

FRONT COVER

Price \$3.00

Crystal Lake

Life or Death

Must Reading About Pollution in Crystal Lake

Non-Technical – Concise



Sponsored by the Ad Hoc Committee
of
Board of Public Works, Benzie County, Michigan

Author
R. William Decker

FRONT COVER

Photograph taken by the author, October, 1986, on the beach at his home located on the west shore of Crystal Lake of King Salmon after spawning in the shallows. This fish entered the Lake by jumping the dam at the outlet or is a descendent of fish which had entered the Lake in a similar way several years ago. Pollution was not the cause of death, but the photograph was chosen as an apt symbol for the possible destiny of the Lake.

BACK COVER

NASA Photograph from 60,000 ft. altitude of Crystal Lake and surrounding area. Infra red processing renders soil and trees as shades of red.

ACKNOWLEDGEMENT

We are deeply grateful to those individuals of the Ad Hoc Committee (1*) and other area residents who have financially underwritten the largest share of the cost of printing this book. Theirs was an act of faith, indicating trust and confidence in the author and the hoped for impact of publication.

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Decker, R. William, Chair, Ad Hoc Committee, Benzie County Board of Public Works, *"Crystal Lake - Life or Death"*, Benzie County, Michigan, 1987, 32 pp + 8 figures.

¹(*) Members of the original Ad Hoc Committee:

R. William Decker, Chairman; Joanne and Alan Applehof, Larry Bibbee, Howard Greene, Ralph Hand, Bob Long, Karl Martz, Max Mattison, Larry Sykora, John Vincent, Inez and Frank Zaring.

Members of the Benzie County Board of Public Works:

Bob Dodge, Doug Houser, Ray Kadlic, Bill MacMillan

ABOUT THE AUTHOR

Viewing the blue waters of Benzie County's Crystal Lake from the hills is a beautiful sight. Other ways to appreciate this glacial gift are on the shores, from a boat, from the air, or even from a diver's view under water. R. William (Bill) Decker has observed this Lake since 1951 from all these aspects. A native of Michigan with homes in Grand Rapids and Crystal West Shore, his interest as shared by many others is in maintaining what we have - a beautiful body of water.

When approached by the Benzie County Board of Public Works to chair the Ad-Hoc Committee dedicated to take some action for the preservation of the quality of the Lake, he accepted knowing first hand that education of the land owners and general public was the first and foremost need.

Bill's engineering background and contractor designer profession instinctively told him to investigate all of the studies made during the last 19 years and in so doing found a need to summarize and make meaningful the implication of the previous studies and reports.

After presentation to the Committee of the outline for the text, he has spent months developing a readable volume.

Robert Long

NOTE TO CURRENT READERS

As a prototypical Lake Owners' Manual, ***Crystal Lake - Life or Death (CLLD)*** is a significant book. It resulted from discussions by local citizens who formed an Ad Hoc Committee to the Benzie County Public Works Department. This Committee raised concerns about two issues: (1) present and future water quality problems of the Crystal Lake Watershed, and (2) absence of an equitable and effective plan for watershed management. At the time of its original printing in 1987, ***CLLD*** was one of the first Lake Owners' Manuals developed for riparian owners and visitors in Northwest Lower Michigan. It specifically addressed environmental issues facing the Crystal Lake Watershed (Benzie County, MI). ***CLLD*** has served well as a model for other Lake Owners' Manuals throughout Michigan. Its basic messages remain timely and are shared by many other riparian communities. Written in plain, non-technical language, the original text touched upon many issues: the water quality of Crystal Lake and Cold Creek, the impact of nutrients on the Watershed, the often opposing forces of government and development, the requirements of good septic systems, and the need for continued public education.

Crystal Lake, the 9th largest inland lake in Michigan, appears unchanged to the passing eye of history. Its long-time attraction as a major recreational resource has continued unabated for more than a century. Land and water use and development within the Watershed continues to intensify, however, and the needs for environmental sustainability and watershed management are very relevant. In the intervening 15 years since ***CLLD*** first appeared, new issues have arisen, such as intensified shoreline and ridgeline developments and invasions by exotic species, such as Eurasian Watermilfoil and the Zebra Mussel. These issues have been addressed in several collaborative monitoring studies conducted by qualified environmental professionals from local environmental organizations, and local and state government agencies.

The original intent of ***CLLD*** was the education of property owners and visitors. A series of annual "Updates" have been provided to the public, first by the Ad Hoc Committee, then by its immediate successor, the Crystal Lake Clean Water Committee, and now by its current successor, The Crystal Lake Watershed Fund, Inc. ^(2*) with its Science Review Panel^(3*). This tradition of public education has continued to date through fourteen "Updates", which have addressed pertinent environmental issues.

This edition of ***Crystal Lake - Life or Death*** is for reflection by previous readers, and for discovery and contemplation by new readers. It is reproduced here in its entirety (with minor editing and annotations) ^(4*).

Dr. Stacy L. Daniels, Crystal Lake Watershed Fund, Inc., January 22, 2002

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²(*) The Crystal Lake Watershed Fund, Inc. (CLWF) ([//www.CLWF.org](http://www.CLWF.org)), a nonprofit organization, was formed in July 1994 by merging the Clean Water Committee of Crystal Lake (focus on water quality monitoring) and the Friends of Crystal Lake (focus on land use and zoning). The CLWF supports citizen initiatives for water quality monitoring, septic system control, sustainable development, & land conservancy through education, for watershed management.

³(*) The Science Review Panel (SRP) of the Crystal Lake Watershed Fund, Inc. (CLWF) is active in developing consensus viewpoints by reviewing environmental issues of particular local interest and by providing scientifically sound recommendations where appropriate to the public. This involves review of CLWF sponsored studies, and assessment of studies conducted by other responsible organizations that have demonstrated performance in related areas.

⁴(*) Current footnotes in this reproduction are numbered and marked with (*) to distinguish them from original footnotes.

INTRODUCTION

Crystal Lake is in a life or death struggle. Weeds and algae are growing in the shallows all around the perimeter in increasing amounts, and if the present rate of increase is not checked, Crystal Lake will die in the sense that the clear water and clean sandy bottom will be gone - probably forever. No single agency or bureaucracy has the authority to provide a solution, and although tests and studies have been performed over the last nineteen years, no equitable, effective plan has been forthcoming. What is needed is a gathering of the facts and a workable solution which will stop the entrance of destructive ^(5*) pollutants into the Lake. This challenge must involve not only the shoreline residents but people living in other areas of the county and beyond - everyone who would have been able to enjoy what might be the finest Lake in the world. This book was written as a starting point in response to that need.

In the spring of 1985, the Benzie Board of Public Work (BPW), attempted to create a special district which would allow County ownership of private septic systems of the homes located around Crystal Lake ^(6*). The ownership feature was necessary to conform to existing law in order to permit taxation or assessments necessary to maintain the program once ownership has shifted to the County. Although this plan would have been effective in controlling pollution from septic systems around the Lake, it failed to deal with pollution from Cold Creek and frightened many property owners who feared that County ownership would lead to invasions of privacy and property. After a public hearing at which considerable opposition was voiced, the BPW decided to shelve that particular approach and instead appointed an Ad Hoc Committee (comprised of local knowledgeable citizens) which was charged with the task of finding an acceptable solution for the water quality problems in the Lake.

In the fall of 1985, the author assumed the chairmanship of the committee and had an opportunity to review in some detail the previous studies which had been done. It soon became apparent that these studies did not give an overall picture of the situation, but rather tended to focus only on one particular area or another considered important at the time. In addition, the studies were presented in language which was understandable to scientists but was hard to decipher by people outside the water quality business. No simple, quick solution seemed possible, and no one study or report provided a complete or practical program to be followed.

After considerable deliberation, the committee decided that public cooperation would be the key to real progress and that the public would not back any scheme until the necessary facts were understood and there was general agreement about the fairness and workability of any proposed activity. Many means to accomplish this end were considered including pamphlets, newspaper articles, seminars, and lake associations. Each of these were felt to be inadequate, and so by process of elimination, it was decided that a book (lake owners' manual), written in plain language, treating the subject in broad terms would be the most effective. Lists of raw data, complicated graphs and charts would be avoided. Preservation of the Lake requires an area-wide effort, not just from those living on the beach, making it necessary to enlist the sympathy and assistance of many people throughout the County.

This small book proposes to show what has been done, what needs to be done, how it can be done, and why everyone living in Benzie County can benefit as a result of the actions recommended.

We are indebted to the many people who have prepared the way for this book by their unselfish dedication to a cause which has seemed hopeless for many years. Without their concerns and hard work, no such document could have been written.

If you would like to make a financial donation to help defray the cost of printing and distribution of this book, please send your check to the BPW, County Building, Beulah, Michigan. One generous prepublication donation has been received from the North Shore Association in the amount of \$1,000.00. Any contribution will be gratefully received and if more than enough is made available, the surplus will be turned over to the BPW to be used only for water quality purposes for Crystal Lake, not the general fund.

No construction should be made that this book is an official expression of any governmental body, past or present. The contents include opinions of the author derived from materials in the public domain.

⁵(*) These "pollutants" are not toxic, but mainly nutrients and sediments which promote or alter growth of aquatic species.

⁶(*) After considerable public discussion, the development of a special district to allow for the public ownership of private septic systems was tabled. The Crystal Lake Overlay District, however, was established in 19xx. This allows for consistent zoning within most of the Crystal Lake Watershed, but excluding that portion to the east of Marshall Road.

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FIGURE 1.

CRYSTAL LAKE WATERSHED

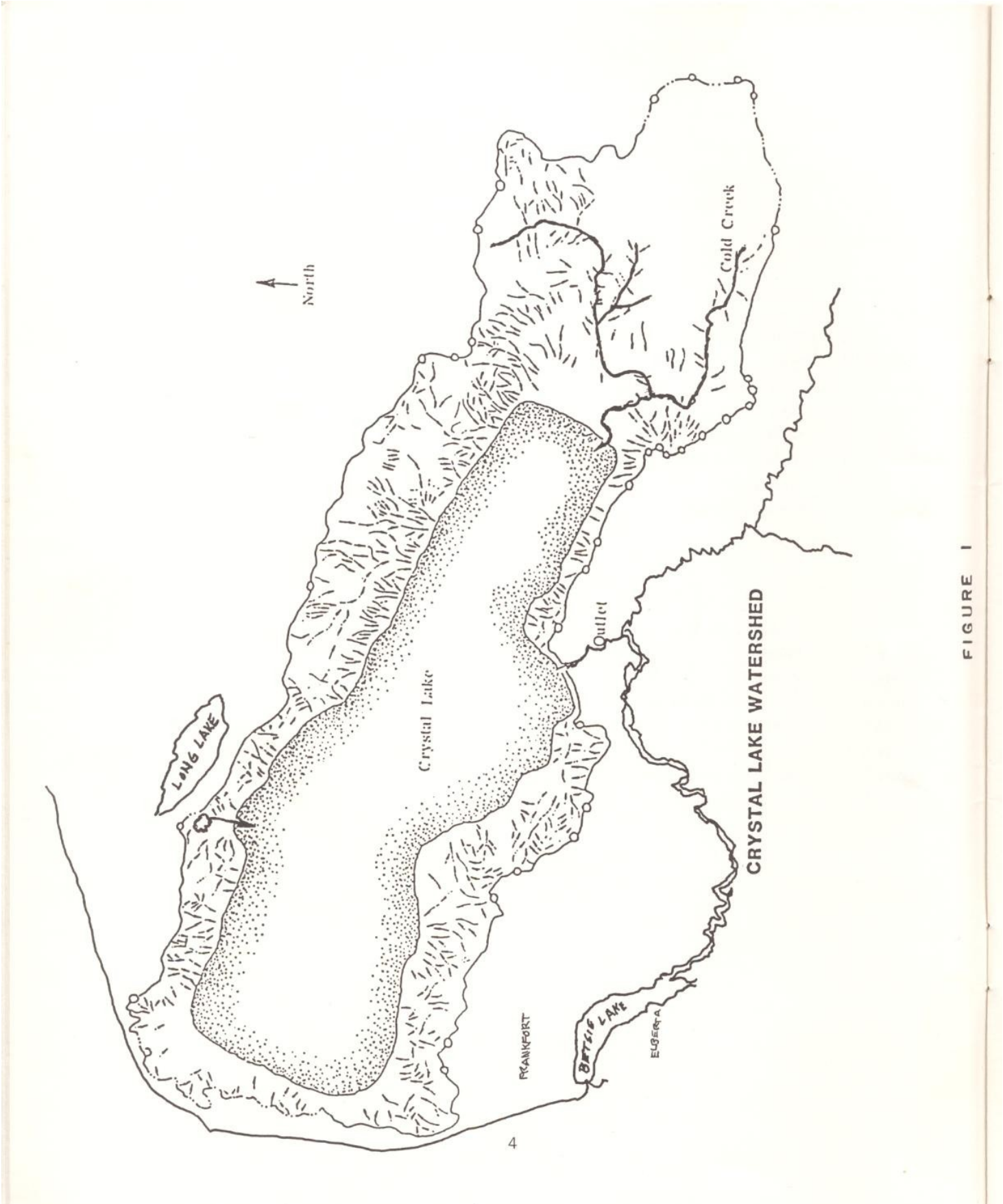


FIGURE 1

CHAPTER 1.

