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The Corporation of the Town of Bradford West Gwillimbury
Environmental Study Report
Bradford Water Pollution Control Plant WPCP Expansion

Prepared by

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Town of Bradford West Gwillimbury

The Town of Bradford West Gwillimbury has undertaken a Class Environmental Assessment (EA) Study to assess the most appropriate alternative to provide increased wastewater treatment capacity to facilitate approved urban growth. The Town's current Official Plan (Office Consolidation to October 1, 2002) was approved by resolution of the Ontario Municipal Board, dated May 30, 2002. The problem statement for this Class EA is as follows:

"The Town of Bradford West Gwillimbury requires additional wastewater treatment capacity to meet the projected sewage flows from intensification and new developments within the service area as defined by the approved Official Plan."

Under the approved OP, the Urban Service Area of Bradford West Gwillimbury is expected to grow to 38,800 persons by the year 2026. By comparison, the estimated population of the Urban Service Area in 2001, based on census data, was 16,352 persons.

The Town completed a Master Servicing Study (MSS) in January 2003, as required by the Official Plan. The MSS met the requirements of Phases 1 and 2 of the Class EA and recommended completion of an Environmental Study Report for wastewater treatment in order to satisfy Phases 3 and 4 of the Class EA. No objections or appeals of the MSS were received with respect to the wastewater treatment projects identified in the Master Plan.

A Public Information Center (PIC) was held on January 26, 2005, at the Town's Treasury Building. The PIC was held in an "Open House" format, including posters and handouts, and provided the opportunity to convey information to the public and receive comment and input for completion of the ESR. Included in the material was identification of the preliminary preferred servicing alternative to provide additional sewage treatment capacity for the Town. An information handout was made available to attendees of the PIC and it was also circulated to Provincial ministries, government agencies, municipalities and interested individuals, some of these identified in Section 1.5 and as noted on the study contact list provided in Appendix A.

Copies of all correspondence received have been included in Appendix A. Respondents comments generally fell into three key areas focusing on environmental, site development and the recommended treatment process. These comments have been taken into consideration and have been addressed in the preparation of the ESR.

Existing Water Pollution Control Plant (WPCP)

Drawing G1 provides an overview of the current site conditions and WPCP layout. The plant is located generally in an industrial/agricultural area, between existing developments to the west and the West Branch of the Holland River to the east. Treated effluent from the WPCP is discharged to the river through an outfall and open channel. The Town owns approximately 33 ha on which the present plant is sited.

The Holland Marsh Provincially Significant Wetlands (PSW) is located north and east of the plant. The designated 120 m planning buffer crosses through the Bradford WPCP property in the vicinity of the outfall channel and part of the original treatment lagoons. No works within the planning buffer are proposed at this time. Existing residences are located west of Dissette Street, which is at least 150 m from the WPCP site. A proposed residential infilling property, west of Dissette Street, is located within 85 m of the WPCP property at its closest point. Given the area available for future works on the WPCP property, the proper siting of future tanks and buildings can be designed to meet the MOE guideline of providing a minimum 100 m separation, or the preferred separation distance of 150 m.

Existing and Future WPCP Flows

Based on the corrected effluent flow meter readings, the WPCP currently treats about 66 percent of its rated average daily flow of 8,870 m^3/day. An analysis of influent and effluent meter readings combined with site inspections determined that the four-year average influent flow between 2000 and 2004 was found to be 13 percent to 17 percent greater than the average effluent flow. Investigations concluded that backwater conditions, adversely affects the accuracy of the influent flow meters. Therefore it is recommended that effluent meter readings be used to document average plant flows. Improvements in flow metering will be incorporated into the recommended plant expansion alternative.

It is noted that the average per capita flow between 2000 and 2004 based on effluent meter readings is 318 L/person/day compared to approximately 450 L/person/day, which was the design basis for the last plant expansion in 1998, and 369 L/person/day based on average flows recorded between 1996 and 2001. This reduction in per capita flow contributes, in part, to a greater uncommitted unit capacity within the existing Plants ‘B’ and ‘C’ than previously calculated. It is estimated that approximately 900 equivalent residential units may be accommodated in the existing facilities up to the WPCP current rated capacity. Future WPCP average daily flows generated by the future population of 38,800 persons and the industrial, commercial and institutional areas referenced in the approved Official Plan are expected to reach 17,400 m^3/day, as shown in Figure 7.1.

Existing WPCP Operation and Performance

The WPCP performance records indicate that the plant has consistently met the effluent compliance limits and has generally met the objective limits. However, it is expected that as wastewater flows increase to the level of the current Certificate of Approval, the phosphorous treatment and ammonia-nitrogen treatment processes will approach their capacity. With further chemical addition and filter operation optimization, above what has been achieved recently, the objective limits for phosphorous are expected to be attained. Plant B nitrification capacity (for average flows) and the secondary clarifier capacity (for peak flows) will limit the capacity of Plant B. Therefore, in order to consistently meet ammonia discharge objectives, it is recommended that Plant B be de-rated by approximately 33 percent, in conjunction with the implementing the preferred wastewater treatment alternative.

Holland River Assimilative Capacity Study and Benthetic Invertebrate Study

Early consultation with the LSRCA and the MOE confirmed that a desktop assimilative capacity study (i.e. assessment of river flow quantities and water quality parameters) and a benthic invertebrate study of the Holland River (i.e. classification of collected aquatic insects and bugs found in and near the river bed) were required to support this ESR. The results of these studies determined that the present water quality of the river (receiver) is impaired. Water quality indicators show that under present conditions, there are no discernable water quality impacts attributable from the WPCP on the Holland River, upstream or downstream of the WPCP outfall. The river was determined to be a MOE Policy 1 (must meet provincial water quality objectives- PWQO) receiver with respect to *E.coli* and un-ionized ammonia (although there were individual months where Policy 2 would apply). The river was also found to be a MOE Policy 2 (does not meet PWQO, but cannot worsen water quality) receiver with respect to total phosphorous.

From an assimilative capacity perspective, the critical water quality parameters under future conditions are un-ionized ammonia and total phosphorous. Significant reductions in effluent limits below current levels would be required to comply with MOE Policies and Objectives (0.11 mg/l for total phosphorous and 0.3 mg/l for total ammonia). However, it is recommended that reasonable and achievable effluent limits, particularly with respect to total ammonia be implemented.

Historically, the WPCP has had a phosphorous load limit (cap) of 2.046 kg/day. The MOE established a lower Certificate of Approval phosphorous limit as a product of the design flow (proposed during the Plant C expansion) and the proposed effluent concentration and did not consider assimilative capacity studies or provincial Water Quality Policies. The full LSRCA load allotment was not reflected in the Certificate of Approval because it was simply not needed at that time. The Official Plan future population of 38,800 persons was prepared on the basis of the historical phosphorous load limit being available to the Town. The MSS was also advanced, on this basis, following adoption of the OP.

Proposed Future Effluent Criteria

The proposed effluent criteria consists of the following key elements, with respect to ammonia and phosphorous limits:

- The future effluent criteria for warm-weather months should be reduced to 0.8 mg/l. This figure is greater than the 0.3 mg/l determined from the assimilative capacity study and is approximately the lowest economically achievable concentration which can be consistently attained. It represents a substantial reduction over currently approved limits and meets new Federal guidelines for release of ammonia. Similarly, a winter effluent criteria of 2.5 mg/l total ammonia is proposed, slightly higher than the level recommended by the assimilative capacity study, for reasons of practical feasibility. Again, this represents a net improvement over the currently approved conditions.

- In the case of the reduced phosphorous requirement, a compliance limit of 0.11 mg/l is proposed and is considered aggressive, but achievable, using existing technology in conjunction with an optimized process control. The resulting loading associated with the proposed future flow rate is estimated to be1.91 kg/day, compared to the current loading cap of 2.046 kg/day, which represents a 6 percent reduction.

Selection of the Preferred Sewage Treatment and Disposal Concept

A range of evaluation criteria was established to provide a basis for comparison of sewage treatment alternatives. Four planning-level alternatives were identified in the 2003 MSS document and the preferred planning approach, involving expanding the existing plant on lands owned by the Town, is confirmed in this ESR. Other options considered, but not recommended, including pumping sewage to York Region for treatment at a facility in Durham Region, and establishing a new WPCP in either Green Valley or further southwest of the Bradford Urban Area, in the vicinity of the 5th Line and the 5th Sideroad.

Four design alternatives were considered for expanding the existing WPCP. These include conventional activated sludge (CAS) treatment, membrane bioreactor (MBR) technology, extended aeration (EA) and sequential batch reactor (SBR) technology. The following table is a summary of present worth cost estimates for the four alternatives, assuming a two-phase approach to construction (i.e. Phase 1 expansion in 2007 and Phase 2 expansion in 2016):

	Conventional Activated Sludge Treatment (CAS)	**Membrane Bioreactor (MBR)**	**Extended Aeration (EA)**	**Sequential Batch Reactor (SBR)**
Present Worth Capital Cost	$24.6 M	$26.1 M	$20.5 M	$22.3 M
20 Year Life Cycle Operational and Maintenance Costs	$25.8 M ($1,290 k annual average)	$28.9 M ($1,445 k annual average)	$22.9 M ($1,145 k annual average)	$23.1 M ($1,155 k annual average)
Total 20 Year Life Cycle Cost	**$50.4 M**	**$55.0 M**	**$43.4 M**	**$45.4 M**

Table 4.2 in the ESR summarizes the advantages and disadvantages of each alternative. The extended aeration alternative is recommended as the preferred design alternative for expanding the WPCP to provide the capacity for growth to 38,800 persons as provided for in the Town's approved Official Plan. Key factors in this determination include:

- Extended aeration is relatively simple to operate and control compared to other technologies that require highly computerized control systems or have proprietary components or controls

- Extended aeration has the ability to easily treat Bradford's variable flow conditions and has a long historical record of being able to provide the necessary nitrification capacity to consistently meet very stringent ammonia effluent criteria

- It is the most well understood and, arguably, one of the most widely adopted secondary treatment technologies in southern Ontario

- Extended aeration technology has the ability to be customized or retrofitted for potential future conversion to CAS technology, simply through the construction of primary and additional secondary clarifiers and conversion to anaerobic sludge digestion

- The present worth capital cost is approximately 20 per cent less to expand the plant using extended aeration, compared to CAS, and almost 10 percent less than SBR technology

- The operational and maintenance costs for extended aeration are marginally lower than SBR technology on a 20-year life cycle cost comparison.

Recommended Projects

The ESR documents in detail the recommended approach to expanding the existing WPCP in two phases, which are shown on Figure G2. This involves construction of new Headworks that would be sized to convey all incoming flow and provide preliminary treatment, and include suitable controls to measure and direct the flow to the various treatment Plants B, C, and D. New aeration and secondary clarifiers would be required as part of Plant D construction. The construction of additional tertiary filters and ultraviolet disinfection capacity, by expanding the existing filter/UV building, is also proposed.

New aerobic digesters will be constructed to provide biosolids treatment capacity for waste sludge generated by Plants C and D. In 2004, the Town issued a design-build tender in order to fully upgrade the Plant A tanks to a new multi-stage aerobic digester. Bids received indicated that the cost to fully upgrade Plant A is expected to be $1.5-2 million, much greater than previously estimated. In view of the high cost, age of this facility and limited return on investment, it is recommended that some incremental modifications, rather than a complete overhaul of Plant A, be carried out in the near future and the sludge from Plant C be transferred to Plant D. There would be some cost savings by not proceeding with the full conversion of Plant A to a conventional aerobic digestion process and in transferring the sludge from Plant C to Plant D. A covered tank would be provided for storage of stabilized sludge.

Environmental Mitigation Measures

The ESR outlines various measures to ensure any potential environmental or social impacts are mitigated to acceptable levels as the WPCP projects advance to detailed design and construction phases. Specifically, these relate to ensuring there is no loss of nearby wetland form or function and that there is adequate separation from nearby residential land uses. In addition, drainage, access, traffic, odour and noise considerations have been considered. It is anticipated that any environmental effects related to these issues can be readily mitigated and they would be temporary in nature, generally occurring during the construction period.

The performance of the expanded WPCP in terms of treating wastewater will be monitored and documented in accordance with requirements of the Ministry of the Environment. This includes influent and effluent wastewater sampling, sludge measurements and testing during digestion, storage and hauling operations. Although, the benthic invertebrate sampling and testing carried out as part of this ESR has indicated poor water quality in the Holland River, under existing conditions, it does provide a benchmark for future reference of any potential changes in the water quality. The MOE, as the regulating authority, will outline the testing and monitoring requirements for the expanded WPCP as part of a new Certificate of Approval that will be required prior to construction.

1.0 Introduction

The Town of Bradford West Gwillimbury is located southwest of Lake Simcoe and along the northwest shoreline of the West Holland River in the southern half of the County of Simcoe. The center of the urban area is situated at the intersection of Holland Street West (formerly Highway No. 88) and Barrie Street (formerly Highway No. 11 or Yonge Street). The municipal boundaries extend from one concession west of County Road 27, to the west branch of the Holland River in the east and from half way between the 13th and 14th Lines in the north to the Holland Marsh in the south, as indicated in Figure 1.1. The Town is accessible from Highway No. 400 via County Road 88, from the City of Barrie via Simcoe Road 4 and from the Town of Newmarket via York Region Road 1. The community of Bond Head is located within the Town of Bradford West Gwillimbury at the intersection of Simcoe Road 27 and Simcoe Road 88.

1.1 Approved Official Plan

The Town of Bradford West Gwillimbury's current Official Plan (OP), which was approved by the Ontario Municipal Board on May 30, 2002, provides the framework for the growth expected in the municipality over 25 years, between 2001 and 2026. Two of the main purposes of the OP are:

- To provide a blueprint for future land uses and physical development, and to
- Establish a structure for evaluation and review of municipal works and private development applications.

Under the OP, the Town of Bradford West Gwillimbury is expected to grow, on a Town-wide basis from 20,200 (1996 population estimate) to 47,800 by 2026. The Town's 2001 census population is recorded as being 22,228. The OP identifies a specific urban service area within the municipality and it consists of an envelope of development around the existing urban community, as shown in Figure 1.2. The OP projects that the population of the urban service area is expected to grow from 15,000 (1996) to 38,800 by the year 2026. The estimated urban service area population in 2001 based on census data was 16,352.

Five "Community Areas" within the expanded urban envelope are identified in the OP and these areas are subject to further refinement in the form of Secondary Plans completed through the Planning Act. Included in the secondary plan process is the preparation of Functional Servicing Reports. To date, the Secondary Plans, or "Community Plans" for Areas 2 and 4 are complete, with the Plan for Community Area 3 in process.

The OP requires that development within the five Community Plans take place on full municipal services (i.e. water supply, wastewater collection and treatment, roads, etc.).

The growth anticipated in the community of Bond Head will be required to connect to the existing municipal water system, which was extended 5.8 km from the existing urban area to Bond Head. However, new development will be required to provide a community-based wastewater treatment facility, separate from services in the existing urban development area.

1.2 Master Servicing Study

A Final Master Servicing Study (MSS) was completed by R. J. Burnside & Associates Limited (Burnside) on behalf of the Town of Bradford West Gwillimbury in January 2003, in support of the approved Official Plan. The MSS was prepared as a Master Plan within the context of the Class Environmental Assessment (EA) requirements meeting the first two phases of the public consultation and review process. The MSS identified stormwater management, water distribution, wastewater collection and treatment and transportation servicing alternatives for the expanded urban area. The preferred alternatives were recommended based on an integrated approach to servicing the five individual but related community plan areas. Over 70 Schedule B servicing projects were identified.

The wastewater treatment solution was identified as a Schedule C activity within the Class EA process, which triggers the need for this Environmental Study Report (ESR) and completion of Phases 3 and 4. This ESR will document the process followed to date, the planning solution recommended in the MSS and recommend a preferred design alternative for implementation at the detailed design phase. Details of the alternative evaluation are provided in Section 4.

1.3 Problem Statement

"The Town of Bradford West Gwillimbury requires additional wastewater treatment capacity to meet the projected sewage flows from intensification and new developments within the service area as defined by the approved Official Plan."

The Official Plan identifies a future serviced residential population of 38,800 persons, an increase from the current serviced population base of approximately 18,400 persons. It is estimated that in order to meet the servicing needs associated with this growth, a wastewater treatment capacity of 17,400 m^3/day is required. With an existing rated wastewater treatment capacity at the Bradford Water Pollution Control Plant (WPCP) of 8,870 m^3/day (existing Plant B and Plant C), the Class EA is being conducted to identify the preferred approach to providing the additional treatment capacity.

1.4 Class Environmental Assessment (EA) Process

The planning of major municipal infrastructure projects or activities is subject to the Environmental Assessment (EA) Act, R.S.O. 1990, and requires the proponent to complete an Environmental Assessment. The Municipal Class EA process was developed by the Municipal Engineers Association, in consultation with the Ministry of the Environment (MOE), as an alternative method to Individual Environmental Assessments for recurring municipal projects that were similar in nature, usually limited in scale and with a predictable range of environmental effects, which were responsive to mitigating measures. Therefore, the Class EA is a streamlined, self-assessment planning procedure developed to ensure that potential social, economic and natural environmental effects are considered during the planning of municipal projects. The Class EA solicits input and approval from regulatory agencies, the municipality and the public at the local level. This process leads to an evaluation of the alternatives in view of the significance of environmental impacts and the choice of effective mitigation measures.

A flow chart prepared by the Municipal Engineers Association to document the Class EA procedure for municipal water supply projects is included as Figure 1.3. The procedure is broken down into five phases as summarized below:

Phase 1	Identify problem or deficiency
Phase 2	Identify alternative planning solutions to problem and select preferred alternative
Phase 3	Identify alternative methods of implementing the preferred solution
Phase 4	Prepare an Environmental Study Report (ESR) and post it for a 30-day period for review by the public and approving agencies
Phase 5	Monitor construction and implement activities.

There are three categories of assessment within the Class EA procedure dependent on the complexity and potential for environmental impact. These classifications are outlined as follows:

Schedule A – Projects having negligible impacts, are approved and do not require evaluation past Phase 1.

Schedule B – Projects with modest impacts are approved subject to a defined screening process and require the proponent to complete the project up to the end of Phase 2.

Schedule C – Projects with significant impacts that require the full planning and documentation procedures (Phase 1-5) as specified above.

Projects classified as Schedule A or Schedule B only requires completion of the first two phases of the procedure. A Schedule C requires all five phases of the Class EA process to be completed, including the preparation and public review of the Environmental Study Report.

The Municipal Class EA also provides an opportunity for any member of the public or agency to request the Minister of the Environment to order a Class EA project to become subject to an Individual Environmental Assessment. This is known as a Part II Order (or "bump-up") request and is made in certain circumstances where concerns are unresolved during the Class EA planning process.

This Municipal Class EA is considered a Schedule C project and projects classified as a Schedule C activity have the potential for significant impacts, and required the completion of all 5 phases of the Municipal Class EA procedure. Following the Class EA process and the subsequent detailed design, project plans and specifications would be submitted to the Ministry of Environment for a Certificate of Approval (C-of-A). This report satisfies Phases 3 and 4 of the Municipal Class EA process.

