hiring of an Executive Director. This is a necessary first step in forming a (long overdue) watershed management program.

Our town agencies and commissions also play a critical role by adopting, funding, and enforcing regulations that utilize proper water and land mnagement techniques. You can help by encouraging and supporting their efforts. It is also important to attend local public hearings when decisions voted on will affect the condition of our Lake's watershed area. There is a list of all your local town commissions and agencies provided at the end of this booklet.

It is essential for all of us to become informed and involved in order to control and hopefully improve the eutrophic condition of our Lake.



D. CONCLUSION

Through awareness and considerable effort and commitment, the eutrophication process is controllable and manageable. We hope that this booklet has served to heighten your awareness of the extremely vulnerable condition of our Lake and the important part that **you** can play in helping to slow the eutrophication process, and thus prolong Candlewood's life.

ACKNOWLEDGEMENTS:

ACWA wishes to express sincere appreciation for the assistance rendered by the following people and agencies:

Candlewood Lake Authority

Connecticut Light & Power Company

Charles Fredette, Connecticut Department of Environmental Protection

Dr. Peter A. Siver, Department of Biology, Western Connecticut State University

Paul L. Lockwood, Deputy Health Officer, Wetlands Enforcement Agent, Town of New Fairfield, Connecticut

Sherman Sentinel Newspaper

Ellen Burnett - Citizen News

Cover Photo by Jim Loya

Sally Conroy, Danbury - ACWA

Dave Halberstam, Sherman - ACWA

RESOURCE AGENCIES

LOCAL

INLAND WETLANDS
(Conservation Commission)

Brookfield	775-4224
Danbury	797-4595
New Milford	354-8047
New Fairfield	746-9847
Sherman	355-1139

TOWN HEALTH DEPARTMENT
(Town Sanitarian)

Brookfield	775-3422
Danbury	797-4625
New Milford	354-8047
New Fairfield	746-4339
Sherman	355-0166

ZONING COMMISSION

Brookfield	775-0586
Danbury	797-4525
New Milford	354-4889
New Fairfield	746-5252
Sherman	355-1139

PLANNING COMMISSION

Brookfield	775-4224
Danbury	797-4525
New Milford	354-7102
New Fairfield	746-3862
Sherman	355-1139

FIRST SELECTMAN
(Mayor)

Brookfield	775-2515
Danbury	797-4511
New Milford	354-5516
New Fairfield	746-2448
Sherman	355-1139

SOURCES OF PUBLICATION

COUNTY

USDA (Fairfield County)
Soil Conservation Service
District Conservationists - 743-5453
(USDA)* - (SCS)

(Fairfield County)
Soil and Water Conservation
District - 744-6108
(S&WCD's)*

(Fairfield County)
UCONN Cooperative
Extension Service - 797-4176
(UCONN)*

ADDRESS OF ALL OF THE ABOVE:

Route 6 - Stony Hill
Bethel, Connecticut 06801

REGIONAL (Planning Agencies)

Northeastern Connecticut Regional
Planning Agency (NERPA)*
P.O. Box 198
Brooklyn, Connecticut 06234
Tel: 774-1253

Northwestern Connecticut Regional
Planning Agency (NWRPA)*
Sakett Hill Road
Warren, Connecticut 06754

Housatonic Valley CEO
Old Town Hall - Route 25
Brookfield Center, Connecticut 06805
Tel: 775-6256

Connecticut River Estuary
Regional Planning Agency (CRERPA)*
Hitchcock Corners
Essex, Connecticut 06426

STATE

Connecticut Department of
Environmental Protection *
(Natural Resources, Water Compliances,
Water Resources, Wild Life & Forestry Unit)
165 Capitol Avenue
Hartford, Connecticut 06106

Connecticut Council on Soil
and Water Conservation (CCSWC)*
State Office Building
165 Capitol Avenue
Hartford, Connecticut 06106

Connecticut D.E.P
Conservation and Preservation Division
Western District Headquarters
RFD #4, Plymouth Road
Harwinton, Connecticut 06791
Tel: 485-0226

U. S. Fish and Wildlife Service
4 Whalley Street
Hadley, Massachusetts 01035

Candlewood Lake Authority
Jon Simpson, Executive Director
(CLA) - 354-6928

Conservation Officer:
George Barone
610 Bennett's Farm Road
Ridgefield, Ct. 06877
Tel: 438-9508