CRYSTAL LAKE

In counting the factors which make a lake outstanding, Crystal (Lake) must be near the top if not the top - a world class lake. The only thing that some might consider lacking would be mountains in the distance. All of the other things are found in Crystal - great depth, large size, a sandy bottom gently sloping to deeper waters, steep wooded hills free from buildings and water so clear it seems transparent. Its climate is special due to the fact that the western third of the Lake is on land that extends into Lake Michigan so that north, west, or south winds are cool in summer and relatively warmer in winter. This feature along with the influence of the great depth causes a delay in the seasons. Spring arrives a little late but fall is also prolonged. Summer temperatures seldom exceed 80 and winter lows are usually around 10. Canadian high pressure weather patterns tend to control the summer skies, affording more sunny days than areas further inland or to the south.

The Lake level is about 10 feet higher than Lake Michigan ^(7*) with a dam situated at an outlet which has prevented many of the problems associated with the Great Lakes such as alewives, lamprey eels, and waste from yachts. Lakes like Torch, Charlevoix, and Portage are directly connected to Lake Michigan and have suffered the consequences along with an ever rising water level which may in time prove to be a considerable hardship. Crystal's level can be controlled to prevent damage and in recent years the level has been set higher in summer and lower in winter ^(8*) to protect north shore properties. This may be an undesirable practice since it tends to flush the water table toward the Lake every time the lowering occurs, washing nutrients into the Lake.

Crystal is underfished because the local fishermen are more interested in the new salmon Fishery in Lake Michigan. Many of the better freshwater species are present in Crystal including lake trout, brown trout, rainbows, perch, smelt, whitefish¹, smallmouth, and rock bass.

Crystal is a lake of stupendous color. Due to the clear water and light sand colored bottom, sky colors are reflected and enhanced producing tropical like blues, greens, and on stormy days menacing blacks. The various depths can be discerned as sharply defined color bands with pale green leading to deep blue as the water deepens. The unusual clarity is illustrated by the story of one visiting regatta entrant who was towed to a buoy in about 12 feet of water and who, not seeing a dinghy coming to get him, and thinking the bottom was close at hand because of the clarity of the water, put his sailbag on his shoulder and proceeded to wade ashore under a stream of bubbles.

The dry statistics are as follows: Size - 9,710 acres, 8.2 miles long and 2.3 miles wide with a depth reaching 195 feet ^(9*). It is important to note that the surface area of the Lake (15.3 square miles), is nearly the same as the watershed² area of 21.8 square miles as shown in Fig. 1^(10*). Most lakes have a watershed area many times their size and thus are more difficult to deal with in terms of controlled inputs. It is this low ratio that has helped to preserve the Lake in its present state along with the great depth.

Only one major tributary feeds the Lake, entering near Beulah at the east end. This stream, Cold Creek, is famous for the annual spring smelt run in which the small silvery fish swim upstream in uncountable numbers to spawn. Dipping for smelt used to be a major event with people coming from hundreds of miles to participate in the fun. In fact, people had so much fun (including fights and brawls) that the practice was banned several years ago. Smelt are transplanted salt-water fish and were introduced into Crystal in the late twenties or

¹ Whitefish are caught almost all year round with many taken by spearing in shallow water during late November from small motorboats equipped with underwater lights. One person in the bow of the boat holds a long spear which is pointed in the direction of the cruising fish and the helmsman responds by turning the boat in the direction indicated. The moment of truth comes when the spear is thrown and all odds are with the fish since the combination of a 12-foot spear, boat, and fish motion plus refraction distortion are all against the angler. Nevertheless, many whitefish are taken in this manner, usually just after dark. The underwater lights cast a blue-green glow in the water with the boat remaining invisible giving the eerie appearance of Captain Nemo surfacing.

² Watershed means the area surrounding a lake or river which drains into that body of water. See Fig. 1, page 4.

⁷(*) Crystal Lake at 600 feet (+/- 0.25 feet) above mean sea level is currently about 22.6 feet above Lake Michigan. This is somewhat greater than the long-term mean difference of 20.85 feet over the past 100 years.

⁸(*) Legal levels for Crystal Lake are 600.25 feet and 599.75 feet, resp. for May 1 - Oct. 31, and Nov. 1 - Apr. 30.

⁹(*) Current revised statistics are: 9,854 acres; depth 165 feet; volume 740,000 Acre-feet or 242 billion gallons; length and width depend on places of measurement.

(Source: CLWF & NWMCOG, 2001). (See the updated map of the Crystal Lake Watershed at www.CLWF.org.)

¹⁰(*) The Crystal Lake Watershed is now interpreted to include the Lake (15.40 sq mi) and the surrounding land (28.27 sq mi) for a total of 43.67 sq mi for a ratio of 2.84 (Watershed/Lake).

early thirties (^{11*}) as a food source for the lake trout because the Department of Conservation was using Crystal Lake trout as an egg source for the entire state. The smelt introduction was a huge success, providing not only food for the trout but a mini fishery as well in the form of private and rental fish shanties by the hundreds. Marked roads for cars were provided on the ice, and sometimes streetlights were installed. Some shanties were large enough to hold a dozen or more people and the catch was measured in pounds. No one seems to know why the smelt population waned in later years, but it did shrink to a mere shadow of its former size. Some smelt escaped over the dam at the outlet and populated the whole Great Lakes chain. Cold Creek has a very important bearing on the life of Crystal and will be discussed at length in a later chapter.

No description of Crystal would be complete without the inclusion of its probable early history. We are told that the Lake is glacial in origin as are all the Great Lakes. The soils forming the Lake bottom and the surrounding moraines are all imported from the far north. Some have suggested that Crystal was once part of Lake Michigan (^{12*}) but wind and wave action built dunes on the west end gradually closing the Lake off. However, the exact glacial nature of the Lake is not important for our purposes except as how it affects the nutrient holding ability of the soils and the flow rate of the water table.³ At any rate, in recent history, Crystal ended up considerably higher than Lake Michigan. Exactly how much higher seems to be unclear but many have postulated a difference of between 15 to 30 feet. In the early 1870's enterprising loggers decided to dig a waterway from the Betsie River to the present outlet to provide a convenient way of floating logs to the sawmill in Frankfort. A steam paddle boat was constructed for commerce between the Lake and Frankfort. When the final mound of soil was dynamited to complete the new canal, the Lake exploded down the chute inundating the entire area causing the death of some cattle and a few human lives, according to some accounts. This was a surveying error of considerable proportion. In later years the level of the drained Lake was partially restored by the construction of the concrete dam still in place which raised the level about 5 feet from the all time low. This change in level produced the bench around most of the Lake on which most dwellings and roads were to be built.

This bench is the primary difference between Crystal and Glen Lake to the north. Both lakes were very much alike until Crystal was lowered and since then a rivalry has existed between Glen Lakers and Crystal Lakers about which is the most scenic. Glen has been called the Eighth Wonder of the World, but Crystal Lakers insist that cottages on level ground with the beach are far better than two level cottages built on silts at the waters edge. Glen is bisected by a causeway and has a shallow arm and a deep end. Sleeping Bear Dune forms the western boundary and continues to encroach on the lake. Glen is mentioned here since many of the problems with water quality are common to both lakes.

Crystal is nearly built up in terms of beachfront with construction pressure now coming on the second and third levels behind the beaches. Man has already had an influence on the Lake in less than 200 years, and it is obvious that more careful and thoughtful planning must now occur, or this great resource may disappear forever. Were it not for the very seasonal (less than 90 days) occupancy of most of the shore dwellings, the quality of the Lake would already be far worse than we presently observe and if the Lake were only two or three hours drive from a major population center, preservation would probably be a hopeless task.

The mechanical features of water preservation are discussed in later chapters, but it should be helpful to first consider the economic and geographical factors which have made the Lake and the County what they are today and what impact these influences will have in the future.

³ The water table is the layer of water below the surface of the ground - literally an underground lake.

¹¹(*) The smelt was introduced into the Great Lakes as a result of an initial planting in Crystal Lake on April 6, 1912.

¹²(*) Crystal Lake is an "embayment" lake and indeed was part of historic Lake Algonquin.

CHAPTER 2.

ECONOMIC GEOGRAPHY

In addressing the problems of Crystal Lake, we must consider the forces and factors which may control the destiny of the area. These factors are both geographic and economic. Our decisions must be based on the realities in order to take advantage of nature and the laws of economics rather than to attempt to overturn these influences which may be immutable. The potentials to be understood are agricultural prospects, industrial possibilities, and natural features.

We are told that all of the Great Lakes and associated inland lakes in Northern Michigan were formed by glaciers - the weight of the ice scooping out depressions which later filled with melted ice water to form lakes. As the ice melted, the soils which had been pushed along by the grinding action of the moving glacier were deposited in a haphazard fashion. This explains how some of the hills are clay and some are sand and some are mixed. It also gives insight to the fact that different areas on the Lake may vary widely in soil composition leading to different needs with respect to sanitation and pollution control.

Early surveyors described Benzie County as a vast, insect filled swamp with poor soils and awkward topography and not suited for much of anything. Apparently scenic beauty and virgin forests were not high in their sensibilities. The origin of a seaport, Frankfort, as a shelter for coastal sailing vessels and trappers was among the first items of development in the area, with logging following soon after and this period probably represents the highest commercial use of the land yet experienced. Later with the demise of timber production, early tourism appeared, making use of new rail facilities and steamship lines which catered to the summer crowd, delivering passengers and cargo to the Victorian hotels which had been built at all the major ports along the east shore of Lake Michigan. Gradually the more accessible and water oriented properties began to be developed as cottage and resort sites.

The short growing season and generally poor soils are not conducive to agriculture with the notable exception of fruit production. The particular climate and well drained soil has permitted an outstanding output of apples, cherries and various other fruits, and although healthy, this industry requires considerable land, heavy investment and many years to bring new trees into production. Orchardists may have several years of bounty followed by years of great loss. It is not likely that fruit farming will increase markedly in the foreseeable future since land for that purpose is not in endless supply, and there is not a large additional market demand. Unfortunately, the fruit business is not labor intensive except at harvest time, and therefore, does not add considerably to the employment potential of the area.

From those days until now there has persisted a notion in the minds of many, that somehow, sometime, industry would come to the area and produce a better standard of living for the residents. Countless nest eggs and retirement savings pools have been lost in the attempt to start a "business up north". Even sophisticated investors and experienced industries have attempted to start something, only to discover that profits were not forthcoming and soon abandoned their efforts.

The underlying problem for industry is twofold. One is that the extra shipping cost for raw materials in and finished goods out to market is so high that competition from other industries nearer their markets spoil the chances of success. Labor is the other problem. There is not a large enough labor pool suited to hi-tech endeavor nor is there adequate local labor to man a really good sized plant. It is axiomatic that in Michigan little success in industry can be found north of a line from Muskegon on the west to Saginaw on the east.

Other communities in the area such as Traverse City, have dwelt too long on the idea of industry, and have neglected the task of controlled, orderly resort development resulting in a form of development of awkward choking growth of hi-rises, condominiums, and attendant traffic which have largely ruined that which was the attraction in the first place - namely wilderness. Some of the small shore towns have been transformed into places of "Cute Little Shoppes" which attract tourists of a transient nature but repel those who would make substantial permanent investments in dwellings. All of this is rather negative sounding, but nevertheless must be comprehended before the logical destiny of the area can be seriously pursued.

The most advantageous future will be found by

extension of the "Status Quo". Preservation of the clean water, forested hills and clean beaches must be given the highest priority along with carefully controlled development. The population of Benzie County is around 12,000 permanent residents and about double that size including summer visitors. Census projections indicate a growth pattern of 15 to 25 percent by the year 1990. This, a substantial population increase can be expected - perhaps to the limit that a wilderness area can support without too much compromise. We have already seen what a determined group of developers can do in spite of contrary wishes of the existing citizenry in the case of the resort property, now vacant, on the south shore of Crystal Lake. Soon there may be multiple units back in the woods funneling down to a few hundred feet of beach adding markedly to the population density, boat traffic, increased runoff of soil, etc. This consequence is unavoidable as long as available vacant property remains and there is a profit to be made, unless countering steps are put into place. The pressure from urban centers to create vacation homes is ever increasing and waterfront or water oriented property is becoming scarcer each year.

Limiting growth is never easy and is best done by carefully thought out zoning regulations and other safeguards designed to protect the general area. An extreme example can be cited in the case of Boca Raton, Florida, where, a few years ago, a moratorium was placed on all construction based on the shortage of utilities. This case was tested in court and found to be legal. Since then the ban has been lifted, but the case stands as a precedent. There are also communities on the east coast which even require admission tickets to enter.

Some help has already arrived. Recent building codes prohibit construction of shacks and require minimum setbacks, minimum home sizes and sizeable lots. The sanitary code now requires certain minimum standards to insure against bacterial contamination of surface or subsurface water, and the tax laws are such that vacant forest land can be taxed at less than one dollar per acre thus encouraging a no-growth position, but more restrictions are needed.

