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REPORT OF WATER QUALITY IN DALRYMPLE LAKE

1972

Ministry of the Environment
Ontario

The Honourable William G. Newman, Minister

Everett Biggs, Deputy Minister

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REPORT OF WATER QUALITY

in

DALRYMPLE LAKE, 1972

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PREFACE

The Province of Ontario contains many thousands of beautiful small inland lakes which are most attractive for recreational use. Lakes close to urban areas and accessible by road often receive heavy use in terms of cottage development, camp sites, trailer parks and picnic areas.

A heavy influx of people may subject a lake and its surrounding environment to great stress. In many cases, developments are carried out on attractive lakes only to find that when this is complete the lake qualities which were initially so appealing have been damaged. The appearance of the shoreline can be marred by construction, fishing ruined by over-harvesting or the growth and decay of excessive amounts of algae and weeds. Motor boats introduce noise and petroleum pollution. Inadequate disposal of human wastes can place a great stress on the lake environment.

The accepted custom of having "a place at the lake" continues to apply pressure for more development, giving rise to an even greater expansion of problems.

The Ontario Ministry of the Environment is attempting to bring some of these stress factors under control with a variety of programs. The cottage pollution control program was initiated in 1967 and was expanded in 1970 in order to solve the cottage waste disposal problem in recreational lakes. There are three on-going studies carried out by the Ministry:

1. Evaluation of existing waste disposal systems and enforcement of repairs to those found to be unsatisfactory;

2. Research to improve the knowledge of septic tank operation and effects in shallow soil areas and evaluation of alternative methods of private waste disposal;

3. Evaluation of present water quality in a number of recreational lakes. A totally undeveloped lake near Huntsville was studied in 1972, in order to obtain more information about natural water quality conditions within a Precambrian Lake, which would assist in defining any unnatural conditions encountered in the developed lakes surveyed.

This report on Dalrymple Lake is one of a series dealing with the water quality aspects of the recreational lakes studied in 1972. As well as defining present status of water quality in the lakes, the data are meant to provide an historical reference for comparison of conditions at any future time.

SUMMARY

Surveys were carried out in Dalrymple Lake in 1972 in June, August and September to evaluate the present status of water quality with respect to bacteria, algae and aquatic plant growth. Plant nutrients, mineral and dissolved oxygen concentrations in the surface and bottom waters were determined as well.

The lake lies in the counties of Victoria and Ontario in a limestone plain with a topography that varies from flat land to gently rolling hills. Soil cover varies from sandy loam which is used extensively for agriculture to Rockland (sand soil over igneous bedrock) which is non-agricultural. Generally, the overburden is shallow and is composed of a sandy to a clay loam till over a limestone bedrock.

The bacteriological water quality was generally good. However, there were several localized areas with moderately high bacterial levels. Bacterial levels were higher after a substantial summer rainfall, due probably to runoff from the cottaged shoreline resulting in densities which were higher than during the spring and autumn surveys.

Chemical water quality was good during all three surveys with no evidence of any serious dissolved oxygen depletion in the bottom waters. Generally, the north half of the lake had higher concentrations of mineral constituents than the south half. While only a moderate status of enrichment was indicated by mean chlorophyll and water clarity measurements which reflect a level of suspended algae that could not be considered troublesome, the south half of the lake was heavily populated by aquatic plants.

Cottagers should ensure that waste disposal systems are functioning properly so that seepage of nutrients and bacteria to the lake does not occur.

PURPOSE OF THE SURVEYS

The surveys were designed, and tests selected, in order to evaluate the present conditions in the lakes with respect to:

-concentration of bacteria
-plant nutrients and algae
-water quality with depth
-inventory of shoreline development

As a result of human activity in the recreational lake environment, some wastes may reach the lake itself and this can lead to either or both of two major types of water quality impairment, microbial contamination and excessive growths of algae and aquatic plants. The two problems can result from a common or different source of pollution, but the consequences of each are quite different.

Microbial contamination by raw or inadequately treated sewage does not significantly change the appearance of the water but poses an immediate public health hazard if the water is used for drinking or swimming. This type of pollution can be remedied by preventing wastes from reaching the lake and water quality will return to satisfactory conditions since most disease causing bacteria do not persist in the lake.

Nutrient enrichment, or eutrophication, results from the addition of plant fertilizers which occur naturally and are also present in virtually all forms of raw or treated human wastes. High concentrations of these fertilizers (plant nutrients), mainly nitrogen and phosphorus, support extensive growths of rooted aquatic plants and of microscopic free-floating plants called algae.

Eutrophication greatly affects the lake appearance but generally does not pose a health hazard. Problems due to nutrient enrichment are generally long lasting and may become irreversible.

Changes in water temperature, dissolved oxygen and quality with depth are very important characteristics of a lake and were examined in the surveys.

Aquatic weed beds provide shelter and food for many kinds of fish. Too much growth is undesirable since it can upset the oxygen balance in the lake and can interfere with recreational uses of the lake.

DESIGN OF THE SURVEYS

Timing

Five day bacteriological, chemical and biological surveys were carried out from June 3 to 7, from August 20 to 24 and from September 18 to 22.

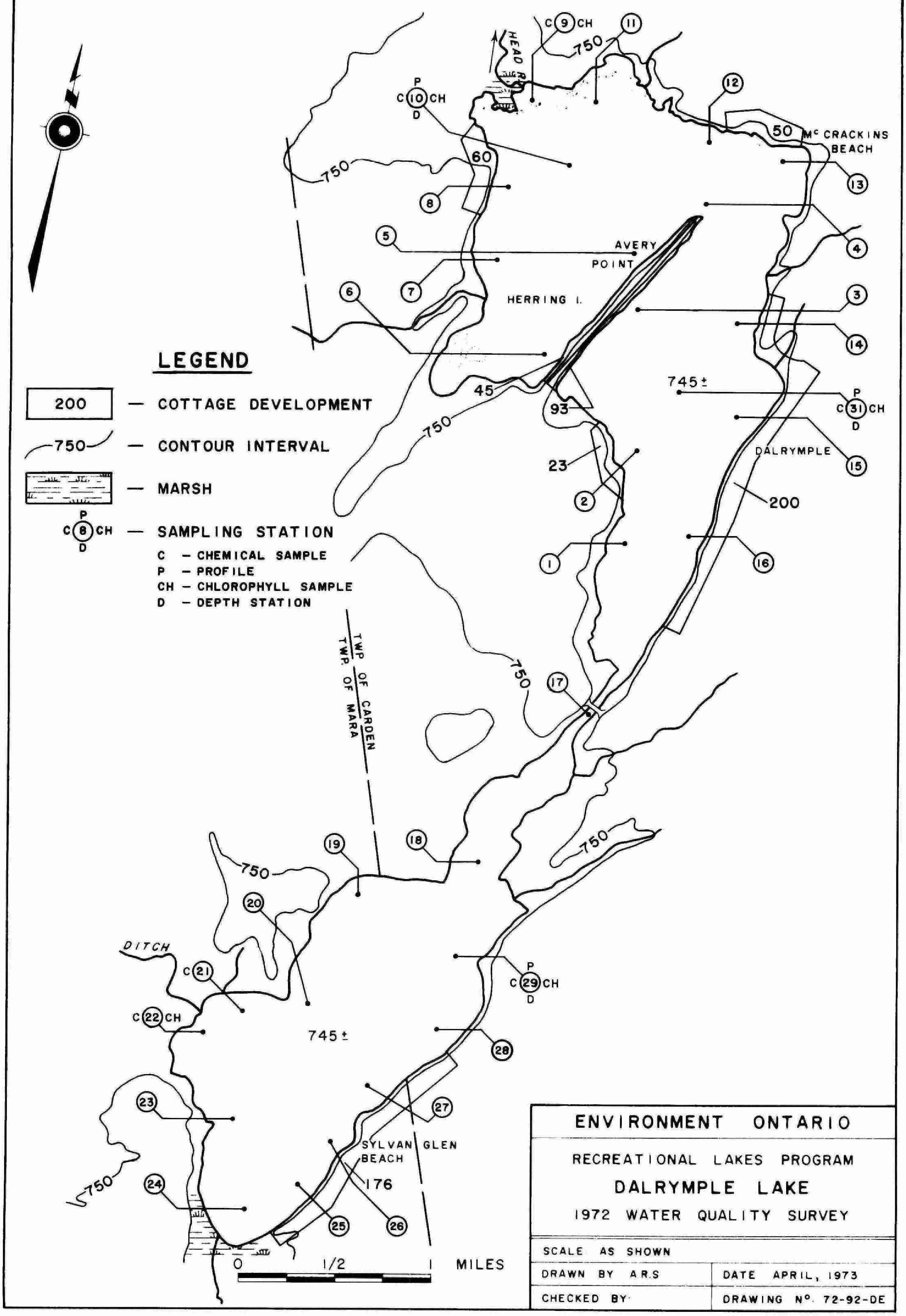
A proper estimation of the bacterial population requires several measurements over a period of time which can then be averaged as a geometric mean. Measurements over 5 consecutive days at each station are regarded as the minimum number which will give reliable data.

