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## MONITORING AND SURVEILLANCE OF WASTEWATER AND WATER TREATMENT PLANTS

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# MONITORING AND SURVEILLANCE OF WASTEWATER AND WATER TREATMENT PLANTS

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# MONITORING AND SURVEILLANCE OF WASTEWATER AND WATER TREATMENT PLANTS

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# MONITORING AND SURVEILLANCE OF WASTEWATER AND WATER TREATMENT PLANTS

## PREFACE

The purpose of this publication is to assist field inspectors conducting complete on-site surveillance and monitoring of water and wastewater treatment operations on Indian reserves, and band personnel operating water and wastewater treatment facilities. The information in this publication is as comprehensive as possible but does not contain all the details associated with the evaluation of water and wastewater treatment equipment and methods. It should therefore be considered neither as a rigid format nor as a replacement for a knowledgeable inspector's investigative skills.

For the purpose of this publication, 'monitoring and surveillance' include field inspections, provision of operator advice, and sampling analyses done regularly. In-depth studies and the investigation of complaints should not be considered part of a regular monitoring and surveillance program.

## Part I

## WASTEWATER TREATMENT PLANTS

### 1.0 INTRODUCTION

The main goal of a monitoring and surveillance program is to protect the public health and safety of residents both on reserves and in neighboring areas. More specifically, a monitoring and surveillance program is desirable for the following reasons:

a. It helps ensure that treatment facilities on Indian reserves are in compliance with the requirements of federal, provincial and municipal regulations, guidelines and codes of good practice.

b. It helps ensure that pollution control systems are operating efficiently and providing adequate protection to the receiving environment.

c. It provides data for assessing the impact of wastewater plants on the environment.

d. It provides background data for the design and operation of pollution control systems.

To ensure that facilities comply with the Effluent Quality Guidelines of Environment Canada which were endorsed by Cabinet as policy, it is necessary that adequate monitoring and surveillance programs be carried out. The implications of this policy for DIAND has been elaborated in the report EA-HQ-87-14, National Survey of Monitoring and Surveillance of Wastewater Treatment Facilities on Indian Reserves.

## 2.0 WASTEWATER

### 2.1 Composition

Wastewater normally includes the used water supply from domestic, industrial and commercial sources, together with ground water infiltration.

Although it is the solids in domestic sewage that make treatment and disposal difficult, they actually represent less than 0.01% by weight. Water forms the bulk of sewage, acting as a vehicle for transporting the solid contaminants.

Ground water that finds its way into a sewage system contains dissolved materials that are characteristic of both the source of the water before it entered the ground and the mineral composition of the formations through which the water has passed.

### 2.2 Classification of Wastewater Contaminants

Solids in wastewater can be broadly classified in two ways:

a. as organic or inorganic solids; and

b. according to their physical size as suspended or dissolved solids.

### 2.3 Characteristics of Wastewater

The concentration, physical form and type of solids cannot completely describe the behavior of wastewater when it is released into the environment. Characteristics of the wastewater must also be described in terms of how fast the organic solids rot, the pH and temperature of the water, the content of pathogenic bacteria, and the concentrations of specific substances that may produce undesirable effects in the receiving water.

Suspended solids are an important measure of potential accumulation of wastewater solids in a receiving water; even colloidal matter can eventually settle out in a stream or lake.

## 3.0 INSPECTIONS

### 3.1 Objectives of Inspections

Inspections of wastewater treatment operations should be used to ensure uniform evaluation of operations and achieve the following objectives:

a. improve efficiency of pollution control equipment;

b. monitor the receiving environment;

c. promote discussion of operating procedures and pinpoint problem areas;

d. review analytical and sampling procedures;

e. assess operating procedures by carrying out independent sampling and analysis; and

f. update inventory of pollution control operations.