One may ask, "How are these restrictions going to be accepted and adopted?" Part of the answer is in the education of the residents and their elected representatives. Another part of the answer lies in a little known right that citizens have in Michigan that is to vote in the community where they have residence for not less than thirty days. Many think that since their summer home is not their principal residence that they cannot vote in Benzie County. However, this is not the case. A family may have one member who does not need out of state registration for tax purposes, register in the appropriate local township. Thus those who have been annoyed at substantial taxation with no opportunity to have a voice in the local government can avail themselves of the right to vote. Indeed, an enormous tax base is found around Crystal and those dwellings require and receive very little in the way of services. With more summer residents voting in Benzie County, elected officials will be more responsive to the wishes of Crystal Lake property owners.

Our intent is not to slam the County or Townships in terms of spending policies of the past. Based on the size of the area, the scant population, the generally low incomes, and the many miles of road, etc., they have performed heroically to just keep things going. So it may be, that, for a time, a special levy will be required to implement certain improvements which will afford protection to the area. Everyone will feel this to be a wise and equitable solution provided it can be clearly established beforehand what the cost and effect will be.

Federal and State grants have been available and most likely will be again (*¹³). In fact, the Clean Water Act recently vetoed by the President was passed, allocating some 22 billion dollars for water clean-up with some emphasis on controlling run-off type pollution. The EPA has gone on record encouraging local communities to find novel and nonstandard methods of solving this kind of problem. What is needed first is understanding, leading to a consensus, followed by a sensible plan to achieve the goal. More specifics will be covered in later chapters.

To sum up, Benzie County should reassess its assets. It already has priceless and irreplaceable advantages in the form of climate, views, waters, and woods. These assets, if properly managed, can provide good incomes for those engaged in servicing the needs of the people, and at the same time continue to provide a beautiful place to live. Short range benefits of a Traverse City type development will in the long run prove to be a tragic loss. It is folly to promote a large industrial revenue and then go about trying to restore the lost wilderness which has been destroyed by development.

¹³(*) A variety of grants are administered currently through the Clean Michigan Initiative (CMI) program. The Benzie/Manistee Soil and Water Conservation Service has received grants for watershed management of the Platte River and Herring Lake Watersheds. The CLWF has received a grant for biomonitoring of Cold Creek.

CHAPTER 3.

WHAT'S HAPPENING TO CRYSTAL LAKE

Eutrophication (you-tro-fi-kay-shun) is a long word used to indicate aging of a lake. The moment a lake is created it begins to change. Shallow lakes slowly fill up with soil and other debris from the surrounding higher ground and as their water becomes more and more fertile, weeds grow along with other life forms slowly choking and filling the lake. Air breathing plants begin to take over eventually producing what we call a bog. In many instances, after a long period of time, the partially decayed matter which has been laid down layer by layer becomes peat. Some shallow lakes in Canada become filled with an algae to such an extent that only the top few inches of the lake remains clear of these plants. This is called muskeg and anyone who has paddled a canoe through a muskeg pond will never forget the experience - like paddling through molasses.

Deeper lakes do not exhibit the same progression that shallow ones do since there usually isn't enough soil to fill up the basin and the sunlight necessary for aquatic life can only penetrate so far, so weed choking does not occur in the deep areas.

Crystal is a deep lake but also has shallow edges and so will show aging and already has begun to do so. The question is, how far has it gone, and how fast will it continue to change? As far as the deep water is concerned, probably very little change will occur in the next several generations except that more and more foams may be noticed on rough days as the phosphate levels increase. The shallower parts are another story in that increasing fertility will increase the number of weeds, bottom sludge, and algae blooms which make the water cloudy. These are the changes that people have noticed and are the cause of the concern and activity over the past 17 years. This concern is well founded, and unless steps are taken to slow the process of nutrient intake, the problems will become greater and greater, spoiling the Lake for the kind of enjoyment we have come to expect.

If we could roll the clock back five hundred years and examine Crystal Lake at that time, it probably would give the appearance of sterility - no plant life - few if any fish, and we would be wrong. As soon as a lake is born, barring extremely hostile chemistry, life begins by algae dragged in by the creating glacier, from the feathers and droppings of birds, and seed and spores through the air. Fish are transported to a new lake or from one lake to another by the kingfisher. This shore and riverbank bird catches fish for its own needs, and then continues to catch more fish transporting them to another lake. Kingfishers frustrated the efforts of the Ontario Fish and Game Authorities to keep some lakes stocked with trout and others stocked with walleyed pike. After a few years, a nice mixture in all the treated lakes was discovered, and upon investigation, the little bird was caught in the act.

The situation, then, is that in a lake like Crystal many life forms are present. All that is needed to create explosive growth in the influx of the required food or nutrient for that particular form of life. In order to have an idea of how to deal with the Lake, it is necessary to understand the nature of these foods and nutrients; where they come from; what forms of life they promote; and how long they last or remain in the environment.

The life chain is twofold in that there is an animal branch and a vegetable branch. The smallest algae are free floating and nearly invisible. These form food for very small fish and plankton which in turn are eaten by bigger fish and so on. Vegetable life grows from spores and seeds and other forms of reproduction. Each type grows in its own natural place. At the shoreline we see a green moss like growth on the rocks. The rocks are necessary for an anchorage but wood may do just as well. This plant is called cladophora and usually indicates the presence of the kinds of "nutrition" from septic tanks. We observe marl formation on dock legs and rocks being formed by the activity of algae and in deeper water are taller bean plant like weeds along the dropoff and finally short pine tree shaped weeds in deep water down to about 60 feet. Reeds and rushes can be seen in sheltered beach areas. Clams, snails, and crawfish perform as a cleanup squad. Without the other forms of life they would not be found.

Lake fertility also influences the insect population. High fertility resulting in thick sediments can deprive bottom mud layers of oxygen thus reducing life to a point where fish and birds are deprived of their natural foods. Many species of insects are born of eggs deposited in the waters and spend

part of their life as aquatic animals before sprouting wings to fly away, mating, and laying eggs for the next generation. These inhabitants are an important source of food for fish and birds. During the mayfly hatch on Crystal, fish can be seen rising all over the Lake on a calm evening as they gorge on the emerging nymphs and adult flies.

What is meant by fertility? It may mean different things to different people at different times, but for the Lake it means the elements necessary to sustain life. The first of these is oxygen which is required by plants along with sunshine to engage in photosynthesis which is the basis of all life on earth. Oxygen enters the Lake from the air, and from the plants themselves. Crystal does not have an oxygen deficit, but many shallow lakes do. In winters where the ice is on for a long time and covered with snow, cutting off sunlight, all the fish may die from lack of oxygen. This is known as winter kill.

Nitrogen is another life basic we are all familiar with from our use of garden fertilizer. Nitrogen is one of the basic elements of the atmosphere, and is a compound, usually in the form of a nitrate or nitrite. These compounds result naturally from the process of the decay of living things and thus enter the Lake from forest water washing in and from decaying grass, leaves, and human wastes. Nitrogenous compounds are active enough to move out of the food chain if in surplus amounts and so do not represent a great threat to the Lake unless present in great abundance.

Potassium is another basic element, a metal, but so reactive it is found in nature combined with something else. Trace amounts are required for life and this element does not pose a threat to the Lake either. These compounds, as used in fertilizer are usually referred to as 'potash'.

We come now to the villain. Really both villain and hero since without phosphorus, again a metal, we would starve. It is essential to growth, and there are countries whose economies are based on the production of phosphates which are used for fertilizer and a host of other products. Phosphorus is so reactive it will spontaneously ignite and burn in air. In a laboratory, phosphorus is kept submerged in kerosene to prevent contact with oxygen which would set it off. Phosphates (phosphorus compounds with oxygen) are the main ingredient in soap that make soap work well. High phosphate detergents were banned in Michigan several years ago, and there is evidence that the Lake shows this reduction in a slowdown in the rate of new weed growth. The familiar heavy duty cleaner, "TSP", stands for tri sodium phosphate. It will get the outside of your house clean and it will also grow weeds in the Lake.

Very small amounts of phosphate promote growth in lake waters. Measurements are made in parts per million (*¹⁴). In fact, the first tests done on Crystal in the late sixties were done prior to the time when such fine measurements for phosphorus could be done on a practical basis.

Phosphorus gets into the Lake in the usual ways and one not so usual - runoff from forests, surface water runoff around cottages, lawns, septic fields, decaying matter, bird droppings, leaf fall into the Lake, and the unusual one, from the air attached to dust particles and rainfall.

Once phosphorus gets in the system, it tends to stay there, picked up in the food chain going from small creature or plant on up through the chain and then returns to start all over again when the creature dies. In some lakes this is not a big problem since some lakes have a big inlet and a big outlet, thus flushing out the lake with new water every few years (Torch Lake for example). Not so with Crystal. Crystal has a very small input and likewise a very small outlet. Studies indicate that water has a "dwell" time of between 30 and 60 years in the Lake and this is why we must be so very careful what we put in. It is going to be there a very long time.

The algae blooms and weeds around the shoreline and foamy water can be traced to increased amounts of phosphorus entering the Lake and much of this increase is due to the activity of mankind (¹⁵). What follows is an attempt to explain how this is happening, what can be done about it, and to some extent who should do it. We have already discussed how general population trends, activities, and attitudes are important.

¹⁴(*) The average level of total phosphorus in Crystal Lake has ranged from 5 - 15 parts per billion (as reported by CLWF in the Cooperative Lakes Monitoring Program, MI DEQ with Michigan Lake & Stream Associations).

¹⁵(*) Although total phosphorus input is small compared to many lakes, there are other contributions from natural sources such as rain and snow, atmospheric dust, and seasonal events (plant pollen, leaf and needle drop, insect hatches, etc.).

CHAPTER 4.

HISTORY OF TESTS, REPORTS

A listing of the better known reports for Crystal Lake is as follows (*¹⁶):

Gannon Report	1970
Tanis Report	1978
Facilities Report	1979
EPA Report	1980
Management Report	1985

A direct quotation from the Tanis report best explains the scope and purpose of both the Tanis and Gannon reports.

"For nearly a decade, the citizens of the Crystal Lake community have been expressing their concerns for its welfare. Prompted by the early environmental movement and detection of changes in Lake water quality, we have sought to understand the problem and define its solution. In 1969 John J. Gannon of the University of Michigan, supported by the "Keep Crystal Clear Committee", conducted a four-month extensive study of the Lake water and Watershed tributaries (Gannon, 1970). Conclusions from that study pointed to Cold Creek and cottage septic systems as significant sources of pollution to Crystal Lake. Recommendations included: collection and removal from the Watershed of all domestic wastes, storm runoff, and discharge from Cold Creek.

Because of concerns expressed by Lake residents that indeed the Lake is deteriorating rapidly, the Crystal Lake Property Owners Association launched a Lake monitoring effort. This program was initiated in April 1976 to provide a more concise understanding of changes in water quality and their causes. In most cases, the above concerns are not those associated with public health problems. There have been only a few cases of coliform bacterial contamination of shoreline surface waters reported by the Tri-county Department of Public Health.

The principal concern for Crystal Lake is that nutrients are arising from shoreline development and causing accelerated enrichment. These nutrients such as nitrogen and phosphorus stimulate algae growth and in sufficient quantities can produce poor water quality. Typical adverse changes which can occur include increased turbidity, nuisance growth of algae, rooted plants, and odors associated with decaying vegetation. When assessing a potential problem, consideration must be given to all sources which may contribute nutrients to the Lake including not only septic systems but surface runoff, ground water, precipitation, and release from bottom sediments.

Because of its long water residence time, Crystal Lake provides a trap for nutrients and is, therefore, sensitive to pollution inputs. This process of eutrophication will gradually produce undesirable conditions if sources of nutrients remain unchecked. Understanding of Crystal Lake's ecology is greatly enhanced when the total inflow of nutrients can be estimated. Results from the monitoring program have helped to size the nutrient inputs and their relative importance.

Since the major project goal was to observe changes which have occurred since the University of Michigan study, most monitoring activities attempted to measure similar parameters.

These activities included:

- 1) Monitoring stream flow and phosphorus levels at several points in the Cold Creek Watershed, the outlet of Crystal Lake and some of the small creeks which flow into the Lake. Levels in the local precipitation were also checked.
- 2) Conducting a complete aerial photographic survey to identify shoreline areas with noticeable algae growth and mapping the location of these growths.
- 3) Measuring Lake water quality parameters including primary productivity, chlorophyll, transparency, and dissolved oxygen level.

Crystal Lake citizens sought and were awarded a Step 1: Sec. 201 Planning Grant for an area-wide (waste)water treatment system from the U.S. Environmental Protection Agency (EPA). The resulting facility plan recommended a sanitary sewer collection system which would ring the entire Lake. The conventional approach including a gravity collector sewer with trunk lines leading to a central treatment plant in/on Betsie Bay. The Crystal Lake plan was designed to serve a potential dwelling population of 1500. This plan caused concern from

¹⁶(*) For a more complete listing, see the Addendum to the References.

EPA reviewers who suspected the plan is too costly and will not effectively mitigate, and is not justified as an effective long-term solution. Secondary inputs resulting from induced development were mentioned as a specific concern. A thorough environmental impact statement (EIS) on the Crystal Lake project is being prepared by the EPA (*¹⁷). The potential problem of deteriorating water quality facing Crystal Lake residents is not unique. The steady population migration from southern metropolitan counties has and will create problems for many northern communities.