Chemical samples were collected on the first and last days of the surveys at inlet and outlet stations and at the mid-lake stations. Chlorophyll samples were collected each day at the inlet and mid-lake stations.

Selection of Sample Locations

Thirty-one bacteriological sites were established over the whole lake (Figure 1). Chemical samples were collected at the two inlet stations, one

FIGURE 1 — COTTAGE DEVELOPMENT AND SAMPLING STATIONS OF DALRYMPLE LAKE



outlet station and at three mid-lake stations. In addition to these surface samples, chemical and bacteriological samples were taken from the bottom water at the mid-lake stations.

Field Tests

The variation in temperature and dissolved oxygen values with depth were measured at the three deep water stations with an electronic probe lowered into the lake and water clarity was measured with a Secci disc, (Figure 2). The pH and conductivity of the samples were measured in the field.

Bacteriological Tests

Three groups of bacteria were determined on each sample: total coliforms, fecal coliforms, fecal streptococci. These organisms are used as "indicators" of fecal contamination. Many diseases common to man can be transmitted by feces, consequently, the probability of occurrence of these diseases is usually highest in areas where the water is contaminated. The total coliforms, fecal coliforms and fecal streptococci organisms are all indigeneous to man and other warm-blooded animals and are found in the colon and feces in tremendous numbers. These indicator organisms in the water denote the presence of fecal contamination and hence the risk of disease causing organisms.

Chemical Tests

Hardness, alkalinity, chloride, iron and conductivity were measured in order to define the mineral composition of the water. The types of plants and animals which thrive, effects of toxic materials and suitability of the lake for various management techniques depend on the mineral content.

The "Secchi Disc Reading" is obtained by averaging the depth at which a 23cm (9") dia. black and white plate, lowered into the lake just disappears from view and the depth where it reappears as it is pulled up.

Most of the free-floating algae are suspended in the illuminated region between the lake surface and 2 times the Secchi disc reading.

Clear, algae-free lake: Secchi disc readings tend to be greater than 3m (9 feet).

Turbid or algae-rich lake: Secchi disc readings tend to be less than 3m (9 feet).

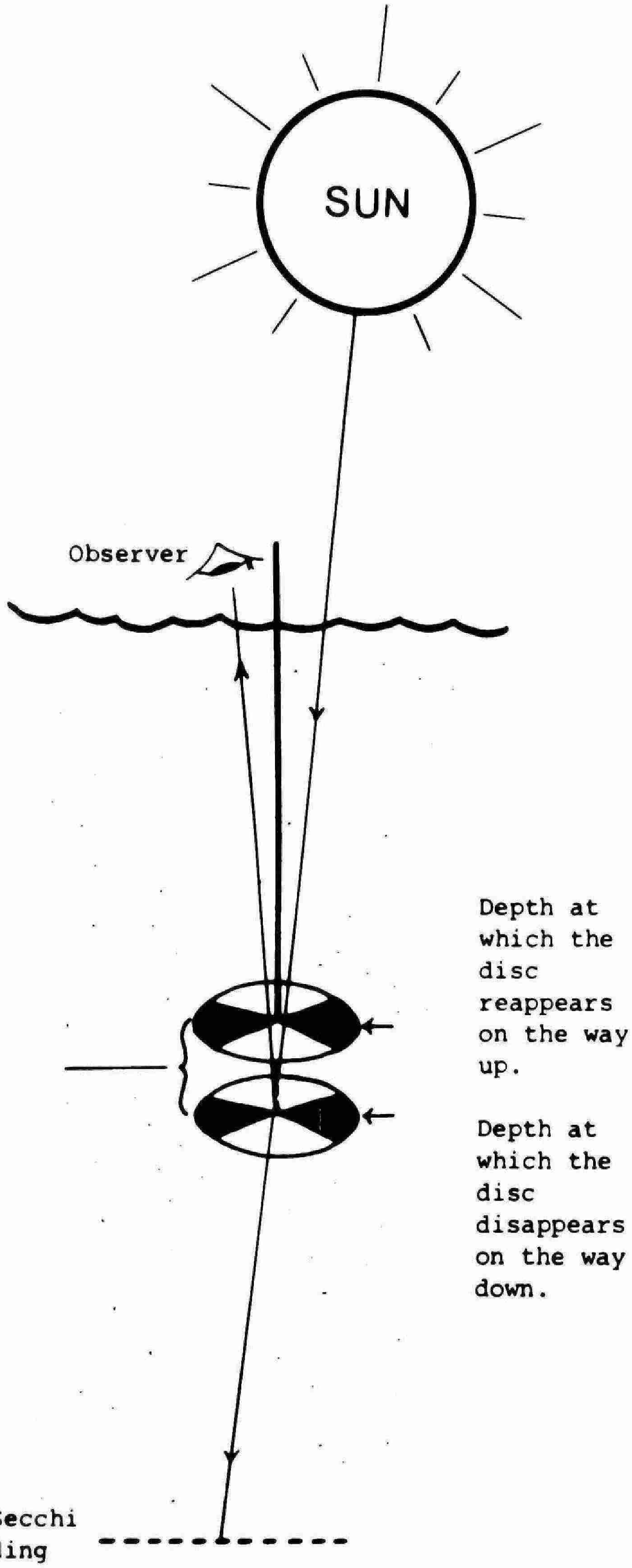


FIGURE 2: USE OF SECCHI DISC TO DETERMINE WATER CLARITY

Total and soluble phosphorus were measured in the inlet and bottom water samples while total phosphorus only was measured in the mid-lake and outlet surface samples. Soluble phosphorus concentrations are used mainly to substantiate various interpretations of total phosphorus concentrations.

The total Kjeldahl nitrogen is essentially the amount of nitrogen contained in organic material. It was measured in all of the chemical samples. The soluble forms of nitrogen, ammonia, nitrite and nitrate were measured in the inlet and bottom water samples. They are particulary important in bottom waters since nitrogen may be regenerated from decaying organic matter in these forms.

Chlorophyll a concentrations are an indication of the amount of suspended algae in the water. The live algae are confined mainly to the illuminated surface waters which extend down to a depth of about twice the Secchi disc reading. The chlorophyll samples were collected by raising the sample bottle through the depth of the illuminated surface waters as it filled. The sample was then representative of the algal density through the sampling depth.

DESCRIPTION OF THE DALRYMPLE LAKE AREA

Soil and Lake Characteristics

Dalrymple Lake lies approximately 25 miles northeast of Lindsay in the townships of Carden and Mara in Victoria and Ontario counties respectively. This area is in the South-Central region of Ontario in a limestone plain with a topography that varies from flat land to gently rolling hills.

A number of soil categories surround Dalrymple Lake (Figure 3) varying from the Otonabee series, which is a sandy loam used extensively for agricultural purposes, to Rockland (sandy soil over igneous bedrock) which is non-agricultural and heavily forested. Muck or organic deposits are found in old glacial spillway channels and other depressional areas. This organic material is the partly decomposed remains of sedges and trees.