1.5 Public Participation

As part of the formal Municipal Class EA procedure, graphically depicted in Figure 1.3 public information centers (PIC's) have been held to keep the public informed of the process and allow for public involvement in the selection of a preferred alternative. Figure 1.4 provides a summary of the process completed to date, including public consultations made during the Master Servicing Study process. In summary, a Notice of Commencement, two Public Information Centers and a Notice of Completion were provided as part of the MSS. Public input in the form of feedback from PIC's and written correspondence was received and incorporated into the MSS. However, no specific comment or input was noted with respect to wastewater treatment aspects of the MSS.

Public involvement is an important and vital part of the environmental assessment process. Please refer to Appendix A, for all correspondence pertaining to this Municipal Class EA process.

The following list of Municipalities, regulatory agencies, School Boards and Ministries form the circulation list for this Town of Bradford West Gwillimbury Class EA. Other individuals or firms in addition are noted on a respondents list (also included in Appendix A) for notification of the status of the study.

Municipalities

- County of Simcoe
- Region of York
- Town of Innisfil
- Town of East Gwillimbury

- Town of New Tecumseth
- Township of King.

Conservation Authorities

- Lake Simcoe Region Conservation Authority (LSRCA)
- Nottawasaga Valley Conservation Authority (NVCA).

Ministries

- Ministry of the Environment (Approvals Branch, West Central Region Office, Barrie District Office)
- Ministry of Natural Resources
- Ministry of Transportation
- Ministry of Municipal Affairs and Housing
- Ministry of Public Infrastructure Renewal.

School Boards

- Simcoe County District School Board
- Simcoe Muskoka Catholic District School Board
- Service de la planification - Conseil scolaire de district catholique Centre-Sud
- Conseil scolaire de district du Centre-Sud Quest.

Other

- Go Transit.

2.0 Existing Conditions

2.1 Natural, Social, and Economic Environment

2.1.1 Physical Setting and Land Use

The urban area of the Town of Bradford West Gwillimbury is located generally on slopes rising from the north side of the Holland Marsh. The westerly and northwesterly portions of the community are found on tableland along the northeast end of the marsh. The elevation difference from the marsh level to the table lands ranges from 45 m in the south to over 60 m in the north. Average slopes across the community towards the marsh are in the range of 2 percent to 6 percent. The lands surrounding the present urban area are generally agricultural in nature, and the majority of the area has been cleared for planting crops or pastureland.

2.1.2 Surface Water Resources and Characteristics

2.1.2.1 Description

Surface drainage within the municipality is split between the Nottawasaga River watershed and the Lake Simcoe watershed. The existing and future urban areas are located in the easterly portion of the Town within the Lake Simcoe watershed. Surface runoff enters the primary drainage feature in the south, the West Branch of the Holland River, which flows from the west to the northeast around the Holland Marsh and outlets to Cooks Bay on Lake Simcoe. Figure 2.1 shows the regional surface drainage system and a substantial portion of the Holland River (West Branch) drainage system. The majority of the river's drainage area exists upstream of the Bradford Urban Area.

The Holland Marsh makes use of the water available from the river for irrigation purposes. The river upstream of the marsh has been diverted around the marsh into the North Canal and the South Canal. The two canals combine downstream of the marsh just west of Bridge Street/York Region Road 1. A center canal (old river) collects runoff from the marsh and is pumped out of the low lands and into the river at the confluence of the two canals. From discussions with the Lake Simcoe Conservation Authority (LSRCA), it is recognized that flow reversals in the Holland River downstream of the marsh may occur during periods of dry weather conditions combined with high irrigation demands from the North and South Canals.

Figure 2.2 shows the Town's topography and the location of the Holland Marsh Wetland and the Fraser Creek Swamp (both are Provincially Significant Wetlands), Areas of Natural and Scientific Interest (ANSI) and the Simcoe County Greenlands. The feature closest to the WPCP is the Holland Marsh Wetland. Also shown are major stormwater drainage areas on the Lake Simcoe-side of the watershed divide. Surface drainage within the existing and approved urban growth areas flows in three general directions:

- Across slopes mentioned above to the east and southeast, entering the West Branch of the Holland River, through features including the North Tributary and the Morris Road Canal
- From approximately the west edge of existing development to the southwest in a feature referred to as the "west tributary" and other tributaries of the Fraser Creek Swamp system
- From approximately half way between the 8th and 9th Lines to the north, drainage outlets to the Scanlon Creek, which flows to the West Branch of the Holland River.

2.1.2.2 Flow Rates

Eleven years of flow data (1982 - 1992) for the West Holland River at Bradford (Yonge Street Hwy 11 bridge) was obtained from a gauge station formerly operated by Lake Simcoe Regional Conservation Authority. Note that the gauge incorporated a flow direction switch that would correct logged daily flows for any periods of reverse river flow.

The average flow rate for the River based on historical data is about 2.1 m^3/s. Average flow rates by calendar month range from 0.65 m^3/s (July) to 6.33 m^3/s (March). Flow rates are generally lowest in summer and highest in spring during the snowmelt, as is typical of southern Ontario rivers.

Flow rates during extended dry periods, which are critical to dilution of WPCP effluent and assimilative capacity of the receiver, are typically quantified by estimating the "7Q20" flow from historical data. The 7Q20 flow can be described as the 7-day average low flow extreme that can statistically be expected to return once in 20 years. The estimated 7Q20 flows analyzed by calendar month range from 0.15 m^3/s (September) to 1.02 m^3/s (April). June, August and September demonstrate the lowest historical flow rates, offering the lowest river flow for the purposes of dilution and assimilation of WPCP effluent

More detailed results of historical flow analysis are included in the assimilative capacity study presented in Appendix F.

2.1.2.3 Water Quality

The background water quality of the receiving stream (the West Holland River) is important in assessing how much additional contamination (if any) the River can accept without an unacceptable environmental impact occurring as a result. A relatively clean river may be able to accept substantial amounts of treated sewage without harm being caused, whereas a River that is already stressed with contaminants may only be able to accept a small amount of additional contaminants before negative impacts start to occur.

Eleven years of water quality data (1985 – 1995) for the West Holland River immediately upstream of Bradford (Yonge Street Hwy 11 bridge) and downstream (below the confluence with the East Holland River) were obtained from the MOE Provincial Water Quality Management Network (PWQMN) and reviewed to gain an understanding of the background river quality.

Generally, the water quality data indicates the River is impaired both upstream and downstream of Bradford when compared to Provincial Water Quality Objectives (PWQO's). There are elevated levels of nutrients (such as phosphorous and ammonia), relatively high pH (averaging about 8), elevated levels of coliform bacteria, and high-suspended solids. The water is characterized as shallow, warm and slow moving.

The West Holland generally appears to be a poor quality river and fish habitat, both upstream and downstream of Bradford regardless of any contribution of contaminants from the Bradford WPCP.

PWQO's have been established by the MOE for some water contaminants to provide guidance in making water quality management decisions. The PWQO's also serve to designate the limit for a parameter beyond which the water quality should not be degraded any further. The PWQO for phosphorous is 0.03 mg/L (rivers), and for un-ionized ammonia it is 0.02 mg/L. The *E.coli* limit is 100 counts per 100 ml.

In order to achieve good water quality, two policies were developed by the MOE:

- Policy 1, where surface water quality is better than the PWQO, and
- Policy 2, where existing surface water quality does not meet the PWQO's.

The Policy 1 guideline states that water quality shall be maintained at or better than the PWQO. For Policy 2 situations, the water quality may not be degraded further.

Normally, the 75th percentile value of a historical set of water quality data is used to assess the quality of the River against the PWQO. It is the concentration level that is exceeded in the River no more than 25 percent of the time.

Based on the historical data and the above noted criteria, the West Holland River is interpreted to be Policy 2 for phosphorous year-round, as the 75th percentile concentration for all months of the year exceeds the PWQO of 0.03 mg/L, both upstream and downstream of the WPCP outfall.

A review of the historical data also reveals that un-ionized ammonia meets the PWQO objective of 0.02 mg/L for most months of the year, except for July. The months of June and August are also very close to approaching the PWQO limit. Therefore, the Holland River is considered a Policy 1 receiver for un-ionized ammonia except July.

Historically, the background water quality at times exceeds the PWQO of 100 counts/100ml (July and November). For this parameter, the West Holland is considered Policy 1 for *E.coli* for every month except July and November, where it would be designated Policy 2.

2.1.2.4 Benthic Invertebrate Study

Benthic invertebrates are small animals without backbones that live on the bottom of streams and lakes. They are worms, crayfish, snails, and the larvae of many flying insects such as dragonflies and caddisflies. They are considered to be good indicators of aquatic ecosystem health because: they tend to remain within a small geographic range throughout their life span; they show variations in tolerances to water conditions; and, they integrate the effects of all pollutants and overall environmental conditions.

As requested by the MOE in commencing this phase of the EA, a study of the benthic-invertebrate communities in the receiving watercourse was conducted, with the intention of using the results to both characterize the existing water quality in the West Holland River and to aid in establishing new effluent criteria for the expanded WPCP. This study was conducted in Spring of 2004 by Tarandus Associates Limited. Samples of benthic invertebrates were collected in April 2004 at five stations in the West Holland River in the vicinity of the Bradford WPCP discharge (outfall) channel and at one station located approximately 1.75 km upstream of the plant outfall in accordance to the collection methods defined in the BioMAP protocol. A copy of the Tarandus report is presented in Appendix E. Key findings of the study are as follows:

- BioMAP results suggest that the water quality in all stations observed is "**impaired**". There is no apparent difference in water quality among the five stations at the WPCP discharge channel nor is there any difference in water quality between that group of stations and the one further upstream

- The results of the survey suggest that the main sources of water quality impairment is organic in nature.

Although the water quality of the West Holland is impaired, there is no indication that this condition is associated with the operation of the Bradford WPCP.

2.1.3 Biological Resources

The existing water pollution control plant is located southwest of the Holland Marsh Wetland. The Holland Marsh Wetland is located within an Environmentally Significant Area (ESA), as shown in Figure 2.2. The wetland complex is identified as a Class 1 Provincially Significant Wetland (PSW). The form and functions associated with this feature are:

- Groundwater recharge and discharge areas
- Significantly large enough to provide wildlife habitat
- Includes rare or endangered species
- Provides natural corridor linkage
- High diversity of species.

Operation, modification and/or expansion of the WPCP are to be carried out in such a way that adverse impacts are not imposed on the ESA. Any works proposed within a 120 m buffer distance from the boundary of an ESA are subject to specific study of the ESA and potential impacts from loss of habitat or disruption of the form or function of the ESA. The limit of the 120 m distance from the ESA is located about 40 m east of the existing filter building however, it crosses the easterly portion of the existing aerated sludge and storm surge pond, as shown on Drawing G1. The discharge/outfall channel from the WPCP is within the 120 m buffer distance from the ESA.

2.1.4 Groundwater Resources and Water Supply

The Town presently obtains its supply of drinking water from groundwater sources. The water system is comprised of seven groundwater wells and pumping facilities, two water storage standpipes, one water booster station, one re-chlorination station and a piped distribution system.

A Water Master Servicing Plan Addendum Class EA was completed in September 2003 and stated that the water demands from future growth identified in the OP will exceed the available supply. The preferred servicing alternative identified in the EA is to connect to the lake-based treatment plant at Alcona in the Town of Innisfil. An inter-municipal agreement has been reached on a number of related projects involving the water supply program and the infrastructure is presently being designed to begin construction in 2005. As part of this program, the current chlorination procedures for the groundwater-based system will be converted to a chloramination process in order to be compatible with disinfection procedures used at the Alcona water treatment plant. Introduction of the lake-based water supply may have an incremental impact on the characteristics of sewage (hardness, alkalinity, pH, etc.).

2.1.5 Social and Economic Environment

The Town of Bradford West Gwillimbury originated in the early 1800's as one of a number of small settlements formed in the Township of West Gwillimbury. Bradford was incorporated as a village in 1857 and subsequently incorporated as a Town in 1960. In 1991, the original Township and the Town were amalgamated as the Town of Bradford West Gwillimbury.

Although the Town has diversified and attracted a wide range of residents, businesses and industry, the Holland Marsh continues to define the overall character of this agricultural community. Based on the direction of the current OP, the Town's goal is to create new and inviting urban spaces which will accommodate growth while preserving the Town's history and function as an agricultural center through:

- Defining distinct boundaries for the Bradford Urban Area (BUA) to preserve the function of the Holland marsh and adjacent prime agricultural lands
- Planning for mixed land uses in the BUA which will accommodate growth and promote self sufficiency in terms of local employment
- Promoting innovative methods of infilling and intensifying suitable locations within the existing urban area including redevelopment and expansion of the commercial core through improved use of existing infrastructure
- Preserving and beautifying the downtown core
- Protection and enhancement of the natural environment as a factor in making land use decisions.

2.2 Serviced Area of Bradford West Gwillimbury

The existing urban area as shown in Figure 1.2 occupies about 570 ha (excluding open space). The location of the residential and non-residential land uses are shown on the figure. Of the non-residential land uses, the industrial, commercial and institutional area breakdown is estimated to be 55 percent, 37 percent and 8 percent respectively. As mentioned in section 1.1, the 2001 urban serviced population is estimated to be 16,352 persons.

Based on water records obtained from the Town, three industrial and two commercial sites were considered to be high water users and therefore, sources of high volumes of wastewater. The industries are associated with the agricultural business and the commercial sites involved laundry and car washing facilities. The average of these high volume users is about 70 m^3/ha/day compared to the average of the remaining users sampled at 2.4 m^3/ha/day. A “blended” non-residential water consumption rate of 4.6 m^3/ha/day was determined from the properties sampled. The MOE recognizes that non-residential and especially industrial land uses can generate a wide variation in the amount of wastewater for many reasons including the nature of the industry, whether water conservation or re-cycling is practiced or water export from the property is carried out. A summary of the water records sampled is provided in Appendix G.

2.3 Wastewater Characteristics

2.3.1 General

The WPCP operations staff maintain detailed records of flow, sample collection, and sample analysis results. Summaries of these data are presented in Appendix C. Data is trended and process statistics are used as required to make operational adjustments. Flow metering equipment is calibrated on an annual basis. Other online, process and other supporting analytical equipment is maintained and calibrated in accordance with recommended standards. It is recognized that this data is vital to proper operation of the WPCP in order to minimize operational costs while maximizing performance to meet MOE effluent criteria.

Plant operating data and other relevant statistics generated in this ESR are based on the period January 2001 to November 2004. Selected data trends spanning this period are presented and shown graphically in Appendix C.

2.3.2 Wastewater Flow

Table C.1.1 in Appendix C summarizes raw wastewater (influent) sewage flows measured by two Parshall flumes located at the Division Structure, which receives all raw sewage before treatment at the Bradford WPCP. In general, daily influent flows have been relatively steady over the past four years, averaging between 6,182 m^3/d to 6,616 m^3/d, on an annual basis. On average, this is approximately 72 percent of the current C-of-A WPCP rating of 8,870 m^3/d for Plants B and C. The maximum day recorded during the same period was 12,885 m^3/d. Measurement of influent flow is an important operational tool and can also be used in evaluating peak flow factors and per capita flows, assuming that conditions permit error free recording of flow data.

Table C.2.1 in Appendix C presents a summary of treated effluent flows measured by an electromagnetic flow meter located in the Filter/U.V. Disinfection Building. Measured daily effluent flows averaged between 5,359 m^3/d and 5,829 m^3/d, on an annual basis, or roughly 66 percent of the current C-of-A rating. The maximum day recorded during the same period was 11,315 m^3/d.

Effluent flow, which represents the total flow discharged to the Holland River, should under ideal conditions, be statistically similar to influent flow to the WPCP, with the noted exception that effluent flow should be approximately 0.5 percent lower than influent flow due to biosolids wasting. However, based on the above observations and as shown in Table C.3.1 in Appendix C, influent flow is historically higher than effluent flow by about 13-17 percent, which is also consistent with previous observations. Given the relative precision and accuracy of these flow measurement instruments, there should be no difference between the two flow data sets, which suggests other factors are affecting flow measurement accuracy.

To further evaluate this discrepancy, the Town engaged the services of XCG Consultants Ltd. (XCG) to conduct an investigation of flow measurement at the Bradford WPCP. The work was completed in April 2004. A technical memorandum presenting the findings of this study is presented in Appendix D. Key findings of the study are as follows:

- The influent flow metering Parshall flume installations do not conform to a standardized configuration and would require in-situ calibration to improve accuracy if free flow conditions were achievable

- The discharge chamber arrangement and associated hydraulic backwater condition impedes the discharge from the flumes creating a submerged flume flow condition. All flow measurements collected when submerged will have an associated error, as flows would be recorded as higher than actual (as observed)

- Significant modifications, including physical changes to the Division Structure, would be required to correct the current deficiencies. Since the proposed expansion of the Bradford WPCP includes a new Headworks with improved flow control and monitoring, influent flow measurement will be incorporated into the new works.

Based on the above noted observations and evaluation of historical flow records, the use of plant effluent flow meter data for the reporting of WPCP flow, evaluating per capita sewage flow, calculating unit capacity and estimating effluent loadings to the Holland River is recommended. Certified calibrations of the plant effluent flow instrumentation ensure that the instrumentation is operating properly, and the current configuration of the effluent flow metering station lends itself for more accurate flow determination.

Table C.2.1 in Appendix C presents the estimated per capita sewage flow based on effluent flow, serviced population and the number of water permits issued between 2001 and 2004. Per capita flow over this time period averaged approximately 318 L/person/d. This is significantly lower than previously reported values:

- As per the MSS, the analysis of historical data spanning period 1996 to 2001 yielded a per capita flow of 369 L/person/d

- Previous expansion of WPCP to a rated capacity of 11,146 m^3/d was based on a design per capita value of about 450 L/person/d.

The general reduction in per capita sewage flow can be attributed to a number of factors including the use of more accurate flow measurement (as discussed above), reductions in Infiltration/Inflow, reductions in individual water consumption and a levelling off (or reduction) of industrial based flows relative to residential flows. The reduction offers the Town the opportunity to realize an increase in uncommitted capacity even with the reduction in the rated treatment capacity of the WPCP.

2.3.3 Influent Wastewater Quality and Loadings

Table 2.1 presents the historical annual average raw wastewater (influent) sewage characteristics. In general, the data appear normally distributed without measurable bias or significant variations from year to year. A more detailed summary of these data is presented in Section C.1 in Appendix C.

The concentrations of key parameters including BOD_5, (5-day biochemical oxygen demand), TKN (total kjeldahl nitrogen) and TP (total phosphorous) were marginally lower than typical domestic wastewater characteristics (MOE, 1984), whereas the concentration of TSS (total suspended solids) was higher. This suggests sewage concentrations entering the Bradford WPCP are not characteristic of dilute wastewater strength typical of collection systems with significant inflow/infiltration. Industrial contributions, notably food-processing related, are likely contributing to the marginally elevated TSS concentrations, even though these sources produce a relatively small portion of total flow to the WPCP.

