LADYSMITH

TOWN OF LADYSMITH

LIQUID WASTE MANAGEMENT PLAN
STAGES 1 AND 2

FINAL

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Consulting Engineers

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LADYSMITH

TOWN OF LADYSMITH
LIQUID WASTE MANAGEMENT PLAN – STAGES 1 AND 2

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EXECUTIVE SUMMARY

The Town of Ladysmith Three-Stage Liquid Waste Management Plan (LWMP) is to provide the strategies for wastewater management over the next 20 to 30 years. The LWMP addresses existing and future development, including servicing of areas not yet connected to the central or other planned wastewater collection systems, greenfield developments, and potential boundary expansions.

The LWMP was initiated in November 2007; the plan developed using the published Guidelines, and the recent update, produced by the B.C. Ministry of Environment (MOE). In accordance with the Guidelines, the LWMP includes consideration of source control of contaminants, wastewater volume reduction, stormwater management, wastewater collection and treatment, beneficial use of treated wastewater and residual solids, and the incorporation of sustainable design and integrated resource recovery technologies.

For the Town of Ladysmith LWMP, Stages 1 and 2 were combined to include both the identification of existing conditions and constraints, and the development of technical solutions. The LWMP committee structure combined the Technical and Local Advisory Committee into one Joint Advisory Committee (JAC) to facilitate communications and scheduling. A Steering Committee including representatives of the Town, a member of the combined committee and a Ministry of Environment (MOE) representative provided overall project direction and planning. Seven Joint Advisory Committee meetings were held throughout Stages 1 and 2, and two open houses provided public feedback. First Nations were consulted at a meeting on April 6, 2010. The Townsite maintains a website with LWMP documentation.

Currently the Town occupies about 1,480 hectares of land and stretches about 9 km north to south, along the Island Highway. The OCP identifies a build-out population of 17,200, assuming no additions to the service areas or boundary expansion. Prudence suggests that siting of a plant should accommodate up to 30,000 people, to allow for the potential inclusion of additional service areas in future. New growth areas within the Town Boundary include Holland Creek, North End (Rocky Creek), South End (Russell Creek); Waterfront and infill. The Town may also elect to accept wastewater from outlying areas Saltair, Diamond Improvement District and First Nations lands on a fee-for-services basis. The OCP contains environmental protection policies relating to development and the wastewater and stormwater systems, which are included in the LWMP objectives.

The Town of Ladysmith is situated adjacent to embayed Ladysmith Harbour. Holland Creek, Stocking Creek and Russell Creek flow to the outer harbour, and Rocky Creek flows to the inner harbour; all creeks are fishbearing. The harbour has a low tidal exchange rate. The riparian zones along the streams and undeveloped harbour provide wide areas of wildlife habitat and conduits for movement.

The existing Ladysmith wastewater treatment plant (WWTP) provides primary treatment and disinfection of effluent with outfall discharge to Ladysmith Harbour. Primary settled solids are pasteurized and stabilized in thermophilic digesters (ATAD), dewatered and trucked to the Town Works Yard for composting. Water and sediment studies by MOE indicate that the existing wastewater discharge is impacting the marine environment. The shellfish resource in Ladysmith Harbour is a primary concern.

The Town is currently undertaking a staged upgrade at the WWTP to implement secondary treatment; this will greatly reduce the impacts of the discharge to Ladysmith Harbour. Once the secondary treatment facilities have been commissioned, water quality studies will be undertaken, to determine if additional action is needed to protect the Harbour. If required, future improvements could include the addition of tertiary treatment and/or extension of the outfall to open marine waters. As described in this report, wastewater treatment criteria developed for the LWMP are designed to eventually meet the requirements of provincial and federal regulations, including the Municipal Sewage Regulation and the proposed federal Wastewater System Effluent Regulation.

Various options were considered for inclusion in the LWMP; these were developed by the study team in consultation with the JAC and the public and are described in detail in this report. The LWMP components recommended for inclusion in the Stage 1 and 2 LWMP (to be advanced to Stage 3) are outlined below:

Source Control

- develop a sanitary sewer source control bylaw to protect effluent quality and biosolids quantity;
- public and private sector education and consultation with other knowledgeable jurisdictions;
- sampling and inventories to identify problem discharges to the sewer system;
- water quality monitoring.

