# 5.0 EXISTING RECEIVING WATERS

## 5.1 General

At present, the effluent of the Haliburton Sewage Treatment Plant outlets into the Drag River, which in turn flows into Grass and Kashagawigamog Lakes. The importance of these lakes to the community is primarily due to aesthetic and recreational considerations. At an Open House session held at the Royal Canadian Legion on June 21, 1988, several concerns were raised regarding the quality of the lakes; Grass Lake in particular. Grass Lake is a relatively small and shallow lake, with a surface area of 63.7 ha and a mean depth of 3.4 m. Kashagawigamog Lake was of lesser concern to those in attendance, most likely due to its larger size, having a surface area of 817.9 ha and a mean depth of 13.0 m.

According to the Provincial Water Quality Objectives (PWQO), all surface waters must be of adequate quality to support aquatic life and be aesthetically pleasing. Monitoring of the quality of Grass and Kashagawigamog Lakes was undertaken in 1975, 1977 and 1985 to determine whether the lakes were maintaining an adequate water quality at various times of the year. Prior to selecting a preferred solution to expanding the existing STP, TSH have undertaken a water sampling program to obtain seasonal data to ensure a reliable data base of background information. Samples were collected in March, May and September, 1988. These data are presented in Appendix 4.4.

This section of the report outlines information on the hydrology and water quality of the existing receiving waters and describes the proposed effluent criteria to be utilized in the consideration of possible alternatives to expansion of the existing sewage treatment plant.

## 5.2 Hydrology

The Haliburton Sewage Treatment Plant presently discharges to the Drag River, a connecting waterway between Head Lake to the north and Grass Lake to the south. Grass Lake subsequently discharges into Kashagawigamog/Canning Lake before merging with the Burnt River south of Gelert.

Environment Canada's Water Resources Branch, Water Survey of Canada, maintains a permanent gauging station No. 02HF003, located at latitude 44-42-03N and longitude 78-40-40W on the Burnt River. The drainage area for the station is 1,270 $km^2$. Flow records dating back to 1962 were obtained from staff of the Water Survey of Canada.

The Trent-Severn Waterway maintain a permanent gauging station on the Burnt River at Gelert. The drainage area for this station is 543 $km^3$. Flow records from 1917 to 1949 and 1975 to present were obtained.

The Trent-Severn Waterway is part of a water resources system comprised of eight (8) navigable lakes and connecting channels and thirty-six (36) reservoir lakes. Some lakes in the Dysart Township are used as reservoir lakes in supplying water to meet minimum flow requirements in the rivers and waterway.

By utilizing the average annual flow rates at the two gauging stations and the drainage area for each station, the average flows for the Drag River, Grass Lake and Kashagawigamog/Canning Lakes were calculated. The drainage areas, derived from a 1:50,000 scale map are as follows:

| | |
|---|---|
| Drag River | 157.0 $km^2$ |
| Grass Lake | 161.4 $km^2$ |
| Kashagawigamog/Canning | 270.8 $km^2$ |

5.2 Hydrology (Cont'd)

The following annual flow rates were determined based on the flow records at the gauging stations:

| | Water Survey of Canada Flow Records | Trent-Severn Waterway Flow Records |
|---|---|---|
| Drag River | 2.36 $m^3/s$ | 2.53 $m^3/s$ |
| Grass Lake | 2.42 $m^3/s$ | 2.60 $m^3/s$ |
| Kashagawigamog/Canning | 4.37 $m^3/s$ | 4.65 $m^3/s$ |

The seven day minimum flow for a return period of 20 years (7Q20) is as follows:

| | Water Survey of Canada Flow Records | Trent-Severn Waterway Flow Records |
|---|---|---|
| Drag River | 0.28 $m^3/s$ | 0.24 $m^3/s$ |
| Grass Lake | 0.29 $m^3/s$ | 0.24 $m^3/s$ |
| Kashagawigamog/Canning | 0.53 $m^3/s$ | 0.44 $m^3/s$ |

Flushing rates of 16 days for Grass Lake and 282 days for Kashagawigamog Lake were calculated based on volumes of approximately $3.25 \times 10^6$ $m^3$ and $106.327 \times 10^6$ $m^3$, respectively and the annual average flows calculated from the Water Survey of Canada flow records.

## 5.3 Water Quality

The Provincial Water Quality Objectives (PWQO) are criteria established by the MOE to ensure the protection of aquatic life and recreational enjoyment in and on the water. In the protection of aquatic life, the PWQO are set to protect all aquatic life through all stages of development. Criteria for the protection of recreational uses are based on public health and aesthetic considerations.

According to the PWQO, all surface waters must be able to support aquatic life and be aesthetically pleasing. When a surface water is the recipient of effluent from a sewage treatment plant, that effluent must undergo sufficient treatment prior to discharge into the watercourse. The criteria for the plant effluent will vary, depending on the intended use of the water supply, i.e. whether the supply will be used for drinking water or recreational purposes.

This section of the report briefly describes the conventional and non-conventional water pollutants of concern when discharging treated sewage effluent into a receiving water, outlines the existing water quality of Grass and Kashagawigamog Lakes with respect to these pollutants, and describes the potential impact on the water quality of the lakes. The effluent criteria necessary to minimize the potential for further deterioriation of either lake are outlined in a subsequent section.

Water quality data have been collected for Head, Grass and Kashagawigamog Lakes in previous studies. Copies of these data are presented in Appendix 4 of this report.

5.3 Water Quality (Cont'd)

a) Conventional Pollutants

The primary pollutants of concern in the discharge of treated sewage effluent to surface waters are 5 day biochemical oxygen demand ($BOD_5$), suspended solids, pH, fecal coliforms and phosphorus. The MOE has established guidelines for determining effluent criteria, however, these criteria are site specific, depending on the characteristics of the particular receiving water. These criteria will be discussed further in Section 5.4.