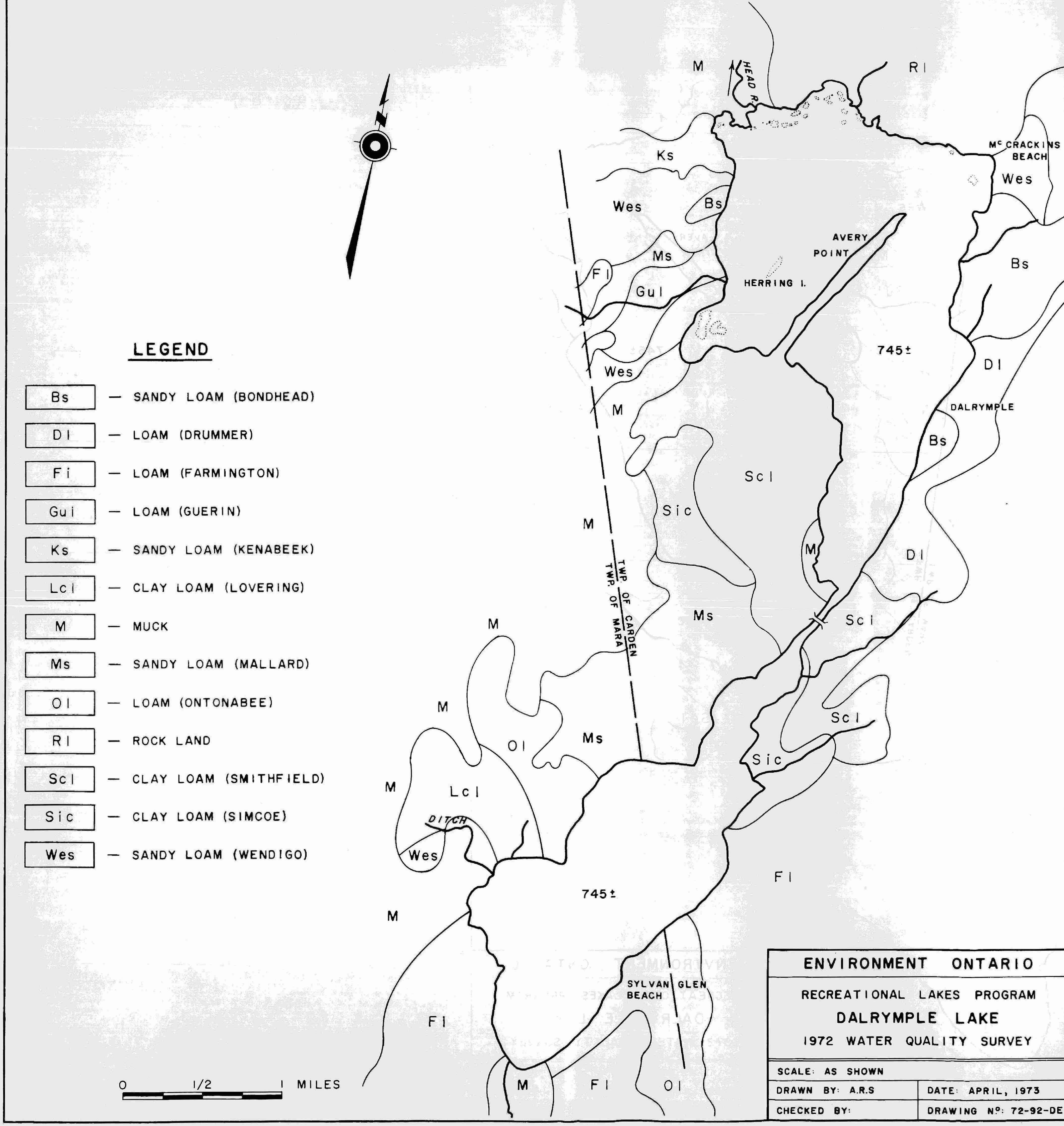
Dalrymple Lake is at an elevation of 226 meters (745 feet) above sea level and is in the form of two basins divided by a narrows over which Highway 503 has been built. The total length of the lake is approximately 10 kilometers (6.4 miles) lying along a north-south axis. The south half (upper lake) has a surface area of 8 square kilometers (3.2 square miles) and a shoreline length of 11 kilometers (7 miles). The north half (lower lake) has a surface area of 5 square kilometers (2 square miles) and a shoreline length of 21 kilometers (13 miles). The maximum water depth is 11 meters (36 feet) in the north half and 5 meters (16 feet) in the south half.

The watershed of Dalrymple Lake consists of 70 square kilometers (27 square miles) in area with most of the water from land drainage entering the lake through the south end. The only outlet, the Head River, drains Dalrymple Lake at the north end. The drop between Dalyrmple Lake and Lake Couchiching is 8 meters (27 feet).

Water Usage

Most of the cottagers use the lake as their source of domestic water supply. The lake is used for recreational purposes such as boating, fishing, water skiing and swimming, but, owing to the dense aquatic vegetation in the south half, much of this activity is restricted. The common game fish found in the lake are pike, pickerel, maskinonge, largemouth and smallmouth bass.

FIGURE 3 - SOIL TYPES NEAR DALRYMPLE LAKE



Shoreline Development

There are approximately 400 cottages on Dalrymple Lake. The shoreline of the south half of the lake has very little development except along the southeast shore for a distance of approximately 1.6 kilometers (1 mile). In the north half, the shoreline has been heavily developed especially along Avery Point which is a narrow peninsula jutting out into the lake a distance of approximately 2 kilometers (1.2 miles).

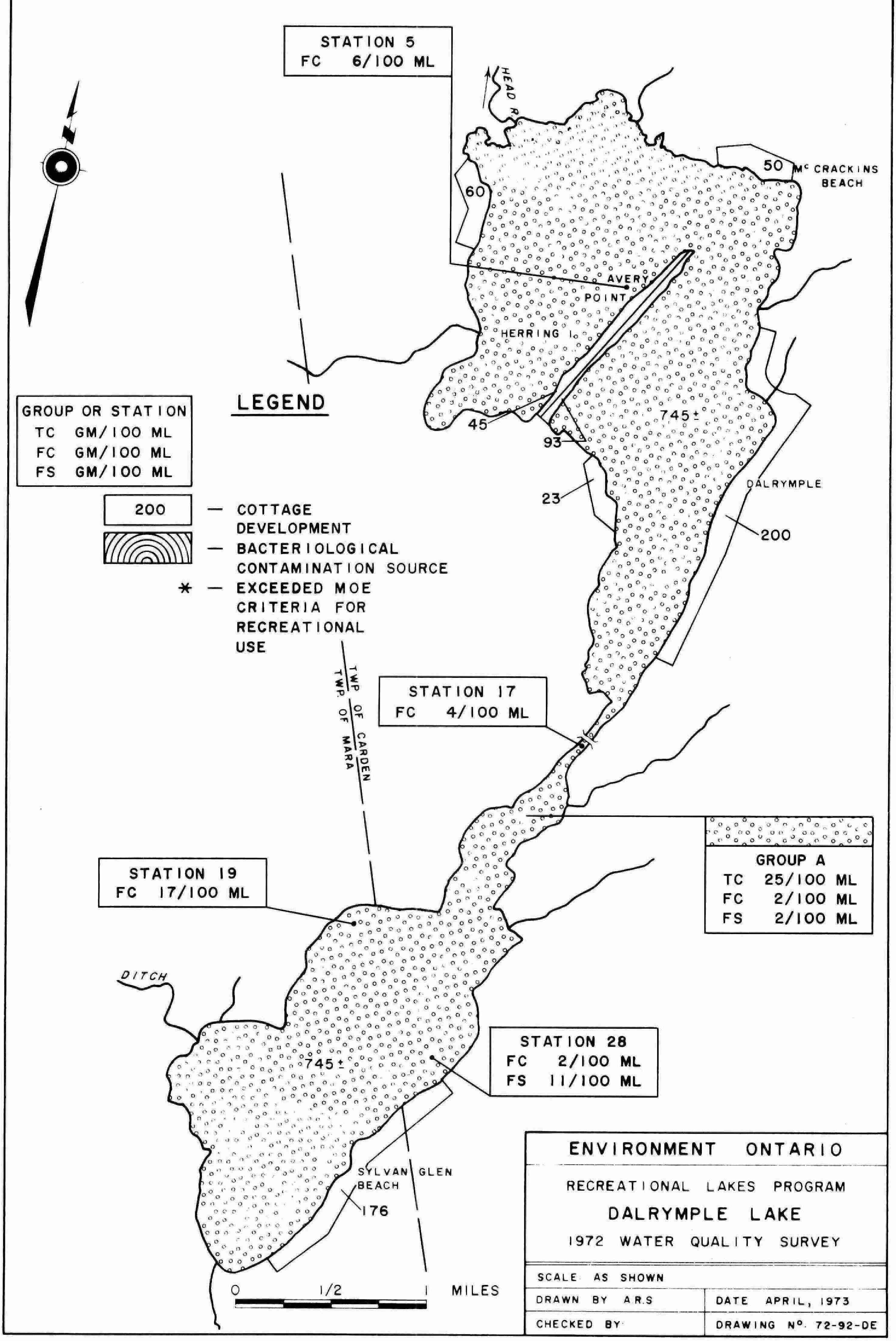
RESULTS AND DISCUSSION

Bacteriology

The quantities of bacteriological data necessitated statistical methods to summarize the results into a concise presentation without the inconsistency associated with manual interpretation. The methods used are based on the analysis of variance and Barlett's test of homogeneity by which stations on a lake can be grouped into areas with the same bacterial level. Areas or stations with only slight differences in bacterial concentration can be isolated. It was found on previous work that areas, or stations, with significantly higher bacterial numbers generally indicated a pollution input. Details of statistical methods and data are available on request.