Wastewater Volume Reduction

- universal metering to help minimize water use;
- public education to reduce water use;
- regulations requiring use of low-flow plumbing fixtures (e.g., low-flush toilets);
- ongoing reduction of infiltration and inflow to the sewer system.

Stormwater Management

- develop a Master Drainage Plan for the Town;

- identify environmental resources needing protection;
- implement a storm drainage bylaw;
- encourage onsite infiltration of precipitation where feasible;
- public education.

Wastewater Management

- complete the current upgrade at the WWTP to achieve secondary treatment for a service population of 17,200 people. Include consideration of resource recovery in designing the upgraded facilities (e.g., heat recovery). Monitor the effectiveness of I&I reduction efforts so that a realistic schedule can be developed for eliminating the bypass to primary treatment.

- once the WWTP upgrade to secondary treatment has been commissioned, conduct environmental studies of Ladysmith Harbour to determine if additional action is needed to protect the environment. If additional action to meet water quality objectives is needed, determine whether the addition of tertiary treatment and/or extension of the outfall to open marine waters is the preferred solution.

- identify and secure a property suitable for construction of wastewater treatment facilities in future (possibly in the Industrial Park). New facilities may include treatment for waste solids generated at the existing WWTP, as well as future facilities for treating liquid wastewater. When the existing (upgraded) WWTP reaches capacity at 17,200 population, the decision can be made to either expand the existing plant, or to initiate construction of a second facility for treatment of wastewater at the new site.

- pursue the implementation of satellite water reclamation plants for pockets of new development, with localized use of the reclaimed water (e.g. for planned development in the Holland Creek area and other developments as appropriate).

Biosolids Management

- the Town is currently pursuing a partnership with the Cowichan Valley Regional District to construct a composting facility for waste solids produced at the WWTP. The composting facility could be located at the Peerless site, or at another mutually agreeable site. Once a site has been identified, a concept design and cost estimate for the composting facility should be developed, so that it can be compared to the cost of onsite solids treatment at the WWTP with subsequent beneficial reuse (e.g., woodlot application, private sector reuse).

- other potential biosolids management options include

  - woodlot application through Vancouver Island University Program (requires minimum of Class B treatment of waste solids at the WWTP);
  - partnership(s) with the private sector (e.g., commercial reuse at a private facility at Duke Point which requires minimum of Class B treatment at WWTP, or involve private sector in request for proposals to manage the resource).

Water Reclamation and Reuse

- reclamation and reuse of treated wastewater should be focused on internal use for non-potable purposes at the (upgraded) WWTP, and on localized satellite reclamation plants in new developments for seasonal landscape irrigation as described above in Section 10.4.

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LIQUID WASTE MANAGEMENT PLAN – STAGES 1 AND 2

1.0 INTRODUCTION

1.1 Background

The Town of Ladysmith began the development of this Liquid Waste Management Plan (LWMP) in November 2007. Preparation of a LWMP is a timely project for the Town, since it provides the community with an opportunity to review past wastewater management decisions, and to reassess future plans in light of updated data bases and new environmental regulations.

Guidelines for developing a LWMP were produced in 1992 by the B.C. Ministry of Environment (MOE, 1992a), and Revised Guidelines, while not formally adopted were prepared in March 2004, for reference and use. The Town has specified that the LWMP be developed using the MOE Guidelines. These Guidelines typically serve as an adjunct to the terms of reference for a LWMP. The Guidelines encompass municipal and industrial wastewater, urban storm runoff, septage, solid residuals, and reuse or recycling of treated wastewater and solid residuals.

The LWMP must address existing and future development, including servicing of areas that are not yet connected to the central wastewater collection system, and greenfield developments. The municipal Official Community Plan (OCP) sets out the proposed strategy for future development in the study area. The OCP references two further municipal plans as key implementation tools, which the LWMP must also consider in order to effectively address future development:

1. Town of Ladysmith Community Energy Plan (2008) – identifies seven initiative areas and 31 actions that the community plans to undertake to achieve the Town's greenhouse gas reduction targets.
2. Ladysmith Community Vision for a Sustainable West Coast Town (2009): articulates an ambitious and highly supported vision for a sustainable community, including a detailed sustainability strategy and fundamental sustainable development goals for the community.

Taken together, the documents outline and provide legislative substance to Ladysmith's stated commitment to being one of Canada's greenest communities. As such, the LWMP is designed to address existing environmental issues, minimize the adverse environmental impacts of development, and seek opportunities to develop environmentally sustainable wastewater infrastructure in a manner consistent with the OCP and the municipal plans and policies referenced therein..