**Dissolved Oxygen** has a lower limit, below which the propagation of fish and other aquatic life is threatened. The primary pollutant associated with low dissolved oxygen concentrations is carbonaceous BOD. The criteria for BOD are developed to minimize the demand on the available oxygen supply of a watercourse.

Most fish species and other aquatic life require dissolved oxygen to survive. Their oxygen requirements may vary according to species, age, activity, temperature and nutritional state. In general, the minimum level necessary to support a diverse fish population is 5 mg/l. Coldwater fish require 6 mg/l, with a minimum of 7 mg/l during spawning, where warm water species can tolerate a minimum dissolved oxygen concentration of 4 mg/l.

**Suspended Solids** consist of silt, clay, plankton and other microscopic organisms. In high concentrations, these solids interfere with light transmission and can settle out of suspension, covering a stream or lake bottom. Turbid water interferes with the recreational and aesthetic enjoyment of a water supply as well as the survival and propagation of many fish populations. High suspended solids (SS) concentrations can damage aquatic invertebrate populations, fill gravel spawning beds and inhibit fish growth by preventing the successful development of eggs and larvae and reducing the amount of food available. According to the PWQO, suspended solids should not change the natural secchi disk reading by more than 10 percent.

5.3 Water Quality (Cont'd)

The pH of surface waters is important for the recreational enjoyment by users, the protection of fish life and for the control of undesirable chemical reactions. Many substances increase in toxicity with an increase in pH, thus a range of 6.5 to 8.5 is deemed acceptable for surface waters.

The presence of **fecal coliform bacteria** indicate the possible presence of pathogenic organisms, originating from warm blooded animals, such as humans. The PWQO indicate a potential health hazard exists if the fecal coliform mean density for a series of samples exceeds 100 per 100 ml.

**Phosphorus** is a key nutrient, stimulating plant growth such as weeds and algae in surface waters. This process of eutrophication can be accelerated by the discharge of wastewaters and agricultural drainage containing phosphorus into the receiving waters. To avoid nuisance concentrations of algae in lakes, average total phosphorus concentrations for ice-free periods should not exceed 0.02 mg/l.

b) Non-Conventional Pollutants

Fish are good indicators of water quality, as their presence indicates an adequate habitat for food supply, shelter and breeding. In addition to anoxic (low oxygen) conditions, the presence of non-conventional pollutants can result in significant damage to aquatic life due to associated toxic effects. Parameters such as un-ionized ammonia and residual chlorine are non-conventional pollutants associated with treated effluent from wastewater. The effects on fish due to the presence of these parameters will depend on the fish species, the overall quality of the watercourse and the water temperature.

5.3 Water Quality (Cont'd)

Un-ionized ammonia is toxic to fish and other aquatic life in concentrations greater than 0.02 mg/l. It is not measured directly; its concentration in water is based on measured total ammonia ($NH_3$ + $NH_4$) concentrations, pH and water temperature. The concentration increases with an increase in pH and temperature. High ammonia concentrations can be reduced in treated effluent by additional aeration in biological treatment to convert the ammonia to nitrate.

Residual chlorine concentrations result from the disinfection of wastewater effluent. When present in concentrations greater than 0.002 mg/l, residual chlorine can be toxic to certain fish.

Senes Consultants were retained as a subconsultant to TSH to evaluate the existing water quality data of Grass and Kashagawigamog Lakes and to determine the potential impacts on the water quality due to inputs from natural and anthropogenic sources (sewage effluent, septic tank effluents). A copy of their revised report is included in Appendix 5. The impacts were determined by an evaluation of phosphorus and chlorophyll a concentrations and secchi disk transparency data. These data are summarized in Appendix 4 and include data from previous studies in 1976, 1977 and 1985.

Chemical water quality in Grass and Kashagawigamog Lakes is characteristic of the lakes on the Canadian Shield. The lake waters possess low alkalinity (20-30 mg/L as $CaCO_3$) and near neutral pH conditions (pH ranging from 6.8 to 7.6). In general, the concentrations of metallic constituents are low. As expected, calcium is the most abundant metal ion; the waters, however, are undersaturated with respect to calcite ($CaCO_3$). The waters of both Grass Lake and Kashagawigamog Lake are coloured, most likely due to humic and fulvic acid complexes with iron and manganese.

5.3 Water Quality (Cont'd)

Based on previous water quality results, and discussions with staff of the Ministry of the Environment, phosphorus and dissolved oxygen concentrations were evaluated in detail, using various modelling techniques to predict the impacts on the water quality of Grass and Kashagawigamog Lakes due to the plant expansion.

A discussion of existing water quality with respect to phosphorus and dissolved oxygen concentrations will be presented in this section. The impacts on these parameters resulting from the implementation of various alternatives will be addressed in Section 9.0 of this report.

For analysis purposes, Senes divided Kashagawigamog Lake into a north and south basin based on the bathymetry of the lake. A summary of the morphometric characteristics of Grass Lake and the north and south basins of Kashagawigamog Lake are summarized in Table 5.1.

Table 5.1

Morphometric and Hydrological Characteristics of Grass and Kashagawigamog Lakes

| | | Kashagawigamog Lake | |
|---|---|---|---|
| | Grass Lake | North Basin | South Basin |
| Surface Area ($m^2$) | $6.37 \times 10^5$ | $3.15 \times 10^6$ | $4.93 \times 10^6$ |
| Mean Depth (m) | 3.4 | 9.5 | 15.2 |
| Volume ($m^3$) | $2.17 \times 10^6$ | $2.99 \times 10^7$ | $7.4 \times 10^7$ |
| Outflow ($m^3$/y) | $7.92 \times 10^7$ | $1.02 \times 10^8$ | $1.42 \times 10^8$ |
| Areal Hydraulic Loading (m/y) | 124.3 | 32.4 | 28.9 |
| Drainage Area ($km^2$) | 4.4 | 45.3 | 84.1 |

5.3 Water Quality (Cont'd)

a) Phosphorus Loading

With regard to trophic status, the lakes are phosphorus limited. According to the previous water quality surveys, Grass Lake was mesotrophic, while Kashagawigamog Lake was late oligotrophic during the 10 year (1976-1985) survey period. Results obtained during 1988 indicate that the water quality has not changed significantly since 1985.