RESOURCE PUBLICATIONS

TITLE	*AGENCIES/SOURCES
Erosion & Sediment Source Inventory	CCSWC, S&WCD's
Erosion & Sediment Control Handbook for Connecticut	USDA, SCS
Model Erosion & Sedimentation Control Regulations	NERPA
Septic System Manual	DEP Water Compliance Unit
A Proposed Septic System Inspection & Maintenance Program for Killingworth, Ct.	CRERPA
A Voluntary Septic System Management Program for Canterbury, Killingly, and Woodstock	NERPA
A Voluntary Septic System Management Program for Quaddick Lake, Thompson	NERPA
A Homeowners Guide to Septic System Maintenance	NERPA
Logging & Water Quality in Connecticut - A Practical Guide for Harvesting Forest Products & Protecting Water Quality	Ct. 208 Forestry Advisory Committee

Best Road Maintenance Practices for Critical Watersheds	NWRPA
Connecticut Ag 208 Project	CCSWC
Inventory of the Trophic Classifications of Seventy Connecticut Lakes	DEP Natural Resources Center
Lake Management Handbook A Guide to Quantifying Phosphorus Inputs to Lakes	DEP Water Compliance Unit, Windham RPA

SOURCES OF INFORMATION

- A Watershed Management Guide for Connecticut Lakes, Connecticut Department of Environment Protection - Revised 1984

- Phase 1 Diagnostic/Feasibility Study Candlewood Lake - 1983, (Section V - Watershed Management Recommendations) Connecticut Department of Environmental Protection.

- A Preliminary Report on the Candlewood Lake Project for 1983-84, Dr. Peter Siver - Limnology Laboratory, Department of Biological and Environmental Sciences, Western Connecticut State University, Danbury, Connecticut 06810

- Connecticut Lakes - Recreation Areas...or Cesspools. It's Up To You, (COLA) Conference of Lake Authorities

- From Valley to Candlewood Lake - A History, Bob Chuvala, Danbury NEWS-TIMES Staff

E. ABOUT ACWA - **AND YOU!**
(Affiliated Candlewood Watershed Associations)

ACWA is a non-profit organization of your friends and neighbors who enjoy Candlewood Lake and want to preserve it for the pleasure it brings to us all.

We prepared this booklet to help you participate knowledgeably in the work ahead of us to save our Lake from destruction. Rather than watch passively as this tragedy occurs, you can join with us, and help to shape events so that Candlewood can be enjoyed by our children and grandchildren. If we all work at it, we can preserve Candlewood.

Organized in the summer of 1981, ACWA recognizes the need for a united approach to the whole watershed. We must all work collectively and individually to control those situations which affect the eutrophication process in Candlewood Lake.

Collectively, ACWA members have helped fight for the strengthening and improvement of the Candlewood Lake Authority in the five towns. We have pressured the CLA to devote more of its resources to "Water Quality" problems, and have appeared before Zoning Boards of Appeals, Inland-Wetlands Commissions and Health Officers on behalf of Candlewood's protection. We have labored to gain more cooperation in matters of water quality from CL&P, which owns the Lake. We have also financially supported WestConn's Lake Study and provided a boat used for collecting water and plant samples. The need for these actions can be expected to continue.

Individually, we can each follow the guidelines in this booklet so that we will not contribute to Candlewood's degradation. Each of us can contribute time and money to further ACWA's work. ACWA can provide the direction and focus for united action, but nothing much will happen unless you join in, too. Working together, we can achieve results.

The first step is to fill out and mail in the form that follows:

A C W A
AFFILIATED CANDLEWOOD
WATERSHED ASSOCIATIONS

Your contributions are deductible from your federal income tax. Mail your check with this form to: ACWA
P.O. Box 51
Sherman, Connecticut 06784

( ) Individual Membership $10

( ) Organization or Business Membership $50

( ) Contribution to the Continuing Research Study Program $_____

( ) I am willing to give some time.

NAME_____

ADDRESS_____

_____

PHONE_____

A.C.W.A.

AFFILIATED CANDLEWOOD WATERSHED ASSOCIATIONS

ACWA
P.O. Box 51
Sherman, Connecticut 06784

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