The study area for the LWMP encompasses the areas that are serviced by centralized collection and treatment of domestic wastewater at the Wastewater Treatment Plant (WWTP), which discharges primary-treated effluent to Ladysmith Harbour. Nearly all of the Town's current 8,000 residents are serviced by the WWTP. Options such as satellite (scalping) treatment plants for upstream developments, reclamation/reuse of treated effluent, and partial or complete relocation of the WWTP as well as expansion/upgrading of the existing WWTP were considered in the LWMP.

Upgrading of the existing WWTP is required immediately, to meet current provincial and planned federal regulatory requirements; this is currently underway. If the community desires an alternative approach for the long-term future, many years of planning and public consultation will be required, to select one or more sites for new wastewater treatment facilities. This process cannot be entirely completed within the schedule and budget for the current LWMP. However, it can initially be undertaken at a concept level within the LWMP to determine future directions, and recommendations can be provided for actions to be taken in pursuing alternate locations. The current upgrade plans for the existing WWTP are designed for the immediate future, and will not be impacted by selection of other long-term planning options.

The Town of Ladysmith and the MOE are committed to ensuring the water quality of the Harbour is protected. MOE Nanaimo has identified the following issues associated with the Town of Ladysmith LWMP (MOE, 2008):

- the treatment standards contained in the Municipal Sewage Regulation (MSR) should be considered the minimum for wastewater discharges (this will require upgrading to secondary treatment at a minimum);
- receiving water uses in the area include shellfish harvesting and recreational prawn fishing;
- disinfection of the effluent may be required;
- the LWMP solutions should address minimizing greenhouse gas emission, low energy consumption and resource recovery;
- stormwater management and water supply quality are related to the LWMP solutions;
- some members of the public have expressed concerns regarding the use of unproven technologies for wastewater treatment; and
- the Ministry has no objection to combining Stages 1 and 2 of the LWMP.

A key issue for the Province is water conservation. This can reduce the volume of wastewater discharged to the environment, as well as result in potential cost savings for wastewater collection and treatment. The LWMP Guidelines and the B.C. Municipal Sewage Regulation (MSR) both emphasize reduction of inflow and infiltration (I&I) to the sanitary sewer system.

The provincial Guidelines specify that stormwater runoff be included in a LWMP. Urban development generally results in reduced infiltration of precipitation and increased surface runoff. This tends to cause greater erosion and sedimentation in streams, as well as reduced groundwater replenishment, which in turn leads to lower dry season water levels in lakes and streams. In addition, contaminants associated with urban and agricultural activities often become incorporated into surface runoff, and can adversely affect water quality. Comprehensive drainage planning and watershed management are typically outside the scope of a LWMP; however, these processes should be coordinated with relevant aspects of the LWMP.

Ground disposal of effluent from onsite (septic tank) systems can threaten groundwater and surface water quality if ground conditions (water table, soils, slope, etc.) are unsuitable. The MOE and the Ministry of Health (MOH) have concerns with some onsite sewage systems that affect groundwater quality in the Ladysmith area, but these systems are located outside of the Town boundary. However, wastewater management solutions could be planned to potentially include potential future connection of outlying areas currently not serviced by collector sewers.

1.2 LWMP Process and Objectives

The Guidelines for developing a LWMP produced by the MOE require a three-stage process, each involving meaningful public consultation (B.C. Environment, 1992a). Stage 1 includes identification of existing conditions, development projections, and consideration of a range of treatment, reuse and disposal options. The treatment, reuse and disposal options that pass an initial technical evaluation and public review are advanced to Stage 2 for more detailed evaluation. Finally, the selected option is described and costed, the implementation schedule is developed, and draft Operational Certificates are prepared in Stage 3. When the Stage 3 LWMP is approved by the Minister of Environment (MOE), the local government has the authority to implement the Plan. Permits are cancelled in favour of Operational Certificates issued under the

LWMP. An approved LWMP allows the local government to implement the works without further approvals from the electorate. An approved LWMP should be updated from time to time (e.g. every 5 to 10 years), to monitor progress and evaluate changing conditions and new technologies.

Discussions with the MOE Nanaimo office indicate that the Town of Ladysmith may combine Stages 1 and 2, since much of the work typically required in Stage 1 has already been completed by the Town. As set out in the MOE Guidelines, the LWMP will be developed by the combined efforts of the Steering Committee, the Technical and Local Advisory Committee as summarized below.