Table 2.1 Summary of Influent Wastewater Characteristics

Year	BOD_5 (mg/L)	TSS (mg/L)	TKN (mg/L)	TP (mg/L)
2001	156	173	27	4.4
2002	137	265	27	4.4
2003	182	219	28	4.0
2004	149	199	26	3.7
Average	156	214	27	4.1
Domestic Wastewater (MOE 1984)	170	200	35	7.0

Historical loadings of key wastewater parameters to the WPCP were reviewed. A detailed summary of these data is presented in Section C.1 in Appendix C. Figures C.10 and C.11 in Appendix C present the historical monthly average loadings of BOD_5 and TSS to the

WPCP. Data indicate significant monthly loading variations, which may be partially the result of the current operation of the collection system, variations in contributions from industrial sources or raw wastewater sampling frequency.

Table 2.2 presents a summary and a statistical analysis of the historical loading data to the WPCP for the key pollutants. To account for the observed historical loading variation and the anticipated increase of average loadings to the WPCP in the future, the historical 80th percentile loadings, shown graphically in Figure C.13 found at the end of Appendix C, are used to provide a conservative estimate of the per capita loadings as the mean value would tend to underestimate per capita contributions due to the cyclical variations of the data (Figures C.10 and C.11 in Appendix C). These data are summarized in Table 2.3

Table 2.2 Summary of Influent Loading Analysis

Parameter	BOD_5 (kg/d)	TSS (kg/d)	TKN (kg/d)	TP (kg/d)
Average	983	1,352	170	26
Minimum	424	623	124	20
Maximum	1,978	2,807	234	35
Standard Deviation	255	407	23	3
80th Percentile	1,113	1,583	191	35

Table 2.3 Summary of Estimated Average Per Capita Influent Loadings

Parameter	80th Percentile Loadings (kg/d)	Estimate Per Capita Loadings (g/cap/d) (1)	Per Capita Loadings Guidelines (MOE, 1984) (g/cap/d)
BOD_5	1,113	64	75
TSS	1,583	91	90
TKN	191	11	15
TP	35	2	3
(1) Based on historical serviced population of 17,392			

With the exception of TSS, the historical per capita loadings generated by the Bradford WPCP service area are marginally lower than typical values for Ontario municipalities (MOE, 1984).

2.3.4 Sludge Production

Sludge produced, digested, and stored in the sludge storage lagoon has consistently met the *Ontario Guidelines for Sewage Sludge Utilization on Agricultural Lands*. The digested sludge is disposed on an annual basis by land applications in accordance with these guidelines.

A summary of sludge disposal data is presented in Table C.4.1 in Appendix C.

2.4 Sewage Collection Infrastructure

The Town's present sanitary sewage collection system consists of six pumping stations with forcemain piping and a gravity sewer system. Wastewater enters the water pollution control plant (WPCP), which is located east of the urban area and accessed by a driveway located between Holland Street East and Jay Street on the east side of Dissette Street. It is estimated that the collection system consists of about 920 manholes and 60,400 m of sanitary sewer.

Following completion of the MSS in January 2003, three sanitary sewer projects have been substantially completed:

- Installation of a 900 mm diameter sewer siphon from Dissette Street east, under the Go Transit railway tracks to the WPCP division structure, including expansion of the division structure to accommodate the new sewer

- Installation of a750 mm diameter sanitary trunk sewer from Dissette Street west through existing and proposed development areas to Barrie Street at John Street

- Installation of a 525 mm diameter sanitary sewer on Barrie Street from John Street south to Holland Street, including diversion of existing flows from Holland Street to the new 525 mm diameter sewer.

Additional extensions of the second and third projects listed above will provide services directly to future growth areas identified in the OP.

Drawing G1 shows that wastewater enters the WPCP through the new 900 mm diameter sewer siphon and two existing siphons, which are 400 mm and 250 mm diameter sewers. The siphons are connected to the division structure at the headworks to the plant. Following completion of an additional sewer improvement project on Dissette Street in 2004 as part of the Countryside Estates servicing requirements, two other previously used sewer siphons extending from Jay Street to the division structure have been abandoned. Therefore, all wastewater from service area enters the WPCP through the three sewer siphons described above.

2.5 Wastewater Treatment Infrastructure

2.5.1 Description of Facilities

The Bradford Water Pollution Control Plant (WPCP) is located between Dissette Street east of the GO Transit railway tracks, west of the Holland River, north of Holland Street East and south of Jay Street. The existing site plan is shown in Drawing G1. The first treatment system was constructed in 1962 and consisted of a pumping station and waste stabilization lagoon. Currently, the WPCP consists of three treatment "trains" with different capacities and capabilities identified as Plants A, B and C. This represents plant expansions undertaken in 1970, 1982 and 1998, respectively. A graphical representation of the WPCP expansions and associated rated capacities is shown in Figure 2.3. The current rated capacity of the Bradford WPCP is 8,870 m^3/d. Refer to the Certificate of Approval in Appendix B for more details.

The original 70,000 m^3 waste stabilization pond, constructed in 1962, has been converted into a three-cell lagoon system. The largest cell is used as a storm surge pond with a gross effective volume of approximately 44,000 m^3. This cell is connected to the Division Structure at the inlet of the WPCP and provides for detention of peak inflows exceeding the peak hydraulic capacity of the WPCP. The remaining two cells are sludge storage cells, each with a gross storage capacity of approximately 10,000 m^3. Currently, only the most southerly of these two cells is in constant use. This cell includes a decanting chamber, which is used to draw off supernatant from the lagoon to further thicken the sludge. The decant is pumped back to the Division Structure for reprocessing in the WPCP. The sludge storage cells were upgraded in 1999 and in 2002, as approved by the MOE, which included the addition of course bubble diffusers in the south cell and other improvements to sludge management and maintenance operations.

The existing inlet sewers to the Division Structure, last modified in 2003, are rated for a peak hydraulic capacity of 120,000 m^3/d.

The Division Structure (inlet works) common to Plants A, B and C contains two inlet chambers, overflow weir, two Parshall flumes and receives decant from the sludge storage lagoon and septage pumped from the septage receiving station. Discharge from the flumes overflow into two buried gravity siphons that connects to the Influent building housing two mechanical screens and grit classifier. A new screen and grit conveyor were installed in 2003. Flow through the two mechanically cleaned bar screens (10-12mm bar opening size), splits to Plant B or Plant C. There is currently no way to reliably control the volume split to either Plant B or Plant C.

Untreated wastewater flow to Plant A was terminated at about the time Plant C was commissioned in the spring of 1998, although the digesters continue to be used for sludge digestion for Plants B and C. Plant A was taken off-line in order to initially start-up, commission and operate Plant C.

Flow into Plant B passes through an aerated grit removal tank followed by two plug flow tapered aeration tanks, followed by two center feed circular secondary clarifiers. The air diffusers in Plant B have been in operation for over 20 years and may need to be replaced in the near future.

Flow into Plant C passes through a vortex grit separator and then into one of two sequencing batch reactor tanks. The membranes on the fine bubble tubular diffuser assemblies in Plant C were replaced in 2004 after six years of operation.

There are no primary clarifiers and Plant B is operated in a high-rate aeration mode to maximize nitrification. Plant C is a dual-cell, automatically controlled, sequencing batch reactor (SBR) including effluent equalization tank and transfer pumps. The SBR is controlled by SCADA and may be programmed to aid nitrification and biological phosphorous removal. It also can be manually stepped into storm mode to handle larger volumes of inflow during extreme weather events. Measures to improve the reliability of the decanter mechanisms and implement instrumentation and control upgrades are ongoing.

The WPCP employs aerobic digestion to further convert organics, stabilize sludge and destroy solids. Currently, waste activated sludge and phosphorous sludge from Plants B and C are combined in the Plant B (stage 1) sludge digester. The course bubble air diffusers in Plant B have been in operation for over 20 years and may need to be replaced in the near future. The partially digested sludge is then pumped to Plant A (stage 2) that consists of two operational aerobic digester trains, each equipped with two aerated digester cells and a hopper-bottom settling tank. The digested sludge is partially thickened by means of manually decanting the stage 2 digesters using a portable submersible pump. The decant is pumped back to the Influent building, ahead of Plant B and Plant C, in batch mode. The stabilized sludge that overflows into the settling tanks is then pumped to the south sludge storage lagoon. Decant from the sludge storage cell is collected and pumped back to the Division Structure. The operational objective to achieve more than 45 days total sludge age before pumping to the sludge storage lagoon is achievable with current operations.

The WPCP currently generates between 9,000 and 11,000 m^3 of stabilized sludge per year. The biosolids are hauled away once per year for disposed by land application, all in accordance with applicable regulatory requirements.

Treated secondary effluent from Plants B and C are routed and combined in an inlet channel in the Filter/UV Disinfection building. From there, the combined flow passes through deep bed, continuous backwash sand filters followed by ultraviolet disinfection facilities. The filters and UV system are both rated for a peak flow capacity of approximately 31,811 m^3/d. Since the four filter cells and the two UV modules must be operational to provide adequate treatment at peak flow, there is insufficient firm capacity (e.g., with at least one unit off-line) at peak flow.

The disinfected effluent flows by gravity into the effluent chamber containing three submersible pumps. Pumping of the effluent is necessary since the hydraulics of Plant B would not permit gravity flow through the filters (constructed as part of Plant C) to the river. The three pumps combined have a total rated capacity of 31,200 m^3/d, which meets the peak flow rating of the WPCP.

The discharge from these pumps flows through an electromagnetic flow meter (measuring the total effluent flow from the WPCP) and connecting outlet sewer which discharges to the outlet (discharge) channel. The discharge channel conveys the flow in a northeasterly direction to the west branch of the Holland River.

The WPCP has been operated very effectively with no reported exceedences of MOE C-of-A effluent limits. In particular, the effluent objective for total phosphorous is 0.10 mg/L, which is low compared to many other jurisdictions. As a result, the WPCP has worked diligently to optimize phosphorous removal employing liquid alum in conjunction with filtration.

The justification for the last major plant expansion (Plant C) was provided in an April 1994 Environmental Study Report (ESR), prepared by Proctor and Redfern Ltd., which put forward a number of recommendations including the following:

- Decommissioning Plant A and conversion of all tankage to aerobic sludge digestion
- De-rating of Plant B to address nitrification requirements
- Construction of an additional extended aeration plant in two stages
- Retrofitting the lagoon's sludge storage cell.
- Modifications to the influent works.
- Installation of additional stand-by (emergency) power capacity.

Since the 1994 ESR, a subsequent design-build concept for the SBR (instead of the first phase of the extended aeration plant) was proposed by a consortium including Ainley & Associates and Maple Engineering, adopted in 1996 and was constructed in 1998. The treatment capacity of Plant A was not required initially with the construction and commissioning of Plant C. However, the digestion components were left operational, but not fully converted to an aerobic sludge digester as had been previously recommended by the 1994 ESR. Plant B was also not de-rated from the present rated capacity of approximately 4,545 m^3/day. The sludge lagoon and influent works modifications have been progressively carried out over the past few years and a new 900 kW/1000 kVA stand-by power generator was installed in 2001. Although the WPCP was expanded in accordance with the design-build proposal, not all major items as recommended by the 1994 ESR were carried out and therefore, the Town has been faced with additional capital expenditures, including installation of the generator, to make up for these requirements.

The 1994 ESR planned for an ultimate expansion to a total average day flow (ADF) capacity to 15,000 m^3/day and service a population of 30,000 persons. The ADF determined in this ESR study to support the population projection of 38,800 persons is 17,400 m^3/day, as summarized in Table G.1 in Appendix G.

The Certificate of Approval Number 0016-4GALGG, dated February 8, 2000 consolidated approvals and amendments issued from 1996 through 2000. Further amendments to this consolidated approval have been issued to facilitate ongoing upgrades at the WPCP, with the latest dated August 25, 2004. Please refer to Appendix B for more details.

2.5.2 WPCP Unit Capacity Evaluation

The following unit capacity evaluation has been updated from the 2003 Final MSS, as summarized in Table G.2 in Appendix G, based on the latest 3-year average WPCP flow, the estimated connected population, and the summary of committed WPCP units (adjusted for the number of building permits issued):

Average day "corrected" effluent flow (3 year period per MOE guidelines), 2002 to 2004 = 5,604 m^3/day

WPCP Capacity (per Certificate of Approval)	8,870 m^3/day
3 Year Average WPCP flow	- 5,604 m^3/day
Reserve Capacity	3,266 m^3/day

Based on MOE guidelines, the flow per capita (to determine unit service capacity) is determined based on the average 3-year flow and the serviced population. Summarized in Table C.2.1 in Appendix C, the average flow per capita is 0.318 m^3/day/person.

Estimated no. of existing connected units $= \frac{5{,}604 \text{ m}^3\text{/day}}{(0.318 \text{ m}^3\text{/day/person} \times 3.14 \text{ persons/unit})} = 5{,}612$ units

The estimate of 3.14 persons per unit was derived from the 2001 Census data.

Reserve population capacity = Reserve Capacity divided by the average flow per capita

$$= \frac{3{,}266 \text{ m}^3\text{/day}}{0.318 \text{ m}^3\text{/day/person}} = 10{,}270 \text{ persons}$$

Therefore, the Reserve Unit Capacity = 10,270 persons divided by 3.14 persons per unit
= 3,270 single family units

Summary of committed WPCP units:

As shown in Table G.2, total committed units was 3,002 units
No. of building permits issued by Town in 2002 and 2004 = 663 units
Therefore, reduction in committed WPCP units = 3,002 – 663 = 2,339 units

Therefore, remaining unallocated capacity in Plants B + C = Reserve Unit Capacity - Total Committed Units = 3,270 – 2,339 = 931 units

Therefore, estimate of existing allocated capacity = connected units + total committed units
= 5,612 + 2,339 = 7,951 units

Therefore, estimate of existing allocated flow
= 7,951 units x 3.14 persons/unit x 0.318 m^3/day/person = 7,939 m^3/day

The updated unit capacity evaluation shows that there are just over 900 unallocated units remaining in the combined rated capacity of Plants B and C. The increase in the number of unallocated units is attributable to the lower per capita flows recorded at the WPCP and the corresponding reduction in committed units. However, as described elsewhere in this report, the capacity of Plant B to meet future more stringent effluent requirements is a limiting factor, which must be addressed, in the planning process, so the availability of unallocated units is expected to be lower.

2.5.3 Effluent Quality and Current Discharge Criteria

Current discharge criteria, as specified in the existing Certificate of Approval, are given in the following Table.

Table 2.4 Bradford WPCP Effluent Discharge Criteria

Parameter	Operational Objective		Non-Compliance Criteria	
BOD_5	5 mg/L	55.73 kg/d	10 mg/L	111.46 kg/d
Suspended Solids	5 mg/L	55.73 kg/d	10 mg/L	111.46 kg/d
Total Phosphorous **	0.10 mg/L	1.12 kg/d	0.14 mg/L	1.56 kg/d
Total Nitrogen (Ammonia + Ammonium)	1.0 mg/L (April-Oct) 3.0 mg/L (Nov-March)		2.0 mg/L (April-Oct) 4.5 mg/L (Nov-March)	
E.Coli	100 organisms /100 mL		200 organisms /100 ml	

** Reference MOE memo dated December 8, 1999 (see Appendix A)

Loading Estimates based on WPCP Capacity of 11,146 m3/d as per the previous Certificate of Approval No. 0016-4GALGG (dated February 8, 2000)

These treatment objectives and compliance limits are relatively stringent, and can be achieved only with a fairly high degree of treatment (tertiary treatment with complete disinfection). The low criteria reflect the degraded nature of the receiving watershed, and the relatively low dry weather flows in the West Holland River for dilution of effluent (see Section 5 for further discussion).

In particular, the phosphorous criteria are aggressively low, and well-operated chemically assisted filtration systems are needed to meet them.

WPCP operating data summarized in Appendix C demonstrates that the Bradford WPCP has consistently met the effluent compliance criteria during the 2001-2004 period, and usually meets the effluent objectives for all parameters. As far as effluent quality is concerned, the plant is performing very well under current flow and loading conditions.

Phosphorous performance was not as good in 2004 as in prior years, but Phosphorous compliance was always achieved. Average suspended solids concentrations were also slightly higher in 2004 than previous years, and these two trends are probably connected. As shown in Figure C.8 in Appendix C, effluent total phosphorous concentrations were on a declining trend until the end of 2002. At the time, the monthly average TP concentration ranged from 0.07-0.08 mg/L. This high level of performance was largely the result of efforts to optimize this process. With this knowledge and experience, starting in early 2003 to current, the WPCP was able to further tweak phosphorous control to optimize the operation (to produce less sludge and use less alum) relative to the existing effluent compliance limit of 0.14 mg/L. As a result, the apparent negative trend as suggested by the data plot in Figure C.8, from 2003 to current, is a result of this second stage of process control tweaking, not because the process was losing effectiveness. Likely, some further optimization of the chemically assisted filtration process and additional preventative maintenance (e.g., addition of sand filter media, etc.) is required to return the phosphorous levels consistently below the objective level.

The particularly low ammonia levels in the effluent (usually far below the treatment objectives) indicate that the WPCP is achieving a high level of nitrification. As influent flows increase and approach the WPCP capacity, the rate of nitrification can be expected to drop somewhat and effluent ammonia levels rise, which is the main reason for recommending de-rating Plant B.

The pH level in the effluent tends to be fairly basic, ranging from 7.6 to 8.2. This is significant since the potential for ammonia toxicity is reduced at lower pH.

2.5.4 Process Evaluation

In 2004, XCG Consultants Ltd. conducted a desktop evaluation of the performance of existing Plants B and C, based on WPCP operating data (Appendix C) and supplemental sampling. Some of the key findings of this evaluation are as follow:

- Plant B achieves complete nitrification year-round. Effluent ammonia concentration is consistently below 0.5 mg/L

- Plant C achieves complete nitrification year-round. Effluent ammonia concentration consistently below 0.2 mg/L

- The Plant B design was not intended to achieve the level of treatment that is currently required for the overall WPCP for the additional serviced population. At C-of-A peak flow rating, Plant B is not designed to meet the current ammonia criteria or the proposed future ammonia criteria (see discussion in Section 6). This could potentially result in problems reliably meeting the overall WPCP compliance criteria for ammonia. The problem results from the capacity of the Plant B secondary clarifiers, which are under-sized based on the maximum solids loading rate recommended by MOE guidelines for nitrifying treatment facilities

- It may be possible for Plant C to achieve greater capacity than it is currently rated for, however, additional instrumentation, monitoring and stress testing (optimization) over multiple seasons (summer-winter) would be required to test this hypotheses.

2.5.5 Identified Deficiencies

The operation and efficiency of the WPCP, and hence the cost to maintain, is directly affected by a number of variables including treatment performance objectives, regulatory requirements, age and reliability of equipment, capacity bottlenecks within the process, reliability, budgets, health and safety, etc. In addition, continued growth in the community results in increased sewage flows requiring greater effort to operate at maximum efficiently.