Factors affecting lake water quality and long-term eutrophication are complex, and therefore difficult to eliminate in a single remedy solution. In trying to find the answer for Crystal Lake, community leaders should be advised to examine the problem from all aspects and to employ innovative programs in the solution. The EPA is committed to supporting unconventional or alternative treatment systems for small communities on inland lakes.”

The Gannon and Tanis reports are considered to be invaluable in that they form a benchmark against which future study results may be measured. It is the rate of change that concerns us now and their data and pictures provide a good start. Also it should be noted that many people gave unselfishly of their time and talents to make these reports possible. We are in their debt.

There are two important areas in the reports that follow Gannon and Tanis that require discussion in order to de-fuse misunderstanding. One is the recitation over and over, copied by one author to another of a supposed nutrient budget, which in some cases looks like this:

Sources of nutrients to Crystal Lake		
Precipitation	48%	
Stream runoff	28%	
Ground water	6%	
Cultural-Inc. Septic	22%	104%

Or this:

Precipitation	42.8%
Runoff	11.7%
Cold Creek	38.8%
Septic Tanks	6.7%

It is easy to see how different conclusions might be drawn from the two tables. Most people who have been involved since the beginning view these numbers with suspicion. It would be impossible to have sufficient monitoring stations to achieve real accuracy. Yet many groups have seized on one percentage or another and tried to build a whole case on that number. Thus we have those who say it is folly to attack the septic problem since only 6.5% is coming from that source. Others say it's all hopeless since so much comes in from the atmosphere. (It has been determined that the atmospheric samplings were done in unwashed vessels in the vicinity of an orchard in the springtime when spraying may have occurred – remember phosphorus measurements are in parts per million). Still others claim Cold Creek is the biggest problem.

It would seem appropriate here to relate a simile about a family whose house catches fire and when the fire department rushes up several men get off and run into the house to measure temperature, smoke developed, toxicity, and other interesting facts, leaving the hose on the truck. This exaggerates, of course, but still there is a lesson to be considered. Since we know parts per million of one nutrient can cause trouble, and that the Lake problems coincide with human population, who are we to say that any one of the sources, no matter how small, may not be the proverbial straw? This is not to say that any one area should be ignored or neglected in favor of another, but it does mean that we should get on with treatment as fast as we can and not wait for a perfect provable scientific model before proceeding.

The other item unsaid in any report has to do with political twisting. It is common for a particular bureaucracy to have a certain fund of money to spend in a particular way – sewers for instance. If nearing the end of the allotted period, it can be seen that not enough money has been spent, and if it is not spent, next year's appropriation and some jobs will be lost, sewers are promoted in some rather strange places. Figures are cited which look good. Figures which don't look good are somehow overlooked. Then the reverse is true. When the word goes out from Washington that we are now on an austerity drive, many of the heretofore important projects are found by reanalysis to be unworthy after all. Many are convinced that this mechanism was at work in the Facilities report and the EPA report which counterclaimed that the Facilities' call for a sewer was misplaced and impractical, and that a smaller, regional approach was best. The bickering continues to this day.

The Management Report, done in 1985, is largely a rehash of old data only this time designed to

¹⁷(*) The Final EIS was issued in July 1980.

promote the idea of a smaller sewer system by use of existing law to establish a district in which the County would actually own the septic system. This idea was correctly discarded. Part of this report goes on to discuss amending present law to assist the control of septic systems and general zoning. This will be discussed in Chapter 10.

The reader is urged to carefully examine these reports if he or she is inclined to do so. Copies are located in the County Building at Beulah in the BPW Office.

The collected data is invaluable provided proper interpretation is followed. The Committee is recommending a financially possible schedule of monitoring tests so that needs can be more exactly assessed and results can be measured.

While on the subject of controversy, Cold Creek is receiving its share. At first there was a move to hold Beulah responsible for Cold Creek in spite of the fact that the Creek and its branches drain about 10 (*¹⁸) square miles of land outside the Village limits. Beulah's sewer system was overloaded and could not take on any more sewage without help. Some aid has arrived in the form of a demand by the government to upgrade the Beulah treatment plant, but this will not include the Creek.

Settling ponds for Cold Creek were dug just east of the main street to alleviate soil runoff into Crystal Lake and tests indicate that Beulah alone probably does not add significantly to the nutrient load except possibly through its storm sewers.

Cold Creek (Fig. 1) is not a big stream. For those who have not seen it, the Creek is about 4 feet wide and six or eight inches deep at the mouth. The flow rate is usually less than 20 cubic feet per second which is very small (^{19*}). Small things can add up, however, and running round the clock, year after year, Cold Creek is having an impact of substantial proportions on Crystal Lake. The dark mud on the bottom, large weed beds and murky water attest to this. Scientific measurements are not necessary to determine this – just one good look at the east shore near the bridge and launching ramps. The reports cite Cold Creek as a contributing source of nutrient to the Lake of around 35% and thus the Creek rates as a high priority item for remedy. All those concerned with the various committees, associations, and advisory boards know of Cold Creek's contribution, but in spite of this knowledge, even now in the winter of 1987 when the Board of Public Works outlined a simple testing program for measuring flows and phosphates at several points along the stream to determine total inflow and from what branch, another body reviewed the plan and argued that they should first do a land use study in order to get ready for possibly different tests! It is past time to permit any more posturing. If we had an informed and aroused citizenry, this sort of thing would never happen. The wasted time and money debating may well have been enough to pay for at least one simple solution –to pump Cold Creek out of the settling basins up over the hill at Benzonia letting it fall by gravity to the Betsie River where it ends up anyway a mile or two downstream. Calculations indicate a tile of not larger than thirty inches in diameter would suffice, with an installed cost of approximately \$40.00 per foot. It could be buried in the highway right of way with relatively little expense. The pump and electrical cost could be all County, or if assessed, the cost would be minimal on a per household basis. If this was wartime or there was a bacterial problem, such a scheme could be implemented almost overnight.

More study is need on the Creek and its tributaries in the hope that some of the nutrition might be stopped at the source, but all this might be wisely put aside in favor of the diversion scheme. Diversion might save both money and time thus accelerating solutions to the other problem areas of the Lake.

Past testing then, has been discussed, and it has outlined the problems, and hinted at solutions. Some future testing and monitoring will be required, but not an excessive amount.

¹⁸(*) The three subwatersheds of Cold Creek drain an area of 16.54 sq mi representing 37.9 % of the Crystal Lake Watershed (Source: CLWF & NWMCOG, 2001) .

¹⁹(*) Dry weather flow may drop to 2 cfs; wet weather flow may exceed 90 cfs.

FIGURE 2.

PLUMES

FIGURE 3.

WATER TABLE FLOW PATTERNS

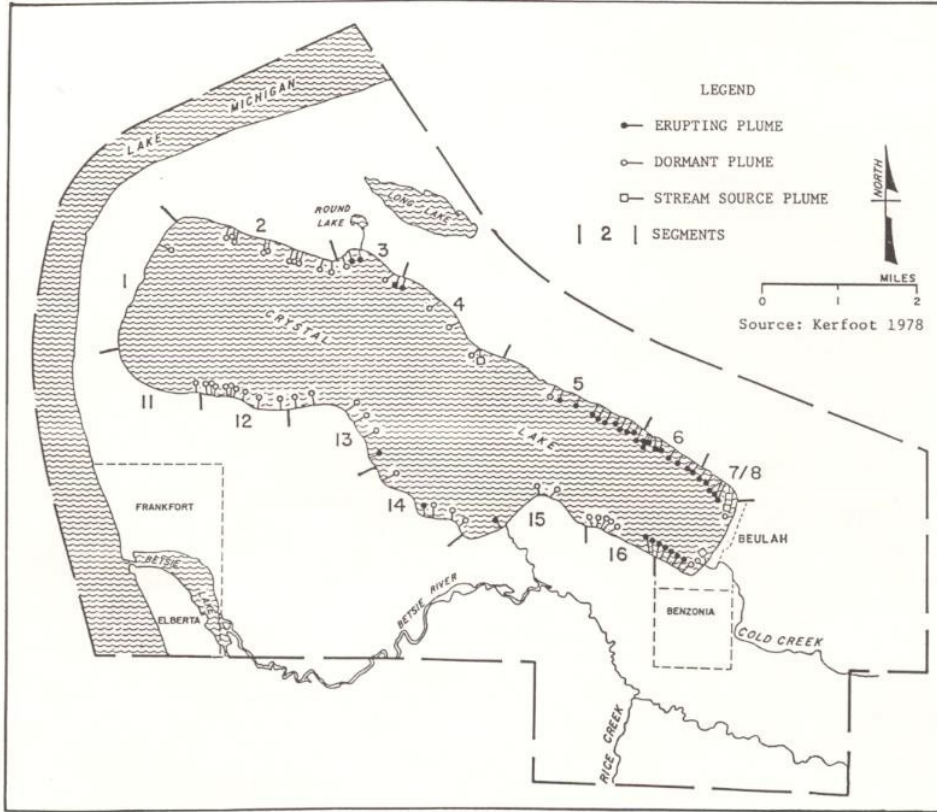


FIGURE 2

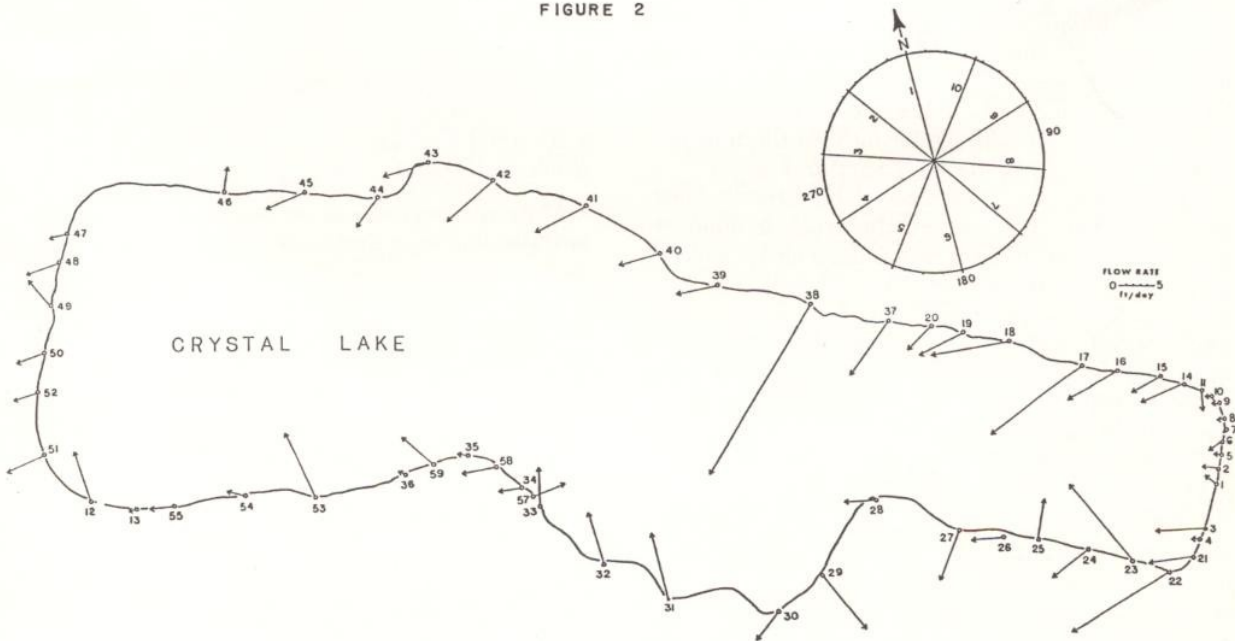


FIGURE 3

CHAPTER 5.

NUTRIENTS IN CRYSTAL LAKE

So far, eutrophication has been discussed in general, and Cold Creek has been mentioned specifically. Let us examine the other sources of nutrition inflow into Crystal Lake, bearing in mind that the percentages which have been shown are not totally accurate nor that important given the concept that even a small contributor may be the trigger amount promoting weed growth, algae, foam, and silt.

Atmospheric contamination is largely uncontrollable. However, some observers feel that orchard spraying near the Lake in windy weather may result in some airborne deposits. Obviously, orchardists do not spray in windy weather if they have any choice, but it would be well if they exercised extra caution around the Lake in this regard. Acid rain has become a matter of some interest in the past few years. One study indicates that since Crystal is quite alkaline, we have little to fear from acid rain, at least in the supposed amounts we are receiving. The author has conducted crude tests on rain gage samples for two summers and has not found any readings that would indicate acid rain.

Non-point or surface runoff (Fig. 1) is just what it sounds like. Rainwater falling on the forests and particularly on the steep slopes around the Lake flows downward, carrying any materials that may have been dissolved or are simply mechanically washed along. This is an important source for Crystal, and one which people can influence to a certain degree. Driveways and boat launching ramps to the Lake can input a great deal of surface water especially as they also usually receive a considerable amount of road water as well. Lawns, parking areas, and building roofs also accelerate the inflow of rainwater but do no harm if contaminants are not picked up on the way.