- ***Steering Committee***: The objective of the Steering Committee is to provide overall direction for the preparation of the plan. Participants are the Town of Ladysmith (Council member and staff representative), and a Ministry of Environment (MOE) representative.

- ***Technical Advisory Committee**:* The objective of the Technical Advisory Committee is to address technical and regulatory issues, develop design criteria, and to provide technical input and assist in developing technically sound solutions and recommendations. Participants include municipal staff and representatives from senior government agencies including the MOE, the Ministry of Community Services, the Ministry of Health, and others as applicable (e.g. Environment Canada). The Technical Committee membership is listed in Appendix 2.

- ***Local Advisory Committee**:* The objective of the Local Advisory Committee is to provide input on all aspects of the LWMP process from a community perspective, focusing on the anticipated acceptability of various options and providing ongoing liaison with the public. Invited participants include the Town of Ladysmith, and members of the public that represent a cross-section of local interests (e.g. local businesses, rate payers associations, environmental groups, School District, Rotary Club, First Nations representatives, interested citizens, etc.).

The Technical and Local Advisory Committees were combined to facilitate communications between technical and community/stakeholder representatives. The Joint Advisory Committee (JAC) membership is listed in Appendix 2.

The local government must also organize a public participation process. Adequate consultation with the public while preparing a LWMP is essential, since there is no mechanism to appeal a LWMP once approved by the Minister. Furthermore, the bylaw to adopt the LWMP does not require the assent of the electors. A full range of possible alternatives should be investigated and presented in an easy-to-understand format, clearly showing their advantages or disadvantages. The process is intended to give the public open access to liquid waste planning within the community.

1.3 Scope of Work

The terms of reference (attached in Appendix 1) set out the scope of work for the Town of Ladysmith LWMP, which is summarized as follows:

- consider and ensure consistency with the planning principles, community values, development goals, sustainability strategies and energy reduction targets outlined in the OCP, Community Energy Plan and the report, "*Community Vision for a Sustainable West Coast Town*";

- forecast the sewage collection and treatment needs and reclaimed water utilization or effluent disposal requirements for the next twenty to thirty years;

- prioritize areas of existing development requiring connection to the sewer facility;
- examine all methods of sewage treatment and disposal of treated liquid waste including those that may be suggested by the public for technical practicality and cost;
- provide direction on both long-term and short-term disposal or utilization of waste sludge (biosolids) from the WWTP;
- examine and classify all watercourses contained within the Town boundaries, and indicate any proposed potential stormwater retention areas and guidelines for development adjacent to sensitive streams;
- organize and arrange “Workshops or Focus Group Sessions”, with technical representatives from the appropriate federal and provincial agencies to discuss the Liquid Waste Management Plan Draft;
- organize and arrange two Public Information Meetings;
- prepare the Liquid Waste Management Plan in three (3) stages:
- include a summary of public participation for each stage in the LWMP report;
- provide the technical details required to permit preparation of the Operational Certificate for the WWTP;
- prepare submissions on behalf of the Town of Ladysmith and submit them to the Ministry of Environment for review and approval as they are produced; and
- prepare press releases and informational handouts as required during the course of the development of the LWMP.

1.4 Conduct of Study

The Town of Ladysmith issued a request for proposals to prepare a LWMP on October 15, 2007. The process commenced in November, 2007. A consulting team led by Dayton & Knight Ltd. was retained by the Town to assist the project team responsible for providing the technical input and analysis for the study. The team included specialty assistance from sub-consultants in the fields of environmental protection (Castor Consultants Ltd., Ladysmith, B.C.), and hydrogeological services (EBA Engineering Consultants Ltd., Nanaimo, B.C.).

The work was initially undertaken through the development of a series of draft chapters for the LWMP report. The draft chapters were circulated to the members of the Joint Advisory Committee (JAC) for review. After a review period, the draft material was discussed at follow-up meetings of the JAC; the draft material was then be revised as required based on discussion at the meetings and written comments from committee members. After approval by the JAC, the draft material was presented at two public information meetings to gain input from the public. These meetings were held on July 9, 2009 and May 13, 2010 in the Town of Ladysmith at Agricultural Hall. A separate meeting was held with Stu'zminus First Nations and the Town Council on April 6, 2010. The LWMP report was then submitted to the MOE Nanaimo office for review. After receiving MOE Nanaimo comments and recommendations, the LWMP was amended and submitted to the JAC. The next steps are to obtain JAC consensus and endorsement of this Stage 1 and 2 report to the Steering Committee and Council for approval. The Stage 1 and 2 LWMP will subsequently be submitted to the Ministry of Environment, Nanaimo office for approval.