The June survey revealed that all stations on the lake were statistically homogeneous for total coliforms (TC) with a very low geometric mean of 25 TC/100 ml (Figure 4). However, the TC levels fluctuated markedly during the survey and appeared to be highest on June 6. The TC counts around some heavily cottaged areas and within the influence of streams usually exceeded 1000 TC/100 ml on this day. The Lorneville and Coboconk weather stations

FIGURE 4 - DISTRIBUTION OF BACTERIA IN JUNE



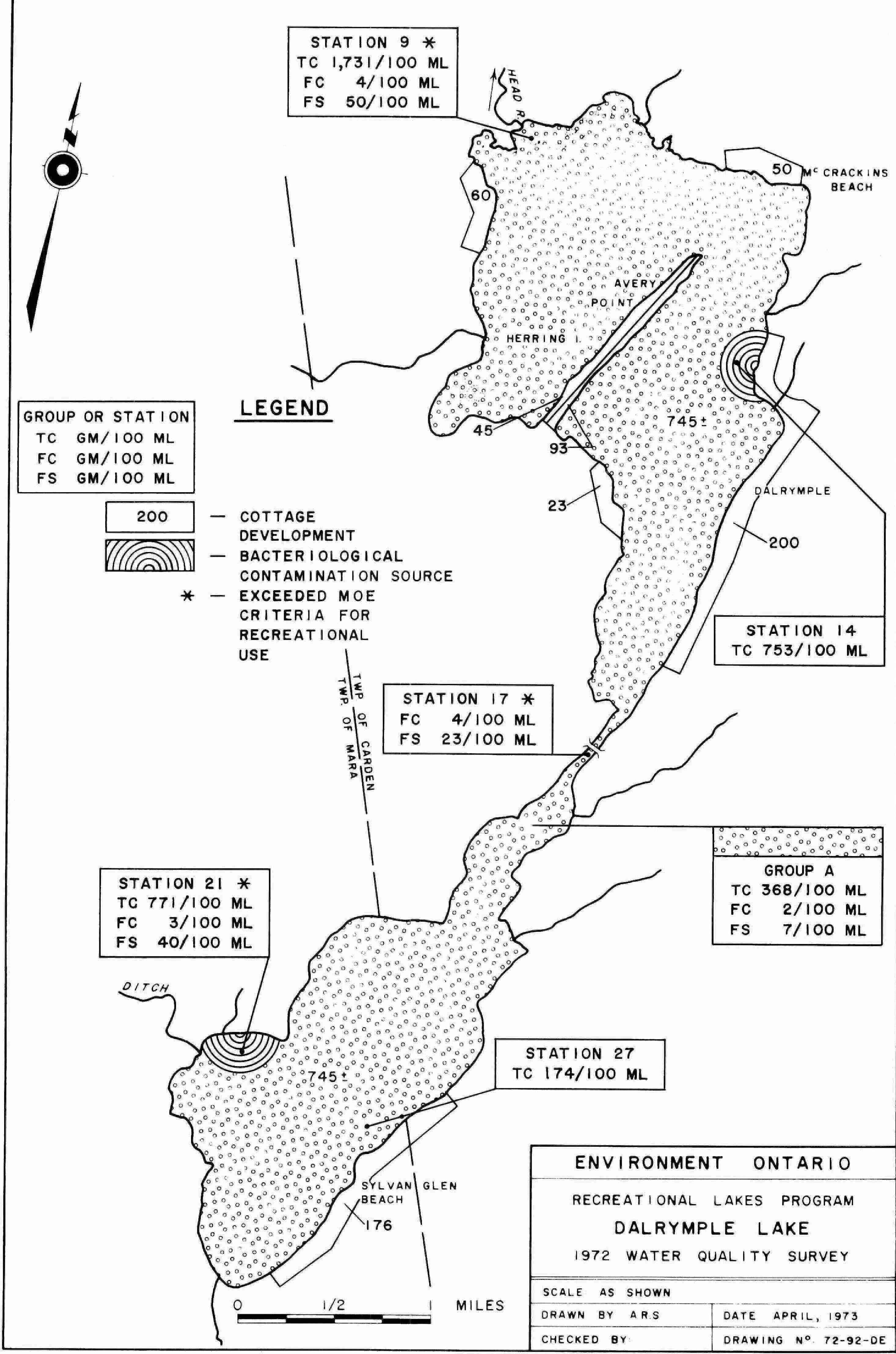
recorded only trace amounts of rainfall during this survey so that the TC fluctuations cannot be attributed entirely to the input of bacteria to the lake by runoff resulting from rainfall.

The majority of the stations on the lake (Group A) displayed a very low fecal coliform (FC) mean of 2 FC/100 ml. The area in the vicinity of the Avery Point peninsula (Station 5), adjacent to dense cottage development, had a higher FC mean of 6 FC/100 ml. A mid-channel area, separating the northern and southern halves of the lake (Station 17) and with the shoreline characterized by light soil cover, had 4 FC/100 ml while Station 19, close to an inlet ditch, showed 17 FC/100 ml.

FS concentrations for most of the stations on the lake (Group A) revealed a mean of 2/100 ml. The eastern area of the south half of the lake just north of Sylvan Glen Beach (Station 28) had moderately high FS levels of 11/100 ml.

In August, TC levels for the majority of stations (Group A) were 368/100 ml while the relatively heavily cottaged area close to the northeastern sandy beach (Station 14) revealed a mean TC level of 753 TC/100 ml (Figure 5). The area near to the northwest outlet (Station 9) and the inlet area at the southwest corner of the lake (Station 21) had higher bacterial levels for all three parameters. Station 9, with 1731 TC/100 ml, 4 FC/100 ml, and 50 FS/100 ml, exceeded the MOE TC and FS Criteria for recreational use, and Station 21 with 771 TC/100 ml, 3 FC/100 ml, and 40 FS/100 ml exceeded only the FS Criteria, but both stations appeared to be subject to bacterial inputs. The highest bacterial levels for the three parameters occurred on August 23. The Lorneville Climatological station recorded 0.91 inches of rainfall on August 22. This rainfall and the subsequent runoff carrying contamination into the

FIGURE 5 - DISTRIBUTION OF BACTERIA IN AUGUST



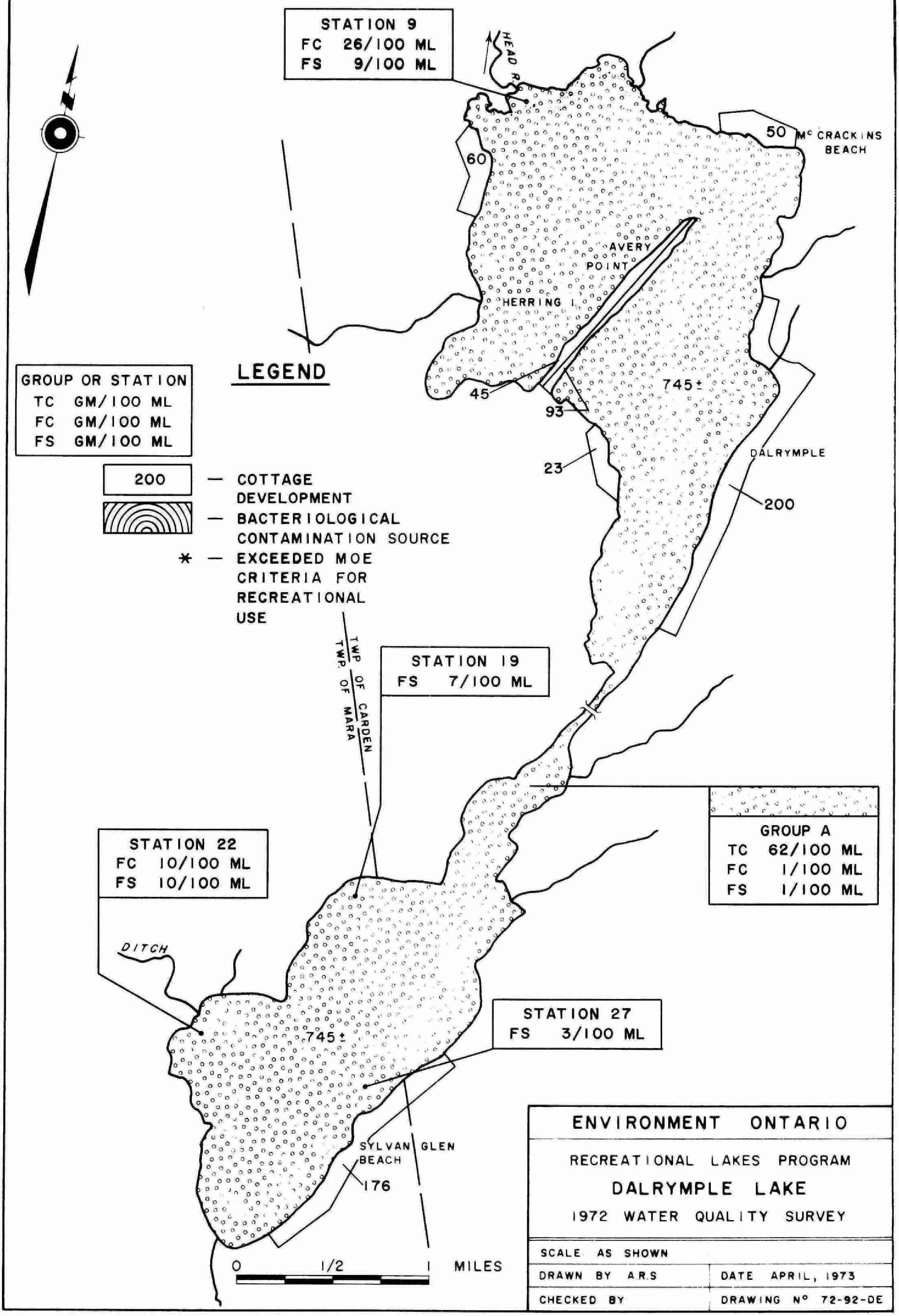
water appears to be the major factor causing the increase in bacterial concentrations (see page A-2). All other stations on the lake, except the mid-channel station separating the northern and southern portions of the lake (Station 17), had a low FC mean of 2/100 ml.