The following is a listing of the most notable deficiencies, some of which were identified in the MSS that impact the current and future operation of the Bradford WPCP and influence the development of strategies to expand the WPCP.

2.5.5.1 Division Structure

The Division Structure is not configured to provide sufficient hydraulic head to drive peak flow through the WPCP. With future increases in influent flow and with the expansion of the WPCP, additional hydraulic head will be required.

A study to evaluate flow measurement at the WPCP, as summarized in the XCG Report included in Appendix D, concluded that influent flow measurement was not reliable, compared to effluent flow measurement, and that in order to provide more accurate influent flow metering at the plant, significant modifications, including physical changes, would be required at the Division Structure. It was recommended that a new influent flow metering system be installed as part of a future expansion of the WPCP.

The configuration of the existing inlet to the Division Structure results in the settling of grit. As a result, the removal of grit must be completed by hand, which is undesirable for a number of reasons. Therefore, further modifications would be required to ensure the grit remains sufficiently mobile to reach the downstream automatic grit removal facilities.

2.5.5.2 Flow Split to Plant B and Plant C

The influent channel following the mechanical bar screens in the Influent building splits into two separate channels leading to Plant B and Plant C. This channel configuration cannot be modified for reliable flow control and measurement. This is critical as the overall efficiency of Plant B, Plant C and ultimately Plant D, depend on proper flow control.

2.5.5.3 Rated Capacity of Plant B

As discussed in the preceding section, the existing clarification capacity is undersized for the current treatment requirements, and limits the overall treatment capacity of Plant B. As discussed elsewhere in this report, this adds further justification to eventually down-rate the capacity of Plant B. For the purpose of this report, it has been assessed that the effective capacity of Plant B is reduced by approximately 33 percent (1,470 m^3/d) to 3,075 m^3/d and that the peak instantaneous flow should not exceed about 5,800 m^3/d, which may be the limiting factor. The appropriate rating for Plant B could be determined through future optimization and stress testing.

2.5.5.4 Reliability and Redundancy

The overall reliability and efficiency of the treatment process relies on the availability of key process equipment to be operational 100 percent of the time. Alternatively, regular maintenance of equipment often requires taking units out of service for extended periods of time. The lack of some critical backups or firm capacity, including extra tertiary filters, ultraviolet disinfection and effluent pumping capacity, will become more critical as flow through Plant B and Plant C continues to increase towards capacity.

2.5.5.5 Biosolids Management

Previous studies conducted by the Town concluded that digestion facilities for the existing Plant B and Plant C were not adequate, and recommended that Plant A be fully converted to an aerobic digester complex to increase the biosolids digestion capacity. However, it has since been learned that the cost to convert Plant A is significantly higher than originally anticipated, and the original decision to proceed with the conversion may no longer be the preferred course of action based on this new information.

In addition, biosolids are currently stored in lagoons, which offer no containment of odour. Changes to improve the management of biosolids that reflect current and future regulatory requirements should be evaluated.

2.5.5.6 Administration and Control

The Administration / Blower building provides a number of specific functions and includes administrative offices, a lunch room, the main MCC room and laboratory, blower room, single washroom and decommissioned chlorine room. A number of improvements to this building, to meet current and future needs, are required.

3.0 Future Conditions

3.1 Population and Flow Projections for Design

The Official Plan identifies a future urban area residential population of 38,800 persons for Bradford West Gwillimbury. From the areas identified in the 2003 MSS, there is an expected marginal increase in the percent of the non-residential land uses from 27 percent of the urban area to 31 percent of the urban area at build-out in 2026. Figure 1.2 shows the distribution of the future growth.

The calculation of the expected future average day flow and peak flow, summarized in Table G.1 in Appendix G, was based on the average flow over the last four years of records, using the WPCP effluent flow data as discussed in section 2.3.2, and the serviced population:

Four year average flow	= 5,527 m^3/day
Serviced population	= 17,392 persons
Average per capita flow	= 318 L/capita/day (includes non-residential flows)

Based on water consumption data (where water is not incorporated as part of a finished product and therefore is returned to sewer as wastewater flow) from selected industrial, commercial and institutional (ICI) sources, it is estimated that the equivalent non-residential flow is 42 L/capita/day. Therefore, the estimated residential component is:

318 L/capita/day total (includes non-residential flow)
-42 L/capita/day (ICI)
276 L/capita/day residential or 280 L/capita/day (rounded off)

For the purposes of projecting a future ICI wastewater flow, it was assumed that the proportion of "high" ICI water users would increase marginally from 3 percent of the non-residential area to 5 percent. In addition, the remaining future ICI development lands would contribute flow at the current average rate of the "low" water consuming businesses. The "high" and "low" water user rates were estimated to be 70.4 m^3/ha/day and 2.4 m^3/ha/day based on current use, as discussed in section 2.2.

After accounting for the projected future population of 38,800 persons, the future ICI lands and the MOE guideline for extraneous flow, a calculated average daily design flow of 17,400 m^3/day was determined, compared to 17,300 m^3/day projected in the 2003 MSS. Based on the MOE guideline for the peak extraneous flow allowance and the Harmon peaking factor for the equivalent population of 46,941 persons, the design peak flow rate of 40,800 m^3/day was determined.

Peak flow beyond this value can be accommodated by the storm surge pond, which is connected to the Division Structure.

3.2 Future Wastewater Quality for Design

Based on the approved Official Plan, by the years 2025-2026, the population to be serviced by the Bradford WPCP will be approximately 38,800 persons. The future average day (sewage) flow (ADF), as discussed in the previous section, is estimated to be 17,400 m^3/d, which includes septage. The current C-of-A allows the WPCP to receive up to a maximum of 54 m^3/d septage for co-treatment. There are no plans to increase this amount in the future.

Table 3.1 Summary of Estimated Future Influent Loadings

Parameter	80th Percentile Loadings Flow= 5,527 m^3/d (kg/d)	Estimate Per Capita Loadings (1) (g/cap/d)	Average Design Loading (2) ADF= 17,400 m^3/d (kg/d)
BOD_5	1,113	64	3,004
TSS	1,583	91	4,272
TKN	191	11	516
TP	35	2	94

(1) Based on historical average serviced population of 17,392
(2) Based on projected equivalent service population of 46,941 (refer to Table G.1), based on OP population of 38,800

Future loadings, presented in Table 3.1, will be reallocated to the expanded facility based on proportional balancing and control of future flows to Plant B, Plant C and Plant D.

3.3 Regulatory Considerations

A number of new regulatory requirements need to be considered in establishing the preferred solution. These include Ontario's Nutrient Management Act and Greenbelt Protection Act, the federal Guidelines for the Release of Ammonia Dissolved in Water Found in Wastewater Effluents, and ongoing programs of the Lake Simcoe Region Conservation Authority to limit and reduce releases of phosphorous into the Lake Simcoe watershed.

3.3.1 Nutrient Management Act

The Nutrient Management Act (NMA) was passed in 2002 and came into force in July 2003. In September 2003, O. Reg. 267/03 came into force under the NMA. The

Regulation applies to all generators of non-agricultural source material. Non-agricultural source material includes pulp & paper biosolids, sewage biosolids, and any other material that is not from an agricultural source that is capable of being applied to land as a nutrient

A brief summary of the implications of the NMA and O.Reg. 267/03 on the Bradford WPCP follows.

As a generator of non-agricultural source material i.e. sewage biosolids, the Town will be required to submit a Nutrient Management Strategy (NMS). A NMS is essentially a paper trail that defines the quantity and quality of biosolids produced at the WPCP and the disposal methods. The NMS must be prepared by qualified personnel as defined in the regulation and must be renewed every five years. Increases of 20 percent or more in the quantity of material generated, or a change in destination, etc., will require amendments to the NMS.

According to Section 12 of O. Reg. 267/03, the Town will need to have an approved NMS for the Bradford WPCP by January 1, 2007, based on the size of the facility.

Under the regulation, formal transfer agreements will be required with any parties transferring biosolids off the WPCP. However, material may be transferred to any location, regardless of distance from the location of operation.

According to Section 98 of O. Reg. 267/03, biosolids may not be transferred unless they meet the standards outlined in Table 1 of Section 98. It should be noted that these standards are identical to the previous standards outlined in the MOE Guideline for the Utilization of Biosolids for aerobic, dewatered and dried biosolids. Section 98 also states that sewage biosolids have to be subjected to a pathogen treatment process prior to transfer. Acceptable pathogen treatment processes are as follows:

a. anaerobic/aerobic digestion
b. waste stabilization ponds
c. composting
d. lime stabilization
e. air drying.

It should also be noted that Section 97 defines an *E.coli* limit of 2 x 10^6 colonies per gram of total solids (dry weight) for sewage biosolids that are to be land applied. However, the *E.coli* limit is only a prohibition on application, not on transfer of material.

As per Section 70 of the regulation, storage for 240 days must be provided by an operation that generates sewage biosolids. However, the storage does not have to be provided at the source i.e. the WPCP or on property owned by the operator if the NMS for the facility provides for the use or transfer of some or all of the sewage biosolids that eliminates the need for storing for 240 days. In this case, a generator only has to provide storage capacity as per the requirements of his strategy. Storage in this case refers to "permanent nutrient storage facility", a "temporary field nutrient storage site" or a combination. Acceptable storage structures are defined in Part VIII, Sections 62 through 88. Although there may be some advantages to the Town to consider the possibility of off-site storage of biosolids (by others), the current plan is to provide a minimum of 365 days storage of biosolids on the WPCP site for the proposed expansion. Future studies required in preparing the NMS will better define longer-term sludge storage and disposal options.

It is understood that there is some uncertainty as to whether the NMA will create additional obligations for municipal WPCP's to accept and treat septage generated from private sources. Bradford WPCP already has such facilities, but any requirements to accept more septage than anticipated could impact the details of the WPCP expansion.

3.3.2 Greenbelt Protection Act

For the most part, the Town lies just outside of the Greenbelt Plan area, so the draft plan/statute will not apply to this project, especially since this is not a "development" activity to be approved under the Planning Act. The eastern extreme part of the property, including a portion of the effluent channel, and the Holland River itself (the effluent receiver) are within a designated Special Policy Area under the Greenbelt Plan for the Holland Marsh.

No changes to the effluent channel are anticipated, but it is understood that the policies of the Holland Marsh Special Policy Area require that the WPCP discharge into the Holland River not adversely impact the River.

3.3.3 LSRCA Phosphorous Initiatives

The Lake Simcoe Region Conservation Authority (LSRCA) has ongoing initiatives and studies on the impacts and quantities of phosphorous discharged to the watershed, and for further reducing the quantities discharged.

This has significant impacts on the Bradford WPCP because the current phosphorous limits are already aggressive and significant growth could necessitate even more stringent treatment to conform to the LSRCA's objectives.

3.3.4 Recent Federal Requirements

The Canadian Guidelines for the Release of Ammonia Dissolved in Water Found in Wastewater Effluents are relatively recent. This guideline applies to wastewater treatment plants discharging greater than 5,000 m^3/d, therefore it is applicable to Bradford. It relates to control of ammonia discharged to the receiver. However, because of the already-stringent limits for ammonia in place at Bradford (more stringent than the federal guidelines), the Guideline is not expected to have any impact on the Town.

There is also a federal requirement for WPCP's to prepare and implement Pollution Prevention Plans for Inorganic Chloramines and Chlorinated Wastewater Effluents. This is not expected to impact the Town because chlorination is not used as part of the treatment process and is not part of any of the contemplated alternatives.

4.0 Selection of Preferred Sewage Treatment and Disposal Concept

4.1 Evaluation Criteria

Table 4.1 presents the alternative evaluation criteria discussed in this ESR.

Table 4.1 Evaluation Criteria

Technical Factors • Technical feasibility • Proven Performance • Compatibility with existing conditions and facilities currently operated by the Town • Ease of Implementation • Flexibility to modify, expand and phase to meet future requirements • Level of energy and utility use required • Regulatory Requirements
Natural Environment • Water quality and aquatic systems • Terrestrial systems • Air quality • Groundwater resources • Soil
Social Considerations • Visual / Aesthetic • Odour • Noise • Community health and safety • Occupational health and safety
Economic • Capital cost • Operating and Maintenance cost

Design information and life cycle cost estimates for each of the alternatives described in more detail in the following sections, are provided in Appendix H. Life cycle cost estimates include capital costs and 20 year operating and maintenance costs. ***The estimates are brought to a present worth value assuming a historical average annual real interest rate value of three (3) percent.*** This approach provides an economic basis for comparison of the alternatives.

4.2 Sewage Treatment and Disposal Planning Alternatives

The 2003 Master Servicing Study (MSS) identified and evaluated the following planning-level sewage treatment and disposal alternatives:

1. Pump raw sewage from future growth areas to the future extension of the York Durham Sanitary Sewer (YDSS) system at Holland Landing
2. Construct a stand-alone WPCP to service the Green Valley area
3. Construct a stand-alone WPCP to service future growth in the west tributary watershed
4. Modify, rehabilitate and expand the WPCP to provide the necessary treatment for discharge to the West Holland River.

The MSS recommended Alternative 4 (Modify, Rehabilitate and Expand the Bradford WPCP). The following sections summarize the evaluation of the planning alternatives.

4.2.1 Pump Raw Sewage From Future Growth Areas to the Future Extension of York Durham Sanitary Sewer System (YDSS)

The Region of York completed a Class EA study to extend the YDSS to Holland Landing, which is within approximately 8 km of the Town of Bradford West Gwillimbury. Therefore, the option exists to consider connection to the YDSS to convey flows beyond the existing plant capacity for treatment in Durham Region. The MSS recommended not to pursue this option for the following reasons:

- Negotiations would be required with York Region to obtain capacity within the YDSS, which has been created for municipalities within York Region as opposed to other jurisdictions. Also, additional negotiations would be necessary to establish the cost to Bradford West Gwillimbury for sewage treatment. In 2003, these were estimated to be at least $\$0.60/m^3$, compared to the calculated cost for treatment at the existing Bradford West Gwillimbury treatment plant of about $\$0.33/m^3$. With the need to conduct multiple negotiations, there would be significantly more uncertainty in establishing a timeline confirming when capacity in the YDSS would be available and at what cost

- Bradford West Gwillimbury would be responsible for the capital costs of installing 8 km of dual forcemain and the incremental upgrades required (i.e. pumping stations, sewer capacities) for conveying flows not originally considered for the YDSS

- There are potential environmental implications of constructing two major river crossings as part of the capital works.

4.2.2 Construct a Stand-Alone WPCP to Service the Green Valley Area

The construction of a stand-alone wastewater treatment plant for the Green Valley area was considered as an alternative to pumping wastewater to the Bradford WPCP. A new wastewater treatment plant in this area would require an assimilative capacity study for discharge to the Morris Road canal, which outlets to the North Canal and ultimately to the West Branch of the Holland River. Flow in the Morris Road canal originates primarily from the local stormwater drainage system and it has been noted that sections of the canal become stagnant or dry up completely during extended periods of dry weather. Therefore, in the absence of advanced wastewater treatment, the Morris Road canal is likely unsuitable as a receiving body for treated wastewater effluent.

In addition, the Green Valley area is presently populated and additional future growth is approved within the current Official Plan. The construction of a WPCP so close to existing and proposed residential areas would raise concerns regarding odours, noise and aesthetics related to the WPCP. These impacts would be difficult and costly to mitigate due to the close proximity of the residential areas.

In the absence of further studies to determine the suitability of the receiving water body and expected social and other impacts, a WPCP in Green Valley is not considered a viable option.

4.2.3 Construct a Stand-Alone WPCP to Service Future Development in the West Tributary Watershed

A separate WPCP in the west tributary watershed has the potential to service new development located generally west of Professor Day Drive, employing a gravity flow collection system. The WPCP would operate independently (although connected by SCADA) of the Bradford WPCP, however, its receiving body would eventually be the same, namely the West Branch of the Holland River. Trunk sewers would be required from the area west of Professor Day Drive to the WPCP, assumed to be located in an area near the 5th Line and the 5th Sideroad.

In evaluating the feasibility of a separate WPCP in the west tributary watershed, a number of significant disadvantages are noted:

- The effluent criteria would have to be determined through an assimilative capacity study of the immediate receiver (i.e. the Fraser Creek) and the downstream water bodies such as the North Canal, the West Branch of the Holland River and potentially Lake Simcoe.

- It is possible that the allowable phosphorous loading for a new WPCP would be tied to the phosphorous allocation (2.046 kg TP/d) at the Bradford WPCP. This is a significant disadvantage for both WPCP's, particularly if no new phosphorous allocations are made available by the MOE or LSRCA

- In terms of implementation, this alternative limits the timing and flexibility of all landowners to access the trunk sewer

- The west tributary WPCP location is a substantial distance from the Bradford WPCP, Additional Town staff will be required to operate, monitor and maintain the new WPCP. SCADA integration and cross-communication would be helpful. However, inefficiencies would be expected to occur by the creation of new locations for treatment and disposal of wastewater.

On the basis of the above, it is clear the option to construct a new wastewater treatment plant in the west tributary watershed has significant disadvantages and therefore, is not considered further.

4.2.4 Modify, Rehabilitate, and Expand the Bradford WPCP

The provision of more treatment capacity by modifying, rehabilitating and expanding the Bradford WPCP has the overall advantage of offering a centralized, cost effective solution with available property for future expansion(s).. However, the facility is located within an existing flood plain area, which in fact was selected by the MOE (then known as the Ontario Water Resources Commission) in order to efficiently collect sewage from the Town back in the early 1960's. In addition, required buffer zones further restrict ultimate development of the site.

The size of the site allows for future works to be efficiently located ensuring there is more than 150 m buffer from existing residential areas (as shown in Drawing G1). The property is readily accessible from a driveway running from Dissette Street and crossing a GO railway line just before the front gate entrance. Approximately 2.5 ha immediately beside the existing tanks and structures is available for plant expansion on the Town's property. Other selected areas on the Town's property as well as adjacent properties, may be made available for future development, subject to a thorough review of site-specific constraints.

4.2.5 Summary Evaluation of Planning Alternatives

Upgrades to the existing Bradford WPCP on lands presently owned by the Town have many advantages over the other planning-level alternatives discussed above. These include an established receiving water body based on historical use, flexibility in phasing plant expansions, no reliance on inter-municipal negotiations for wastewater disposal and better efficiencies associated with maintaining treatment operations at one location. In addition, since completion of the MSS, investment in infrastructure has already been made through upgrading existing trunk sewers and installing new trunk sewers to the existing WPCP site. Therefore, design alternatives should consider technologies available to modify, rehabilitate and expand the Bradford WPCP.

4.3 WPCP Expansion Design Alternatives

The following sections provide details of design alternatives to expand the treatment capacity of the Bradford WPCP that were considered in the MSS. Table 4.2 presents a summary of key evaluation criteria applied in the evaluation of the alternatives. A more detailed breakdown of costs is provided in Appendix H:

4.3.1 Conventional Activated Sludge (CAS) Treatment Plant with Multi-Stage Anaerobic Sludge Digestion

The general concept is shown in Figure 4.1, which shows the WPCP expansion employing a conventional activated sludge treatment plant with anaerobic sludge digestion. The expansion is depicted in phases and shows the main interconnections with existing facilities.