### 3.2 Checklist for Facility Assessment

It is impossible to conduct an outside laboratory analysis of wastewater samples on every reserve. Therefore, some criteria must be used in selecting those that will be monitored. Factors to consider are:

a. What is the size of the facility and the nature of the operation?

b. Where is it located?

c. What effect will the activity have on the environment (for example, discharge to a small stream)?

d. Will the results be meaningful (for example, long storage periods for samples and delays in analyzing samples will affect results)?

e. Have there been complaints about the facility in the past?

f. Does the facility contain new technology which must be assessed?

g. Is the pollution control installation new and without an operational history?

h. Have modifications to existing systems been made that need evaluation?

i. What is the workload of field personnel; how much time can field personnel spend on monitoring?

## 4.0 SAMPLING PROCEDURES

### 4.1 Importance of Good Sampling

Sampling is the process of withdrawing a small portion of the whole in such a manner that the sample represents the character and quality of the mass from which it was taken. The samples should provide quantitative information on the levels of contamination in the wastewater during the various stages of collection, treatment and subsequent discharge to the receiving waters. Sampling and analytical programs should be carefully planned and carried out by competent personnel. The data obtained can be used:

a. to determine plant efficiency in order to control waste discharge;

b. for the early detection of abnormalities in influent quantity and quality that may affect operation;

c. to calculate the effects of effluent on receiving waters;

d. to demonstrate compliance with government regulations and standards;

e. in the design of wastewater treatment systems; and

f. in planning plant expansions.

Good sampling procedures are the key to meaningful laboratory analyses. A typical sample represents only a small fraction of the total flow, and great care must be taken to ensure that the sample is representative. If it is not, the data from subsequent analyses are worthless for process control.

## 4.2 Types of Sample

### 4.2.1 Grab Samples

A grab or dip sample consists of a single portion collected at a given time, and may not be representative. If it is possible to collect only grab samples, this should be done when the treatment plant is operating at peak flow conditions.

### 4.2.2 Composite Samples

A composite sample consists of portions taken at known times and then combined in volumes that are proportional to the flow at the time of sampling. Composite samples generally represent the wastewater characteristics over a specified period of time. The ideal procedure incorporates the use of 24-hour composite samples consisting of hourly grab samples proportioned to the flow at the time of sampling. This procedure is only feasible in treatment facilities with full-time operators or where automatic samples are warranted.

## 4.3 Sampling Equipment

Automatic sampling equipment should be used where possible, as this reduces personnel costs.

For manual sampling, a dipper should be used which is approximately 150 mm in diameter and 100 mm in depth. A long handle should be attached to the dipper for collecting samples from tanks and channels.

## 4.4 Tests Required

The laboratory responsible for the analysis should instruct the person collecting samples on the tests to be conducted, volume of sample required, and sampling procedures. Sampling procedures should be conducted in accordance with Standard Methods for the Examination of Water and Wastewater.

## 4.5 Volume and Container

The volume of sample required will vary, but usually 2 L should be sufficient for all physical and chemical tests. A plastic container, which has been rinsed two or three times with the source of sample, should be used except when phenol determination is required. For such samples glass containers should be used. When collecting samples for bacteriological examination, the sample should be

introduced directly into a sterilized sample bottle which is usually obtained from the laboratory.

4.6 Dissolved Oxygen

Special methods should be used for sampling dissolved oxygen (DO). The samples should be taken with the sample container completely immersed and without aerating the sample or trapping any air bubbles. If special equipment is not available, a wide mouthed glass jar or other suitable collecting container should be used. The temperature of the sample should always be taken immediately.

4.7 Storage of Samples

The following considerations apply to storing samples:

a. The time elapsing between sample collection and its analysis should be kept to a minimum; and never more then 24 hours.

b. Samples which must be stored longer then 6 h should be iced and laboratory tests started before 12 hours have elapsed.

c. If refrigerated facilities are available, the samples should generally be stored at temperatures of $3^{o}$ to $4^{o}C$.

d. The elapsed time between collection and analysis should be noted when recording results.

5.0 TREATMENT PLANT SAMPLING SURVEYS

5.1 General Remarks

Sampling provides information on the degree of treatment being obtained.

Treatment plant sampling surveys can be divided into two basic categories: the continuing routine sampling and the special investigation.

The special investigation is usually an extension or an acceleration of the continual program. It is usually intensive and is used if an industrial waste problem in the treatment plant is suspected at the start-up and evaluation of a new treatment plant. It may also be used to investigate problems in an existing or older plant if the continuing routine sampling does not identify the problems.