FS concentrations, although statistically homogeneous throughout the lake with a mean of 7/100 ml exceeded the criteria around some of the cottaged areas (Stations 16 and 28) and within the vicinity of inlets (Stations 19 and 21).

In September, three stations (7, 10D and 31D) had unusually high statistical variances relative to the remaining stations on the lake and consequently were treated separately from the main group of stations (Figure 6). The majority of stations on the lake (Group A) had a mean TC level of 62/100 ml. The Lorneville Climatological station, quite distant from Dalyrmple Lake, recorded 0.13 inches and 0.02 inches of rain on September 18 and 21 respectively. However, no correlation between rainfall and TC concentrations was possible since the TC populations fluctuated erratically throughout the September survey. Both the FC and FS mean levels for the majority of stations on the lake (Group A) were 1/100 ml. The area adjacent to the lake's outlet (Station 9) displayed higher FC and FS densities of 26 FC/100 ml and 9 FS/100 ml.

Generally, TC, FC, and FS densities were substantially higher in the summer than in the spring and fall surveys. These higher bacterial levels at Station 9 do not appear to have originated from cottage sources and hence are probably related to a documented phenomenon called the 'funnelling effect'. This effect refers to inexplicably higher bacterial levels encountered in lakes around outflowing streams.

FIGURE 6 - DISTRIBUTION OF BACTERIA IN SEPTEMBER



ENVIRONMENT ONTARIO	
RECREATIONAL LAKES PROGRAM DALRYMPLE LAKE 1972 WATER QUALITY SURVEY	
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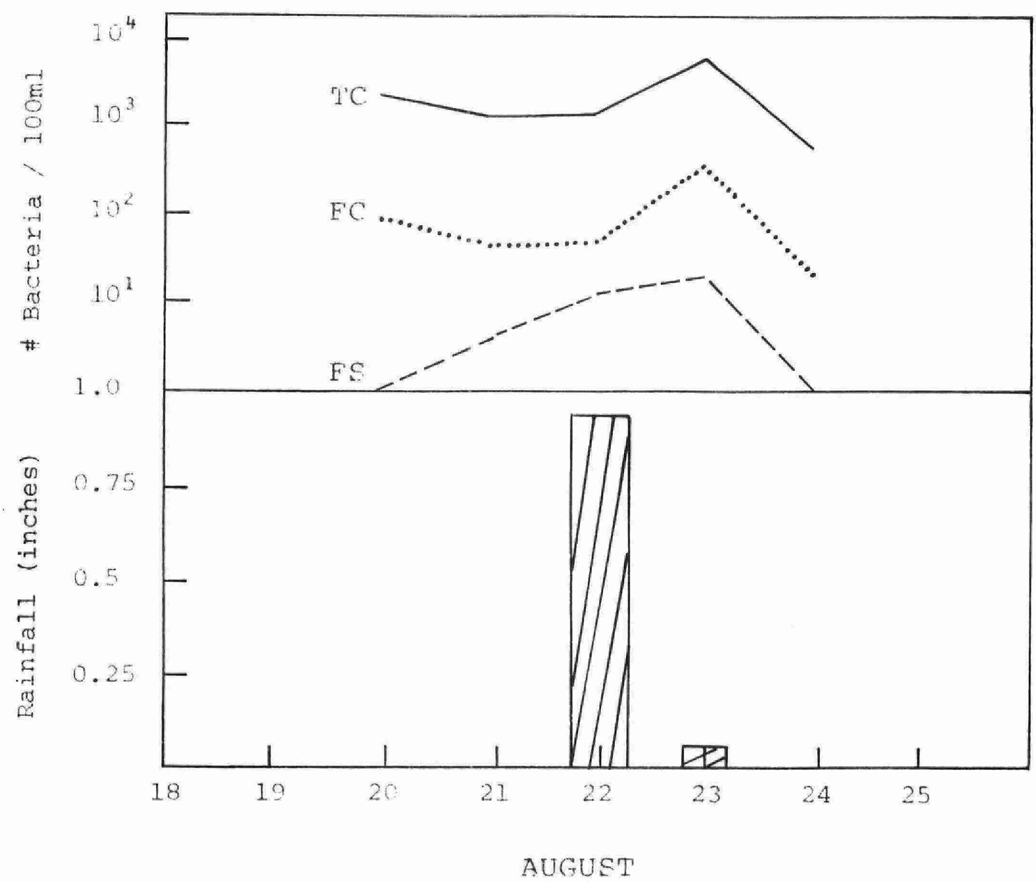

Figure 7: Number of Bacteria/100 ml vs Rainfall
at Station 9 of Dalrymple Lake

Chemistry

As indicated by temperature and dissolved oxygen, the lake remained well mixed during all three surveys. Temperature differences between the surface and bottom were less than 2°C at Station 10 and 4°C or less at Station 31. Dissolved oxygen concentrations in the bottom waters were always in excess of 70 percent while surface values were near or above saturation.

Dalyrmple Lake is a moderately hard water lake. Alkalinity and conductivity results correlated well with variations in hardness and together with chloride, iron and pH data indicated no unusual mineral water quality characteristics. Generally, the north half of the lake had higher concentrations of mineral constituents than the south half, while the range of concentrations in the inlets was generally comparable to those in the lake as indicated below.

Overall Ranges

	South Half (Upper Lake)	North Half (Lower Lake)	Inlet Streams
Alkalinity (as mg $CaCO_3$/l)	81-117	120-134	80-127
Hardness (as mg $CaCO_3$/l)	102-148	130-164	94-152
Conductivity (umhos/cm^3)	190-249	253-285	189-273
Chloride (mg/l)	3-6	4-5	4-5
Iron (mg/l)	0.05-0.15	0.05-0.20	0.05-0.35
pH (units)	8.2-8.6	7.9-8.6	8.1-8.5

Relatively high pH values throughout the surveys are probably indicative of the uptake of inorganic carbon by the abundant aquatic plants in the lake and stream beds. Kjeldahl nitrogen and total phosphorus concentrations were moderately high at the mid-lake stations with mean values 0.59 mgN/l and