Crystal has numerous small streams entering the Lake which run down from the hills (Fig. 1) (*²⁰). Most of these are higher in nutrients and the evidence can be seen in increased algae and weed growth near their entry points. Decaying forest litter is the enrichment of these streams and therefore little can be done to influence the amount of material delivered.

Cold Creek is a major source of phosphorus and other nutrients as has been pointed out. This source can be dealt with and is discussed in Chapter 10.

Finally, there is the matter of septic systems. These systems are probably the latest addition to nutrient inflow, and there is much that can be done to prevent nutrient inflow from septic systems. One area of the Lake which is a major problem is the northeast corner, from about Warren Road to the Beulah Village limits. This area is characterized by abrupt, steep hills, with a very narrow beach area containing buildings nearly wall to wall. The groundwater table is high there and moves very rapidly. Thus, there is little opportunity for septic waters or surface waters to have a chance to be absorbed by vegetation or modified by bacteria in the soil before entering the Lake. Previous tests have found the highest concentration of "plumes" in this area (Fig. 2). A plume is an upwelling stream of water in the Lake which is high in nutrients and can be identified by a variety of machines and test methods. Septic systems will be discussed in more detail in the chapter dealing with remedies.

All sections of the Lake which have high, steep hills and narrow beaches with dwellings create difficulties with proper septic tank operation and unfortunately, a great deal of the area around Crystal falls into this category.

The water table (Fig.3) needs a bit of further explanation beyond that given to properly appreciate the challenge facing the Lake. Simply stated a water table is encountered if one digs a hole in the ground. Obviously, in some areas of the country one would have to dig a long way to find water, but typically in the vicinity of a large lake, the water table is usually close to the surface, and Crystal is no exception. Since the soils around the Lake are sandy, the water table water communicates with the waters in the Lake, and what gets into the water table can be expected to show up in the Lake. If the water table is quite deep, the soils have a chance to modify the water, often removing much of the nutrient load by bacterial action or by vegetation taking up the nutrients. Around Crystal, the water table is usually close as 4 feet or less below the sites where cottages have been built. This is the bare minimum required to satisfy the sanitary code for septic systems and although it may be proper for the removal of bacteria from waste, it is seen as not enough to remove phosphates in all cases.

²⁰(*) There are 18 subwatersheds identified within the Crystal Lake Watershed, including the beach area not associated with identifiable tributaries, but excluding Outlet Creek subwatershed and the Pt. Betsie Watershed.

This is the problem with the Northeast corner of the Lake. Almost everything put into the septic system goes right into the Lake in a few days or so. One might suspect that the water table would be flat or uniform all around the Lake, but such is not the case. In fact, tests have shown that the water table is higher on the east, falling toward the west. These tests also have shown that the water table does flow generally into the Lake everywhere except the west shore where the direction of flow is toward Lake Michigan (Fig.3). These tests were all done in the summertime and should be repeated to verify that the flow direction is constant year round. It is suspected that they are constant, and if so, this constitutes a boon for those residents on the west shore as ordinary precautions on their part will be sufficient to safeguard the Lake. The other areas which have the water table draining into the Lake must be watched closely.

Uninformed human activity also has an impact on Crystal just as it does on any other recreational lake. We observe people washing themselves and their hair in the Lake, as well as the family pet. Boat soaps and bilge cleaners have high concentrations of phosphates and more than one pail of dirty washwater has been dumped on the beach or in the water. Motorboats also make a contribution, but not necessarily a nutrient. Oil, mixed with gasoline when used in outboard motors is incompletely burned in combination and is injected in the water with the exhaust gases. Other products of combustion are also added through the underwater discharge. Running an outboard for a few minutes in a barrel of clean water will provide a dramatic illustration of this fouling. To what extent this pollution is harmful to the Lake is unknown and based on the small number of boats on the Lake for such a short time, probably no long term lasting harm is done, but nevertheless, it is one more impact which is foreign to the Lake.

Miscellaneous nutrients reach the Lake through leaf fall and waterfowl excreta, the latter being considerable at times, and perhaps people should stop feeding the ducks⁴ and geese for this reason. Every source of nutrient that can be reduced or eliminated should receive attention since the Lake is in a "threshold condition".

⁴ Ducks are a vector in the occurrence of "Swimmers itch", a parasite that attacks human skin causing intense itching, Waterfowl control has proven easier than snail control, the other vector involved.

CHAPTER 6.

WHY NOT A SEWER

Indeed, why not a sewer around the Lake to eliminate all the business of septic tanks, unsuitable soils, and holding tanks. The Facilities report recommended a sewer to be connected to new disposal facilities to be built for Frankfort and Elberta. (*²¹). From a practical standpoint it turns out to be too much pipe and plant for too few people. This was reflected in the cost estimate of approximately \$8,500.00 per dwelling for installation cost alone. Other smaller sewer schemes have been talked about, and one organization of Lake people is still promoting the idea of a sewer.

The Environmental Impact Statement was probably biased in favor of no sewer to conserve government funds, but did correctly point out that a sewer brings more than just relief. It is well known that sewers either accompany or preclude more intense development – more people – more building – more stores and so on. Every land developer knows this well, and in fact, availability of a sewer is usually the key factor in obtaining zoning, financing, and resale. There can be little doubt that a pent up demand exists for shoreline properties in Northern Michigan. Waterfront is not even a must. Accessible land with a view and proximity to water is a limited resource and buying pressure is ever increasing. The reason Crystal Lake does not already have second and third tier development is partly zoning but mostly lack of sewer.

The tough zoning restrictions have sought to protect the environment by requiring large parcels of land for dwellings to insure adequate room for the installation of a septic system which would function adequately and also be located far enough from the water well to insure that contamination of the well would not result. This practice of requiring large

²¹(*) The Betsie Lake Utilities Authority (BLUA) was created to service only Frankfort and Elberta.

lot sizes has the effect of limiting development and almost preventing condo construction due to the large land requirement for the septic needs for a multi-unit project. An example of this is the large amount of acreage required for the development of the Hauser property on the south shore just for the septic field.

As soon as sewers are installed, developers descend with a vengeance. The original land owner, after paying a healthy assessment for the sewer, is suddenly presented with an offer for his land that is far higher than he ever dreamed of and is hard pressed to say no. Back lands that are now taxed minimally and acting as a scenic buffer strip become choice property. Development continues and stores are built along with restaurants and other businesses, and the area is changed forever. If the current residents are willing to make a profit by losing the ambience of Crystal Lake, construction of a sewer is the shortest road to that end.

Some have thought to build in a safeguard to prevent intense and cluster development by establishing a special zoning process called PUD (planned urban development). This was invented originally to give zoning boards more control of what is to be built than is afforded by simple zoning which classifies an area by a number or letter and then spells out exactly what can or cannot be built. Under PUD anything goes as far as what questions the zoning board can ask, the number and complexity of documents they may require and seemingly trivial requirements they may demand. However, the mere existence of the PUD designation infers that some use is fitting and proper and legal pressures can be brought to bear on the zoning body to not unreasonably withhold approval of a project to the point of working economic hardship on the owner. Thus, PUD has had a tendency to backfire in some cases. It is not a panacea. Good, tough, but fair zoning may be more effective in preventing development, but continued pressure almost always results in compromise and the land eventually is given over to some plan or other. As of now, the strict sanitary code is the main defense against development and a sewer largely removes this restriction. Efforts are underway to strengthen the code to include environmental protection in a form as strong as the sanitary code. This is a difficult thing to do as will be described later.

Although it is recognized that every bit of nutrient load to the Lake is important, it does seem illogical to spend \$8,500.00 per dwelling ^(22*) for a sewer which would remove only a small portion of the total nutrient load when for a small fraction of that cost, Cold Creek could be dealt with eliminating 25% to 35% of the nutrient loading – at least for a first action. If, in the future, other improvements are in place, and the Lake is still losing the battle, and with hard zoning rules cast in concrete, then the idea of a sewer as a last ditch gamble might make more sense.

The biggest irony, however, may be in the total nutrient loading on the Lake before and after installation of a sewer. While a sewer would remove the percentage of loading from septic systems, it would: add the combined load of additional runoff from disturbed soils from building activity; particularly on the steep hillsides, eliminate that much forest reducing the amount of vegetation able to absorb nutrients; and also produce that much more runoff from lawns, erosion, car washing, and general people doings. The net result would probably be a total increase to the Lake instead of a decrease.

^{22(*)} The 1987 Consumer Price Index (1983-4 = 100) for 1987 was 113.6 and 177.2 for 2001. A comparable connection to a sewer in 2001 would be \$13,260 adjusted for inflation. This does not include fees for use.

CHAPTER 7.

SEPTIC SYSTEMS

Esthetically, septic systems may leave something to be desired. However, a rough idea of how they work (Fig. 4) will be an invaluable aid in preventing contamination of the Lake. Previous reports indicate that as many as 50% of the systems around the Lake are in a "failed" condition. "Failed" meaning occasional back-ups, sewage effluent observed on the ground, or not adequately treating the materials contained in the system.

The handling and treatment of human waste is a late chapter in the history of man. As recently as 150 years ago whole cities dealt with human waste by dumping it in the gutter. As knowledge of bacterial spread, methods to effectively collect and treat sewage were developed and many of the dread plagues and pestilences began to subside. By the turn of the century suburban and rural treatment was typically a hole dug in the ground. The privy above was either periodically moved to a new site as the hole filled up or certain tradesmen removed the contents of the hole and carted it away. Lime was added from time to time in order to control disagreeable odor and kill some of the bacteria. There is no question that privies caused many an early death by contaminating nearby wells with deadly bacteria.

Cesspools were the next step and some were in use at the same time as the suburban privy. A cesspool is little more than an open pit such as the moat surrounding medieval dwellings, or a buried tank, either of wood or metal.

Human excrement includes waste materials from digestion and metabolism and contains many forms of bacteria. Given time, the bacteria make use of the matter in which they are contained and can multiply very rapidly. The actual chemistry of this process is complex, but the end result is that waste is broken down to simpler and simpler compounds until the residue is relatively harmless to human health and essentially becomes fertilizer. Dried processed sewage sludge is sold as fertilizer under the name of "Milorganite". The "Mil" stands for Milwaukee, which is the city where this material comes from.

Some bacteria, particularly *E. coli*, is not so easy to get rid of. In city treatment plants, dosing the mixture with chlorine takes care of this but some systems rely on the process whereby the bacteria eventually run out of food or encounter unsatisfactory conditions and die. This is accomplished by filtering the solid matter out of the mixture and by dilution. When enough liquids travel through a filter bed, the nutrient level becomes too low to support life and the bacteria die or are consumed by other organisms.

In the first part of this century, cesspools gradually gave way to what we call a septic tank. Probably the most noteworthy difference between the two is that the septic tank contains an overflow device to allow water to spill out after the tank is full to prevent household drains and toilets from backing up. Many people have the idea that a septic tank continues to fill up until it is time to pump it out, perhaps every year or two. This is not the case, as can be shown with a little simple arithmetic. The average septic tank is around 800 gallons in size (about the size of two spinet pianos back to back), buried in the ground deeply enough to allow the house drains to flow downhill to the tank. The average toilet uses about five gallons per flush. A family of three, each flushing six times a day plus the amount used for bathing – another 40 gallons, dishwashing perhaps 20 gallons, etc. for a rough total of 200 gallons per day; four days and the tank is full.