Senes calculated a baseline phosphorus budget from the 1985 water quality data to estimate the natural phosphorus loading on the lakes. To determine estimates of phosphorus loading to Kashagawigamog and Grass Lakes, the following sources of phosphorus were used: a) inflow from upstream lake, b) natural load from watershed, c) anthropogenic load (cottages, existing sewage treatment plant, resorts), d) precipitation. The phosphorus flux due to precipitation is considered negligible. The sewage treatment plant and resorts would be affected most significantly by the proposed sewage treatment plant expansion. These data are summarized in Table 5.2.

The projected phosphorus budgets and the potential impacts on Grass and Kashagawigamog Lakes due to phosphorus inputs will be addressed in the evaluation of the various alternatives of the sewage treatment plant expansion, in Section 9.0 of this report.

b) Dissolved Oxygen Concentrations

Due to the relatively shallow depth of Head Lake (mean depth 2.6 m), the lake does not stratify during the summer. The dissolved oxygen concentrations are acceptable throughout the water column, however, the uniformly high temperatures do not provide suitable habitat conditions for cold water biota.

Measured dissolved oxygen concentrations indicate that the hypolimnion of Grass Lake becomes periodically anoxic (dissolved oxygen concentration approaches zero) during the summer.

5.3 Water Quality (Cont'd)

During the latter part of summer stratification, the north basin of Lake Kashagawigamog experiences dissolved oxygen depletion to less than desirable levels for cold water biota in the hypolimnion. The dissolved oxygen concentration in the hypolimnion of the south basin of Lake Kashagawigamog approaches the provincial criterion at the end of summer stratification and the end of ice cover during the spring.

Dissolved oxygen depletion due to oxidation of organic matter in the hypolimnion originates from phytoplankton production in the euphotic zone. The extent of depletion is dependent on the hypolimnion depth and the hydraulic residence time, with phytoplankton production, in most lakes, being limited by the areal phosphorus load.

Senes Consultants utilized two different models to evaluate the impacts of the proposed alternatives on dissolved oxygen concentrations. The Vollenweider and Janus (1981) model utilized measured chlorophyll a and total phosphorus concentrations to determine the volumetric hypolimnetic oxygen demand. The Welch and Perkins model (1979) utilized measured phosphorus concentrations to determine areal hypolimnetic oxygen demand. A detailed outline of the models, including the equations used, is presented within the Senes report, attached as Appendix 5 of this report. The predicted volumetric hypolimnetic oxygen demand for each alternative will be addressed in Section 9.0.

5.3 Water Quality (Cont'd)

Table 5.2

Baseline Phosphorus Budget Calculated From 1985 Water Quality Data

| | Grass Lake | Kashagawigamog Lake (North Basin) | Kashagawigamog Lake (South Basin) |
|---|---|---|---|
| Natural Load from Watershed (kg/y) | 17.6 | 181.2 | 336.4 |
| Anthropogenic Sources (kg/y) | 53.5 | 214.2 | 121.3 |
| Influent Load (kg/y) | 884.9* | 908.2 | 938.6 |
| Total Load (kg/y) | 956.0 | 1,303.6 | 1,396.3 |
| Retention Coefficient | 0.05 | 0.28 | 0.30 |
| Areal Loading ($mg/m^2.y$) | 1,500.8 | 413.8 | 283.2 |
| Total Phosphorus ($mg/m^3$) | 12.0 | 9.6 | 7.2 |

* Includes the existing sewage treatment plant outfall phosphorus load of 54.4 kg/y.

5.4 Effluent Criteria

The MOE has established criteria for the discharge of treated effluent from wastewater plants based on the parameters $BOD_5$, suspended solids and total phosphorus. These parameters are monitored to evaluate the performance of the plant and to determine compliance with the designated effluent criteria. The effluent criteria for a sewage treatment plant are specific for that plant, dependent on the characteristics of the receiving water. The MOE has established general guidelines of 15 mg/l, 15 mg/l and 1 mg/l for $BOD_5$, suspended solids and phosphorus, respectively. These concentrations are the maximum allowable concentrations in treated effluent from a sewage treatment plant. When applying these criteria to a specific location, local conditions should be considered, including the natural background pollutant concentrations, the presence or absence of sensitive

5.4 Effluent Criteria (Cont'd)

aquatic species, biological community characteristics, water temperature and flow characteristics. The ability of a receiving water to accept treated effluent without resulting in a high concentration of pollutants is dependent upon the assimilative capacity of the watercourse.

Comments received from residents of Grass Lake at the Open House on June 21, 1988 expressed concern with the potential impacts on the water quality of Grass Lake due to an increase in effluent discharged from an expanded sewage treatment plant located at the existing site. These concerns will be addressed in the evaluation of the alternatives where the effluent is discharged to the Drag River and to Grass Lake.

Due to the sensitivity of Grass Lake, proposed effluent criteria of 5 mg/l, 5 mg/l and 0.3 mg/l will be used for the Haliburton sewage treatment plant expansion.

Table 4.7 summarizes the effluent quality of the existing sewage treatment plant with respect to the afore-noted parameters, for the period 1985 to 1987. The existing effluent quality is in compliance with the MOE guidelines of 15, 15 and 1 mg/l, but slightly exceeds the criteria of 5, 5 and 0.3 mg/l set for the proposed expansion of the existing plant. To comply with the more stringent criteria proposed for the expanded plant, additional treatment facilities will be included. These facilities are described in Section 9.0 of this report, in the evaluation of alternatives.