The conventional activated sludge (CAS) treatment plant expansion alternative has a relatively high capital cost due to the required construction of anaerobic sludge digestion tanks and associated appurtenances. This system would require secondary digesters providing for a minimum 180-240 days covered storage of digested sludge.

The work recently completed by the Town in upgrading the existing sludge storage lagoons would be lost since open storage in these lagoons is not suitable and all sludge produced by Plants B and C would be transferred to the new anaerobic digestion system.

Converting the WPCP to anaerobic sludge digestion may help reduce hydro costs because aeration blowers are not necessary for anaerobic digestion. However, the reduced hydro costs are offset by the cost of natural gas used to heat the digesters in the winter, particularly during the start-up years, to maintain the required operating temperature. Other offsetting operation and maintenance issues include:

- Corrosive/explosive conditions which exist in anaerobic digestion can lead to more frequent repair and replacement of digester and other gas handling components

- Staff safety issues related to working around corrosive and explosive conditions related to the production of biogas, composed of explosive methane gas, carbon dioxide and hydrogen sulfide

Table 4.2 WPCP Expansion Alternative Evaluations

	Conventional Activated Sludge with Anaerobic Sludge Digestion (CAS)	Membrane Bioreactor with Aerobic Sludge Digestion (MBR)	Extended Aeration Activated Sludge with Aerobic Sludge Digestion (EA)	SBR with Aerobic Sludge Digestion (SBR)
Description	Plant D built in 2 phases (1 primary clarifier, 2 aeration tanks, 2 secondary clarifiers, 1 sludge pump building and including anaerobic digesters and building sized to include sludge flow from Plants B, C and D. Build Phase 1 in year 2 (2007) and Phase 2 in 2016.	Plant D built in 2 phases (1 equalization tank (Phase 1 only), 2 bioreactors, 1 membrane building), and including aerobic digesters and building sized to include sludge flow from Plants C and D.	Plant D built in 2 phases (2 aeration and 2 secondary clarifiers, 1 clarifier building), and including aerobic digesters and building sized to include sludge flow from Plants C and D. Arrange components to allow for potential longer-term conversion to CAS or other higher-rate treatment process.	Plant D built in 2 phases (1 equalization tank (Phase 1 only), 2 SBR tanks, 1 SBR effluent equalization tank) and including aerobic digesters and building sized to include sludge flow from Plants C and D.
Technical Feasibility **Hydraulics**	Low lift pump station required as part of new headworks to provide sufficient hydraulic capacity through plant. Final effluent pumping system to be upgraded as required.	Low lift pump station required as part of new headworks to provide sufficient hydraulic capacity through plant. Final effluent pumping system to be upgraded as required. Requires additional pumping through equalization and through MBR.	Low lift pump station required as part of new headworks to provide sufficient hydraulic capacity through plant. Final effluent pumping system to be upgraded as required.	Low lift pump station required as part of new headworks to provide sufficient hydraulic capacity through plant. Final effluent pumping system to be upgraded as required. Requires additional pumping through equalization and from SBR effluent equalization tank.
Constructability	No construction related issues. May require structural shoring of existing structures.	No construction related issues. May require structural shoring of existing structures.	No construction related issues. May require structural shoring of existing structures.	No construction related issues. May require structural shoring of existing structures. Aeration and clarification combined in a single tank.
System Efficiency and Reliability	Proven technology best suited for flows greater than current planning horizon. Anaerobic digestion produces methane (biogas) with greater O+M requirements.	Relatively new technology in Ontario, but is considered proven technology with potential to produce highest quality treated effluent.	Proven technology. High efficiency, robust treatment process, well adapted in Ontario.	Proven technology. Relies on automated control for maximum performance. Not considered
Phasing Flexibility	Modular and flexible 2 phase design.	Modular, compact and flexible 2 phase design.	Modular and flexible 2 phase design.	Modular and flexible 2 phase design.

	Conventional Activated Sludge with Anaerobic Sludge Digestion (CAS)	Membrane Bioreactor with Aerobic Sludge Digestion (MBR)	Extended Aeration Activated Sludge with Aerobic Sludge Digestion (EA)	SBR with Aerobic Sludge Digestion (SBR)
Land Requirements	Can be accommodated on Town property at WPCP. Largest land requirements due to anaerobic digesters.	Can be accommodated on Town property at WPCP. Minimal land requirements.	Can be accommodated on Town property at WWTP. Second largest land requirement.	Can be accommodated on Town property at WWTP. Larger land requirement compared to MBR option.
Regulatory Requirements	Completion of Class EA process and MOE, municipal, and LSRCA approvals required.	Completion of Class EA process and MOE, municipal, and LSRCA approvals required.	Completion of Class EA process and MOE, municipal and LSRCA approvals required.	Completion of Class EA process and MOE, municipal, and LSRCA approvals required.
Environmental and Social Implications	Minimal disruption to surrounding properties. Proposed works are a minimum 150 m from residential areas.	Minimal disruption to surrounding properties. Proposed works are a minimum 150 m from residential areas.	Minimal disruption to surrounding properties. Proposed works are a minimum 150 m from residential areas.	Minimal disruption to surrounding properties. Proposed works are a minimum 150 m from residential areas.
Natural Environment	Plant expansion is located within the shallowest depths of the Regional storm floodplain; no loss of provincially significant wetlands (PSW), works are outside of 120 m PSW buffer zone.	Plant expansion is located within the shallowest depths of the Regional storm floodplain, no loss of provincially significant wetlands (PSW), works are outside of 120 m PSW buffer zone.	Plant expansion is located within the shallowest depths of the Regional storm floodplain, no loss of provincially significant wetlands (PSW), works are outside of 120 m PSW buffer zone.	Plant expansion is located within the shallowest depths of the Regional storm floodplain, no loss of provincially significant wetlands (PSW), works are outside of 120 m PSW buffer zone.
Present Worth Capital	$24.6M	$26.1M	$20.5M	$22.3M
20 Year Operation and Maintenance (1)	$25.8M ($1,290 k annual average)	$28.9M ($1,445 k annual average)	$22.9M ($1,145 k annual average)	$23.1M ($1,155 k annual average)
Total 20 Year Life Cycle Cost	$50.4M	$55.0M	$43.4M	$45.4M

	Conventional Activated Sludge with Anaerobic Sludge Digestion (CAS)	Membrane Bioreactor with Aerobic Sludge Digestion (MBR)	Extended Aeration Activated Sludge with Aerobic Sludge Digestion (EA)	SBR with Aerobic Sludge Digestion (SBR)
Summary	Higher O+M and replacement cost due to a number of factors including natural gas rates for heating sludge in winter months, higher capital costs to build anaerobic digesters and sludge storage (lagoons are not suitable) and corrosive and explosive gas environments requiring more system operation and maintenance. More cost effective at sewage flow greater than currently projected.	Highest O+M and replacement cost due to need of highly computerized process requiring more trained staff and high life cycle cost of membrane units. Highest capital cost. Disadvantages include most complex mechanical / electrical, provision of equalization and is not commonly employed at larger facilities.	Lowest O+M cost. Lowest capital cost. Best suited for conversion to CAS with anaerobic sludge digestion in the future.	Low O+M cost (comparable to EA process). Second lowest capital cost. Disadvantages include more complex mechanical / electrical, provision of equalization, produces more dilute sludge and is not commonly employed at larger facilities.
(1) Projected To End Of Current Official Plan Period - 2026				

- A high level of operator training, equipment maintenance and control is needed.

These factors will influence the decision of the Bradford WPCP to continue employing aerobic sludge digestion, or convert to anaerobic digestion at some point in the future when influent flow volumes are greater and WPCP conditions warrant.

The anaerobic sludge digestion process is used at most large treatment plants where flow rates from population growth have resulted in lower hydro costs (where energy is recovered), which outweigh the higher capital and operating costs. The operation and maintenance cost comparison between anaerobic digestion and aerobic digestion indicates that anaerobic digestion is between 10 percent and 15 percent more expensive over the initial 20-year planning period (i.e. $25.8 million versus $22.9 million, or $145,000 on an average annual basis), although this will depend on implementation of costly measures for energy recovery, which have not been included in this estimate. The 20-year life cycle cost estimate is $50.4 million.

The benefits of the anaerobic digestion process (production of biogas with potential for energy recovery) would only be realized at higher flow rates as the Town's serviced population increases beyond 40,000 persons, which is beyond the current planning period associated with this ESR. The present worth capital cost to expand the Bradford WPCP employing a CAS treatment plant is also higher compared to the extended aeration expansion option (i.e. $24.6 million versus $20.5 million respectively) due largely to the anaerobic sludge treatment process. The CAS treatment process would be more economically competitive with the extended aeration and SBR treatment alternatives at flows beyond the current projections.

4.3.2 Membrane Bioreactor (MBR) System with Aerobic Sludge Digestion

Membrane bioreactor systems (e.g., Zenon ZeeWeed technology or similar) previously referred to in the MSS as microfiltration units, combine specialized membrane technology with biological treatment. This high-rate system enhances conventional biological treatment by combining aeration (at elevated biomass concentrations) and solids separation (specialized membrane "filters") into a compact configuration. The process is considered capable of producing consistent, high quality effluent. The general concept is shown on Figure 4.2, which shows the WPCP expansion employing a MBR treatment plant with flow equalization and aerobic sludge digestion. The expansion is depicted in phases and shows the main interconnections with existing facilities.

Treatment occurs as the screened, degritted and equalized sewage flow is aerated in the main biological treatment reactor and then drawn through the membrane by vacuum pressure. The membrane tanks would be installed in a suitable building to protect the membrane system from exposure to extreme weather conditions.

According to information from the various membrane manufacturers, the effluent from the membrane tank does not require filtration. This claim would have to be substantiated and guaranteed, likely by carrying out costly pilot test trials, before this level of performance could be accepted. However, this offers a potential benefit since the existing filters would conceivably not have to be upgraded, at least not to the level required by the other treatment alternatives. Influent equalization also provides reduced peak flow through the downstream processes. This also offers the benefit of reducing the size of the tertiary filters and disinfection units. UV disinfection would still be required.

This alternative has the highest present worth capital cost, which includes a substantial portion of largely proprietary equipment including membrane units, tankage, computer control and mechanical equipment (i.e. $26.1 million compared to $20.5 million for extended aeration).

In addition to the high capital cost, a number of other concerns include:

- Short life cycle of the membranes
- Requirement to clean the membranes
- Degree of computer process control required
- Overall maintenance requirements
- Higher unit replacement cost
- Higher operating costs
- More time and cost for training staff.

These issues are reflected in the higher operational and maintenance costs estimated over a 20 year period of $28.9 million versus $22.9 million for the extended aeration alternative (i.e. a difference of $300,000 on an average annual basis). The 20-year life cycle cost estimate is $55.0 million. While the technology offers the possibility to potentially achieving lower effluent phosphorous concentrations, the incremental cost to achieve this level of performance, in the absence of a firm process guarantee, is high.

4.3.3 Extended Aeration Activated Sludge Treatment Plant with Aerobic Sludge Digestion

Expansion of the Bradford WPCP employing the extended aeration activated sludge treatment process would provide many advantages including a high level of treatment efficiency, flexibility and reliability, ease and simplicity of operation compared to the other alternatives and facilitates conversion to a CAS, BNR (Biological Nutrient Removal) or other treatment process in the future, unlike some of the other alternatives. The extended aeration process modification is conceivably the most understood and well adopted secondary treatment technology in Ontario. There are a number of hybrids and modifications to this process, besides CAS, that offer the potential for future increases in capacity, all within the same or smaller foot print.

The general concept is shown in Figure 4.3, which shows the WPCP expansion employing an extended aeration activated sludge treatment plant with aerobic sludge digestion. The expansion is depicted in phases and shows the main interconnections with existing facilities. The digesters are depicted as circular tanks, which can be designed to facilitate conversion to covered anaerobic digesters. As noted under Section 4.3.1, conversion to a CAS treatment process including anaerobic digestion would become more economically attractive at flows beyond the current planning period.

The present worth capital cost is estimated to be $20.5 million, the lowest of the alternatives. Operations and maintenance costs over the initial 20-year planning period are estimated to be approximately $22.9 million. The 20 year life cycle cost is estimated to be is $43.4 million. This option offers significant advantages and benefits at the lowest projected cost and represents a reasonable approach to expanding the Bradford WPCP.

4.3.4 Sequencing Batch Reactors (SBR) with Aerobic Sludge Digestion

Expansion of the Bradford WPCP by constructing a new SBR treatment system is a reasonable alternative for the Town to consider since the last plant expansion in 1998 included a proprietary SBR treatment process and operating staff are familiar with the nuances of this treatment system. The general concept is shown on Figure 4.2, which shows the WPCP expansion employing a SBR treatment process with flow equalization and aerobic sludge digestion. The expansion is depicted in phases and shows the main interconnections with existing facilities.

Unlike CAS or extended aeration, the SBR process has the advantage of integrating aeration and settling within a single tank. This offers some benefit since secondary clarifiers are not required. However, in order to control the flow to the tertiary filters and UV disinfection units, SBR effluent equalization tanks including transfer pumps and flow controls, are required. Influent equalization also provides reduced peak flow through the downstream processes, which offers the potential to marginally reduce the size of the tertiary filters and disinfection units.

The present worth capital cost is estimated to be $22.3 million, marginally higher than the extended aeration option. Operations and maintenance costs over the initial 20 year planning period are estimated to be approximately $23.1 million, which is comparable to the extended aeration option. The 20-year life cycle cost is estimated to be is $45.4 million, again only marginally higher than the extended aeration option.

Overall, this option offers some minor advantages and benefits at the second lowest life cycle cost compared to the other alternatives. However, SBR processes are considered to be less reliable in meeting stringent ammonia criteria compared to extended aeration, produce a more dilute waste sludge, generally suffer from higher start-up costs, may require special measures to protect mechanical equipment from exposure to freeze conditions and relies heavily on automated control (PLC), often proprietary in nature, interfaced with SCADA. In addition, since there are a number of proprietary SBR process modifications that may be "different" or offer distinct advantages over the CASS SBR process currently employed at the Bradford WPCP, the choice of supplier(s) could be limited. Finally, this option may require more area for construction and would not be amenable to conversion to CAS in the future.

4.4 Results of Public Consultation for Preferred Sewage Treatment and Disposal Alternatives

During the public consultation and agency review process as part of the MSS, there were no significant discussions or issues related to the wastewater treatment component of the Master Plan. Any comments or enquiries were minor in nature. The originally proposed concept of expanding the existing wastewater treatment plant with an extended aeration process + Aerobic Digestion, with the flexibility for long-term conversion to a CAS + Anaerobic treatment plant was proposed in the MSS and adopted.

4.5 Preferred Sewage Treatment and Disposal Alternative

Table 4.2 summarizes the advantages and disadvantages of the design options considered for the expansion of the Bradford WPCP. Appendix H provides a more detailed breakdown of costs, including capital and operating and maintenance (O&M) costs for all the expansion alternatives. On the strength of the preceding evaluation, the extended aeration alternative is the recommended choice to expand the WPCP, based on the following key strengths:

- Less reliant on proprietary controls and technologies
- Relatively simple to operate and control
- Provides a high level of treatment efficiency, flexibility and reliability
- The most understood and arguably, one of the most adopted secondary treatment technologies for communities in Ontario
- Excellent ability to treat variable wastewater loadings and flow rates
- High confidence to meet stringent ammonia criteria
- Ability to customize or retrofit for future conversion to CAS through addition of primary clarifiers and additional secondary clarifiers and anaerobic sludge digestion or other hybrid activated sludge treatment processes
- Marginally lower capital cost than the SBR alternative and a comparable operating and maintenance cost.

Section 7 of this ESR presents in more detail the recommended projects involved in the design and implementation of the extended aeration alternative.

5.0 Assimilative Capacity Study

5.1 Overview

In order to assess the ability of the Holland River to assimilate discharges from the proposed expanded Bradford WPCP and to establish suitable effluent criteria, a desktop assimilative capacity study was carried out. The detailed report on this study is provided in Appendix F. The highlights and key results are presented below.

Historical and future river quality was evaluated in comparison to the Provincial Water Quality Objectives (PWQO's). The PWQO's have been established by the MOE to provide guidance in making water quality management decisions and are often used to derive effluent requirements for new or amended Certificates of Approvals. The PWQO's also serve to designate the limit for a parameter beyond which the water quality should not be degraded any further.

The MOE document "Water Management – Policies, Guidelines, Provincial Water Quality Objectives" (sometimes referred to as the MOE "Blue Book"), dated July 1994, is the province's main policy document on the protection of surface and groundwater resources. The provincial surface water quality goal is "to ensure that the surface waters of the province are of a quality which is satisfactory for aquatic life and recreation." In order to achieve this goal, several policies were presented in the Blue Book, including: Policy 1, where surface water quality is better than the PWQO, and Policy 2, where existing surface water quality does not meet the PWQO's. These designations must be assessed on a parameter-by-parameter basis for the river.

The Policy 1 guideline states that water quality shall be maintained at or better than the PWQO. In this case, the maximum acceptable after-mixing concentration (downstream of the point of discharge) is equal to the PWQO criterion.

For Policy 2 parameters, the water quality may not be degraded further. In this case, the maximum acceptable after-mixing concentration is equal to the upstream river (background) 75th percentile value of the parameter being evaluated. In other words, if the receiver is considered Policy 2 for parameter X, then the WPCP effluent concentration of parameter X should be no higher than the historically-expected concentration of parameter X in the River (upstream) for that time of year. In this situation, the actual flow rate or load discharged is not limited; it is only the concentration that is critical.

In cases where compliance with these policies is not practically achievable due to technology limitations or pre-existing impairment of the receiver from other sources, the MOE may approve projects that do not comply with Policies 1 or 2 at their discretion.

5.2 Methodology

The objective of the assimilative capacity study is to establish the quality of effluent which can be discharged from the Bradford WPCP without causing or increasing negative impacts on the quality of the receiving water body, in support of the ESR and an amended C of A. It is proposed that the WPCP ADF be increased to about 17,400 m^3 /day in order to meet the planned 25-year growth of the Town. In order to establish new effluent limits for the WPCP, the following work was undertaken:

- Historical Holland River water quality and flow data was analyzed. For the purposes of assessing capacity, the 75th percentile of the upstream historical data set for each calendar month was considered to be the background concentration

- For each water quality parameter of interest, an assessment was made of whether the river should be considered Policy 1 or Policy 2, for each calendar month

- Maximum acceptable after-mixing concentrations of the contaminants of concern in the river were assessed in accordance with Policy 1 or Policy 2, or general "Blue Book" principles for parameters without PWQO criteria, as applicable

- River flow data available from the Water Survey of Canada was compiled and analyzed to estimate the 7-day average low flow rate (20-year return period) at Bradford for each month of the year (7Q20)

- Maximum acceptable WPCP discharge concentrations of key wastewater contaminants for each month of the year were evaluated.