1.5 Acknowledgements

The participation and assistance of all of the members of the Steering Committee and the Joint Advisory Committee is gratefully acknowledged (see Appendix 2 for a list of the

Committee membership). In addition, we thank the Town of Ladysmith staff for their valuable assistance in providing technical information, organizing Committee meetings, and providing follow-up documentation.

2.0 PUBLIC CONSULTATION

Essential to the success of the LWMP process is effective public consultation. The public consultation program for the LWMP commenced with the formation of the Steering, Technical and Local Advisory Committees, and will continue through newsletters, posting information on the Town's website, press releases, committee meetings and public information meetings. A summary of the public consultation program undertaken during the LWMP is outlined in this section.

It should also be noted that another consultation process focusing on establishing a community sustainability vision was underway throughout the fall of 2008 - roughly the same time period as many of the LWMP consultation initiatives discussed in this section. This award-winning process yielded unprecedented levels of community participation, and resulted in detailed report, which is now formally referenced in the Town's Official Community Plan – "*Ladysmith Community Vision for a Sustainable West Coast Town*".

The report outlines a detailed sustainability strategy for the community, and is important in the development of the LWMP in the sense that includes a recent and very highly supported vision for future development in Ladysmith, as well as specific goals and strategies with respect to development of innovative infrastructure and wastewater management.

The LWMP must therefore consider and ensure consistency between the results and final report from the sustainability visioning consultation process, and the input gathered through the LWMP consultation process described throughout the remainder of this section.

2.1 Committee Meetings

As described in Section 1.2, the MOE guidelines (B.C. Environment, 1992a) require the Town of Ladysmith to strike Advisory Committees to administer the development of the LWMP. A summary of the meetings of the Advisory Committees undertaken is provided below. Meeting minutes are included in Appendix 2.

1. Steering Committee Meeting No. 1

   Steering Committee Meeting No. 1 was held on Tuesday May 13, 2008 to initiate the Stage 1 work. Items presented and discussed with the Steering Committee included the LWMP process, the roles of the Advisory Committees, meeting protocols, review of the project work plan and schedule, and Committee membership.

2. Joint Advisory Committee Meeting No. 1

   Joint Advisory Committee (JAC) Meeting No. 1 was held after the first Steering Committee Meeting on Tuesday May 13, 2008. Committee terms of reference, meeting protocols, role of committees and means of defining consensus were reviewed with the members of the JAC. The work plan and schedule were also reviewed. Draft initial public information advertisement was reviewed. JAC Meeting No. 1 also included a presentation on the Municipal Sewage Regulation, and the fundamentals of wastewater treatment, as well as an update on the impending upgrades to the existing WWTP.

The JAC decided at Meeting No. 1 that the next committee meeting should be dedicated to a discussion of appropriate technologies for adding secondary (biological) treatment to the existing WWTP; this was to include one or more site visits to reference facilities by selected members of the JAC and the technical team.

3. Joint Advisory Committee Meeting No. 2

JAC Meeting No. 2 was held on June 17, 2008 to discuss the results of the site visit to a reference treatment facility located in Olso, Norway. This facility was based on the use of the moving bed bioreactor (MBBR) process for secondary treatment. The MBBR process was identified as a suitable candidate for use at the Ladysmith WWTP based on an evaluation of four candidate processes, namely integrated fixed film activated sludge (IFAS), membrane bioreactor (MBR), biological aerated filter (BAF), and MBBR. The MBBR process was identified as the preferred candidate based on an evaluation that included costs, space requirements, track record, reliability, operating characteristics, expandability, effluent quality and sludge production (Dayton & Knight Ltd., 2008). See Section 4.3.3 of this report for additional information regarding process selection.