A review of the recent data from the Haliburton STP revealed that the concentration of ammonia present in the effluent ranged from 0.05 mg/L to 1.20 mg/L during the period January, 1987 to March, 1988, with an average concentration of 0.28 mg/L. The residual chlorine concentration ranged between 0.3 mg/L and 0.4 mg/L during the same time period. Assuming complete mixing of the effluent volume with the receiving water flow, these concentrations would be diluted to below the limit found to promote harmful effects to fish and other aquatic life. The impacts of these parameters on the quality of the receiving water and on the aquatic environment will be addressed in more detail in Phase 3 of the study, upon selection of the preferred alternative.

5.4 Effluent Criteria (Cont'd)

The initial dilution, $D_I$, of the effluent from the Haliburton STP into the Drag River was calculated where the volume of the treated effluent mixes with the receiving river flow ($Q_R$) using the average design flow of the plant ($Q_{EFF}$) and the minimum seven consecutive day average river flow for a return period of twenty (20) years (${}_7Q_{20}$) such that

$$D_I = \frac{Q_{EFF}}{Q_{EFF} + Q_R}.$$

Preliminary calculations, based on the ${}_7Q_{20}$ flow and the existing plant capacity show an initial dilution ratio of 48:1 for the discharge of effluent into Drag River resulting in $BOD_5$ 0.11 mg/l, SS 0.10 mg/l and Phosphorus 0.01 mg/l, assuming complete mixing of the effluent volume with the entire river flow.

In the determination of dilution ratios for the discharge of sewage treatment plant effluent into a lake, specific diffuser designs must be undertaken, with respect to depth of diffuser, diffuser length, port spacing and port diameter. This type of detailed design is beyond the scope of a Phase 1/Phase 2 report. As outlined in the MOE publication entitled "Dispersion of Effluent Plumes from Diffusers on Near-Shore Regions of the Great Lakes", an initial dilution ratio of 20:1 is used in the design of outfalls discharging into the Great Lakes. This ratio will be used in the initial evaluation of the alternatives that propose to discharge effluent into a lake, however, a more detailed evaluation would be undertaken during Phase 3 if the preferred solution includes discharge to a lake.

The concentrations of the above parameters upon initial dilution will be described for each of the proposed alternatives in Section 9.0 of this report.

# 6.0 POPULATION ESTIMATE AND FLOW PROJECTION

## 6.1 General

The Ontario Ministry of the Environment recommends that major water and sewage projects be designed for a twenty year period. This section outlines the population estimates and the projected sewage flows for the Hamlet of Haliburton and the development along Highway 121 which will be serviced by the proposed Haliburton-Kashagawigamog Sewer Extension.

## 6.2 Population Estimate

### 6.2.1 Hamlet of Haliburton

The Municipality of Dysart et al consists of the Townships of Dysart, Bruton, Clyde, Dudley, Eyre, Guilford, Harburn, Harcourt and Havelock. Information obtained from the Municipality indicates that since 1971 the total population in the Municipality has grown at an average rate of 1.4% as shown in the following table:

| Year | Population | Growth Rate (%) |
|---|---|---|
| 1971 | 3,061 | |
| 1976 | 3,411 | 2.2 |
| 1980 | 3,521 | 0.8 |
| 1985 | 3,742 | 1.2 |
| Average | | 1.4 |

## 6.2 Population Estimate (Cont'd)

Separate population records are not available for the Hamlet of Haliburton. Since the Hamlet is the commercial, service and administrative centre of the municipality, its growth rate is much higher.

A review of sewage flow records (refer to Table 4.1) indicates that the average daily sewage flow in the Hamlet increased from 155 $m^3/d$ in 1982 to 317 $m^3/d$ in 1987. This represents an average annual growth rate of 15%. Assuming that the sewage flow is directly proportional to the equivalent service population, it is inferred that the equivalent service population in the Hamlet has grown by an average of 15% over the last five years. It is doubtful that such a high rate of growth can be sustained over the entire design period of 20 years. After consultation with the Municipality, a growth rate of 4.0% was selected for estimating the design population for the Sewage Treatment Plant Expansion.

As of 1987, the equivalent service population in the Hamlet was 880. A growth rate of 4% per year results in a 2008 service population of 1,928.

### 6.2.2 Haliburton Kashagawigamog Sewer Extension

A summary of equivalent service populations for the proposed Haliburton Kashagawigamog Sewer Extension is presented in the following Table 6.1. The data were obtained from Rysco Engineering Corporation.

The equivalent service populations were determined based on 3 persons per Equivalent Residential Unit (ERU). One Equivalent Residential Unit represents the sewage generated by a single family dwelling occupied by 3.0 persons, each generating 100 imperial gallons of liquid per day. For the full service resorts that contain separate bedrooms to accommodate up to four persons, main kitchen facilities, a bar or dining lounge and transient visitors, a value of 0.75 Equivalent Residential Units is assigned.

6.2 Population Estimate (Cont'd)

Table 6.1

Equivalent Service Population

Haliburton Kashagawigamog Sewer Extension

| User | Equivalent Residential Units | Equivalent Population (3 persons/unit) |
|---|---|---|
| Original Users: | | |
| Commercial Block | | |
| Boyces | 1 | 3 |
| Brewers Retail/Skyline Automotive | 1 | 3 |
| Curry Motors | 1 | 3 |
| Driftwood Restaurant | 2 | 6 |
| F. Hall Real Estate | 1 | 3 |
| Haliburton Lumber | 1 | 3 |
| Haliburton Marina | 1 | 3 |
| Kashaga Ford | 1 | 3 |
| Deer Lodge | 100 | 300 |
| Hydl Hills | 50 | 150 |
| Lakeview Motel | 18 | 54 |
| Langdon Apts. | 20 | 60 |
| Locarno Resort | 46 | 138 |
| Pinestone Inn | 100 | 300 |
| Silver Beach Camp | 35 | 105 |
| Slipper Property | 50 | 150 |
| Wigamog | 100 | 300 |
| Willow Beach | 15 | 45 |
| TOTAL | 543 | 1,629 |
| 1987 & 1988 Additions | | |
| Commercial Block | | |
| 30 Surrounding Houses | 30 | 90 |
| 30 Industrial | 30 | 90 |
| 1 Laundromat | 45 | 135 |
| TOTAL | 105 | 315 |
| 1989 Proposed Additions | | |
| Maple Hill Nursing Home | 50 | 150 |
| Walling Farm Subdivision | 79 | 237 |
| TOTAL | 129 | 387 |
| GRAND TOTAL | 777 | 2,331 |