## 5.2 Location of Sampling Stations

The location of appropriate sampling points must be established independently for each treatment plant, as conditions vary from one plant to another. It is advisable to sample raw sewage after it has been screened or after it has passed through a comminutor.

Samples should be taken at accessible locations where the waste (or sludge) is well mixed (that is where the flow is turbulent).

## 5.3 Frequency of Sampling

The frequency of sampling will depend upon variations within the individual waste stream, as well as practical considerations such as the treatment plant size, loading, staff and hours of supervision. Small plants tend to have a limited budget, making it difficult to pay for qualified laboratory help.

Regardless of the size of the plant or the laboratory facilities available, every effort should be made to maintain routine testing on a regularly scheduled basis.

# 6.0 PARAMETERS AND TESTS

## 6.1 General Remarks

The parameters that should be analyzed in effluent samples are identified in the applicable Environment Canada effluent standards. The parameters and associated maximum and minimum limits for wastewater treatment plants on Indian reserves are given in Table 1.

These parameters should be adequate to note problems in plant operation. Once noted, a more detailed plant evaluation can be conducted.

## 6.2 Temperature

### 6.2.1 Raw Sewage

In process control, accurate temperature measurements are helpful in evaluating process performance because temperature is one of the most important factors affecting microbial growth. Generally, the rate of microbial growth doubles for every 10°C increase in temperature within the specific temperature range of the microbe. Temperature measurements can be helpful in detecting infiltration and inflow problems, and illegal industrial discharges. A sudden drop from the normal pattern could indicate increased infiltration from ground

water or a water-main leak. An unusual rise in temperature will often indicate the presence of hot industrial waste.

Because of variable conditions, the average temperature of raw sewage should be established for each plant.

Table 1

EFFLUENT STANDARDS FOR WASTEWATER TREATMENT PLANTS

| Parameter | Minimum | Maximum |
|---|---|---|
| 5-day Biochemical Oxygen Demand | - | 20 mg/L |
| Suspended Solids | - | 25 mg/L |
| Fecal Coliforms | - | 400/100 mL |
| pH | 6 | 9 |
| Oils and Greases | - | 15 mg/L |
| Phenols* | - | 0.02 mg/L |
| Chlorine** | 0.5 mg/L | 1.0 mg/L |
| Phosphorus** | - | 1.0 mg/L |

* If applicable -- phenols are not normally a problem for small plants treating only domestic wastes.

** If applicable -- other parameters (for example nitrogen) may also apply depending on the specific standard or limits for the discharge.

6.2.2 Effluent

The temperature of the effluent should be checked daily. This is important in areas where pollution control agencies place restrictions on effluent temperatures or allowable increases for receiving waters. A serious increase in temperature of the receiving waters, for example, will decrease oxygen capacity, increase oxygen demand, and encourage the formation of anaerobic zones

and the growth of sewage fungus. All of these will result in undesirable stream conditions.

6.3 Suspended Solids

Suspended solids are important in measuring the efficiency of a plant and determining the quality of the final effluent.

If possible, suspended solids tests should be performed on composite samples of raw sewage and final effluent so that the efficiency of the plant and effluent quality can be determined.

Samples should be refrigerated or treated with an inhibitor when analyses are delayed more than 12 hours.

6.4 Dissolved Oxygen

As outlined in 5.6, special precautions must be taken when collecting samples for dissolved oxygen analysis. If a dissolved oxygen analyzer is used, the probe should be placed directly into the sampling source.

The minimum dissolved oxygen residual in aeration tanks should be 0.5 mg/L when tests are conducted on a regular basis. Values in this range should ensure that there is adequate dissolved oxygen for periods during the day when oxygen demand is greater than at the time of testing.

Dissolved oxygen calculations should be made on the raw sewage to check for septicity, and on the effluent to assess water quality. If the Winkler test is used to determine DO, the sample should be collected before chlorination because chlorine is an oxidizing compound which will release additional iodine, thus giving high results. For applicable test procedures refer to Standard Methods for the Examination of Water and Wastewater.