5.3 Phosphorous Load Allocations for Lake Simcoe Watershed

Typically, phosphorous is considered one of the main contaminants of concern for surface water discharge of treated municipal wastewater. High levels of phosphorous lead to excess plant life and decreased oxygen levels, which in turn harm fish and other aquatic animals. The LSRCA in conjunction with the MOE have identified phosphorous as a particular contaminant of concern in this watershed, and they are in the process of implementing phosphorous load reduction strategies for dischargers to the watershed.

The LSRCA total phosphorous allocation for the Bradford WPCP is 2.046 kg/d, although the MOE C of A currently allows only 1.56 kg/day. This allocation is best described in a letter dated December 8, 1999 from Don Grabowski of the MOE, which is attached in Appendix A. In part because of this letter, it is understood that limits higher than the current MOE load limit may be permissible to the MOE if it can be demonstrated that higher loads comply with the intent of provincial policies for surface water.

The current MOE approved phosphorous load amounts to an effective concentration of 0.14 mg/L at the design flow of 11,146 m^3/d, or around 0.176 mg/L based on the current WPCP rating of 8,870 m^3/day. However, the Town has maintained effluent phosphorous concentration well below this value.

It understood that the current MOE phosphorous load limit was simply based on the product of the design flow and the proposed effluent concentration criterion, and did not have any particular scientific basis (e.g., no connection to assimilative capacity or provincial Water Quality Policies). The full LSRCA load allotment of 2.046 kg/day was not reflected in the C of A simply because it was not needed at that time.

5.4 Summary of Findings

Key findings of the assimilative capacity study, as presented in Appendix F, are as follows:

- The West Holland River is MOE Policy 2 with respect to Total Phosphorous (year-round). In other words, there is **no remaining assimilative capacity** in the river for phosphorous, even before the river reaches Bradford. Regardless of the concentration of phosphorous in the WPCP effluent, the PWQO criterion cannot be met downstream

- To meet MOE Policy 2 requirements, it was determined that a monthly average TP concentration less than or equal to 0.111 mg/L would be required in the WPCP effluent (rounded down to 0.11 mg/l), based on the analysis of the historical data. Relative to the existing C of A compliance limit of 0.14 mg/l, this represents a small, but significant reduction

- The West Holland River is usually MOE Policy 1 with respect *E.coli* and un-ionized ammonia (although there are individual months that exceed PWQO, where Policy 2 should apply). Thus there are loading limitations (flow and concentration) for these parameters

- A monthly maximum average TP concentration of 0.11 mg/L would result in a maximum daily loading to Lake Simcoe of 1.914 kg/day (based on the design flow of 17,400 m^3/d), which is an increase over the existing allotment defined by the C of A, but a 6.5 percent reduction in the total daily loading allotment (cap) of 2.046 kg/L currently allocated to the Bradford WPCP

- For the purposes of phosphorous impacts on surface water and compliance with MOE policies, there is no limitation on phosphorous flow rate, as long as the concentration limit of 0.11 mg/l is met. However, the loading limit to Lake Simcoe effectively places a flow rate limit on the WPCP discharge, and at higher flow rates than currently proposed, other water quality parameters become limiting to flow

- A low flow analysis of the West Holland River shows that flows are lowest in June, July and September, with 7Q20 flows ranging from 0.15 m^3/s in September to 1.02 m^3/s in April

- From an assimilative capacity perspective, the critical water quality parameters are un-ionized ammonia and TP. Significant reductions in effluent limits would be required to comply with MOE Policies and Objectives (0.11 mg/l for total phosphorous and 0.3 mg/l for total ammonia)

- *E.coli* limits for the WPCP effluent would need to be maintained below 123 counts/ 100 ml, in order to comply with PWQO's and MOE Policies

- Basic pH sensitivity analysis shows that the maximum allowable total ammonia in the effluent can be increased substantially if the after-mixing pH in the River is lowered relative to historical levels. For example, if the after-mixing pH were reduced consistently below 7.5, the WPCP ammonia limit for compliance with the MOE policies increases from 0.3 mg/l to 1.4 mg/l It is recommended that a more detailed assessment of expected after-mixing river pH be performed to confirm appropriate ammonia criteria prior to detailed design. This would need to consider the future pH of the effluent, which may be impacted by future changes in the supply of potable water. Currently all potable water distributed within the Town is derived from groundwater. A new water transmission main from the Town of Innisfil will be constructed to provide the Town with potable (lake-based) water, which will be "softer" and less alkaline than the ground water currently utilized in the Town.

The resulting effluent criteria indicated by the assessment are summarized in Table 5.1 below.

Table 5.1: WPCP Effluent Discharge Criteria Required to Meet MOE Policies 1 and 2

Parameter	Existing Non-Compliance Criteria C of A #. 4233-623HNH ADF = 8,870 m^3/day	Effluent Criteria to Meet MOE Policies ADF = 8,870 m^3/day	Effluent Criteria to Meet MOE Policies ADF = 17, 400 m^3/day
Total Phosphorous	0.14 mg/L (1.24 kg/d)	0.111 mg/L (0.96 kg/d)	0.111 mg/L (1.94 kg/d)
Total (Ammonia + Ammonium) Nitrogen	2.0 mg/L (April – Oct) 4.5 mg/L (Nov – March)	0.3 mg/L (April – Oct) 3.4 mg/L (Nov – March)	0.3 mg/L (April – Oct) 2.1 mg/L (Nov – March)
E.coli	200 organisms/100 ml	145 organisms/100 ml	123 organisms/ 100 ml
In addition, un-ionized ammonia levels shall not exceed 0.1 mg/L in the effluent.			

5.5 Comparison of Findings with 1994 Assimilative Capacity Assessment

The findings and recommendations of the current assimilative capacity study are substantially different than the results of the assessment done in support of the April 1994 ESR prepared by Proctor and Redfern. In particular, ammonia limits that would be required for MOE Policy compliance are much lower than the existing limits. Comparison of current results and methodologies to previous work is especially relevant to understanding if significant changes have occurred to receiving water quality and quantity over the past 10 years. A summary of the most notable differences is outlined below:

- As stated in Section 2 of this report, Burnside reviewed 11 years of the most recent water quality data to determine the historical background concentration of key wastewater parameters. The previous study only reviewed three years of river quality data. The average river quality from that 3-year period is generally better than the long-term average demonstrated by the current study, so the current data set is believed to be more representative of the actual background water quality.

- The seasonal variability of free ammonia levels was disregarded in the previous analysis. The previous approach calculated a yearly 75th percentile value for total ammonia, rather than calculating separate 75th percentile values for each month of the year. Using this method, the resulting 75th percentile value was well below PWQO and therefore only Policy 1 applied. The Burnside approach is more in keeping with current practices and is considered to be more reflective of the seasonal highs and lows of ammonia that occur during the critical months.

- Differences were also noted in the low flow analysis of the Holland River. Burnside performed analysis to determine 7Q20 flows using standard low flow statistical analysis techniques on a historical data set spanning eleven years. The previous analysis used the lowest seven-day flow rate actually observed over 9 years of data rather than calculating statistical 7Q20 flows. Therefore, the river flow rates tend to be higher and provide more dilution, than 7Q20 flows. The current method is consistent with currently accepted practice and MOE expectations, and considered more representative of extreme dry events that may occur. In addition, the previous flow analysis was performed on a quarter-by-quarter basis, instead of a month-by-month basis, making the extreme dry periods less pronounced. The month-by-month assessment now employed is more reflective of the seasonal extremes and is the preferred method of assessment.

These differences in the approach to the assimilative capacity assessment provided a better background water quality assessment and more dilution. This resulted in the recommendation of higher allowable effluent criteria than what has been determined from the assimilative capacity study completed for this ESR.

6.0 Proposed Effluent Discharge Criteria

The West Holland River is in an impaired state, and has been for many years. The river water is often of poor quality with elevated nutrients and elevated pH, both upstream and downstream of Bradford. The benthic study has confirmed this assessment, showing poor diversity of benthic organisms both upstream and downstream of Bradford.

The River has no remaining assimilative capacity with respect to phosphorous, and during some months of the year has little or no remaining capacity for ammonia and *E.coli* bacteria.

The West Holland also contributes to the degradation of Lake Simcoe, which is also considered impaired, as documented by the LSRCA.

The data shows that this impaired condition would exist regardless of any contribution to impacts from sources within the serviced community of Bradford. Nonetheless, it is recognized that discharges from the Bradford WPCP could potentially worsen this pre-existing condition, and as such it is important that discharge criteria for the WPCP be established such that the impact is minimized.

The desktop assimilative capacity study has shown that the proposed expanded WPCP would theoretically require lower concentration limits for Total Phosphorous and Total Ammonia in order to conform to the MOE "Blue Book" Policies. The *E.coli* objective can be maintained at the current level. It was concluded that the existing compliance limits for (c)BOD and TSS are adequately protective and do not need to be reduced for the WPCP expansion.

The proposed effluent criteria for the expanded Bradford WPCP are summarized in the following Table 6.1. No new parameters are recommended.

Table 6.1: Proposed Effluent Criteria for Expanded WPCP

Average Daily Flow Rate (ADF) (m^3/d)	17,400
5-day (Carbonaceous) Biochemical Oxygen Demand (mg/l)	10
Total Suspended Solids (TSS) (mg/l)	10
Total Phosphorous (TP) (mg/l)	0.11
Ammonia + Ammonium Nitrogen (NH_3-N) (mg/l)	Warm months: 0.8 Cold months: 2.5
E.coli (organisms/ 100 ml)	100

Historical *E.coli* counts in the treated effluent are well below the current objective and that this level of performance is expected to be achievable for the expanded WPCP.

In the case of lower total ammonia effluent concentrations required to conform to the MOE Policies, it is not considered practical to design plant facilities to consistently meet the very low warm-month concentration limit (<0.3 mg/l total ammonia) at design capacity flow. Therefore, in the case of total ammonia, it is proposed that the future effluent criteria for warm-weather months be reduced to 0.8 mg/l. This figure is in the vicinity of the lowest economically achievable concentration which can be consistently met, represents a substantial reduction over currently approved limits and meets new Federal guidelines for release of ammonia.

The consequence of an ammonia limit higher than that suggested by the assimilative capacity study is that when at or near capacity, the WPCP discharge will occasionally cause the PWQO for ammonia to be exceeded in the river. However, this is also true for the currently approved plant, and the frequency and severity of poor ammonia quality will be less under the proposed scenario than at full capacity and rated ammonia effluent concentration of the existing plant.

In fact, even at 0.8 mg/l total ammonia, the maximum loading to the River at future capacity will be substantially lower than the currently approved WPCP discharge load, as illustrated in Table 6.2 below.

Table 6.2: Comparison of Current versus Proposed Ammonia Loading Criteria

Condition	Flow Rate (m^3/day)	Maximum Summer Concentration (mg/l)	Maximum Load (kg/d)
Previous C of A (revoked 2004)	11,145	2.0	22.3
Current C of A (approved 2004)	8,870	2.0	17.7
Proposed Future	17,400	0.8	13.9

Similarly, a winter effluent criteria of 2.5 mg/l total ammonia is proposed, slightly higher than the level recommended by the assimilative capacity study, for reasons of practical feasibility. Again, this represents a net improvement over the currently approved conditions.

In the case of the reduced Phosphorous requirement, the target is aggressive, but is considered achievable with existing technology in conjunction with optimized process control. As shown in Table 6.3, compared to the existing C of A criterion, the lower criterion will require some design (e.g., providing more filters to lower filtering rates) and operational enhancements (improve flow control and Alum dosing) in order to achieve the target consistently. Chemical usage and sludge generation will increase. Overall, the reduced limit is considered achievable.

Table 6.3: Comparison of Current versus Proposed Phosphorous Loading Criteria

Condition	**Flow Rate (m^3/day)**	**Maximum Concentration (mg/l)**	**Maximum Load (kg/d)**
Current C of A (approved 2004)	8,870	0.14	1.56
Proposed Future	17,400	0.11	1.91
LSRCA / MOE Lake TP Cap	-	-	2.046

Note that the proposed phosphorous limit is rounded down from the approximate limits derived from the MOE policies (0.111 mg/l) and the LSRCA Lake loading allotment (0.1175 mg/l, based on 2.046 kg TP/d).

As the net effect of the proposed expansion at the proposed criteria is a net improvement to conditions in the River, and further reductions are deemed impractical for a number of reasons (e.g., technical, cost, future treatment objectives, etc.), the proposed criterion is considered appropriate.

7.0 Recommended Projects

7.1 General

The recommended projects to modify, rehabilitate, and expand the treatment capacity of the Bradford WPCP are described in detail in this Section. The details are provided to assist in understanding the basis of the recommended design concepts and cost estimates. In conjunction with the electronic databases (drawings and design calculations) developed for the ESR, this will assist in expediting design and construction, the final phase (Implementation) of the EA process.

Expansion of the WPCP is to proceed in phases, including new works (Plant D) to provide more overall capacity and upgrades and other strategically times modifications as required to maximize the performance, efficiency and capacity of the Bradford WPCP.

The extended aeration process is recommended as the preferred alternative for construction of Plant D, the next phase of the WPCP expansion. This process offers economic and functional benefits and facilitates conversion to a CAS, BNR (Biological Nutrient Removal) or other treatment process in the future, referred to as future Plant E. Final design and expansion of the WPCP in 2005-2007 would be necessary as the average daily flow increases to the committed flow capacity of Plants B and C combined. The general arrangement and the associated details of the proposed expansion are shown in drawings G2, G3, P1 and P2. The configuration of tanks (circular, rectangular), buildings and site works will be finalized during detailed design. The works as planned are delineated by Phase, based on the timeline and growth projects shown in Figure 7.1

Phase 1 (illustrated in blue on the drawings) will be initiated immediately following approval of this ESR. The design will incorporate a new and expanded, multi-purpose Headworks to service the entire facility well into the future including new primary treatment equipment and flow control and monitoring capability, two new extended aeration tanks, two new secondary clarifiers, new sludge pumping facility, two new aerobic digester tanks, new biosolids handling facility including transfer pumps and covered storage tank and expanded tertiary treatment system including four new filter cells, two new filter modules, one new UV disinfection module and three new effluent pumps, all in an expanded Filter / UV Disinfection building. The works will be integrated to existing operations with minimal impact.

Phase 2 (illustrated in red on the drawings) includes addition of primary treatment equipment in the Headworks, two aeration tanks, two secondary clarifiers, sludge pumping facility and biosolids thickening equipment.

A summary of preliminary design calculations for the proposed WPCP expansion, broken down by Phase, is presented in Appendix G. In conjunction with the new works, improvements associated with the existing digesters, rather than a complete conversion of Plant A, and other future capital projects, are proposed. A detailed breakdown of these projects including operating and maintenance costs, capital projects and planned future maintenance requirements are outlined in Appendix H.

7.2 Inlet and Primary Treatment Design Alternatives

As previously reported, the Division Structure is not configured to provide sufficient hydraulic head to drive peak flow through the WPCP. With future increases in influent flow and with the expansion of the WPCP, additional hydraulic head will be required.

The first stage of treatment includes flow diversion to a new Headworks housing mechanically cleaned bar screens including screenings washer, conveyor, hopper and bin, a dry pit/wet pit low lift pump system, vortex grit units and grit classifier followed by a flow distribution and control chamber. This approach is similar to well proven processes and practices at the WPCP and can be readily adopted by operations staff.

All wastewater from the service area enters the WPCP through three sewer siphons (900/400/250 mm diameter) connected to the Division Structure located at the entrance to the plant. The assessment of the inlet hydraulics to the WPCP concluded that the existing Division Structure cannot provide sufficient head to drive flow through the expanded WPCP and that a new influent low-lift pump station is required. The preliminary hydraulic profile of the proposed Plant D expansion and its integration with existing Plants B and C, is shown graphically in Drawing P2. Conceptually, the drawing shows that in order to provide gravity flow through the expanded WPCP, the hydraulic grade line (HGL) must be raised to an elevation greater than 224 m, which is almost 1.2 m higher than the current high water level (HWL) at the Division Structure.

The Division Structure would be modified to include a new outlet chamber and controls to facilitate installation of a 900mm diameter gravity sewer running to the new Headworks. This can be accomplished without disruption to the existing operation by tying into the new inlet chamber, which was designed and constructed with this modification in mind.

The sluice gates (formerly used to modulate flow) ahead of the existing Parshall flumes would be retained in order to shutoff flow through the flumes to the Influent building. The intent is to ultimately redirect all flow to the new Headworks, but still permit the existing overflow weir to remain hydraulically connected to the redirected influent stream. The overflow would be directed through an existing 450mm diameter pipe that runs to the storm surge pond.

The Headworks would be a multi-purpose facility to include as conceived a primary treatment zone, odour controls, expandable blower room, training and administrative /

operations offices, new control room, new MCC and other supporting service areas including a material transfer garage and chemical room. Detailed design could evaluate the possibility of expanding the existing chemical feed and transfer facilities located in the existing Influent building to service the needs of the entire WPCP, including Plant D, rather than constructing a new chemical room in the Headworks. Ideally, all chemical storage and handling facilities would be centralized in one location.

At the inlet to the Headworks, mechanically cleaned screens would remove plastics and other large diameter materials entering the WPCP. The concept design assumes that the screen would be designed to remove any particles of 6 mm size or greater, which would be an improvement over current screens and provide downstream flow controls greater protection from in-coming debris. Liquid will pass through the screens but the larger material would be retained by the screens, removed from the liquid flow, discharged to screenings washer via a hopper in order to remove organics, and then transferred to a screenings conveyor. Ideally, to minimize operator exposure to health hazards handling these materials, the screenings conveyor discharge would be equipped with a bagging unit inserted in a bin for ultimate disposal.

After screening, the flow will enter the influent low-lift pump sump, which should be sized for a peak flow (PF) of 60,000 m^3/d (half the PF capacity of the incoming sewers). Low-lift pumps would elevate the incoming flow to a distribution channel feeding vortex (hydraulic centrifugal) grit separators. Heavier grit will be concentrated and removed to a grit classifier for dewatering and bagging.

The flow control chamber will collect the de-gritted wastewater and direct the combined flow to Plant B, C and D. It will be possible to more accurately control flow to each Plant by means of individual flow control valves and electromagnetic flow meters controlled by SCADA. In this way, peak instantaneous flow may be reduced to Plant B, with the balance of short duration peaks being routed through either Plants C or D.

Screens, pumps and grit separators would be sized based on peak flow in equally sized modules to accommodate future expansion. If and when the WPCP is ultimately converted to conventional activated sludge, conceived as future Plant E, the de-gritted flow would be rerouted to primary treatment clarifiers ahead of the aeration tanks. Conceivably with this modification and the addition of more secondary clarification and blower capacity, the flow through the Plant D aeration tanks can be increased significantly.

7.3 Secondary Treatment Design Alternatives

An expansion alternative considered in the 1994 ESR was an extended aeration plant located south of the existing tanks on the site. An extended aeration process alternative provides the option for future conversion to a conventional activated sludge (CAS) or other treatment processes beyond the current planning period through the addition of primary and secondary clarifiers and other associated process equipment.