## 6.3 Projected Flows

### 6.3.1 Average Design Flow

As noted in Section 4.1.3, the average per capita sewage flow in the Hamlet of Haliburton during 1985, 1986 and 1987 was approximately 326 L/d. Rysco Engineering Corporation, however, used a per capita flow rate of 454 L/d for the design of the Haliburton Kashagawigamog Extension. Therefore, in order to be conservative, an average per capita flow rate of 454 L/d is also used for the expansion of the sewage treatment facilities.

Based on the projected equivalent service population outlined in Section 6.2, the average design flows for the plant expansion are indicated in Table 6.2.

Table 6.2

Projected Average Daily Flow

| | Haliburton | Kashagawigamog Extension |
|---|---|---|
| Projected Service Population | 1,928 | 2,331 |
| Per capita flow (L/d) | 454 | 454 |
| Average daily flow ($m^3$/d) | 875 | 1,058 |

### 6.3.2 Peak Design Flow

Sewage from the Hamlet of Haliburton is conveyed to Pumping Station No. 1 prior to pumping to the sewage treatment plant. Since a flow meter is not provided at the pumping station inlet, actual peak flow data are not available for analysis. Therefore, the Harmon formula was used to estimate the peak flow as shown in the following Table 6.3.

6.3 Projected Flows (Cont'd)

Table 6.3

Projected Peak Flow

| | Haliburton | Kashagawigamog Extension |
|---|---|---|
| Projected Service Population | 1,928 | 2,331 |
| Average flow at 454 L/d | 875 $m^3/d$ | 1,058 $m^3/d$ |
| Peak factor | 3.63 | 3.53 |
| Peak flow | 3,176 $m^3/d$ | 3,735 $m^3/d$ |
| | (36.7 L/s) | (43.2 L/s) |

# 7.0 INVESTIGATION OF SYSTEM DEFICIENCIES

## 7.1 General

During the course of preparing this report, a visual inspection of the treatment plant was undertaken to determine the physical condition of the plant components as well as to evaluate the plant capacity, thus determining the available capacity of the treatment facilities. This section outlines the findings of the investigations.

## 7.2 Visual Inspection

A visual inspection of the sewage treatment plant facilities was conducted on August 6, 1987 by staff of TSH in the presence of the plant operations personnel. It was concluded that, in general, the plant is in good condition and is working satisfactorily. However, it was noticed that weeds were growing in the filter beds which had been taken out of service in 1986.

## 7.3 Plant Capacity Evaluation

As noted previously, the existing plant was originally designed to operate either as an extended aeration process with a capacity of 455 $m^3/d$ or as a contact stabilization process with a capacity of 955 $m^3/d$. In order to determine the potential capacity of the existing plant, a plant capacity evaluation was undertaken.

7.3 Plant Capacity Evaluation (Cont'd)

7.3.1 Aeration Tank and Aerobic Digesters

According to the Ministry of the Environment's Guidelines for the Design of Sewage Treatment Plants, dated July, 1984, the organic loading should be from 0.17 to 0.24 kg/$m^3$.d for extended aeration, or from 0.31 to 0.72 kg/$m^3$.d for a contact stabilization process. Based on these design parameters and assuming an influent BOD of 150 mg/L, the allowable capacity of the existing plant is between 494 $m^3$/d and 697 $m^3$/d for extended aeration and between 900 $m^3$/d and 2093 $m^3$/d for a contact stabilization process.

The same guidelines indicate that aerobic digesters should be sized for 1.6 kg/$m^3$.d volatile suspended solids based upon the first stage digester only. Based on this design parameter and assuming a volatile suspended solids concentration of 90 mg/L, the existing plant could be rated at 1,973 $m^3$/d for a contact stabilization process. The aerobic digester will be part of the aeration tank with the extended aeration process.

During the course of preparing this report, staff of the Ministry of the Environment were contacted regarding conversion of the existing plant from an extended aeration process to a contact stabilization process. Staff of the Ministry of the Environment recommended that because there were very few contact stabilization plants in Ontario and because of the wide range of the organic loading design parameters for sizing the contact stabilization process, the lower range of the organic loading parameter should be used. It was also indicated that if the existing plant is converted to a contact stabilization process, a plant performance test would be undertaken by the Ministry of the Environment prior to determining the allowable plant capacity.

In view of the above, the existing plant could be rated at a capacity as low as 900 $m^3$/d for the contact stabilization process.

## 7.3 Plant Capacity Evaluation (Cont'd)

### 7.3.2 Settling Tank

The Ministry of the Environment's Guidelines for the Design of Sewage Treatment Plants indicate that a final clarifier surface settling rate for an activated sludge plant with chemical addition for phosphorus removal should be no greater than 35 $m^3/m^2.d$ at the peak overflow rate.

The surface area of the existing settling tank is 57.3 $m^2$ with an allowable capacity of 2,006 $m^3/d$ at peak flow. Therefore, assuming a peak factor of 3.7, the allowable capacity of the existing settling tank is 542 $m^3/d$.

### 7.3.3 Plant Rated Capacity

Based on the above-noted evaluation, it is suggested that the existing Haliburton sewage treatment plant should continue to operate using the extended aeration process with a rated capacity of 542 $m^3/d$.

### 7.3.4 Plant Reserve Capacity

The average daily flow recorded at the sewage treatment plant during 1987 was 317 $m^3/d$. With a rated plant capacity of 542 $m^3/d$, the plant has a reserve capacity of approximately 225 $m^3/d$.