As the tank fills (Fig. 5), solid material settles to the bottom where bacteria commence to work causing some gas to rise to the top creating a layer of lighter material which forms a scum. Grease floats, being lighter than water. At the overflow, a baffle prevents the scum from leaving the tank. It is in this tank that most of the digestion occurs and this is the reason that the condition of the tank contents is important. When the sludge and scum layer exceed approximately one third of the depth of the tank, the digestion process is hampered and undigested materials will be passed along to the final stages of the system where they do not belong. Tanks constructed of reinforced precast concrete nowadays have at least one removable cover to permit inspection and access. The homeowner should know where this cover is and have inspections made to determine the status of the contents. Local pumping service people can usually find an unknown tank quite easily. It will help with future

FIGURE 4.
TYPICAL SEPTIC TANK

FIGURE 5.
TANK AND DRYWELL

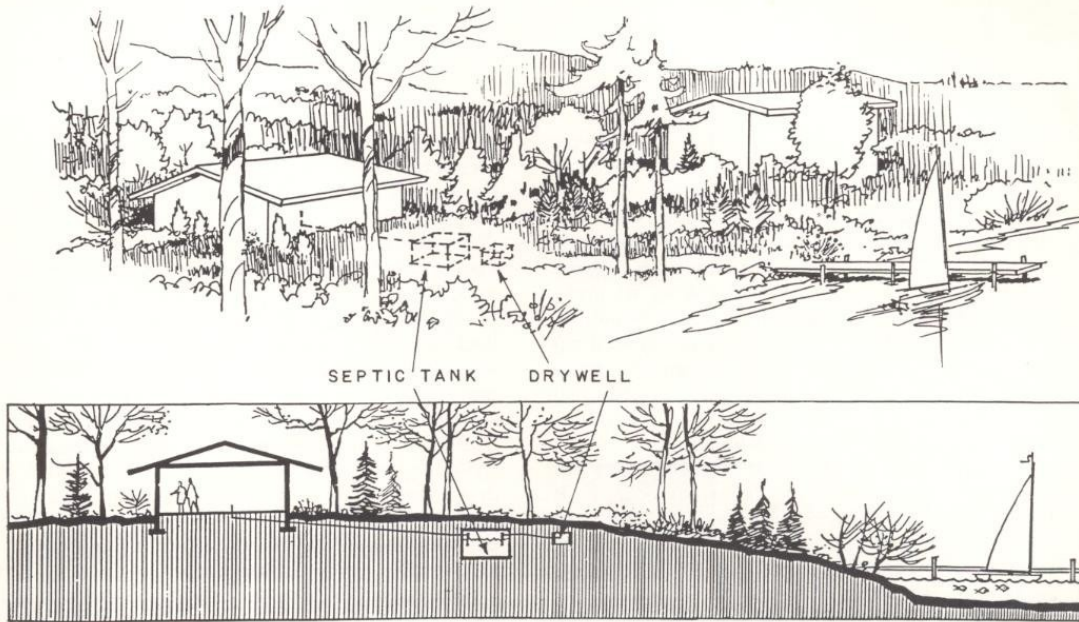


FIGURE 4

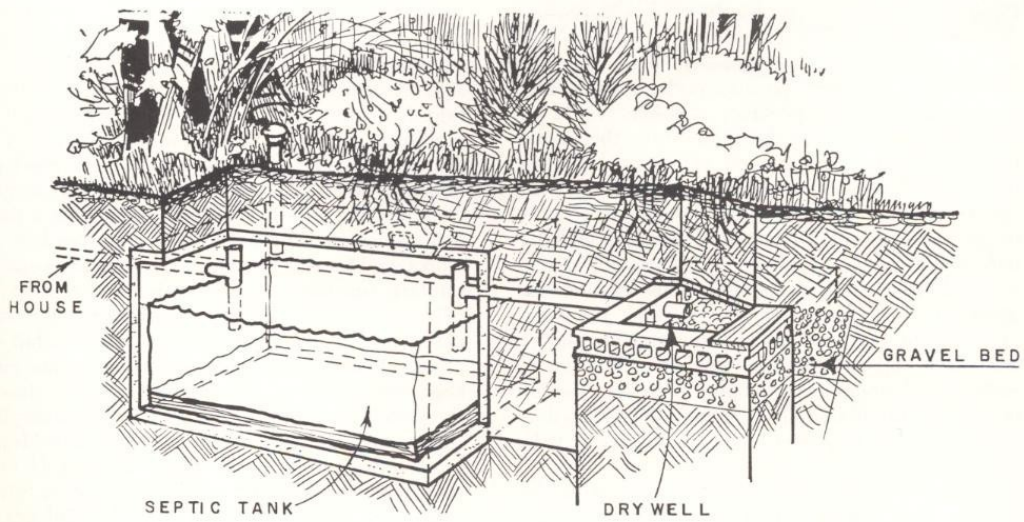


FIGURE 5

pumping and inspection to install a 6" diameter plastic pipe upward from the inspection cover to slightly above ground. A cap is placed over the pipe to prevent odor, et. and permits future activity without disturbing the ground or shrubbery.

The length of time between pumping is impossible to predict since it is dependent on so many variables including: amount of solid matter entering the tank, the nature of the materials (ground up garbage takes a long time to digest), and the number of days the system is used. Some systems can go as long as ten years or more whereas others need pumping every year or oftener.

We now come to the point where failures are most often seen. Tanks do fail from collapse if heavy vehicles are driven over them and old steel tanks rust away and also collapse, but may leak for years before being discovered. However, the biggest failure areas is that of the so-called drywell (Fig. 5). The overflow pipe leads from the tank into the drywell where the excess water can disperse into the soil. Drywells are typically constructed of concrete blocks laid on their sides so that the holes are parallel to the ground. An earth floor is also left for drainage. Water can move horizontally through the holes in the blocks or down through the dirt floor, and a concrete cover is placed over the blocks to prevent soil from filling up the hole. Early drywells were small, perhaps two feet by four feet in the expectation that this would be plenty of area to absorb water from the septic tank. Experience has proven otherwise. After a few years, drywells can be completely plugged and the only place for the water to go is straight down, where little, if any, evaporates, thus loading the ground with moisture. If a septic tank has been neglected by failure to pump often enough, sludge may have carried over and plugged the drywell early on. Plumbers and septic pumping service people are prohibited by law from repairing drywells in order to hasten their replacement with drainfields.

A much more efficient means to deal with the overflow is to send it onto a drain field (Fig. 6), a system of perforated pipe laid under the surface of the ground on a suitable bed of properly sized gravel and overlain with clean sand. The amount of perforated pipe is derived from formulas based on the total gallonage to be handled. A great deal of the water entering the drainfield is lost to evaporation so the underlying soil does not have to accept the total load. After a field has been in place for a short time, certain organisms set up housekeeping in the soils beneath and help to break down the nutrients remaining in the water. It is known that certain soils, not found around the Lake in any great quantity, actually absorb and bind phosphorus preventing the phosphorus from going back into the Watershed^(*23). However, in sandy soils, this bacterial layer does help and does the job quite well. This band of bacterial activity may be seen as a layer of darker sand just under the gravel bed if a field is excavated. Every homeowner should learn whether his system is connected to a drywell or a drainfield (even if it means digging). Systems installed before 1972 undoubtedly have drywells and should be converted to proper drainfield systems as soon as possible.

Sometimes the existing soils are too dense or too low and wet to absorb any more water. In this case, the sanitarian may refuse a building permit or require another type of system which is called a mound system (Fig. 7). This involves bringing in extra suitable soil and constructing a hill on which the field is installed requiring a pump to lift the water from the tank to the field since the field is now higher than the tank. Pumping the water necessitates the addition of an extra tank just outside the septic tank, and also digging and disruption. The pump is installed in this new tank and it is equipped with a float switch which pumps out the pump chamber as soon as it fills from the septic tank overflow. This concept of adding a pumping chamber also can be used when installing a drainfield at a higher elevation away from the Lake and works well for this purpose. The pump has another salutary function. It forces the water into the field in doses. Each time the pump runs, the water enters the field pipes with force, travels a fair distance and then runs back somewhat as the pump shuts off. This tends to spread the water through the system providing a greater areas for absorption. In extremely difficult situations, two drainfields may be installed with a valve allowing one field to be used for a year or two and then the other, giving each a rest. The use of two drainfields prolongs the life of each considerably. Most drainfields can be expected to last upwards of ten to fifteen years. Again, this is dependent on usage, location, size, and treatment. Treatment has to do with things like inadvertently covering a drainfield with asphalt or covering it in some other way with rooting plants.

²³(*) The Benzie/Leelanau District Health Department has conducted a demonstration of seven systems for alternative and decentralized wastewater treatment technologies funded under the National Onsite Demonstration Project (US EPA).

FIGURE 6.
DRAIN FIELD

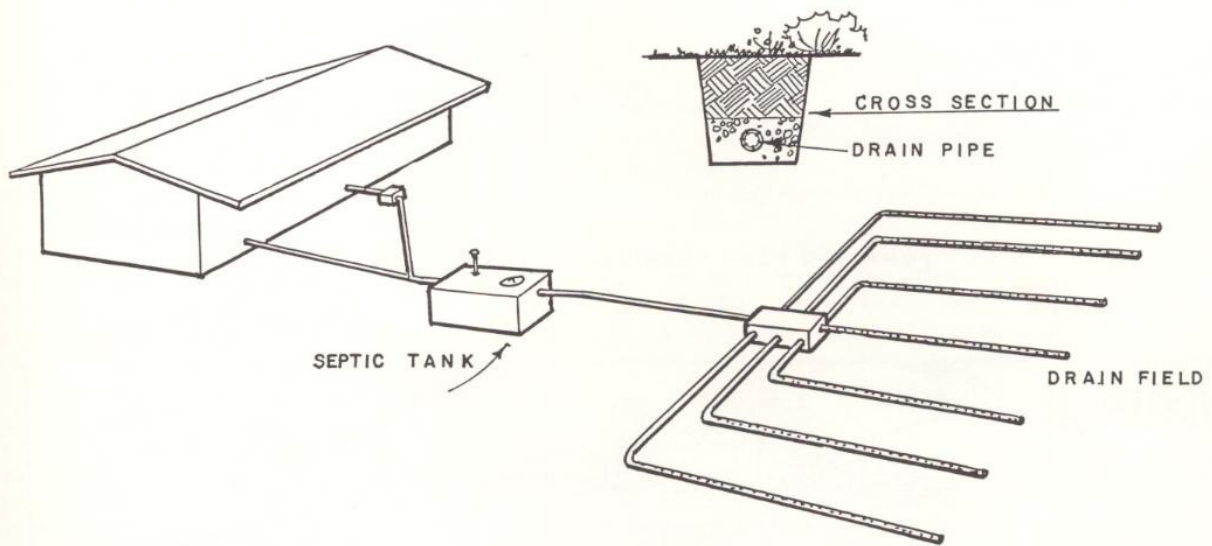


FIGURE 6

FIGURE 7.

PUMP AND MOUND SYSTEM

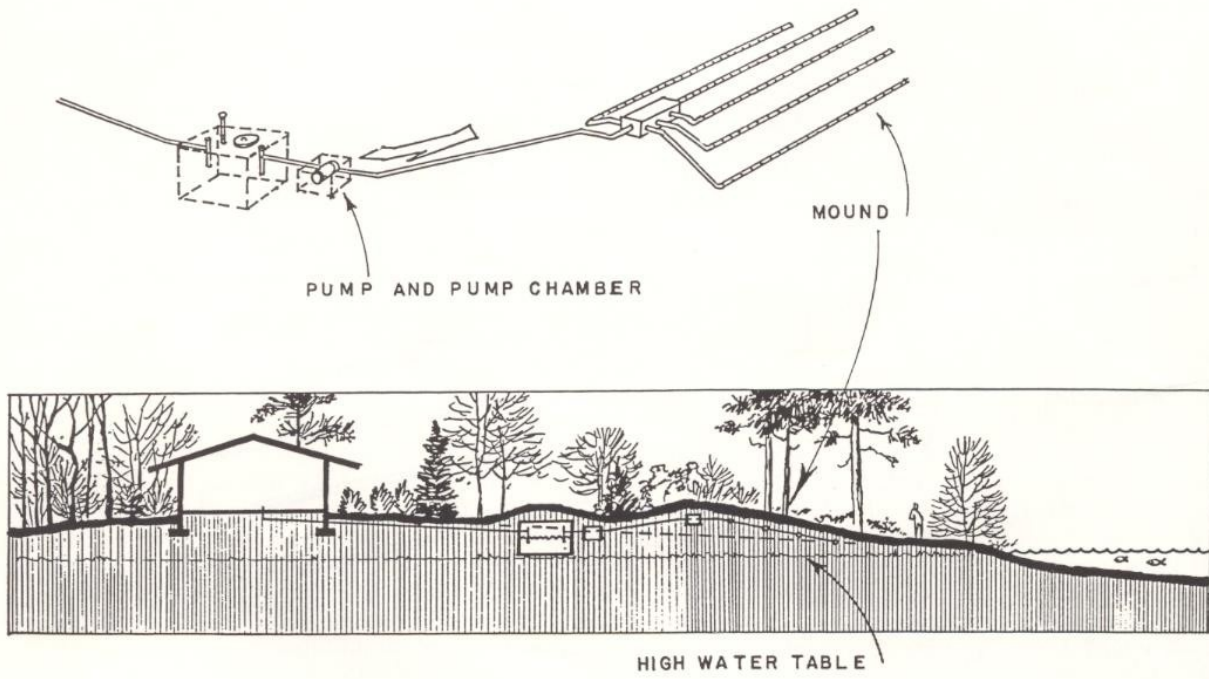


FIGURE 7

The installation of a pumping chamber (Fig. 7) as described is also the first step in planning a cluster system septic arrangement. Several neighbors join together purchasing a small parcel of land in a location where soils and location are suitable. Then all pump their sewage water to this common field. The pipe leading from the pump to the field can be plastic and between two and three inches in diameter – not an expensive installation. In the northeast corner of Crystal, this arrangement is badly needed. The saturated soils and highly mobile and near surface water table on this corner mandate the cessation of low level drainfields. A parcel on top of the hill would be adequate for safe disposal.

Present day costs for complete systems should range between \$1,500.00 and \$3,500.00, depending on circumstances (^{24*}). A pump and pumping chamber should be in the area of \$1,500.00.

One other solution for problem areas is the installation of a holding tank. This is nothing more than an empty tank which is pumped daily, weekly, or whatever the loading demands. Naturally, this method produces no contamination but is very costly. Those who have opted for this method are heroic indeed and should be interested in joining a cluster system. Rumor has it that a few holding tank owners are not so heroic in that they have managed to provide a secret hole somewhere in the tank so pumping will be less frequent. This should be regarded as a felony.

Volumes have been written on the subject of septic systems, but the information presented here is intended to give a worms eye view of the workings of septic systems since they are the most controllable factor in lake pollution (^{25*}), and so that the owner may recognize potential problems and have an idea of corrective possibilities.