Secondary biological treatment provides for the removal of organics by means of aeration and solids control. The secondary treatment system consists of aeration tanks, secondary clarifiers and sludge recycle (RAS) and sludge wasting (WAS) pumps. Organics, solids and nutrients (nitrogen and phosphorous) are essentially assimilated by the biomass, which are maintained under aerobic conditions, as is the normal mode of operation for extended aeration activated sludge treatment.

The aeration tanks for the plant D expansion have been configured as long, relatively narrow rectangular basins. This is preferable since the existing property is limited to an area of about 100m wide, south of the existing Plant C SBR basins. Each aeration tank will be configured for plug flow incorporating fine bubble diffusers, which could employ a tapered pattern to equally distribute the airflow and accommodate the higher loadings at the front end of each basin. A plug flow-mixing pattern provides higher treatment efficiency and less short circuiting compared to complete mix systems and is equally suitable for extended aeration, conventional activated sludge and other advanced treatment processes.

As conceived, each Phase will consist of two aerated tanks sized to handle an ADF of 5,000 m^3/d and PF of 12,500 m^3/d, followed by two secondary clarifiers and a sludge pumping building. Aeration tanks are sized based on providing 24 hours HRT whereas clarifiers have been sized based on a flow allowance that includes PF, 100 percent ADF sludge recycle and internal recycles (a portion of the filter reject and decant flows) and solids loading criteria, assuming an MLSS of 5,000 mg/L.

The secondary clarifiers are estimated to be approximately 22 m diameter with a side water depth of 4.5m and would comprise integral solids contact / flocculator mechanisms designed to further optimize phosphorous removal. Alternative configurations including rectangular clarifiers with common wall construction would be evaluated during final design. Multi-point alum dosing should be provided. Pumps, valves and controls designed specifically for activated sludge pumping duty would be integrated with the clarifiers and be located in a clarifier building.

7.4 Tertiary Treatment Design Alternatives

Tertiary treatment provides for the polishing of the secondary effluent after clarification. This step ensures the treated effluent contains virtually no residual organics, solids and metals, particularly phosphorous, and active pathogenic organisms such as *E.coli*.

The key treatment process is filtration, which is currently accomplished at the WPCP using continuous backwash, deep-bed (2 m) sand filters. The existing "Dynasand" filters (four modules each consisting of six filter cells), have proven effective in maintaining very low solids and phosphorous concentrations following secondary treatment and alum dosing.

The existing filters were originally sized by the Ainley Maple Design-Build consortium for a peak flow capacity of approximately 31,811 m^3/d, based on the combined ADF for Plant A, B and C of 11,416 m^3/d. Based on the total available filter area of approximately 112 m^2, this results in a peak surface-loading rate of approximately 3.3 L/s/m^2, the maximum rate recommended under MOE guidelines. On the basis that more stringent effluent phosphorous concentrations are required, the peak surface-loading rate should be reduced for the expansion to maximize filter performance. In addition, since there is limited firm capacity to take a filter module off-line for maintenance, additional filtration capacity is required and should be implemented with the Phase 1 of the Plant D expansion, even though the proposed peak rating for the WPCP at Phase 1 is less than the current PF rating.

For the purpose of this report, the sizing of the filter expansion is based on a reduced peak surface-loading rate of 2.1 L/s/m^2 serving the combined peak flows from Plants B, C and D. This provides essentially double the current filtration capacity, the equivalent of four additional cells.

To achieve this, it is proposed to expand the existing Filter / UV Disinfection building with the construction of the complete building expansion including four filter cells, filter reject sump with duplex pumps, two compressors and installation of two of four filter mechanisms in Phase 1. Interconnections to the existing filter feed and effluent channels would be required. Installation of the remaining two filter mechanisms would be implemented as part of the Phase 2 work.

Following filtration, the combined flow from the existing and new filters will be routed through the existing effluent channel that includes two existing banks of ultra violet (UV) disinfection lamps. The existing Trojan UV banks are rated for a peak flow capacity of approximately 31,811 m^3/d, based on the combined ADF for Plant A, B and C of 11,416 m^3/d (same rating as the existing filters). Since there is insufficient firm capacity to take one of the UV banks off-line for maintenance, additional UV disinfection capacity is required and should be implemented with the Phase 1 of the Plant D expansion, even though the proposed peak rating for the WPCP at Phase 1 is less than the current PF rating of the existing UV system. To accomplish this, it is proposed to install two new UV banks in the existing effluent channel, one during each phase of the expansion.

After disinfection, the final effluent flow is pumped via three submersible pumps. The three pumps combined have a total rated capacity of 31,200 m^3/d, which meets the current peak flow rating of the WPCP. However, with one pump out of service, the firm capacity is reduced to approximately 26,100 m^3/d. Therefore, new larger submersible pumps that can be installed on the existing discharge elbow and guide rails (to minimize disruption of the existing operation) are proposed as part of the Phase 1 works. The capacity of the existing electromagnetic flow meter (measuring the total effluent flow from the WPCP) and connecting outlet sewers and outlet (discharge) channel are considered to be adequate for the expanded WPCP peak flows including Plant D (both phases).

7.5 Biosolids Handling Design Alternatives

The WPCP currently generates between 9,000 and 11,000 m^3 of stabilized sludge per year. The biosolids are hauled away once per year for disposed by land application, all in accordance with applicable regulatory requirements.

There are a number of the key driving forces that impact short and long term planning for the phasing in of improvements to manage residual biosolids from the WPCP. The current operation is managed effectively and in accordance with government guidelines. However, forthcoming changes driven primarily by the Nutrient Management Act and other factors related to public perception and input, availability of land for biosolids deposition, health and safety, operations and maintenance and MOE guidelines, require further evaluation.

The WPCP currently employs aerobic digestion to further convert organics, stabilize sludge and destroy excess solids. The operational objective is to achieve more than 45 days total sludge age before pumping the stabilized sludge to the south sludge storage lagoon. Overriding factors from an operational perspective include minimizing sludge generation while maximizing stabilization. This is based on provision of adequate control of digestion of biosludge, comprising waste biological sludge from the activated sludge treatment trains (Plants B and C) and chemical sludge comprising mostly aluminum and phosphate residues as required for Phosphorous polishing. With addition of Plant D and continued increase in sewage flow to be treated, sludge digestion and storage requirements will increase significantly, well beyond the current capacity of the WPCP.

As previously indicated, modifications to improve the existing digestion process are recommended. However, it is concluded that with incremental changes and adjustments to the operation of the existing digesters, rather than the total conversion of Plant A for the digestion of sludge from Plants B and C, it should be possible to continue to operate with existing digester tankage and then when Plant D is constructed, redirect WAS from Plant C to Plant D. This appears to be a more cost effective solution given that the cost to fully upgrade Plant A ($1.5-2 million as discussed in the next section) is much greater than providing for the necessary upgrades to the Plant B and Plant A digesters (new diffusers, valves and instrumentation) and providing for the additional sludge digestion capacity for Plant C in Plant D. The incremental cost to upgrade the proposed Plant D digesters to accommodate the Plant C waste sludge, estimated to be approximately $0.5 million, is minor compared to the overall cost to expand the WPCP.

To accommodate the waste sludge from Plant D and Plant C, two new circular aerobic digesters would be installed as part of Phase 1. This configuration includes a "removable" inner wall that is initially intended to subdivide the digester into primary and secondary stages. The inner wall would also facilitate removal should these tanks be converted in the future to anaerobic digesters.

For the purpose of this report, the sizing of the aerobic digesters to achieve the necessary sludge stabilization time is based on an estimate of projected sludge production from Plants C and D of 510 m^3 of digester capacity per 1,000 m^3/d treatment capacity. The basis for this capacity is discussed in more detail in Section 7.6. With future improvements in waste sludge management, the actual sludge production per unit of wastewater treated is expected to be less.

Based on the above, the digesters are estimated to be approximately 28 m diameter with side water (sludge) depth of 6 m, yielding a gross sludge capacity of approximately 7,300 m^3. Each digester would be equipped with a coarse-bubble diffused air system (fed from three blowers in the Headworks) and contain integral decanters designed to assist in increasing the sludge solids consistency and sludge age in the digesters. Decant from the digesters would be pumped back or flow by gravity to the chamber feeding the Plant D aeration tanks. Pumps, valves and controls designed specifically for sludge pumping and transfer would be integrated with the digesters and biosolids storage tank and be located in a digester building. The Digester building should be configured for future installation of a sludge thickening process and other possible modifications. It is recommended that both digesters be constructed as part of Phase 1.

A circular configuration is recommended on the basis of the possibility of converting these tanks to anaerobic digesters in the future. As such, the design of the tanks and appurtenances should take that future possibility into consideration.

The existing sludge storage lagoons will be maintained, at least into the foreseeable future, to provide storage for stabilized sludge from Plant B. Stabilized sludge from the Plant D digesters will be transferred to a 12,000 m^3 covered biosolids storage tank. The conceptual design is based on a glass-lined steel tank sized to provide the equivalent of 365 days storage. While this is greater than the minimum storage time of 240 days required by regulations, this is necessary since the Town is currently only able to dispose of the stabilized sludge by land application once per year. With the diversion of sludge from Plant C to Plant D, there will be a total of 22,000 m^3 of sludge storage available at the WPCP site.

As part of Phase 2, a mechanical sludge thickening process designed to increase the solids concentration of the stabilized sludge (from about 2% to 5%) would be installed in the Digester building. This is considered a more cost effective means to reduce the sludge volume for storage and ultimate disposal, as compared to just adding more storage volume.

7.6 Modify Plant A to Increase Aerobic Digestion Capacity

The 1994 ESR assumed that the aeration tanks and clarifiers of Plant A would one day be used in some capacity to provide the necessary sludge stabilization time for Plants B and C. However, pricing the digestion requirements was based on new facilities that were never built to accommodate the entire WPCP expansion. Since this was never implemented, the cost to make up this deficiency must now be incurred.. This was further recommended in the MSS since it has been determined that based on current and future operations, there may not be sufficient digester volume for Plants B and C.

Following the MSS, a design-build tender was issued in 2004 with the general intent to expand the existing aerobic digestion capability at the WPCP (before the Plant D Expansion) to service the combined sludge digestion needs for Plant B and Plant C. This would be achieved, in concept, by constructing a multi-stage, multi-train aerobic digestion process by converting the existing aeration and settling tanks of Plant A to new digester cells since these tanks are not longer in service. This work would require further modifications to existing equipment and structures, but would provide the equivalent of approximately 3,000 $m^3$of new sludge digestion capacity. To meet MOE guidelines, the total digestion volume including the Plant B digester would be approximately 4,500 m^3 with the conversion (compared to about 3,000 m^3 without the conversion), which was estimated to be sufficient to service the combined sludge of Plants B and C at the full rated capacity (8,870 m^3/d). This is equivalent to about 510 m^3 of digester capacity per 1,000 m^3/d plant capacity. This is higher due largely to the more dilute SBR sludge than the estimate of 440 m^3/1,000 m^3 indicated in the 1994 ESR, which recommended a digester volume of 6,615 m^3 for the plant expansion to 15,000 m^3/d. This is due largely to the more dilute sludge from the Plant C SBR's.

Based on the two formal bids received to carry out the proposed modifications to Plant A, the cost to fully upgrade Plant A is expected to be $1.5-2 million, which is much greater than previously estimated. In view of the high cost associated with the proposed Plant A conversion, Burnside revisited the need for additional biosolids digestion capacity or other digestion improvements for the existing treatment trains, for the interim period before the implementation of the proposed Plant D expansion. Calculations based on historical WPCP data, summarized in Tables G3 and G4, show that the existing sludge digestion facilities may not meet the 45-day criterion for Plants B and C as flow reaches the rated design capacity of 8,870 m3/d. However, at current and near-term flow rates, improvements to decanting and other operational considerations are recommended to ensure the 45-day criterion is met over the next few years.

In view of the above, it is recommended that some incremental modifications, rather than a complete overhaul of Plant A, be carried out in the near future to address short-term needs for Plants B and C. Once the new Plant D digesters are commissioned, the sludge from Plant C would be transferred to Plant D, resulting in a significant reduction in sludge flow to the existing digesters. In effect, there would be some cost savings by not proceeding with the full conversion of Plant A to a conventional aerobic digestion process and in transferring the sludge from Plant C to Plant D.

7.7 Optimization of Plants A, B, C and D

Opportunities to extract more capacity out of the existing and new treatment processes, improve treatment efficiencies and reduce operating costs may be realized through further process optimization and treatability studies. Key objectives include:

- determine the potential to increase the rated capacity of Plants B and C to treat flows beyond the current rated capacity of 8,870 m^3/d
- identify upgrades that would be needed to the existing processes and the estimated costs to allow additional capacity or improved efficiencies to be realized
- pilot test advanced technologies that offer the potential of increased capacity by retrofitting existing treatment tanks.

With the expansion of the WPCP, the opportunity to explore the full treatment potential of existing (and new) facilities will be improved; giving operations staff additional flexibility to stress test and optimize the processes. This work may have to be coordinated with ongoing preventative maintenance activities as there is little value in optimizing systems that need refurbishment, e.g., the Plant C membrane diffusers were replaced in 2004 and some further upgrades to instrumentation have taken place to facilitate potential optimization of Plant C.

With improved efficiencies yielding more available treatment capacity, it may be possible to provide treatment capacity at the Bradford WPCP for intensification or other populated areas in the Town currently outside the serviced area defined by the current OP, including Bond Head and future commercial growth along Highway 400.

7.8 Discharge (Outfall) Design Alternatives

The existing outfall consists of a 600mm diameter gravity sewer running from the outlet structure (converted chlorine contact chamber behind the workshop) to a discharge structure located at the end of the existing outfall channel. Under normal backwater conditions, the outlet sewer and discharge structure are capable of handling flows beyond the current design levels. No changes are considered necessary to accommodate the Plant D expansion.

7.9 Other Design Considerations

7.9.1 Geotechnical

A geotechnical investigation was undertaken by Terraprobe Limited in December, 2003. The report is included in Appendix I.

The report indicates varying depths of fill over the site, ranging from 1.8 to 4.7 metres below existing grade. Buildings constructed as slab on grade will require deeper than conventional 1.2 metre depth for footings and the removal of all fill material below the slab.

In the vicinity of the proposed aerobic digesters and biosolids storage tanks, the depth of fill is approximately 4.0 metres below grade requiring relatively deep foundation and/or the use of engineered fill. The full depth of fill must be excavated and filled below the tank slabs.

Bearing capacities range from 100 to 250 kPa. The lower value is generally in the northern edge of the expansion site (near the existing ditching) at approximately the 218 metre elevation. Much of the tankage will be founded at an elevation with a minimum bearing capacity of 150 kPa, which is suitable.

At the time of the investigation, the water table was measured at 2 to 3 metres below grade and is noted to vary seasonally. The structures should be designed for hydrostatic pressure and uplift assuming the water table is at grade. For deeper/large span structures this could result in heavier (thicker) bases/walls. Alternately, the use of pressure relief valves could be considered where appropriate.

Deeper excavations will require dewatering.

An expansion of the existing Filter /UV Disinfection Building is proposed. Given the depth of this building (approximately 7.5 metres), measures will have to be taken to protect the existing and adjacent structures (shored excavation).

7.9.2 Electrical, Instrumentation, Control and SCADA

The WPCP expansion in 1998 (construction of Plant C) included the installation of a number of upgrades including the following:

- 1,000 kVA substation in a four-sided substation fenced enclosure, together with power fuse mountings and holders, intermediate class arrestors and cable terminator at terminal pole
- 44 kV poleline with load breaker switch
- 660 volt 1,200 amp main switchboard (to allow for future expansion)
- new feed from switchboard to then existing MCC along with additional MCC's, panels and exterior lighting.

The construction of Plant C included installation of a 80-kilowatt diesel generator, which provided backup power to the final effluent pumps and one filter backwash pump. In the event of an extended power outage, sewage would be conveyed to the Storm Surge pond or through the plant without full biological treatment or disinfection. Excessive solids washout from the aeration tanks would require bypassing the filters, which would be considered a spill by the MOE.

Subsequently, the smaller backup power unit was replaced with a 900 kW/1000 kVA standby diesel generator in 2001 to provide full backup power to the existing plants A, B and C. The generator is connected to provide power to maintain the biological treatment processes and filters to maintain effluent quality. This generator was also sized to potentially accommodate the Plant D expansion. The generator is tested monthly for a minimum of four hours and has functioned as designed.

The instrumentation, control and SCADA system has been gradually upgraded and the old software and PC has been replaced with an Allan-Bradley SLC 503 PLC and Ci-Tect MMI software. The software can accommodate expansion of the plant although some new PLC's would be required.

The general intent is to relocate centralized control and monitoring to a new Control Room in the proposed Headworks. Detailed design will evaluate the deployment of high-efficiency motors and other power saving measures as well as the capacity of the electrical sub-station, potential need for more stand-by power and configuration and location of the main MCC.

7.9.3 Administration and Control

As previously discussed, the existing Administration / Blower building requires a number of improvements to meet current and future needs at the WPCP. This includes the following:

- Construction of new and improved laboratory in a separate room (existing laboratory facilities are located in the same room as the main MCC), particularly since sampling and analysis requirements will be increased with the proposed WPCP expansion
- Amenities to provide separate washroom and shower facilities for male and female staff and disabled persons; and

- Relocation of centralized HMI (human machine interface) and WPCP SCADA control system to a new location in the proposed Headworks.

8.0 Public Consultation for Recommended Projects

A Public Information Center (PIC) was held on January 26, 2005, at the Town's Treasury Building. The PIC was held in an "Open House" format, including posters and handouts, and provided the opportunity to convey information to the public and receive comment and input for completion of the ESR. Included in the material was identification of the preliminary preferred servicing alternative to provide additional sewage treatment capacity for the Town. An information handout was made available to attendees of the PIC and it was also circulated to Provincial ministries, government agencies, municipalities and interested individuals, some of these identified in Section 1.5 and as noted on the study contact list provided in Appendix A.

Copies of all correspondence have been included in Appendix A. Respondents comments generally fell into three key areas:

Environmental – the MOE, MNR, LSRCA have generally confirmed the approach and have acknowledged this undertaking.

Site Development – memos from Stantec Consultants Ltd., on behalf of Geranium Corporation, and GO Transit have identified a few site development issues that would be addressed during detailed design.

Recommended Treatment Process – memo from Stantec, on behalf Geranium Corporation, discussing the suitability of Conventional Activated Sludge (CAS) treatment in conjunction with Anaerobic Digestion, as the preferred alternative. Follow-up correspondence from Geranium confirms their agreement with the preliminary preferred recommendation to expand the Bradford WPCP employing Extended Aeration with Aerobic Digestion.

In recognition of this input, the preliminary preferred recommendation to implement the extended aeration alternative with aerobic sludge digestion remains as recommended in this ESR to service the approved growth.

9.0 Summary of Recommended Projects and Implementation Schedule

9.1 Summary and Costs

This section provides a summary of the recommended projects to modify, rehabilitate and expand the Bradford WPCP, incorporating where necessary public/agency input.