### 7.3.5 Plant Deficiency

The existing sewage treatment plant does not have adequate capacity to accommodate the projected future flows from the Hamlet of Haliburton and the Kashagawigamog Sewer Extension, thus it will be necessary to expand the existing plant as outlined in Table 7.1.

7.3 Plant Capacity Evaluation (Cont'd)

**Table 7.1**

**Required Expansion of Sewage Treatment Plant**

| | |
|---|---|
| Projected average daily flow: | |
| Haliburton | 875 $m^3/d$ |
| Kashagawigamog Extension | 1,058 $m^3/d$ |
| Total | 1,933 $m^3/d$ |
| Rated Capacity of Existing Plant | 542 $m^3/d$ |
| Required Expansion | 1,391 $m^3/d$ |

To handle the projected peak flow of 3,176 $m^3/d$ (36.7 L/s) from the Hamlet as outlined in Section 6.3.2, it will be necessary to install a third pump in Pumping Station No. 1. Provision has been made in the pumping station piping for the installation of this third pump.

To minimize the flow variations into the sewage treatment plant, a flow equalization tank will be provided. An equalization tank will equalize the influent flows from the new sewage collection system and the Hamlet of Haliburton, thus providing a constant sewage flow to the treatment plant. The specific method of flow equalization will be considered in Phases 3 and 4.

# 8.0 GENERAL ALTERNATIVE SOLUTIONS AND ENVIRONMENTAL EVALUATION CRITERIA

## 8.1 General

This section outlines the potential alternative options available to the Municipality for accommodating the projected future sewage flows from the Hamlet of Haliburton and the proposed Kashagawigamag Sewer Extension.

This section also outlines the environmental factors and criteria by which each alternative will be evaluated. Based on the general envaluation of the potential options, the recommended alternatives for the expansion of the Haliburton Sewage Treatment Plant will be evaluated in Section 9.0.

## 8.2 General Alternatives

The following alternatives can be considered for the expansion of the Haliburton Sewage Treatment Plant:

1. Do nothing;
2. Limit community growth;
3. Provide individual sewage disposal systems;
4. Expand existing sewage treatment plant with outlet sewer to Drag River;
5. Expand existing sewage treatment plant with outlet sewer to Grass Lake;
6. Construct new sewage treatment plant on a new site:
   a) Plant sized for Highway 121 Development
   b) Plant sized for Highway 121 Development and Hamlet of Haliburton; and
7. Expand existing sewage treatment plant with outlet sewer to Burnt River.

## 8.2 General Alternatives (Cont'd)

### 8.2.1 Do Nothing

Under this alternative, the Municipality has the option of doing nothing, or in other words, not expanding the Haliburton Sewage Treatment Plant.

As outlined in previous sections, the existing plant provides adequate treatment and produces an acceptable effluent with $BOD_5$, SS and total phosphorus levels less than 15 mg/l, 15 mg/l and 1 mg/l respectively, the criteria set for the treatment plant design. The plant also has a reserve capacity of approximately 225 $m^3$/d which is adequate to accommodate an additional service population of 500 persons at a per capita flow of 450 L/d.

This alternative will not solve the sewage disposal problems currently faced by the resorts and other commercial/industrial establishments in the Municipality. The lack of adequate sewage treatment facilities has severely curtailed the expansion of resorts and other commercial/industrial development along Highway 121.

In 1983, several of the resorts on the north shore of Lake Kashagawigamog, under the leadership of Pinestone Inn, commissioned a feasibility study to investigate the feasibility of providing a piped system for the collection and transportation of sewage from the resorts to the Haliburton Sewage Treatment Plant. The Municipality supported the study and applied to the Provincial Government for financial assistance, which was approved in 1985. Design of the sewer system (Haliburton-Kashagawigamog Sewer Extension) was subsequently completed, however, construction cannot proceed further until firm commitments are made to expand the sewage treatment plant.

Due to the need for adequate sewage treatment facilities, the "Do Nothing" alternative is not acceptable and will not be considered further.

8.2 General Alternatives (Cont'd)

### 8.2.2 Limit Community Growth

Limiting community growth in Haliburton could be detrimental to the growth of the tourism industry as well as to the existing commercial establishments in the community. This course of action would be in conflict with the interests of the community as expressed by its political leaders and stated in the Official Plan of the Municipality.

Based on the above-noted circumstances, this alternative will not be considered further.

### 8.2.3 Provide Individual Sewage Disposal Systems

Under this alternative, the resorts and other commercial and industrial developments which cannot be serviced by the existing Haliburton Sewage Treatment Plant would have to provide their own sewage disposal systems. Such systems are not only expensive to construct and maintain, but also present health hazards and pollution problems when not operated properly.

Due to unsuitable geotechnical conditions, many septic tanks and tile fields constructed in the general area in the past have not performed satisfactorily. An inspection of 273 private sewage disposal systems on Kashagawigamog Lake undertaken by the MOE Central Region during the summer of 1980 revealed that 44.7% were classified as substandard, 16.5% were unsatisfactory due to improper disposal of solid waste or wash water and 4.8% were classified as direct polluters.

Due to the above-noted problems with existing sewage disposal systems, this alternative is not acceptable and will not be considered further.

## 8.2 General Alternatives (Cont'd)

### 8.2.4 Expand Existing Sewage Treatment Plant with Outlet Sewer to Drag River

Under this alternative, the existing Haliburton Sewage Treatment Plant will be expanded to accommodate the projected sewage flows from the Hamlet of Haliburton as well as the Haliburton-Kashagawigamog Sewer Extension. Treated effluent from the plant will be discharged into the Drag River via the existing outfall.

Incorporation of the existing site and facilities into the new treatment works has economic advantages accruing from land ownership and savings in capital costs. The economic value of the site and usable facilities will be taken into account when comparing alternative treatment options.

As economic advantages may be realized by constructing a new sewage treatment facility at the existing site, this option will be evaluated further in subsequent sections.