6.5 Biochemical Oxygen Demand

The biochemical oxygen demand (BOD) test should be used to assess the strength of the sewage and the quality of the effluent. The efficiency of a plant should be based on the reduction in oxygen demand between the raw sewage and effluent.

The BOD is an index of the amount of oxygen that will be consumed by the decomposition of the organic matter in wastewater. The analysis consists of measuring the initial dissolved oxygen concentration, incubating for five days at 20°C, and measuring the final dissolved

oxygen. The difference in concentration, corrected for the initial dilution and sample volume, is called the BOD. The BOD test is related to both the organic loading on the biological process and the removal efficiency of the process. The efficiency of the process is determined by the following formula:

$$\frac{\text{BOD applied, kg/day} - \text{BOD leaving, kg/day} \times 100}{\text{BOD applied, kg/day}} = \text{the removal efficiency.}$$

As outlined in the effluent standards, the maximum allowable BOD should be 20 mg/L, regardless of whether the effluent is subjected to chlorination or not. If possible, composite samples should be collected and forwarded to a laboratory for analysis.

6.6 Chlorine Residual

Grab samples for chlorine residual tests should be collected at the discharge end of the chlorine contact chamber. They should be collected when the hydraulic loading on the plant is at a maximum so that the results indicate the most severe conditions that can be expected. A field test kit using colored discs is satisfactory for determining the chlorine residual. The minimum chlorine residual should be 0.50 mg/L after a minimum contact period of 30 min based on maximum flow.

6.7 Coliform Count

In measuring the efficiency of a treatment process, reduction in the coliform count of treated wastewater is an important parameter. Also, it must be determined if the coliform counts are within the specific effluent limits of 2.4.

Grab samples should be collected when the loading on the plant is at a maximum. Samples from the raw sewage should be collected with sterilized bottles, before and after chlorination. Tests should be conducted as soon as possible, and if storage is required, the samples should be cooled (see 4.7).

Procedures for this test are outlined in Standard Methods for the Examination of Water and Wastewater.

It should be noted that the effluent standard for fecal coliforms (MF method) is that the effluent shall not exceed 400 coliforms per 100 mL.

## 6.8 Settleable Matter

The settleable matter test (also known as the Imhoff Cone Test) is a measure of the volume of settleable solids in the raw waste and influent that settles to the bottom of an Imhoff cone in one hour. The volume of settled solids is read as millilitres per litre (mL/L) directly from the graduations on the Imhoff cone.

This test provides a quick and efficient check of a sedimentation unit. In addition, a rough estimate can be made of the volume of solids removed by the unit. Only a trace of settleable solids should remain in the secondary effluent. Poor removal of settleable matter may indicate the following problems:

a. hydraulic overload;

b. irregular flow distributions to multiple units;

c. short circuiting caused by effluent weirs of uneven height; or

d. improper raw sludge removal rates.

When performing the settleable matter test, the following procedures should be used in conjunction with those outlined in Standard Methods for the Examination of Water and Wastewater:

a. Take a sample volume greater than one litre.

b. Use grab samples for this analysis.

c. Fill the Imhoff cone exactly to the one-litre mark, without stopping.

d. After the sample has settled for 45 minutes, gently tap the sides of the cone or gently spin it between the palms of your hands to settle those solids sticking to the sides above the compacted settled layer at the bottom.

e. Record the volume of settled matter (mL/L) at the end of one hour. Read the graduation at the average depth of the solids and not at a peak or valley.

6.9 Settleability For Mixed Liquor And Return Activated Sludge

To test the settleability of activated sludge solids, take 1 L of a well-mixed sample and allow it to settle for 30 min in a 1-L graduated cylinder.

The condition of the activated sludge may be observed by this test. If it is in good condition, the sludge solids will settle rapidly and compact into a very small volume. The liquid above will also be very clear. An activated sludge in poor condition may not settle readily.

Two 1000-mL graduated cylinders with graduation lines 10 mL apart are required for this test. The procedure is as follows:

a. Test the sample immediately after taking it.

b. Mix the sample well and pour 1000 mL into the 1-L graduated cylinder.

c. At the end of 30 minutes, record the volume occupied by the sludge to the nearest 5 mL.