The County Sanitarian, whose offices are in the County Building in Beulah is an expert in these matters and will, on request, supply information for any site in the area. A small fee for an inspection may be charged, but a request for information will not incur a charge. You are earnestly requested to assess the condition of your system and take corrective action if indicated. The whole thrust of this book is that an informed public will not knowingly and willfully contribute to lake pollution. With cost figures in the range of those quoted there can be no excuse not to take timely action. Failure to do so will eventually result in having some other agency force such action possibly at a greatly increased cost.

It bears repeating, that although total septic load on the Lake is small in relation to some of the other loadings, it is worthwhile to remedy the septic problem at once, while the other areas are getting started. The portion coming from septic tanks appears to be the trigger force causing shoreline problems. There can be no disguising the fact that the narrow beach dwellings and the northeast dwellings are going to have to pay more for correction than others. There is no equity in site development cost. Steep slopes and/or poor soils have always been more costly to build on due to the extra labor, machine time and material required. The fact that inadequate septic systems were allowed for years should not be the controlling factor in this matter. Even self-interest dictates that a clean lake will preserve and enhance values.

²⁴(*) Costs adjusted to 2001 dollars would range between \$2,340 and \$5,460.

²⁵(*) Septic systems are examples of point sources that can be identified. Surface runoff of precipitation with sediment loading is an example of a nonpoint source that is more difficult to identify but which can be controlled by greenbelts.

FIGURE 8.

POLITICAL BOUNDARIES



FIGURE 8

CHAPTER 8.

AGENCY INFLUENCES

A recitation of every department and agency which might have some jurisdiction on some aspect of the conditions of the Lake would be exceedingly lengthy and tedious. One report indicates there are at least nineteen. Unfortunately, no one agency is able to respond to the increase of nutrients in the Lake with a satisfactory solution. This is a gap in the bureaucratic blanket found in our society.

Starting at the local level, the Lake lies in three different townships (Fig. 8) (*²⁶). This presents a problem since township needs and goals tend to be different. Lake Township, for example, also contains a portion of Platte Lake which is having pollution problems of an entirely different nature, from different sources, and requires a different corrective approach. Therefore, no simple stroke of local regulation will answer for both lakes.⁵

County level agencies not only have the usual problem of insufficient funds, but also a diversity of lakes and streams, each with its own unique character. State and federal bureaus the same. There has been no legislation, or even codification which would establish a particular nutrient level and/or weed free condition for a particular lake, defining that status, and demanding a preservation of that condition. Therefore, all past efforts have relied on some indirect approach, such as modification of the sanitary code, or changes in zoning, or establishment of special districts. This is an awkward and difficult task at best.

Sewer recommendations such as those set forth in the Facilities Report, rely on broad phrases such as "Enhanced Water Quality", which are so vague that no one can actually enforce specific remedies. Other recommendations have also been too broad and unspecific. These failures are not the result of lack of imagination or ability, they are the result of ignorance of what is happening to the lakes and why. Fortunately, public awareness is now increasing and community pressure should soon be sufficient to engender meaningful results. This is the primary reason that your Committee has decided upon education as the base on which to build the necessary laws and actions to preserve water quality.

The Department of Natural Resources (DNR) formerly known as the Michigan Department of Conservation, is a vast organization and has fingers in almost every pie. It is so large and diverse that it would appear that sometimes one branch operates to the detriment of another. The DNR has been active in Crystal Lake matters from the beginning starting with an interest in the Lake from its fishery potential, with the use of lake trout eggs, then advancing to the planting of smelt, and then by a string of experiments with several other species. None of these experiments, following the smelt introduction, have been very successful. In fact, one DNR employee was heard to remark that they "had really messed up the Lake". In the fall of 1986, several thousand Atlantic Salmon were planted in Crystal with little publicity or fanfare. A DNR official was quoted as hoping a new "commercial fishery" could be started in Crystal. So here is an example of one government branch attempting to establish a benefit for one group of citizens at the expense of another group. The first group pay license fees and state taxes. The other group happens to live on the shores and pay local taxes. Equity becomes foggy. The DNR can literally put you in jail if you are apprehended introducing a toxic waste into Michigan waters. You cannot even construct a permanent dock, or alter the shoreline or deepen the water near shore without a permit, and obtaining that permit is so difficult that only the most dedicated will succeed. You can with impunity, however, wash your boat, spill gasoline, or drop a bag of fertilizer in the Lake.

There are those in the DNR whose main interest is in the fish production, who probably would applaud the addition of more weed beds and increased plankton growth as an indication of better habitat for more fish. In this same vein, Crystal has suffered from the byproducts of DNR manipulation. Fish populations in Crystal have been widely erratic ever since the introduction of the smelt. Now another phenomenon is occurring. Each fall, thousands of King Salmon die on the beaches - each

⁵Platte Lake flushes rather quickly, is surrounded by low lying ground, and is receiving most of its problem nutrition from the upper Platter River which is carrying excessive amount of food and waste from the fish hatchery upstream through which the river flows.

²⁶(*) The EIS study area extended beyond the Crystal Lake Watershed. Three townships (Benzonia, Crystal Lake, and Lake) share the shoreline of Crystal Lake, but portions of three other townships (Homestead, Inland, and Weldon) appear to lie within the Watershed on the headwaters of the branches of Cold Creek.

10 to 15 lbs. - soiling the shore. The DNR maintains that they have jumped the dam at the outlet and cannot successfully spawn in Crystal for lack of running water. Other fish experts do not agree and fear that the salmon may take over. If this does occur, we can expect all other game fish in the Lake to be eaten and ever increasing numbers of dead, rotting salmon on the beach each fall. It is interesting to note that if the fish are entering by way of the dam, the same DNR that planted the fish could stop the influx by the installation of about \$25.00 of chicken wire fencing at the outlet as a blockade. Coho Jacks are also found and caught in Crystal. We are told that Jacks do not attempt to spawn (they are immature). Therefore, they did not come in over the dam and must have been hatched in Crystal, so perhaps salmon can successfully spawn in the Lake after all.⁶ What is transpiring is the result of a lack of intent, or recognition, that maintaining the existing water quality of a body of water (except for fishy considerations) has any particular benefit. There is broad recognition that lakes and rivers which have been sorely polluted deserve treatment, but the status-quo idea for pristine waters has not taken hold properly. The DNR has a priority list of lakes needing attention in Michigan, but they have elected to start with the worst lakes first and then progress to the less needy and so on. Crystal is so far down the list that help is indeed very far away. The author of this thrilling philosophy remains unknown.

We do not wish to denigrate the DNR. They have performed beyond the call in terms of the dedication of their employees, particularly the overworked field officers. The problem lies in the nature of the agency; it is driven by the politics of the legislation which in turn reflect the loudest wants of the people who elected the lawmakers. Only public awareness and public pressure to preserve the existing character of a given lake will allow the efforts of a large and talented body like the DNR to provide meaningful help.

Your Committee has recommended that the axis for future coordination of water quality effort be at the County level. There are many reasons for this. The primary one being that the future will undoubtedly offer many diverse state and federal aid programs which will be most helpful in dealing with the problems of Crystal and other lakes in the area. The County government has capable people and an interested staff which can do much along these lines. The local township governments are too small, underfunded, and understaffed to take on this office. Likewise, the State will be hard pressed to focus on this kind of problem on a lake by lake basis. With adequate citizen backing, the existing Board of Public Works is capable and eager to orchestrate the needed activities. Agencies should not be ignored or scoffed at, but rather used creatively insofar as possible. We have a multi-faceted problem - one which requires a multi-faceted solution. In the past, because of lack of information, there has been a tendency to look for a quick fix, such as a sewer alone, or just septic tank cleanup, etc. No one agency will be able to treat everything. It will be a situation of many efforts, in diverse directions, each proceeding on a different time scale, which will accomplish the most. Later chapters outline the specific recommendations as proposed by the Committee.

⁶Unless the DNR is also planting Cohos in the Lake which would be a most unfortunate event.

CHAPTER 9.

SOLUTIONS FOR HOMEOWNERS

Previous reports carried recommendations for ways homeowners could lessen the nutrient load on the Lake. Many were valid ideas but some carried things beyond the point of reasonable acceptance such as removing existing toilets to be replaced by closed system units which use oil as the carrying medium, with solids being separated out in a disposable form, and the oil used over and over. There are such devices, which are quite expensive and rather uncommon looking. We must not overlook the love affair Americans have with the flush toilet. The recommendations which follow are conservative and should cause not undue hardship. Most of these suggestions are directed to persons living within 500 feet of the Lake, but may equally apply to dwellings which are farther but are clearly in the Watershed. If you know or suspect that water from your property runs toward the Lake, then please heed what follows.

Check your existing system to find out what you have and how well it is performing. This was discussed in the section under septic tanks and need not be repeated verbatim. Remember, however, that if your system predates 1972, it probably is failing in some respect and needs attention. Start with a call to the sanitarian's office or with any established plumber or local excavator for a beginning. Once you have correct any problems consider taking steps to reduce the strain on your system. Actually, these steps should be started right away while things are being checked.

Check your soap supply and do not use any except those that are indicated as low phosphorus. Showers use much less water than tub baths. This helps. Install a water saver shower head on your shower. It reduces the flow substantially. A brick or two in the toilet tank may or may not work. Some toilets will tolerate this, and some won't as reduced water capacity may result in incomplete flushing. The idea is to reduce the volume in the tank so less water is used per flush. Most new toilets are designed as water savers so that might be a consideration if you have been thinking about replacement anyway.

If you have a disposal be sparing in its use. Don't use the machine as a prime mover of garbage, but as a convenience to catch small amounts of food and whatnot - nothing down the drain that does not readily decompose. Avoid any grease. The septic tank can hardly handle grease' it also clogs up the drain, enriching the plumber, but nor your or the Lake. Coffee grounds, corn cobs, rinds, paper other than Johnny paper, and other hard and/or fibrous materials are bad news in a septic system. The same for what goes in the toilet. Chlorine or acid bowl cleaners, sanitary napkins, sand, tampons, or other paraphernalia are not good for your septic system. The cost of garbage and trash pickup is mostly charged on a load basis rather than poundage so adding a little more to your garbage bags should not increase your cost of living. Besides you pay either the trashman or the pumper to remove these items, and it is cheaper to pay the trashman.

If you plan on doing any excavating on your property take care to disturb as little topsoil, shrubbery, and grass as possible. Construct an earthen dam to hold any rainwater during the procedure. Do not compost leaves or other matter near the shore. A plastic film tarp under the pile might help to contain the rich water percolating through the pile. In the fall, don't use the Lake as a disposal site for leaves - people have been observed doing this. Don't use fertilizer near the Lake or toxic chemicals either. Sparing use of a high nitrogen fertilizer, carefully applied after a spring runoff and rains is probably safe. Do not apply fertilizer unless real need is shown by the plants. The other nutrients needed by plants are likely available in sufficient quantities already. People are still washing themselves, animals, and boats in the Lake. Some are renters who are simply not aware of what they are doing. Speak to anyone you see doing this. They will hopefully be happy to comply. If they didn't appreciate the Lake, they would not have paid the high rent to get there.

Shoreline plantings can be a great help in absorbing nutrients that would otherwise get into the Lake, and is possibly the easiest way to intercept rich runoff. One of the reports gave a comprehensive lists of plants and trees known to be good absorbers, but all the names were the Latin names only a nurseryman would recognize. Instead, consult with local nursery people for appropriate types, availability, cost, size, and other matters. Crystal

Gardens is one nearby grower located on M22 about one mile north of Frankfort.

Repeated for emphasis. "Soilex" type cleaners for the outside of the house and car washing soaps are added loads that can be avoided rather easily.

With the existing laws as weak as they are, some of you may have a choice either now or in the future regarding the sale of property you may own which is developable. You may have a choice of selling either to someone who intends to build multiple units or someone who intends on using the whole piece for one home^(27*). Environmentally, the choice is easy, financially more difficult. Hopefully, you will be able to decide in favor of the Lake.

If your home is located in the northeast area of the Lake where the groundwater problem is severe, or along the beach where the road is at your back door, or where there is a very steep bank behind your property, which has forced you to install a septic system (Fig. 2) close to the Lake, start now to discuss with your neighbors the idea of a joint cluster system and contact the sanitarian. To form a cluster system, several of you would link together to pump your sewage water up on top where it can be more easily handled. The next chapter outlines Committee and BPW efforts along this line. Obviously, the sanitarian will not recommend rebuilding marginal systems, but will instead recommend the cluster approach. This is another reason for contacting the sanitarian as a first step.

To satisfy yourself that the County has not been spendthrift, examine your tax bill to see how much goes to the school system and how much to the County. We do not advocate higher taxes, but want to call attention to the fact that sooner or later, some additional levy may be required on a temporary basis to get the job done. Far better that than a loss of water quality and a general decline of property value. You can also help by keeping the subject matter alive in conversation with friends and neighbors, and you can contact local and State officials expressing your concerns. Do not hesitate to report anyone suspected of violating general sanitation regulations - the application of a little peer pressure often goes a long way.

If it becomes apparent that additional pressure is needed to convince local officials and other agencies that we are serious about meaningful progress, check with your accountant and/or attorney about the matter of changing your voting residence to Benzie County. The combined voter turnout in the three townships involving Crystal Lake is something in the order of less than a thousand! The eleven hundred or so dwellings around the Lake actually constitute a majority of all voters in recent elections.