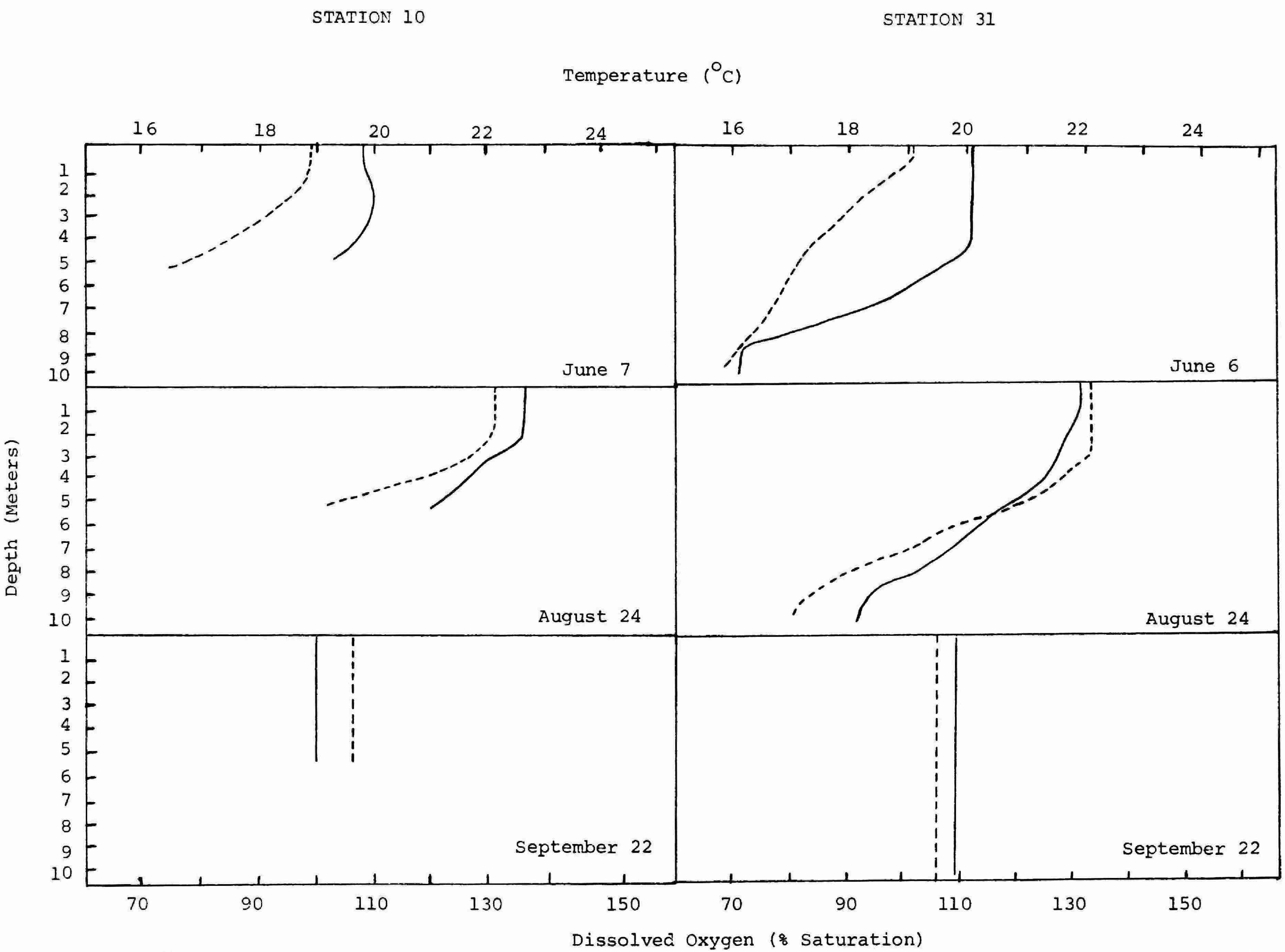

Figure 8: Dissolved oxygen (---) and temperature (——) profiles at Stations 10 and 31 in Dalrymple Lake

0.02 mgP/l in the illuminated surface waters and 0.84 mgN/l and 0.036 mgP/l respectively in the bottom waters of the lake. Iron concentrations in surface and bottom waters were low throughout the three surveys. Kjeldahl nitrogen and total phosphorus concentrations in the inlets ranged from 0.59 to 1.60 mgN/l and from 0.016 to 0.058 mgP/l and indicate inputs normally associated with natural and agricultural drainage.

Chlorophyll a and Water Clarity

A relationship between chlorophyll a and Secchi disc has been derived by staff of the Ministry of the Environment and the moderately enriched nature of Dalyrmple Lake relative to other well known lakes in southern Ontario is shown in Figure 8. Based on mean chlorophyll a and Secchi disc values over the three surveys of 3 ug/l and 2.2 m respectively, Dalrymple Lake is similar to such moderately enriched waters as Chemung Lake and Lower Buckhorn Lake and is far removed from such highly enriched waters as Moira Lake and Lake Scugog (Figure 8) which are more turbid as a result of much larger amounts of suspended algae. It should be noted that as well as maintaining a moderate amount of suspended algae, the south half of the lake supported a thriving aquatic plant community while the north half supported only somewhat higher amounts of suspended algae.

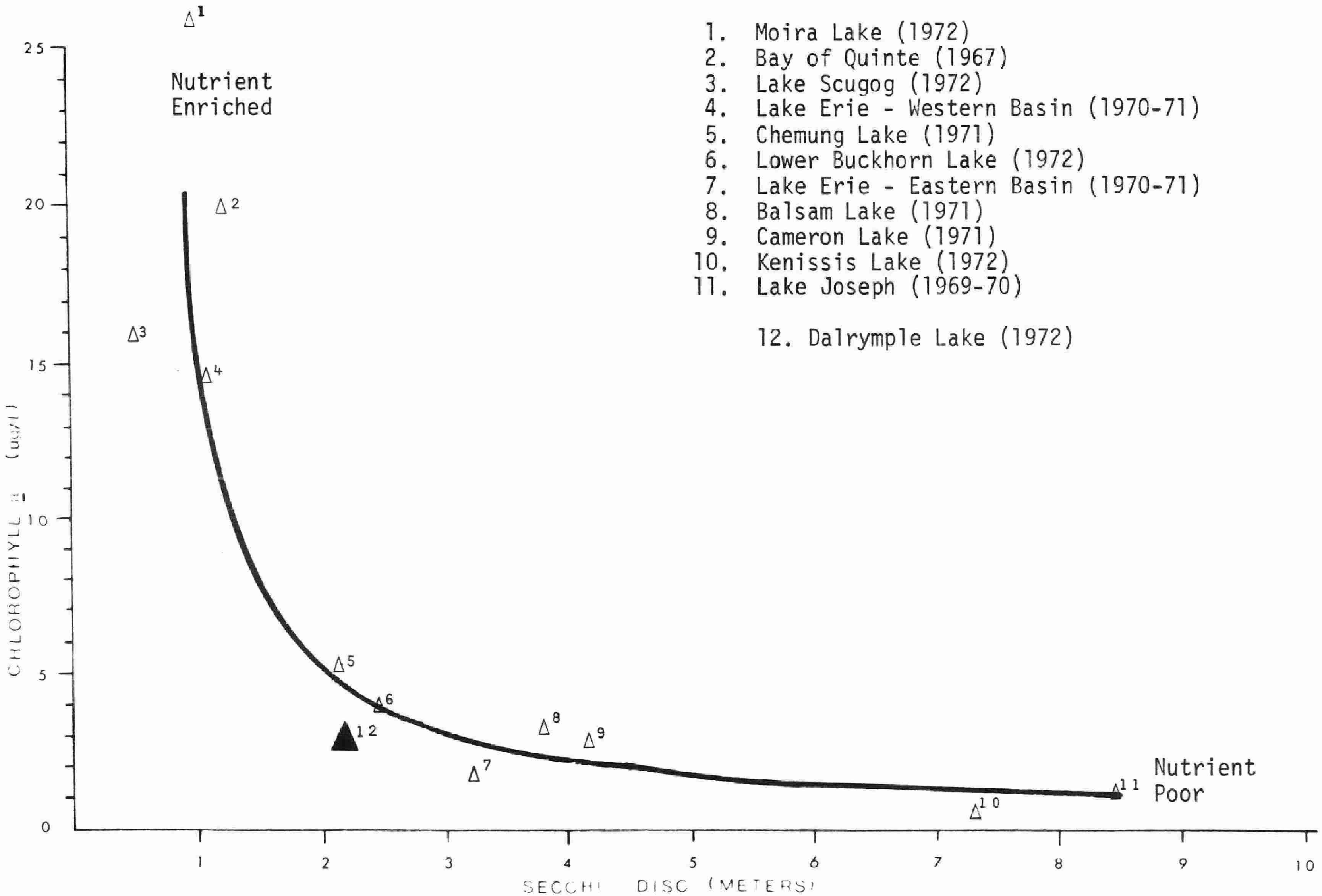

Figure 9: The mean of chlorophyll a and Secchi disc measurements in Dalrymple Lake relative to a curve describing the chlorophyll a - Secchi disc relationship in many Ontario lakes. Eleven other well known lakes are included for comparison with Dalrymple Lake.

INFORMATION OF GENERAL INTEREST TO COTTAGERS
MICROBIOLOGY OF WATER

For the sake of simplicity, the microorganisms in water can be divided into two groups: the bacteria that thrive in the lake environment and make up the natural bacterial flora; and the disease causing microorganisms, called pathogens, that have acquired the capacity to infect human tissues.

The "pathogens" are generally introduced to the aquatic environment by raw or inadequately treated sewage, although a few are found naturally in the soil. The presence of these bacteria does not change the appearance of the water but pose an immediate public health hazard if the water is used fro drinking or swimming. The health hazard does not necessarily mean that the water user will contract serious waterborn infections such as typhoid fever, polio or hepatitis, but he may catch less infections of gastroenteritis (sometimes called stomach flu), dysentery or diarrhea. Included in these minor afflictions are eye, ear and throat infections that swimmers encounter every year and the more insidious but seldom diagnosed, subclinical infections usually associated with several water born viruses. These viral infections leave a person not feeling well enough to enjoy holidaying although not bedridden. This type of microbial pollution can be remedied by preventing wastes from reaching the lake and water quality will return to satisfactory conditions within a relatively short time (approximately 1 year) since disease causing bacteria ususally do not thrive in an aquatic environment.

The rest of the bacteria live and thrive within the lake environment. These organisms are the instruments of biodegradation. Any organic matter in the lake will be used as food by these organisms and will give rise, in turn to subsequent increases in their numbers. Natural organic matter as well as that from sewage, kitchen wastes, oil and gasoline are readily attached by these lake bacteria. Unfortunately, biodegradation of the organic wastes by organisms uses correspondingly large amounts of the dissolved oxygen. If the organic matter content of the lake gets high enough, these bacteria will deplete the dissolved oxygen supply in the bottom waters and threaten the survival of many deep water fish species.

The standard plate count (SPC) populations given in the text supply an indication of the number of these bacteria in the lake.

RAINFALL AND BACTERIA

The "Rainfall Effect" referred to in the text, relates to a phenomena that has been documented in previous surveys of the Recreational Lakes. Heavy precipitation has been shown to flush the land area around the lake and the subsequent runoff will carry available contaminants including sewage organisms as well as natural soil bacteria with it into the water.