The reading at the end of 30 minutes is generally used for plant control. Occasionally it is helpful to measure the settling rate by recording the volume occupied by the sludge at various intervals of time, for example, every 5, 10, 20 and 30 minutes.

6.10 Other Tests

Under certain circumstances, special analyses should be required on raw sewage, effluents and receiving waters to discover if toxic materials, phenols, grease, or nutrients such as phosphates and nitrates are present.

6.11 Records

Keeping adequate records of plant performance is an integral part of good management. These records should be used as a basis for interpreting plant performance, and for analysing the results of sewage treatment.

## 7.0 EXTENDED AERATION

### 7.1 In-plant Testing (Field)

The following tests should be performed daily:

a. dissolved oxygen of aeration tank (mixed liquor) mg/L, and effluent mg/L;

b. 30 minute settleability test of aeration tank (mixed liquor); and

c. chlorine residual in effluent.

The temperature of the influent and effluent should also be taken when required.

### 7.2 Analyses of Samples

Samples should be sent to a laboratory for the following analyses and tests:

a. Biochemical oxygen demand ($BOD_5$) in effluent should be analysed each month.

b. Suspended solids (SS) in effluent should be analysed each month.

c. Oil and grease should be assessed twice a year.

d. Total phosphorous (total P) should be analysed every month where phosphorous removal is or may be required.

e. A coliform count should be taken.

### 7.3 Basic Equipment for In-plant Testing

The basic equipment for in-plant testing is:

a. dissolved oxygen kit;

b. pH meter and probe;

c. thermometer;

d. chlorine residual kit;

e. Imhoff cone;

f. 1-litre graduated cylinder; and

g. ice box.

7.4 Sampling Requirements

The following samples are required:

a. 24-hour flow - proportioned composite sample of the influent and effluent -- when not feasible, hourly composite samples (8 hours at least) should be used;

b. grab samples of aeration tank effluent and return flow, and final effluent; and

c. a grab sample of waste sludge.

When samples cannot be analyzed immediately, they must be preserved. If an adequate refrigerator maintained at 4°C is not available, an ice box of sufficient capacity and thermal insulation can be used. Ice or ice-packs in sufficient quantities should be placed around the samples. Samples should be transferred to the laboratory facilities as soon as practicable and always within 24 hours of taking them.

7.5 In-plant Observations of Unit Plant Processes

a. Check the flow meter accuracy.

b. Visually observe mixing and extent of agitation in the aeration tank.

c. Observe the appearance of the activated sludge floc:

1. very dark-blackish indicates anaerobic conditions;

2. light brown and thin indicates nitrification is occurring; and

3. earthy brown, well flocculated indicates healthy sludge.

d. Note any scum formation in the primary clarifier.

e. Note any floating solids in the primary clarifier -- this may indicate anaerobic conditions with gas production causing flotation.

f. Sludge growth on the clarifier walls should be expected, and the walls should be scraped routinely.

g. Excessive foaming in the aeration tanks may indicate excessive aeration, reduced mixed liquor suspended solids or an excessive amount of detergent in the influent.

h. Sludge or pin floc flowing over the final clarifier weir may indicate excessive aeration in the aeration tank, bulking of sludge, anaerobic conditions of sludge, or excessive nitrification.

Observe any build-up of solids in the chlorination contact chamber.

## 8.0 ROTATING BIOLOGICAL CONTACTOR (RBC)

### 8.1 In-plant Testing (Field)

The following tests should be performed daily:

a. dissolved oxygen of effluent and RBC tank;

b. 30-minute settleability test of RBC tank floc; and

c. chlorine residual in effluent.

The temperature of the influent and effluent should also be taken when required.

### 8.2 Analyses of Samples

Ideally, these analyses should be conducted once a month providing the samples can be shipped to the laboratory in refrigerated containers within 24 hours.