### 8.2.5 Expand Existing Sewage Treatment Plant with Outlet Sewer to Grass Lake

Information obtained from the Ministry of Natural Resources indicates that the section of Drag River between Head Lake and Grass Lake is an important spawning and habitat area for various species of fish and other aquatic life. Thus, discharging the treated effluent from the existing treatment plant into Grass Lake will have the following advantages:

- Preservation and enhancement of the natural environment of Drag River near the existing outfall.
- Better mixing and dilution of the effluent in the deeper waters of Grass Lake.

8.2 General Alternatives (Cont'd)

As the discharge of effluent into an alternate receiving watercourse is a viable solution, this alternative will be evaluated further in subsequent sections.

8.2.6 Construct New Sewage Treatment Plant on a New Site

Two sub-alternatives can be considered under this alternative as follows:

A) Plant Sized for Highway 121 Development: Under this alternative, the existing sewage treatment plant would be expanded to service the projected growth in the Hamlet of Haliburton and the Highway 121 development located near the plant. This development would include the industrial and commercial blocks located near Haliburton Marina, Lakeview Motel, Langdon Apartments and Walling Farm Subdivision.

A second sewage treatment plant would be constructed at a new site to service the following resorts: Deer Lodge, Hydl Hills, Locarno Resort, Pinestone Inn, Silver Beach Camp, Slippers Property, Wigamog Inn and Willow Beach.

The main advantage of this alternative would be the reduction in the length of transmission main required to transmit raw sewage from the resorts to the existing sewage treatment plant, resulting in reduced capital costs for the Haliburton Kashagawigamog sewer extension.

This alternative will be discussed further in subsequent sections.

8.2 General Alternatives (Cont'd)

B) Plant Sized for Highway 121 Development and the Hamlet of Haliburton: Under this alternative, the existing sewage treatment plant would be retired and a new plant constructed to service both the Highway 121 Development and Hamlet of Haliburton. This alternative offers an advantage in that the Municipality would not have to operate and maintain two sewage treatment plants as in Alternative A.

This alternative will be evaluated further in subsequent sections.

### 8.2.7 Expand Existing Plant with Outlet Sewer to Burnt River

Due to the importance of the tourism industry to the economic growth of Haliburton and the influx of families moving to the community and establishing seasonal and/or permanent residences, expansion of the sewage treatment plant is necessary to allow this growth. Concerns have been raised by the Ministries of the Environment and Natural Resources about the deteriorating water quality in Grass and Kashagawigamog Lakes and the associated effects on the local fisheries.

The north basin of Lake Kashagawigamog has been designated a Policy 2 water body by the Ministry of the Environment. The Policy states that "Where new or expanded discharges are proposed, no further degradation will be permitted and all practical measures shall be undertaken to upgrade water quality".

To determine whether improvements to the water quality can be realized, the alternative of diverting the treated effluent to another water course, the Burnt River will be evaluated further in subsequent sections.

## 8.3 Alternative Sewage Treatment Processes

### 8.3.1 Treatment Process Options

In general, alternative treatment design concepts considered in this report are as follows:

1. Conventional Activated Sludge Process;
2. Modified Activated Sludge Process:
   - 2A. Extended Aeration;
   - 2B. Contact Stabilization;
3. Attached Growth Process:
   - 3A. Trickling Filters;
   - 3B. Rotating Biological Contactors;
4. Aerated Lagoon;
5. Waste Stabilization Pond; and
6. Deep Shaft System.

A fact sheet issued by the MOE describing various sewage treatment processes used in Ontario is reproduced in Appendix 6. Processes that are not included in the fact sheet are described below.

The rotating biological contactor (RBC) process is, in principle, similar to the trickling filter process and is frequently referred to as a rotating biological surface or rotating biological disc. Basically, it consists of a series of closely spaced plastic discs mounted on a horizontal shaft, supported in a semi-circular or trapezoidal concrete or steel tank. Each grouping of discs is identified as a stage and each stage operates in a separate compartment of the tank. The disc-stage assembly is rotated slowly in the tank filled with wastewater.

8.3 Alternative Sewage Treatment Processes (Cont'd)

As the shaft rotates, the disc surfaces are alternately exposed to the wastewater and the atmosphere. Microorganisms naturally present in the wastewater adhere to and grow on the disc surfaces. Due to the rotating action, the discs carry a film of wastewater into the air. Oxygen is transferred from the air to the liquid film and ultimately to the slime layer. As the discs pass through the bulk of the wastewater, mixing at the disc surface is promoted and absorption of organics occurs. As the microbial growth proceeds, a biological film is formed on the disc surface. This growth eventually sloughs off under gravity or due to the shear force generated by the rotating action. The biological film that sloughs from the disc is removed by settling before the treated wastewater is discharged.

The deep shaft system is a recent alternative to conventional activated sludge which utilizes a 100-150 m deep shaft instead of a shallow surface tank for aeration, resulting in somewhat smaller site requirements. Operational characteristics are generally similar to those for the conventional activated sludge process.

### 8.3.2 Options Evaluation

Following an initial screening, the following alternatives were eliminated from further consideration:

Conventional Activated Sludge Process;
Contact Stabilization Process;
Trickling Filter Process;
Rotating Biological Contactors;
Aerated Lagoon;
Waste Stabilization Pond; and
Deep Shaft System.

8.3 Alternative Sewage Treatment Processes (Cont'd)

The explanations for the elimination of these processes are detailed in the following paragraphs.

As noted in Environment Canada's 1980 publication, "Design and Selection of Small Wastewater Treatment Systems", total costs for the conventional activated sludge and contact stabilization processes are about 1.5 times those for the extended aeration process for plants of similar capacity to that required at Haliburton. Effluent quality using extended aeration is comparable to that for conventional activated sludge or contact stabilization and the actual operation is less complex. The contact stabilization process is also more susceptible to upsets when there is a large variation in flow passing through the plant. There are no other benefits apparent in using the alternative processes. Accordingly, the conventional activated sludge and contact stabilization processes were ruled out during the initial screening.