4. Joint Advisory Committee Meeting No. 3

JAC Meeting No. 3 was held on September 24, 2008 to discuss the 50% draft LWMP report, which was circulated to members of the Committee in advance of the meeting for review. The content of the 50% draft was reviewed at the meeting, and members of the Committee were requested to provide follow-up comments to the Town via e-mail. Information regarding the biosolids land application program at Malaspina Woodlot was also tabled at the meeting by a member of the Committee. MOE Nanaimo noted that all WWTP upgrades must meet the requirements of the Municipal Sewage Regulation, and that alternatives to chlorination must be considered.

5. Joint Advisory Committee Meeting No. 4

JAC Meeting No. 4 was held on November 26, 2008 to discuss the LWMP options set out in the full draft LWMP report. Three concept options for long-term wastewater management were tabled for discussion and input from the Committee. A disk copy of the draft LWMP report was distributed to members of the Committee for review and comment. The Committee elected to hold a subsequent meeting for initial discussion before providing comments on the draft report.

6. Joint Advisory Committee Meeting No. 5A and 5B

JAC Meeting No. 5A was held on April 22, 2009 to review changes to the draft LWMP report arising from comments provided by MOE and other members of the Committee. A follow-up meeting for further discussion (5B) was held on June 10, 2009. The format, content and schedule for Public Open House No. 1 was discussed and agreed upon at Meeting 5A. Additional matters and clarifications regarding the LWMP process, content and format were discussed at Meeting 5B.

The draft Open House advertising and questionnaire were also discussed. Open House No. 1 was initially scheduled for May 20, 2009; however, this was subsequently re-scheduled for July 9, 2009 to allow more time for advertising.

7. Joint Advisory Committee Meeting No. 6

JAC Meeting No. 6 was held on September 23, 2009 to discuss the results of Public Open House No. 1 (see Section 2.2). Based on feedback obtained from Open House No. 1 and follow-up discussion among members of the Committee, consensus was achieved regarding revisions to the LWMP draft report. The revisions mainly focused on the provision of cost estimates for the wastewater management options, and matters of clarification regarding the descriptions of the options.

8. Joint Advisory Committee Meeting No. 7

JAC Meeting No. 7 was held on November 4, 2009 to review revisions to the draft LWMP report. The primary purpose of Meeting No. 7 was to obtain consensus from the Committee regarding the draft LWMP commitments to be presented at Public Open House No. 2.

2.2 Public Information

During the course of the LWMP work, LWMP information was published on the Town's website and in the local media to keep citizens informed on the progress of the work and to notify citizens of Committee meetings and public information meetings. Copies of these documents are included in Appendix 3.

2.2.1 Public Open House No. 1

Public Open House No. 1 was held on July 9th, 2009 at the Ladysmith Pioneer (Aggie) Hall. The draft material from the Stage 1 and 2 LWMP was summarized on poster displays. The Open House was staffed by representatives of the Town and by members of the consulting team, who were available for discussion and questions throughout the evening. Representatives of senior government regulatory agencies were also present. There was a summary slide presentation by Dayton & Knight Ltd. (see Appendix 3), followed by a question and answer session.

Approximately fifty people attended the first Open House, and thirty-three (33) questionnaires were filled out and submitted. The primary purpose of the Open House was to obtain public feedback regarding which options should be advanced for preparation of cost estimates, analysis and selection of preferred option(s).

A summary of the questionnaire responses is attached in Appendix 3 and is summarized below:

- most of the respondents (nearly 67%) learned of the Open House through newspaper advertising (Question #1).

- 82% of respondents are connected to the sanitary sewer system, with 12% serviced by septic tank/ground disposal and 6% not responding (Question #2).

- 97% of respondents supported source control of contaminants, with 3% not responding (Question #3).

- 100% of respondents supported water conservation (Question #4).

- 90% of respondents supported beneficial reuse of treated biosolids, with 9% not sure (Question #5).

- 97% supported reclamation and reuse of treated wastewater, with 3% not sure (Question #6).

- Question #7 asked whether all residents of the Town should contribute financially to an expanded and improved waste management system to pay the costs generated by new development; 78% of respondents supported this, with 6% disagreeing, 12% not sure and 3% not responding. Additional comments related to Question #7 are listed on the summary immediately following the collated responses to Question #7 in Appendix 3.

- Question #8 asked for input regarding the wastewater collection and treatment options. The responses are summarized below (additional comments received regarding Question #8 are listed on the summary immediately following the collated responses to Question #8) in Appendix 3.