### 8.3 Basic Equipment for In-plant Testing

See 7.3

### 8.4 Sampling Requirements

See 7.4

### 8.5 In-plant Observations of Unit Plant Processes

a. Note the presence of flies.

b. Check the flow meter accuracy.

c. Note the appearance of biological growth on the discs; particularly the colour, thickness, distribution and odour:

1. grey-brown, shaggy, thick (3-6mm) and becoming thinner from stage to stage indicates normal operation;

2. light brown and thin indicates nitrification is occurring; or

3. very dark - blackish slimy, filamentous and shaggy indicates anaerobic conditions are occurring.

d. Check the speed of disc rotation.

e. Check for sludge accumulation in the tank.

f. Make sure any grease balls in the disc tanks are being removed frequently.

g. Take the temperature within the enclosure and in the liquid.

h. Floating solids and the presence of pin flocs in secondary clarifiers may indicate bulking and anaerobic conditions.

i. Sludge growth on clarifier walls should be expected and the walls should be regularly scraped.

j. Check the build-up of solids in the chlorination contact chamber.

## 9.0 WASTE STABILIZATION PONDS (LAGOONS)

### 9.1 Sampling Analysis Prior to Discharge

a. Sample secondary cell for DO, BOD, SS, pH and bacteriological analysis. Bottles will be supplied by the provincial or federal laboratory.

b. 1. If coliform bacteria is less than 1000 MPN (most probable number), BOD less than 20 mg/L; and suspended solids less than 25 mg/L, drain secondary cell. (Results of analysis are forwarded to the sender by the laboratory).

2. If coliform greater than 1000 MPN, add 110 KG dry chlorine powder (HTH) per hectare; let stand for 24 hours.

3. If BOD is greater than 20 mg/L, do not discharge.

# Part II

## WATER TREATMENT SYSTEMS

### 10.0 INTRODUCTION

A safe and dependable water supply is a basic necessity. There are two principal sources for a water supply:

a. surface water, including natural and artificial lakes, rivers and streams; and

b. ground water which includes well water and springs.

### 11.0 LIMITS FOR THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF WATER

The quality of water is judged on considerations of health, colour, taste and turbidity. For example, rusty water may contain no harmful substances but is still unacceptable because it looks and tastes unpalatable.

Maximum acceptable limits have been established for various substances, and these are regarded as the ultimate goal for both health and aesthetic quality. Drinking water that contains these substances in concentrations greater than the limits is either capable of producing deleterious health effects or is aesthetically objectionable.

Water that contains substances at concentrations less than the maximum acceptable is adequate for lifelong consumption, however, the establishment of such a limit does not mean that drinking water quality should be allowed to deteriorate to the specified level.

When the maximum acceptable concentration for a contaminant is exceeded, a new sample must be taken immediately. If the limit continues to be exceeded, the local control agency or the Medical Services Branch of Health and Welfare Canada (HWC) should be consulted to find out the appropriate corrective action. How dangerous the situation is will depend on the nature and concentration of the contaminant. However, no water supply should be permitted to exceed any of the health-based limits indefinitely.

## 12.0 PHYSICAL CHARACTERISTICS

### 12.1 General Remarks

The oldest method of judging water quality is its physical characteristics.

The acceptability of drinking water to consumers still depends, to a large degree, on colour, clarity, taste, odour and temperature. It should be noted, however, that an aesthetically pleasing water could provide a false sense of security if health-related water quality factors have not been analysed fully.

### 12.2 Sampling

Samples for on-site physical examination should be collected at least once a week from the raw water intake and from the treated water, and at least every season from representative points in the distribution system. Where problems of turbidity, odour and taste are common, technical assistance may be necessary for determining the sampling frequency. Sampling should be carried out according to methods approved by the control agency or laboratory. See Table 2.

Table 2

RECOMMENDED LIMITS FOR THE PHYSICAL CHARACTERISTICS OF DRINKING WATER

| Parameter | Maximum Acceptable | Objective |
|---|---|---|
| Colour (TCU*) | 15 | 15 |
| Odour | - | Inoffensive |
| pH | 6.5 - 8.5 | - |
| Taste | - | Inoffensive |
| Temperature ($^{o}C$) | 15 | 15 |
| Turbidity (NTU**) | 5 | 1 |

* True Colour Unit
** Nephelometric Turbidity Unit

## 13.0 BACTERIOLOGICAL INDICATORS

### 13.1 Coliform Organisms

The coliform group of micro-organisms is the most commonly used bacteriological indicator of water quality. Fecal coliform bacteria occur in large numbers in warm-blooded animal intestines and feces. The fecal coliform measurement is used to monitor raw water quality and to indicate the potential presence of disease-bearing organisms (pathogens).