Total coliforms, fecal coliforms and fecal streptococci, as well as other bacteria and viruses which inhabit human waste disposal systems, can be washed into the lake. In Precambrian areas where there is inadequate soil cover and in fractured limestone areas where fissures in the rocks provide access to the lake, this phenomenon is particularly evident.

Melting snow provides the same transportation function for bacteria, especially in an agricultural area where manure spreading is carried out in the winter on top of the snow.

Previous data from sampling points situated 50 to 100 feet from shore indicate that contamination from shore generally shows up within 12 to 48 hours after a heavy rainfall.

WATER TREATMENT

Lake and river water is open to contamination by man, animals and birds (all of which can be carriers of disease); consequently, NO SURFACE WATER MAY BE CONSIDERED SAFE FOR HUMAN CONSUMPTION without prior treatment, including disinfection. Disinfection is especially critical if coliforms have been shown to be present.

Disinfection can be achieved by:

(a) Boiling

B oil the water for a minimum of five minutes to destroy the disease causing organisms.

(b) Chlorination Using a Household Bleach Containing 4 to 5.1/4% Available Chlorine

Eight drops of a household bleach solution should be mixed with one gallon of water and allowed to stand for 15 minutes before drinking.

(c) Continuous Chlorination

For continuous water disinfection, a small domestic hypochlorinator (sometime coupled with activated charcoal filters) can be obtained from a local plumber or water equipment supplier.

(d) Well Water Treatment

Well water can be disinfected using a household bleach (assuming strength at 5% available chlorine) if the depth of water and diameter of the well are known.

CHLORINE BLEACH
per 10 ft depth of water

Diameter of Well Casing In Inches	One to Ten Coliforms	More than Ten Coliforms
4	.5 oz	1 oz.
6	1 oz.	2 oz.
8	2 oz.	4 oz.
12	4 oz.	8 oz.
16	7 oz.	14 oz.
20	11 oz.	22 oz.
24	16 oz.	31 oz.
30	25 oz.	49 oz.
36	35 oz.	70 oz.

Allow about six hours of contact time before using the water.

Another bacteriological sample should be taken after one week of use.

Water Sources (spring, lake, well, etc.) should be inspected for possible contamination routes (surface soil, runoff following rain and seepage from domestic waste disposal sites). Attempts at disinfecting the water alone without removing the source of contamination will not supply bacteriologically safe water on a continuing basis.

There are several types of low cost filters (ceramic, paper, carbon, diatomaceous earth sometimes impregnated with silver, etc.) that can be easily installed on taps or in water lines. These may be useful to remove particles if water is periodically turbid and are usually very successful. Filters, however, do not disinfect water but may reduce bacterial numbers. For safety, chlorination of filtered water is recommended.

SEPTIC TANK INSTALLATIONS

In Ontario, provincial law requires that you obtain permission in writing to install a septic tank system. Permission can be obtained from the local Medical Officer of Health or in some instances from the Regional Engineer of the Ministry of the Environment. Any other pertinent information such as sizes, types and location of septic tanks and tile fields can also be obtained from the same authority.

(i) General Guidelines

A septic tank should not be closer than:

-50 feet to any well, lake, stream or pond.
-5 feet to any building.
-10 feet to any property boundary

The tile field should not be closer than:

-100 feet to the nearest dug well.
-50 feet to a drilled well which has a casing to 25 feet below ground.
-25 feet to a building
-10 feet to a property boundary.
-50 feet to any lake, stream or pond.

The ideal location for a tile field is in a well drained, sandy loam soil remote from any wells or other drinking water sources. For the tile field to work satisfactorily, there should be at least 3 feet of soil between the bottom of the weeping tile trenches and the top of the ground water table or bedrock.

DYE TESTING OF SEPTIC TANK SYSTEMS

There is considerable interest among cottage owners to dye test their sewage systems, however, several problems are associated with dye testing. Dye would not be visible to the eye from a system that has a fairly direct connection to the lake. Thus, if a cottager dye-tested his system and no dye was visible in the lake, he would assume that his system is satisfactory, which might not be the case. A low concentration of dye is not visible and therefore expensive equipment such as a fluorometer is required. Only qualified people with adequate equipment are capable of assessing a sewage system by using dye. In any case, it is likely that some of the water from a septic tank will eventually reach the lake. The important question is whether all contaminants including nutrients have been removed before it reaches the lake. To answer this question special knowledge of the system, soil depth and composition, underground geology of the region and the shape and flow of the shifting water table are required. Therefore, we recommend that this type of study should be performed only by qualified professionals.

BOATING REGULATION

In order to help protect the lakes and rivers of Ontario from pollution it is required by law that sewage (including garbage) from all pleasure craft, including houseboats must be retained in equipment of a type approved by the Ministry of the Environment. Equipment which will be approved by the Ministry of the Environment includes (1) retention devices with or without circulation which retain all toilet wastes for disposal ashore, and (2) incinerating devices which reduce all sewage to ash.

To be approved, equipment shall:

1. be non-portable,
2. be constructed of structurally sound material,
3. have adequate capacity for expected use
4. be properly installed,

5. in the case of storage devices, be equipped with the necessary pipes and fittings conveniently located for pump-out by shore-based facilities (although not specified, a pump-out deck fitting with 1.1/2 inch National Pipe Thread is commonly used).

An Ontario regulation requires that marinas and yacht clubs provide or arrange pump-out service for the customers and members who have toilet-equipped boats. In addition, all marinas and yacht clubs must provide litter containers that can be conveniently used by occupants of pleasure boats.

The following "Tips" may be of assistance to you in regards to boating:

1. Motors should be in good mechanical condition and properly tuned.
2. When a tank for outboard motor testing is used, the contents should not be emptied into the water.
3. Fuel hoses must be in good condition and all connections tight.
4. If the bilge is cleaned prior to the boating season, the waste material must not be dumped into the water.
5. Fuel tanks must not be overfilled and space must be left for expansion if the fuel warms up.
6. Vent pipes should not be obstructed and fuel needs to be dispensed at a correct rate to prevent "blow-back".
7. Empty oil cans must be deposited in a leak-proof receptacle.

ICE-ORIENTED RECREATIONAL ACTIVITIES

The Ministry of the Environment is presently preparing regulations to control pollution from ice-oriented recreational activities. In past years, there has been indiscrimate dumping of garbage and sewage on the ice. The bottoms of fish huts have been left on the ice and become a navigational hazard to boaters in the spring. Broken glass has been left on the ice only to become injurious to swimmers. With the anticipated introduction of the regulations, many of these abuses will become illegal.

EUTROPHICATION OR EXCESSIVE FERTILIZATION AND LAKE PROCESSES

The changes in water quality brought about by excessive inputs of nutrients to lakes are usually evidenced by excessive growths of algae and aquatic plants.

Aquatic plants and algae are important in maintaining a balanced aquatic environment. They provide food and a suitable environment for the growth of aquatic invertebrate organisms which serve as food for fish. Shade from large aquatic plants helps to keep the lower water cool which is essential to certain species of fish and also provide protection for young game and forage fish. Numerous aquatic plants are utilized for food and/or protection by many species of waterfowl. However, too much growth creates an imbalance in the natural plant and animal community particularly with respect to oxygen conditions, and some desirable forms of life such as sport fish are eliminated and unsightly algae scums can form. The lake will not be "dead" but rather abound with life which unfortunately is not considered aesthetically pleasing. This change to poor water quality becomes apparent after a period of years in which extra nutrients are added to the lake and a return to the natural state may also take a number of years after the nutrient inputs are stopped. Changes in water quality with depth are a very important characteristic of a lake. Water temperatures are uniform throughout the lake in the early spring and winds generally keep the entire volume well mixed. Shallow lakes may remain well mixed all summer so that water quality will be the same throughout. On the other hand, in deep lakes, the surface waters warm up during late spring and early summer and float on the cooler more dense water below. The difference in density offers a resistance to mixing by wind action and many lakes do not become fully mixed again until the surface waters cool down in the fall. The bottom water receives no oxygen from the atmosphere during this unmixed period and the dissolved oxygen supply may be all used up by bacteria as they decompose organic matter. Cold water fish, such as trout, will have to move to the warm surface waters to get oxygen and because of the high water temperatures they will not thrive, so that the species will probably die out (see Figure next page).

Low oxygen conditions in the bottom waters are not necessarily an indication of pollution but excessive aquatic plant and algae growth and subsequent decomposition can aggravate the condition and in some cases can result in zero oxygen levels in lakes which had previously held some oxygen in the bottom waters all summer. Although plant nutrients normally accumulate in the bottom waters of lakes, they do so to a much greater extent if there is no oxygen present. These nutrients become available for algae in the surface waters when the lake mixes in the fall and dense algae growths can result. Consequently, lakes which have no oxygen in the bottom water during the summer are more prone to having algae problems and are more vulnerable to nutrient inputs than lakes which retain some oxygen.