Total costs for the trickling filter and rotating biological contactor processes have been shown to be about 1.25 times those for the extended aeration process for plants in the size range required by Haliburton. Effluent quality using either process is comparable but operation of the extended aeration process is less complex. The fixed media system is more susceptible to upset due to shock loadings of both $BOD_5$ and total flow than is the extended aeration process. There are no other benefits apparent in using the trickling filter and rotating biological contactor processes. Accordingly, the trickling filter and rotating biological contactor processes were ruled out during the initial screening.

Aerated lagoons and waste stabilization ponds have area requirements which exceed the area of the existing site. Also, the terrain and groundwater levels at the existing site would make construction of either facility prohibitively expensive. The area within reasonable proximity (set at 1.0 km) of the Highway 121 Development does not contain a suitable site for the construction of an aerated lagoon or waste stabilization pond, due to the following:

## 8.3 Alternative Sewage Treatment Processes (Cont'd)

1. Lack of low permeability clayey silt required in lagoon or pond construction;
2. Low-lying, swampy areas;
3. Hilly terrain with outcroppings of bedrock; and
4. Proximity to cottages, prime shoreline properties and other dwellings.

Aerated lagoons and waste stabilization ponds will not be considered further in this report.

The deep shaft process has primarily been applied at full scale in the treatment of strong industrial wastes in Europe. Two (2) full scale plants are in operation treating municipal wastes in Canada ; neither of these plants are designed to achieve the effluent quality required for discharge from the Haliburton plant. Comparative cost estimates calculated at the predesign stage showed that total costs for a deep shaft process would be higher than those for the extended aeration plant. Since the potential for economic benefits was not apparent, the deep shaft process was ruled out from any further consideration.

Based on the above-noted evaluations, only the Extended Aeration process will be investigated further for the treatment facilities.

## 8.4 Environmental Evaluation Criteria

In addition to the technical merits by which alternatives must be examined, there are several environmental factors and criteria which must be considered in order to evaluate the overall impacts of the project.

The environmental factors and criteria presented in this section generally follow the suggested criteria presented in the MOE Class EA document for Municipal sewage and water projects.

## 8.4 Environmental Evaluation Criteria (Cont'd)

### 8.4.1 Aesthetics

The proposed works may have aesthetically undesirable effects or may result in obstruction to existing views during the construction period. Due to the importance of the tourism industry to Haliburton, efforts to minimize any negative effects, should be made, where possible, in selecting and implementing the preferred alternative.

### 8.4.2 Economic and Social Effects

The economic effects of any project are always important in selecting the preferred alternative with respect to the capital, operation and maintenance costs. The proposed works may promote employment and growth opportunities within the Municipality, thus resulting in positive economic and social effects.

The public's concerns and perceptions of the effects of an alternative are the social aspects which must be addressed.

### 8.4.3 Public Health

The alternatives must all provide an acceptable effluent which complies with the Ministry of the Environment effluent criteria for the particular receiving water. The design of the sewage treatment plant should follow the MOE's "Guidelines for the Design of Water Treatment Plants and Sewage Treatment Plants" in providing an acceptable effluent. The reliability of the system with respect to system failure and/or operator error should ensure that public health will not be endangered.

## 8.4 Environmental Evaluation Criteria (Cont'd)

### 8.4.4 Conflicting Land Use

The preferred solution for the sanitary sewage system should be selected to avoid undue land use conflicts. The location of the sewage treatment facility or pumping stations should be chosen to avoid conflict with existing or proposed land uses. According to the MOE guidelines, a minimum separation distance of 100 m to 150 m between the nearest dwelling or establishment and a sewage treatment facility should be maintained.

### 8.4.5 Effects on Groundwater Quality

The decision to expand the sanitary sewer servicing area or to continue servicing only the existing area may have direct impacts on groundwater quality. In cases where the water table is high around septic tile beds, or where septic tile beds are not functioning properly, there may be some danger to public health from contaminated groundwater. Polluted groundwater may also have adverse effects on nearby surface waters. A properly installed and maintained sewer system can prevent such difficulties.

### 8.4.6 Aquatic Environment

The Ministry of Natural Resources (MNR) has raised concern about the potential impacts on fisheries due to expansion of the sewage treatment plant in Haliburton. The MNR currently stocks lake trout in Lake Kashagawigamog every 2 years and the Drag River is an important habitat and spawning area for muskellunge, perch and bass.

Expansion of the sewage treatment plant may impact the local fisheries, thus all attempts should be made to minimize any adverse effects of an alternative on the aquatic environment of the lakes and river. The first concern would be the immediate effects on aquatic life resulting from the construction of an outlet sewer. Likewise, construction of any forcemain crossings underneath the Drag River would require similar considerations.

## 8.4 Environmental Evaluation Criteria (Cont'd)

A second source of concern is the long-term effects of the effluent on the aquatic life in the receiving waters. Any negative impacts on the fish population would have a significant impact on the tourism industry in the Haliburton area.

As mentioned previously, a malfunctioning tile bed system could seriously impact groundwater quality as well as adjacent surface water supplies. The impacts on aquatic life resulting from the seepage of contaminated groundwater into surface waters and the direct contamination of surface water via runoff should be considered.

The replacement of faulty septic systems with sanitary sewers would result in improved water quality, thus lessening the potential impact on the aquatic environment.

### 8.4.7 Terrestrial Environment

Effects on the terrestrial environment may occur due to the disruption of the environment during the construction period. Efforts should be made to minimize any problems associated with construction such as erosion, and noise. The degree of construction activity and disruption to the environment will vary, depending on the alternative.

### 8.4.8 Growth Potential

The growth potential of the community could be affected by the availability of an adequate sewage treatment facility. The installation of a piped sewage system for the resorts and other commercial and industrial development may increase the demand for land development within the service area, resulting in an increased population size.