In contrast, some strains included in the total coliform group have a wide distribution in the environment, but are less common in fecal material.

### 13.3 Sampling For Bacteriological Examination

The frequency of sampling should depend on:

a. the number and quality of water sources;

b. the past frequency of unsatisfactory samples;

c. the adequacy of treatment and capacity of the treatment plant;

d. the size and complexity of the distribution system;

e. the practice of disinfection; and

f. the population served.

Because of the great variation in these factors, a universal sampling frequency formula cannot be used. The frequency of sampling should therefore be established by the control agency (e.g. HWC) taking local conditions into account. In general, the number of samples to be tested should not be less than four a month.

The samples should be taken at regular intervals throughout the month. When the water supply requires disinfection, chlorine residual tests should also be made.

The location of sampling points should be decided by technical personnel after a thorough inspection of the whole water supply system. The samples should be taken at the point where the water enters the distribution network and from representative points throughout the system, although preferably not the same ones on each

occasion. The majority of samples should be taken in known problem areas.

The sample should be examined as soon as possible after collection to avoid unpredictable changes in the bacterial flora. The interval between collection of the sample and the beginning of its examination should not exceed 24 hours. When greater delays are anticipated, the sample should be refrigerated or a delayed-incubation procedure should be used.

The bacteriological sampling schedule is intended for public water systems and is not applicable to private residential supplies. When a new well or spring is brought into use, frequent samples should be collected under various climatic conditions to establish the bacteriological quality of the supply.

A minimum sample volume of 100 mL is required for the bacteriological examination of drinking water.

Since the presence of any type of coliform organism in treated water suggests either inadequate treatment or contamination, the objective level for total coliforms should be no organisms detectable per 100 mL; however, in practice this level is not always attainable. The following maximum acceptable level is therefore recommended:

a. No sample should contain more than 10 total coliform organisms per 100 mL.

b. Not more than 10% of the samples taken in a 30-day period should show the presence of coliform organisms.

c. Not more that two consecutive samples from the same site should show the presence of coliform organisms.

d. None of the coliform organisms detected should be fecal coliforms.

If any coliform organisms are detected, the site should be resampled, and if the presence of coliforms is confirmed, action should be taken to determine the cause. If the maximum acceptable level is exceeded, the Medical Services Branch of HWC should be contacted for the appropriate corrective action. The most common immediate actions include increasing the chlorine dosage, flushing water mains, using an alternative source of water, and advising consumers to boil drinking water.

If there is a recurrence of coliform organisms, the water system should be inspected to determine the cause. After remedial action has been taken, special sampling should continue until samples taken on two consecutive days are negative.

## 14.0 CHEMICAL CHARACTERISTICS

### 14.1 General Remarks

The chemical characteristics of raw and treated water are significant for a number of reasons. Some chemicals may be dangerous to health above certain concentrations, others may interfere with water treatment processes, stain laundry and plumbing fixtures, or be objectionable to users. Maximum acceptable and objective concentrations have been established for those chemicals. For a complete list of the recommended limits for chemical substances related to health, see Guidelines for Canadian Drinking Water Quality.

### 14.2 Sampling

It is not necessary to examine the chemical characteristics of drinking water as often as the bacteriological content. Surveillance of the chemical quality of drinking water is assuming greater importance, however, as more water sources are exposed to municipal, industrial and agricultural waste discharges. In general, water should be sampled twice a year to monitor health-related chemical substances.

Where there is evidence that particular substances are consistently absent from a water supply system, the frequency of examination for these substances may be reduced, or deleted subject to approval by the control agency. In addition, when the water source has limited exposure to industrial and agricultural wastes, a full analysis may not be required.

## 15.0 References

Health and Welfare Canada. 1979. Guidelines for Canadian Drinking Water Quality.

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