The Ad Hoc Committee needs talent and time donated by concerned homeowners around the Lake. Much remains to be done to expedite known goals in the area of legislation, scientific testing and data work, publicity, and education. This body is the logical starting point as it strongly influences the BPW in achieving governmental cooperation.

Some have worked whole heartedly on the various Lake associations. This is time well spent for different areas of the Lake have different needs with respect to boat-auto traffic control, shore patrols, and other items of a local nature. In the past, groups have been formed to go along with one idea or another to save the Lake by installing a sewer system, a junior sewer system, or what have you. Some of these efforts have generated helpful data, but now we must put aside this concept. The BPW, and the Ad Hoc Committee have the means and the ability to marshal the forces needed for an area solution far better than any segmented Lake group. Fall of 1986 saw an effort to form yet another association, made of members of existing associations to work on the idea of all working together to form a giant association, etc. This is a misdirected effort at best or a smokescreen for another go at a sewer at worst. Either the Ad Hoc Committee has failed to sufficiently publicize its efforts, or the authors of the new committee to form committees have another idea they wish not to share with the Ad Hoc Committee. This book expresses the sentiments and findings of the Ad Hoc Committee so by now you should be able to decide which approach makes the most sense.

Hindsight may well show that the efforts of every individual owner around the Lake were not in vain, but did in fact save the Lake initially, and provided the inspiration to get on with the other necessary changes.

²⁷(*) Another alternative is to make an arrangement with a land conservancy to preserve the land. For example, the Grand Traverse Regional Land Conservancy maintains the Trapp Farm Nature Preserve (132 A) and the Railroad Point Natural Area (61 A) and The Nature Conservancy maintains the Point Betsie Dunes Preserve (94.5 A).

CHAPTER 10.

GENERAL SOLUTIONS

The Ad Hoc Committee has made suggestions to the BPW which have given general approval. The implementation of these concepts will be a difficult task since we are dealing with a new area of public concern, namely a specific type of pollution which is not in the toxic or dangerous category. Spending public money for these tasks requires a farsighted, informed, and sympathetic electorate willing to make some financial sacrifice for long range expected benefits. In the case of Crystal Lake, no other centralized body of government appears to be as well qualified as the Benzie County Board of Public Works. This group cannot work alone, however. Cooperation from the public at large, township governments, lake associations, and many other agencies is needed to insure progress. Various solutions and plans will be outlined, some of which may appear far fetched at first glance. The Committee is not overtaken by naïve optimism nor by excessive gloom, but feels obliged to consider every scheme that has been put forward in order to fully justify whatever action is finally decided upon. Even the EPA recommends the use of unorthodox methods if necessary to achieve the desired end result.

We have shown that Cold Creek is a major source of pollution to the Lake (*²⁸); that it is really a very small stream; that perhaps only one branch of the Creek is the problem source; and that since the sewer system in Beulah is already overloaded, the simple expedient of dumping Cold Creek into the Beulah sewer will not work. In order to attack the problem, further testing needs to be done by means of water sampling at several locations along the stream to determine the sources of high phosphorus concentrations, and also to determine the total loading into Crystal. Although this task was partially accomplished in 1970, it was not reported in sufficient detail nor recently enough. The actual test procedure has been worked out by the BPW and late in 1986, a request for funding in the amount of \$16,000.00 was rejected. (Reference to this incident was made in an earlier chapter). This study is essential and must be done. Refusal to fund would not have occurred had public awareness been what it should be and what we hope it will be very soon. The BPW will reapply very shortly and expects approval this time.

The test results may close some doors and open some others, but based on the existing data and calculations, several possibilities are under consideration. Science has been working on an economical method of precipitating phosphates in order to remove them from a water source. Precipitation, in this case, simply means to render the dissolved phosphates insoluble, so that they fall to the bottom of the holding pond and remain there doing no further harm. Should a breakthrough occur in this area, the problem would be solved for Cold Creek already has retention ponds. All that would be needed would be the addition of the new chemical.

Another considered method of treatment is to find the source of phosphorus entry to see if it is a point source and not just general runoff. An example of this would be to test the north fork (Fig. 1) of the stream which begins in the vicinity of the golf course. The north fork is supposedly very high in phosphorus. If it can be shown that fertilizer from the golf course is the problem, the situation may be rectified in several ways or a combination of ways such as: reducing the amount of fertilizer used; digging a retention pond and reusing the rich water over again in the sprinkling system of the club; or diverting the stream over more absorptive soils as it flows south towards Beulah, or worst case, pumping the entire north fork by the upper reaches of the Watershed or over the hill at Benzonia to join the Betsie. If testing shows that the entire Creek is causing the problem, and that the total loading on the Lake is significant, more drastic measures will have to be considered such as pumping the total output of the Creek over the hill to the Betsie or tiling the Creek to the outlet along the railroad right-of-way, or enforcing extremely rigorous controls on all lands contributing to the loading. The latter would be impossible for all intents and purposes. Yet another possibility would be to pump the output to the high sandy ground at the top of the Watershed and dispose of it by pumping underground or by spray irrigation. It can be seen that each of these solutions will require further study and a means of funding, thus pointing out again, the need for the simple testing program already planned by the BPW. Pending approval of the funding, the tests can start in the summer of 1987 and continue for one year to measure

²⁸(*) While Cold Creek is a major source of sediment and bound phosphorus to Crystal Lake, this should be considered relative to other watersheds with much more severe pollution from point sources. It is indeed fortunate that Crystal Lake has relatively minor inputs of sediment and nutrients compared to most other watersheds in Michigan.

the impact of the seasons. Therefore, by the summer of 1988, decision making may be possible.

Crystal Lake, itself, also needs continued monitoring; this is currently being done by a local high school teacher (*²⁹) with his classes. This is a very low budget exercise, but it is deemed adequate for the purpose. If continuation of this program becomes doubtful, it should be rescued promptly in order to assure continuity.

Some of the above mentioned schemes may well be impractical or unpleasant, but they should be considered nonetheless, until proven unworkable. For example, the local Beulah Chamber of Commerce might originally be horrified to think of Cold Creek no longer winding down past a few stores and emptying into Crystal at the bridge. But what if the choice is between Cold Creek and a dirty, weedy beach with a muck bottom that squishes up between your toes?

Before further tasks are discussed, it might be well to touch on the problem of funding in more depth. This lack has, of course, been the most instrumental in deciding to appeal to the general population by means of informing and explaining in order to generate pressure in local governments to supply the small sums needed for the first stages of the cleanup process. Even if, after further study, some kind of special district must be formed to raise funds by temporary one-time assessment, a convinced populace will respond positively since they have prior knowledge of what is going on and how it benefits them. Those in County government are familiar with all the various ways to receive grants and matching funds from a myriad of other agencies and this is another reason for having the thrust point of activities at the County level. The BPW will be constantly seeking such funding over the next period of time and their task will be simpler having valid plans to execute as well as demonstrated public support.

Cluster systems, in one form or another, seem to be the only satisfactory solution for lakeside homes where insufficient land is available for a septic system or where the groundwater is too high, or where steep banks cause a washing action through the soils that contain septic systems. We have encouraged those owners to seek help from the sanitarian to get an early start upgrading their faulty systems by the installation of a large common drainfield. These systems can range from complex to very simple. One system idea unnecessarily complex for Crystal includes pumps leading into so called package plants which are really miniature sewage disposal facilities. These systems are commonly used in Florida along the beaches beyond the reach of city sewers. This type of system is too costly and requires regular maintenance and frequently poses problems in the form of ownership, law mandated hookups and leakage. In general, it is more technology than required for Crystal since adequate lands exist on top of the hills in most areas requiring treatment. Another type is the mini sewer system, built by private companies which can be financed by bonding and either operated by the cooperative owners or the contracting company. This type has been furnished for a number of small densely populated lakes where the risk of increased development is small and all shore owners would hook in. Legal and operational difficulties attend these systems as well, and again are probably not a good idea for Crystal. The cluster drainfield method is the most promising one to date for Crystal's problem areas. The BPW is seeking a method by which the sanitarian's office can be augmented to provide the extra service, on a temporary basis, to assist owners in securing the most economical design and exact methodology for forming these informal community disposal sites. A questionnaire was mailed to residents in the area to help in the formulation of the necessary planning to secure property, and obtain the permit necessary to cross the road as well as technical data on pump size, type of pipe, and general cost estimates. This data will be updated possibly with another mailing.

It is a pity that the northeast corner of the Lake with the worst soil condition of all the septic systems cannot hook up to the Beulah Sewer which abuts the eastern end of the area in question. A similar connection was made on the southeast corner a few years ago and the improvement in the Lake water in front of those homes has improved dramatically. It is imperative, therefore, that the BPW continue to attempt to find an equitable way to include this much sewer for connection to Beulah if at all possible. This determination will be done as a high priority need so as not to delay the cluster system effort for that area, if the Beulah sewer is out of the question.

The Ad Hoc Committee is also pursuing the inclusion of special language into local ordinances to prohibit any activity which increases nutritional pollution into the Lake. The codes of some townships have been recently revised to include very

²⁹(*) Two excellent studies directed by John Gehring of Benzie Central High School are listed in the Additional References.

rigorous language defining "natural areas" and the like, and requires substantial protections to these areas, mostly in the areas of erosion and bacterial contamination. The language is so nearly perfect to the needs of nutrient control that in some cases, only the addition of a word here and there, or a phrase or two will suffice. It is likely that with education, these changes can be made in the local codes with full public support. However, two major problems remain before these code changes can be effective as they should be. The first is that a standard of nutrient discharge that can be practically used must be developed which would be sensitive enough to find the trace amounts of seepage that might be present, and the second is the enactment of an "anti-grandfather" clause which would, by a specified date, require all older systems to conform with substantial penalties for noncompliance. These are formidable tasks, but not impossible. There is no question that in time, as the public becomes more aware of the cause of soiled waters, such legislation will be commonplace and strictly enforced - enforced as vigorously as the sanitary codes are today. Non-conformance to the sanitary code today means a padlock on the door.

The Committee has undertaken preliminary investigation of this means of control and enforcement, and the BPW has been active in researching existing laws and powers to serve the same end. Donated services of legal people may prove invaluable in assisting with code revisions ^(30*). If you feel qualified, please contact either the BPW or the Committee. The Committee recognizes that the legal approach may take a long time, and therefore has decided to challenge the owners around the Lake to voluntarily repair and remedy their own systems before the law requires this action probably at greater cost than if undertaken now and before the Lake becomes hopelessly changed.

Retesting of the flow rates and direction of the water table around the Lake is necessary for at least one year to confirm the westward flow along the west shore. This will determine whether west shore residents have little or much work to do. Budget-wise, this is a small item in dollars and should be done this year.

Publicity is another area of Committee concern. As the awareness of people increases regarding water quality methods and progress, the media will be employed to maintain the momentum. These efforts will include, but are not limited to, mailbox stuffers, press releases, television and radio copy, and possibly "scorecards" or graphs - all designed to stimulate interest and apply pressure on those who have not yet taken action.

The outlet needs a wire fence to stop the salmon. At present the dam is in more than one jurisdiction and each blames the other for boards in or boards out, etc. The BPW will make a specific request regarding the installation of a "fish preventing" fence and also recommend a permanent Lake level agreeable to the majority to stop the water table from flushing nutrients into the Lake every fall when the Lake is lowered ^(31*).

There are other concerns of the Committee involving representation of all areas of the Lake and all Lake associations in order to include democratic representation, and to prevent possible future claims of railroading. Committee meetings are held at various times from May until October or November, with controlled sessions devoted to matters at hand to prevent aimless discussion. Notice of meetings will be given in the local papers. You are cordially invited to attend, if not to contribute, to be reassured that progress is being made^(32*)

Admittedly, the percentages of nutrient inflow to the Lake are guesses made on the part of the investigators. Thus the numbers have suffered from bias. However, even the most pessimistic interpretation would indicate that success on a number of the remedial solutions discussed could reduce the inflow by as much as 50%. With the strong evidence in hand that the Lake problem is a threshold problem, we have every right to expect success.

Will you do your part?

³⁰(*) One of the first ordinances governing premises with onsite sewage disposal systems (septic systems) in the U.S. was enacted for Benzie Co. in 1989. This ordinance initially required that all properties subject to resale have their septic systems inspected and approved by a Sanitarian from the Benzie/Leelanau Health Department. This is required for all new systems and now also retroactive to all older existing systems by date certain.

³¹(*) A "fish preventing" fence has not been installed, but no migratory fish pass up Outlet Creek. In 1980, levels of 600.25 and 599.75 ft above mean sea level, resp, for summer and winter, were established by law.

³²(*) The original Ad Hoc Committee became independent of the Benzie County Board of Public Works in 1987 as it evolved into the Clean Water Committee of Crystal Lake which merged with the Friends of Crystal Lake to become the Crystal Lake Watershed Fund, Inc.

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³³(*) The original bibliographical entries have been modified for completeness.

³⁴(*) The Clean Water Committee and the CLWF have continued this program to date. See www.mi-water-cmp.org/.

³⁵(*) The following additional references are appended because of their relevance to the Crystal Lake Watershed.

BACK COVER