Projects to expand the treatment capacity of the Bradford WPCP are to be implemented in phases:

- Construction of Plant D, Phase 1 includes modifications to the Division Structure, new 900mm diameter inlet sewer, construction of new Headworks complete with two mechanically cleaned screens, two low-lift sumps, three low-lift pumps, two vortex grit separators, flow control chamber, installation of interconnecting piping, flow measurement instruments and control valves to regulate the flow to Plant B, Plant C and Plant D, construction of two extended aeration treatment tanks including fine bubble diffusers, two secondary solids-contact clarifiers, six aeration blowers (three for secondary aeration and three for aerobic digestion), new chemical storage and feed system, expansion of the Filter / UV Disinfection building to facilitate installation of four new filter cells, installation of internal mechanisms for two of four filter cells, installation of one new UV disinfection bank, replacement of the three existing effluent pumps, construction of two circular aerobic digesters with course bubble diffused air system, a Digester building to house sludge handling equipment and one covered biosolids storage tank. The preliminary capital cost including 10% contingencies and 15% engineering for Phase 1, presented in Table 9.1 (also see Appendix H), is estimated to $17.5 million, based on 2005 dollars.

- Construction of Plant D, Phase 2 includes addition of one mechanically cleaned screen, one vortex grit separator, two additional extended aeration treatment tanks with fine bubble diffusers, two secondary solids-contact clarifiers, three aeration blowers, installation of internal mechanisms for the remaining two filter cells, and sludge thickening equipment in the Digester building. The preliminary capital cost for Phase 2 also detailed in Table 9.1, is estimated to $5.4 million, based on 2005 dollars.

Based on the above, over 75 percent of the estimated capital cost to expand the treatment capacity is incurred in Phase 1. It is possible some capital cost savings would be realized if both Phase 1 and 2 were constructed initially. The major drawback to this is that the added capacity of Phase 2 will not be needed for 8 to 9 years (based on the current OP growth scenario) following construction of Phase 1, resulting in capital being expended sooner than required.

Table 9.1: Capital Cost Estimates – Extended Aeration

Item / Area	Total Cost Phase 1	Total Cost Phase 2	Total Cost Phase 1+2
Flow Diversions & Interconnections	$300,000	-	$300,000
Headworks	$4,500,000	$800,000	$5,300,000
Primary Treatment / Equalization	-	-	-
Secondary Treatment	$2,500,000	$2,000,000	$4,500,000
Tertiary Treatment	$1,300,000	$600,000	$1,900,000
Biosolids	$4,400,000	$600,000	$5,000,000
Site Works	$800,000	$200,000	$1,000,000
Miscellaneous Allowance	$200,000	$130,000	$330,000
Sub-Total	**$14,000,000**	**$4,330,000**	**$18,330,000**
Contingencies (10%)	$1,400,000	$433,000	$1,833,000
Engineering (15%)	$2,100,000	$649,500	$2,749,500
TOTAL[1]	**$17,500,000**	**$5,412,500**	**$22,912,500**
CALCULATED PRESENT WORTH[2]			**$20,500,000**

Note:
1 Based on 2005 Dollars and no discount for combining Phase 1 and 2
2 Reference Table H.2.3.

Further to the above recommendations related to the expansion works, other projects must be carried out in order to maintain the WPCP in top operating efficiency. As previously indicated, opportunities to extract more capacity out of the existing and new treatment processes with the potential of reducing unit operating costs may be realized through further process optimization, multi-season / ongoing treatability studies and planned/preventative maintenance (O+M). The most notable of these projects includes the following:

- Optimization of Plants B, C and D
- Upgrades to Plant A and Plant B digesters
- Aeration systems maintenance
- Other O+M upgrades and replacements.

As part of the overall implementation plan, Table H.2.1 in Appendix H presents cost projections associated with the recommendations in this ESR and includes a preliminary estimate of projected operating and maintenance costs and other estimates of costs associated with ongoing upgrades and replacements. Capital projects and O+M costs are assessed by the Town on an annual basis in projecting operating budgets and unit costs for wastewater treatment at the WPCP. These costs are also depicted graphically in Figures H.2.1 and H.2.2. This information is presented as a planning tool and may be modified to suit the required phasing in of the new works and other projects related to ongoing O+M at the Bradford WPCP.

9.2 WPCP Expansion Design Criteria

Table G.5 in Appendix G presents a summary of treatment unit process design calculations for the extended aeration option. In general, calculations are based on the statistical analysis of WPCP operating data from 2001 to 2004. Specific criteria are compared to MOE Design Guidelines (MOE, 1984) and other recognized references including Wastewater Engineering (Metcalf and Eddy, 2003).

Table 9.2 presents a summary of parameters recommended for the design and operation of the expanded Bradford WPCP.

Table 9.2: Summary of Recommended Design Parameters for WPCP Expansion

Design Flows and Population

Design Flows (Combined Plants)	Units	Phase 1	Phase 2
Average Design Flow (ADF)	m^3/d	12,400	17,400
Peak Design Flow (PF)	m^3/d	29,100	40,800
Equivalent Residential Population Serviced		27,650	38,800

Design Loadings

	Average Design Loadings (kg/d)		
	Basis	**Phase 1**	**Phase 2**
ADF (m^3/d)	5,527 (1)	12,400	17,400
Equivalent Population	17,392	33,452	46,941
BOD_5	1,113	2,141	3,004
TSS	1,583	3,044	4,272
TKN	191	368	516
TP	35	67	94

(1) Flow basis derived from historical effluent flow data (2001 - 2004)

Effluent Criteria

Parameter	**Operational Objective**		**Non-Compliance Criteria**	
	Concentration (mg/L)	**Loading (kg/d)**	**Concentration (mg/L)**	**Loading (kg/d)**
$cBOD_5$	5	87	10	174
Suspended Solids	5	87	10	174
Total Phosphorous	0.10	1.74	0.11	1.91
Total Nitrogen (Ammonia + Ammonium)	0.6 (April-Oct)	10.4	0.8 (April-Oct)	13.9
	2 (Nov-March)	34.8	2.5 (Nov-March)	43.5
E.Coli	50 organisms /100 mL		100 organisms /100 ml	

Loadings based on ADF = 17,400 m^3/d

9.3 Implementation Plan and Schedule

The overall objective is to expand the Bradford WPCP as soon as possible to ensure future growth in the Town as approved under the current OP, is not delayed because of the lack of wastewater treatment capacity. Figure 9.1 presents the Town's overall implementation schedule, which shows the steps following completion of the ESR leading to the construction and commissioning of the upgraded Bradford WPCP. As depicted, the ESR, design, tendering, construction and commissioning is expected to be completed by mid-2007.

All construction activities will be restricted to the WPCP property and no encroachment of environmentally sensitive areas will be necessary. Coordination of construction activities will be an essential part of implementation to ensure no disruption to on-going WPCP operation occurs.

10.0 Potential Environmental Effects and Mitigative Measures

10.1 General Considerations

The works proposed as part of the WPCP expansion are to minimize any potential impacts on the surrounding environment. Measures discussed below are proposed to reduce and mitigate in the short term and the longer term following completion of construction. Once the plant expansion works are complete, it is expected that the Bradford WPCP will have little or no effect on the following:

- Heritage Resources – historical or archaeological significant sites
- Recreation – recreation facilities and activities that are presently enjoyed in Bradford West Gwillimbury and along the Holland River and Lake Simcoe
- Aesthetics – aesthetic condition surrounding the site
- Natural Environment – waterways, woodlands and wetlands
- Existing Land Use – surrounding lands.

10.2 Regional Floodplain and Provincially Significant Wetlands

The WPCP expansion works are proposed as a natural extension of the existing treatment plant. Since the existing WPCP infrastructure is located just within the limit of the Regional storm floodplain, the expansion works are also sited within the fringes of the floodplain. It is noted that any other WPCP siting in the general location of the existing plant would require land acquisition and duplication of collection system and wastewater treatment infrastructure. The new plant and tank sitings are primarily parallel to the floodplain with minimal development toward the Holland River. Given the large expanse of the Holland River floodplain at this location, it is not expected that the minimal loss of flooplain storage would have a noticeable effect on the Regional flood levels.

It is noted that the proposed WPCP expansion components are outside of the 120 m Provincially Significant Wetland buffer, therefore no loss of wetland habitat form or function is expected. Surface drainage during the construction period however, is to be controlled, as discussed later in Section 10.7.

10.3 Land Use Planning Buffer

The Ministry of the Environment's recommended separation distance between WPCP components and residential lands is 150 m, with a minimum separation distance of 100 m, for plants with average daily flows less than 25,000 m^3/day, which currently applies to Bradford West Gwillimbury. The existing WPCP facilities provide a separation of 150 m to residential lands. The proposed expansion works shown in Drawing G3 will meet the recommended buffer zone requirement of 150 m separation. The property was originally acquired by the Town to serve the long-term requirements for wastewater treatment and disposal. The expansion works can fit on the property, largely in the open area to the south of the existing plant. Adjacent property to the south could be acquired by the Town if required for future WPCP expansion.

10.4 Accessibility and Traffic Issues

The sole access point to the site is the existing driveway from Dissette Street east to the WPCP and crossing the Go Transit railway tracks. Therefore, turning movements at Dissette Street pose the greatest potential traffic impact on the local roadway system. The coordination of materials and equipment delivery outside of the peak travel periods would assist in minimizing delays and conflicts. For any excessively large or oversized loads, additional traffic flagging assistance may be required on Dissette Street and potentially at the railway crossing. GO Transit plans on resuming passenger rail service between Bradford West Gwillimbury and Barrie and therefore, rail traffic on this section of railway will increase, particularly during commuting hours. Therefore, special deliveries should also be coordinated with CNR as is necessary. Once construction is complete, no traffic impacts are expected.

10.5 Noise Attenuation

The WPCP site will generally provide suitable dissipation of noise expected during construction periods. During specific operations, barriers may be placed around work areas, pumps or equipment as is necessary to reduce noise emanating from these sources. In general, noise will be restricted by the hours of operation allowed for contractors and trades people to complete construction of the WPCP expansion.

Noise generated inside the plant will come from air compressors (blowers). Blowers will be housed in buildings and equipped with silencers and sound attenuating wall material to reduce noise levels. Occasional noise from the use of a standby power generator may be heard however, it is located within a trailer, which serves to reduce the noise emissions. Noise levels are expected to be very low outside the limits of the 150 m buffer zone. Current regulations generally call for noise to be no greater than local background noise at the property line of the work site and the MOE will review noise issues during review of detailed design of the WPCP expansion. All available mitigating measures will be incorporated into the design of the expansion.

10.6 Odour Control

Potential odours from the wastewater treatment plant originate generally from two sources. The first is the headworks of the plant where screenings and grit are removed from the flow, temporarily stored on-site and then removed from the property. The second is in the sludge storage lagoon.

The screenings and grit removal areas for the existing and future plants are contained within buildings, which substantially reduce odours from the plant. These materials are removed from the site on a frequent basis and disposed of in an appropriate landfill facility, in order to reduce the buildup of material on the site. In addition to odour controls for the new Headworks, odour control in the form of masking may be employed to reduce the severity of odours originating in the existing Influent building.

Odours originating from the sludge storage lagoon may occur during the early spring season where temperature changes have a tendency to release hydrogen sulphide. In order to minimize this occurrence, the Town installed an aeration system in the first sludge lagoon. Sludge transferred to the sludge storage lagoon will be adequately stabilized following digestion, and should not be a source of concern during the remaining periods of the year.

As part of the WPCP Expansion, it is proposed to construct a large glass-lined, covered steel tank to store stabilized sludge. This will provide further containment of odour and could be modified to permit installation of a foul air collection and treatment system if required in the future.

10.7 Storm Drainage

Expansion of the WPCP will require disturbance of existing soils and de-watering for installation of tanks and piping and construction of buildings. At all times when soils are exposed, erosion and sedimentation controls meeting Town and LSRCA standards are to be installed, inspected regularly and maintained. De-watering of excavations is to include proper treatment of pumped discharge, which could include sediment traps, and/or filter bags as required to reduce sediment load to the surrounding areas.

Stabilization of exposed soils is to take place as soon as practically possible following completion of construction. The site is relatively flat and the majority of the area can be stabilized with topsoil and hydroseed. Any steeped sloped areas, such as around terraces matching grade or around headwalls should be stabilized with topsoil and staked sod, which provides immediate erosion protection. Any work necessary near the existing outfall should include stabilization with suitable native shrub species, as outlined in the LSRCA requirements. It is noted that no modifications are proposed to the existing outfall channel itself and existing vegetation is expected to provide adequate erosion protection of the channel. The existing storm drainage characteristics of the adjacent properties (upstream and downstream) are to be maintained as part of the detailed design of the WPCP expansion.

The final design details are also to address measures to control any possible spill of oils, gas or fuels that are used during the construction period. These include but are not limited to an identified re-fuelling location on the property designed for this purpose, proper storage of these hazardous materials, and preparation of a contingency plan in the event of a hazardous material spill. The refueling location should be sited away from sources of groundwater and surface waters.

10.8 Adjacent Properties

Any potential impacts on adjacent properties are to be reviewed during the detailed design stage of the WPCP expansion. These include surface drainage, dewatering discharge and grading issues. Any potential impacts are to mitigated as much as possible and post construction conditions are to be left as good-as or better-than existing conditions. Following completion of construction, it is expected that any adjacent property impacts will be negligible.

10.9 Quality of Life

The WPCP expansion works will have a negligible, if any, impact on those living and working near the plant. Some disruptions or inconveniences may be experienced during the construction period however, these can be mitigated. Following the construction period, no residual effects due to the plant expansion are expected.

The expansion of the WPCP allows for the Town to continue to grow and meet the goals and objectives outlined in the currently approved Official Plan. The WPCP is one of the key pieces of municipal infrastructure that supports local business, industry and residents. The plant expansion also allows the continued collection of municipal revenue as part of approved growth in the Town, which provides funding for other municipal projects. The quality of life in the community is therefore linked to this key piece of municipal infrastructure and it's continued operation and performance in meeting the needs of the approved future population of 38,800 persons.

10.10 Natural Environment

10.10.1 Fish, Aquatic Wildlife, and Vegetation

Any impacts on fisheries and other aquatic life must be minimized. Minimization and avoidance of impacts will require proper staging during construction, the implementation of mitigating measures and monitoring after construction.

Fish species present in the Holland River study area are summarized in the following Table C.4.1 to C.4.4 found in Appendix C:

Table C.4.1 from Lake Simcoe to the confluence of the east and west branches, also referred to as Location 1

Table C.4.2 from the confluence of the east and west branches to the Yonge St bridge, referred to as Location 2

Table C.4.3 the eastern canal south of the Yonge Street bridge, referred to as Location 3.

The study areas (Locations 1, 2 and 3) are shown on Figure 2.2.

The fish community in all sections of the Holland River study area is dominated by warm-water species. Important sport fish found throughout the study area include largemouth bass, northern pike, yellow perch, and black crappie; along with forage fish such as emerald shiner and golden shiner. In the section downstream of the confluence of the East and West Holland River, other important sport fish, specifically muskellunge and walleye have also been found - likely because of the proximity of that part of the river to Lake Simcoe.

In the upstream-most section of the study area, the community is dominated by brown bullhead, pumpkinseed, largemouth bass, northern pike, and rock bass, with those species constituting more than 82 percent of the catch during a recent MNR survey (MNR 2004).

Near the WPCP discharge, at least 18 species of fish have been recorded in the Holland River. Given the lack of physical barriers between the three sections of river, it is highly likely that several other species found in upstream and downstream reaches would also be expected to inhabit the river near the plant outfall.

No vulnerable, threatened, or endangered fish species are known to exist in the Holland River.

Most, and perhaps all constituents of the Holland River fish community would potentially spawn within the Holland River or associated tributaries - typically during spring or early summer. Many reaches of the river and associated marshes also provide important habitat used for nursery and foraging purposes. The outfall channel should be inspected regularly for any potential impacts associated with construction activities. These include but are not limited to increased sedimentation and erosion or introduction of warm water discharges directly to surface water receiving bodies. Siltation control fencing and the use of filter bags or settling ponds for pumped groundwater control during construction are measures that should be implemented, monitored and maintained as necessary to mitigate potential impacts.

10.10.2 Terrestrial Vegetation and Wildlife

Rehabilitation and erosion control measures relate to swales, channels and area grading. Staked sod may be used for swale or channel restoration in conjunction with native plantings. Area grading restoration may consist of topsoil and hydroseeding. Reinspection of hydroseeded areas should be carried out and over-seeding of poor growth areas should be completed as needed. The following shrubs were identified in the 1994 ESR as the most suitable for the Holland Marsh environment.

Table 10.1: Suitable Terrestrial Vegetation

Common honeysuckle	Lonicera stolonifera
Highbush cranberry	Viburnum Opulus
Red osier dogwood	Cornus stolonifera
Nannysberry	Viburnum lentago
Black elderberry	Sambucus Canadensis

These species are preferred since they grow relatively quickly, they are compatible with the surrounding environment and provide erosion protection through development of a root mat.

Some tree removal may be necessary to accommodate some components of the WPCP expansion. However, the majority of the proposed works can be situated in the open area south of the existing plant. Through the detailed design process, the final location of components will be selected and measures taken to limit any tree removal identified.

10.11 Monitoring Program

10.11.1Surface Water Quality and Benthic Invertebrate Monitoring Program

As discussed in Section 2.1.2.4, a benthic invertebrate monitoring program was developed to address concerns expressed by the MOE regarding potential impacts of the proposed WPCP expansion on the Holland River. The results showed that the water quality in all station observed is "impaired", and that there is no apparent difference in water quality among the five stations at the WPCP discharge channel nor is there any difference in water quality between that group of stations and the one further upstream. The conclusion made was that although the water quality is impaired, there is no indication that it is associated with operation of the WPCP. Any further monitoring requirements may be subject to MOE and LSRCA input and review.

10.11.2Construction

It is a requirement of the MOE, the MNR and the LSRCA to be circulated construction plans and details for the proposed WPCP expansion works including grading, drainage, erosion controls and restoration details. The Town's consulting engineering staff will monitor construction activities and environmental impact mitigation measures to ensure they perform as intended. Representatives from the review agencies may participate in any of the construction activities through attendance at site meetings or carrying out site visits.

10.11.3Operation

The expanded WPCP will be operated by the Town in a manner that is efficient and meets MOE requirements for discharge to the Holland River. It is anticipated that monitoring of the following parameters will be required as part of the expanded works (based on the current Certificate of Approval):

- BOD_5 (carbonaceous)
- Suspended solids
- Total phosphorous
- Total Kjeldahl
- Total (Ammonia+Ammonium) Nitrogen
- pH
- Temperature

In addition to the above, the following effluent parameters will be monitored:

- Nitrate nitrogen
- Nitrite nitrogen
- Alkalinity
- Chlorides
- Conductivity
- Fecal coliform.

This is being recommended in anticipation of future assimilative capacity studies that would be required in support of future WPCP expansions.

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