	Agree	Disagree	Not Sure or No Response
Option 1 (expand and upgrade WWTP at present location)	55%	15%	30%
Option 2 (satellite treatment with water reclamation)	48%	6%	45%
Option 3 (new central WWTP)	58%	6%	36%
Option 4 (relocate outfall discharge)	36%	18%	45%

- 79% of respondents agreed that the open house material was easy to understand, with 6% disagreeing and 15% not answering this question (#9).

- Approximately 82% agreed that the level of information presented at the Open House was appropriate, with 3% disagreeing and 15% not answering this question (#10).

- Question #11 requested additional input from members of the public; the comments received are listed at the end of the summary in Appendix 3.

2.2.2 Public Open House No. 2

Public Open House No. 2 was held on May 13, 2010 at the Ladysmith Pioneer Hall. Draft material from Stage 1 and 2 LWMP from Open House No. 1 as well as the new draft material identifying Option Costs was summarized on poster displays (see Appendix 3 for more detail).

The Open House was staffed by the Town and by Dayton & Knight Ltd. Members of Council and the Joint Advisory Committee also attended including a representative from the Ministry of Environment. All were available for discussion and questions throughout the evening.

Very few other people attended the Open House and only two (2) questionnaires were returned.

The questionnaires:

- Indicated strong agreement with all of the questions posed with the exception that one of the two returns did not strongly favour the Option 2 – Central Treatment Plant.
- All attendees stated they had learned of the Open House through the newspaper advertisement and were connected to the Town sewer system.
- A suggestion was made to partner with CVRD to subsidize rain barrel purchase.

Appendix 3 provides a copy of the Open House's 2 questionnaires.

2.3 First Nations Consultation

Information related to the Liquid Waste Management Plan for Ladysmith was presented in a joint Council meeting between the Stz'uminus First Nation and the Town of

Ladysmith on April 6, 2010. The meeting included a power point presentation explaining the LWMP process, timelines, scope and study findings, including the project history/background, the current treatment facility, public consultation, government regulations for protection of the Ladysmith Harbour, environmental studies, and treatment options including cost estimates for protection of the environment. A general understanding was developed that a larger scope of responsibility beyond the Town of Ladysmith boundary would need to be considered to ensure protection of the overall Harbour water quality, since there are inputs to the Harbour from outside the Town boundary.

Minutes from the meeting and a copy of the slide presentation are included in Appendix 3. The Stz'uminus Council representatives voiced concerns at the meeting regarding the health of streams and creeks, pollution in Ladysmith Harbour, lack of traditional food sources, and the current and future waste treatment facility and the outfall.

Specific concerns regarding the Town's wastewater discharge to Ladysmith Harbour will be addressed through the current upgrade to the WWTP (which will add secondary treatment), and additional improvements if shown to be necessary by environmental studies (e.g. tertiary treatment and/or extension of the outfall).

The Town and Stz'uminus First Nation have agreed to a working group that will meet in the near future.

Minutes of the meeting were prepared by the Town of Ladysmith and a copy of the presentation was attached to the minutes (see Appendix 3).

2.4 Ongoing Public and First Nations Consultation

As discussed and agreed at a meeting with representatives of the Ministry of Environment on October 13, 2010, future public and First Nations consultation for the LWMP will be undertaken through a mail-out information package and supplemental material published on the Town's website. Public and First Nations feedback will be encouraged by inclusion of a questionnaire in the mail-out package.

Updated LWMP information (including the most up-to-date publication of this Stage 1 and 2 LWMP Report) will continue to be posted on the Town of Ladysmith website. Contact information to allow public feedback through email, fax, telephone or mail will also be available on the website.

3.0 STUDY AREA DESCRIPTION

3.1 Wastewater and Drainage Facilities Planning

Wastewater and drainage facilities must be planned for the long-term future in a manner that honours and is consistent with the development and sustainability goals of the community. Long-term planning particularly applies to the selection and siting of wastewater treatment plants and the main interceptor and trunk sewers that lead to the plants. A lack of long term planning may lead to the need to duplicate gravity interceptors, trunk sewers, and storm drains at great expense well before the useful life of these pipelines has expired. Should a treatment plant site become too small for future development or should the site become inappropriate with respect to future development, then substantial costs and public opposition may be incurred to reconstruct interceptors and trunk sewers and to locate a new plant site.

It is generally accepted in the municipal wastewater field that treatment plant sites should be secured for a minimum 50 to 100 year planning horizon, or the full development of the service area. Interceptors and trunk sewers are generally sized for a minimum 40-year design period, while pumped mains are generally restricted by hydraulic conditions to a 20-year design period before duplication is needed.