CONTROL OF AQUATIC PLANTS AND ALGAE

Usually aquatic weed growths are heaviest in shallow shoreline areas where adequate light and nutrient conditions prevail.

Extensive aquatic plant and algal growths sometimes interfere with

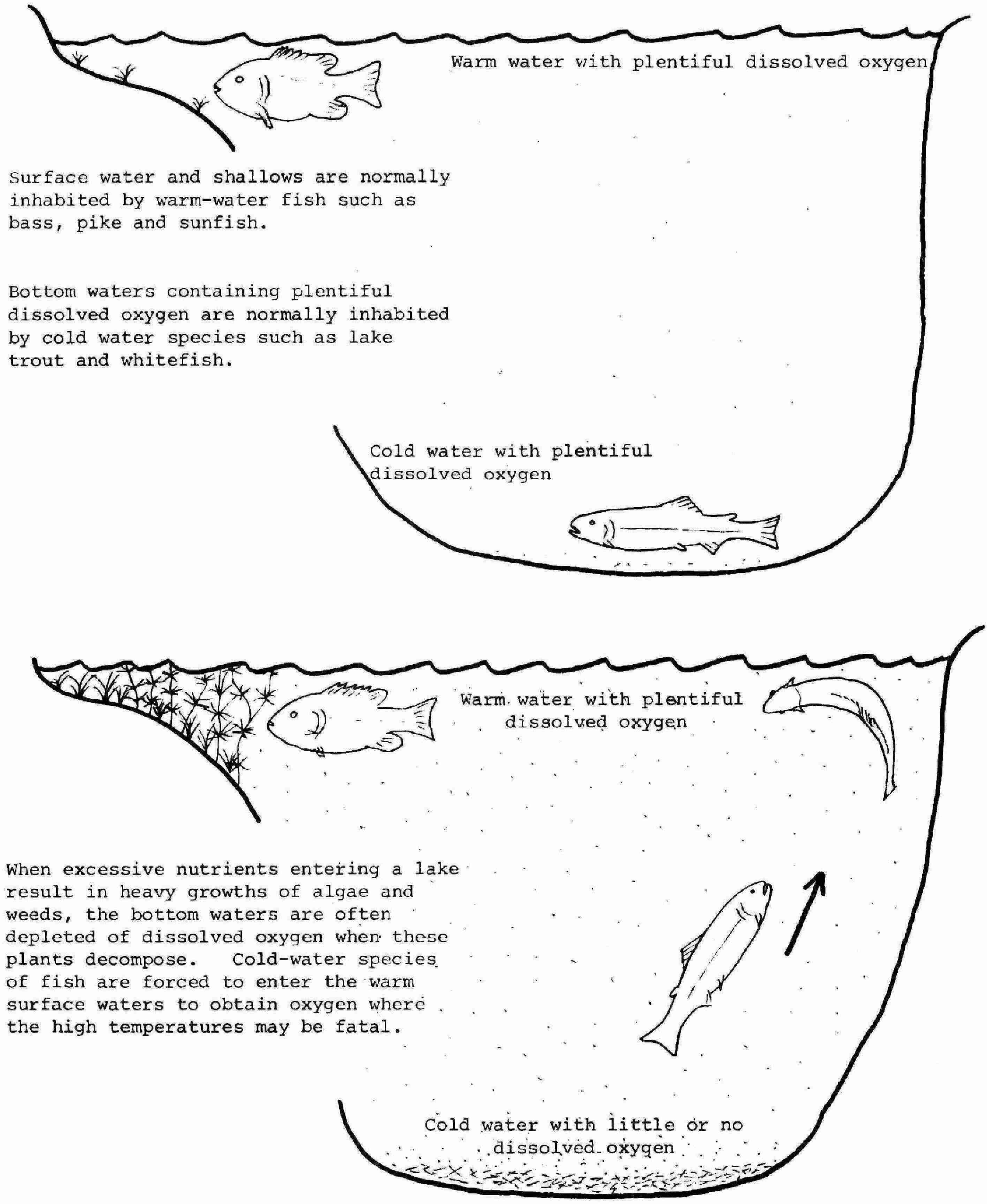

FIGURE A-1: DECOMPOSITION OF PLANT MATTER AT THE LAKE BOTTOM CAN LEAD TO DEATH OF DEEP-WATER FISH SPECIES.

boating and swimming and ultimately diminish shoreline property values.

Control of aquatic plants may be achieved by either chemical or mechanical means. Chemical methods of control are currently the most practical, considering the ease with which they are applied. However, the herbicides and algicides currently available generally provide control for only a single season. It is important to ensure that an algicide or herbicide which kills the plants causing the nuisance, does not affect fish or other aquatic life and should be reasonable in cost. At the present time, there is no one chemical which will adequately control all species of algae and other aquatic plants. Chemical control in the province is regulated by the Ministry of the Environment and a permit must be granted prior to any operation. Simple raking and chain dragging operations to control submergent species have been successfully employed in a number of situations; however, the plants soon re-establish themselves. Removal of weeds by underwater mowing techniques is certainly the most attractive method of control and is currently being evaluated in Chemung Lake near Peterborough. Guidelines and summaries of control methods, and applications for permits are available from the Biology Section, Water Quality Branch, Ministry of the Environment, Box 213, Rexdale, Ontario.

PHOSPHORUS AND DETERGENTS

Scientists have recognized that phosphorus is the key nutrient in stimulating algal and plant growth in lakes and streams.

In the past years, approximately 50% of the phosphorus contributed by municipal sewage was added by detergents. Federal regulations reduced the phosphate content as P_2O_5 in laundry detergents from approximately 50% to 20% on August 1, 1970 and to 5% on January 1, 1973.

It should be recognized that automatic dishwashing compounds were not subject to the recently approved government regulations and that surprisingly high numbers of automatic dishwashers are present in resort areas (a questionnaire indicated that about 30% of the cottages in the Muskoka Lakes have automatic dishwashers). Cottagers utilizing such conveniences may be contributing significant amounts of phosphorus to recreational lakes. Indeed, in most of Ontario's vacation land, the source of domestic water is soft enough to allow the exclusive use of liquid dishwashing compounds, soap and soap-flakes.

ONTARIO'S PHOSPHORUS REMOVAL PROGRAM

By 1975, the Government of Ontario expects to have controls in operation at more than 200 municipal wastewater treatment plants across the province serving some 4.7 million persons. This represents about 90% of the population serviced with sewers. The program is in response to the International Joint Commission recommendations as embodied in the Great Lakes Water Quality Agreement and studies carried out by the Ministry of the Environment on inland recreational waters which showed phosphorus to be a major factor influencing eutrophication. The program makes provision for nutrient control in the Upper and Lower Great Lakes, the Ottawa River system and in prime recreational waters where the need is demonstrated or where emphasis is placed upon prevention of localized eutrophication.

Phosphorus removal facilities must be operational at wastewater treatment plants by December 31, 1973, in the most critically affected areas of the province, including all of the plants in the Lake Erie drainage basin and the inland recreational areas. The operational date for plants discharging to waters deemed to be in less critical condition which includes plants larger than one million gallons per day (1 mgd) discharging to Lake Ontario and to the Ottawa River system, is December 31, 1975. The 1973 phase of the program will involve 156 plants of which 85 are in the Lake Erie basin and another 30 in the Lake Huron drainage basin. The capacities of these plants range from 0.04 to 24.0 mgd, serving an estimated population of 1,600,000 persons. The 1975 phase will bring into operation another 57 plants ranging in size from 0.3 to 180 mgd serving an additional 3,100,000 persons. Treatment facilities utilizing the Lower Great Lakes must meet effluent guidelines of less than 1.0 milligrams per litre of total phosphorus in their final effluent. Facilities utilizing the Upper Great Lakes, the Ottawa River Basin and certain areas of Georgian Bay where needs have been demonstrated must remove at least 80% of the phosphorus reaching their sewage treatment plants.

CONTROL OF BITING INSECTS

Mosquitoes and blackflies often interfere with the enjoyment of recreational facilities at the lake-side vacation property. Pesticidal spraying or fogging in the vicinity of cottages produces extemely temporary benefits and usually do not justify the hazard involved in contaminating the nearby water. Eradication of biting fly populations is not possible under any circumstances and significant control is rarely achieved in the absence of large-scale abatement programmes involving substantial funds and trained personnel. Limited use of approved larvicides in small areas of swamp or in rain pools close to residences on private property may be undertaken by individual landowners, but permits are necessary wherever treated waters may contaminate adjacent streams or lakes. The use of repellents and light traps is encouraged as are attempts to reduce mosquito larval habitat by improving land drainage. Applications for permits to apply insecticides as well as technical advice can be obtained from the Biology Section, Water Quality Branch of the Ministry of the Environment, Box 213, Rexdale, Ontario.