Development tends to increase the amount of impervious land area, reducing the amount of rainwater that infiltrates into the ground, and increasing the amount of surface runoff. Protection of key natural components of the drainage network, as well as drainage and detention facilities constructed to control flooding downstream of developments and/or to remove contaminants from surface runoff, can require significant amounts of space. Land use planning and development should include consideration of the space requirements for protected areas and drainage facilities.

3.2 Development, Official Community Plan and Population Projections

In order to properly plan for wastewater and drainage facilities, it is necessary to project future land use and populations within the Plan area. The LWMP guidelines require that the Official Community Plan (OCP) completed by the municipal or regional government(s) form the basis of the LWMP (B.C. Environment, 1992a). Like the Community Energy Plan (2008) and the Community Sustainability Vision (2009), the LWMP should then be incorporated as part of the OCP.

The OCP for the Town of Ladysmith, plans and policies referenced therein, and other relevant information were reviewed during development of the LWMP, to determine land use planning and population growth projections in the study area (Town of Ladysmith 2007a, 2007b and 2003). A 20-year planning horizon to 2028 was adopted for the LWMP; however, as described on the previous page, planning for sewerage facilities should include consideration of long-term future development well beyond a 20-year horizon, including potential industrial growth. The study area boundary and land use planning within the study area according to the existing OCP are shown on Figure 3-1. The Town occupies 1,480 hectares and stretches 9 km along the Island Highway bordering Ladysmith Harbour.

As recommended in the 2009 report "*Ladysmith Community Vision for a Sustainable West Coast Town*", a comprehensive review of the OCP is expected in the near future.

The analysis contained in this section is based on the existing OCP and policies/plans referenced therein, including the Sustainability Vision.

3.2.1 Official Community Plan: Development

The Town of Ladysmith includes residential as well as industrial, commercial and institutional (ICI) development. The Town is currently engaged in considering development options, for its waterfront lands. The Waterfront Area Plan contains a range of zones permitting multi-family residential, mixed-use residential/commercial, parks and recreation, water recreation and marina, as well as commercial land uses. The Holland Creek area will be an important long-term (15 to 20 years) residential development. The current Area Plan for Holland Creek incorporates mainly single-family homes for new development; however, this may be revised to incorporate more multi-family development as a result of the OCP review. Land use in the Downtown area should be diversified by increased residential uses through infill and residential over commercial/retail development. The South Ladysmith area was included in the Town boundary in 2002. This area is planned to serve as a future growth and employment centre for industrial and agricultural uses, including an industrial park and business park. Some commercial and residential development also exists in this area.

According to the Canada Census data (adjusted for undercount according to the B.C. Stats Service), the population of the Town of Ladysmith in 1996 was 6,456 (BC Stats 6,691). The population was 6,811 according to the 2001 Census, which represents an increase of about 5.5% from 1996 to 2001. From 2001 to 2006, the Census reflects an additional population increase of about 10.7% to 7,538 people (BC Stats 7,885). In 2007, the BC Stats adjusted population was 8,144.

In the OCP, Ladysmith has identified the following key future long-term development areas with a potential population growth of 8,500:

- Holland Creek area: potential population of 2,500;
- North End (Rocky Creek): potential additional population of 1,000;
- South End (South of Russell Creek): potential additional population of 2,000;
- Waterfront: potential population of 2,500;
- Infill surrounding downtown: potential additional population of 500.

The area designated as Agricultural Land Reserve in South Ladysmith may potentially include a golf course in future.

Additional areas that could potentially be serviced by the Town of Ladysmith wastewater system in future include Saltair to the south, the Diamond Improvement District to the north, and undeveloped land to the west currently owned by Timberwest. Saltair currently contains low-density unsewered rural development stretching south to Chemainus; this area could potentially contain an estimated 3,000 people if sewer service were provided. However, it is unlikely that the Saltair area would be incorporated beyond the Lagoon Bridge. The Diamond Improvement District contains about 250 unsewered properties ranging from acreages to small lots.

3.2.2 Service Population Projections

The Town of Ladysmith OCP shows different population growth scenarios with annual population increases between 1.5% and 5%. Population estimates for the different OCP growth for 2028 range from 11,133 to 22,689 people, depending on the growth rate. The level of development over the past few years has been about 100 new units per year. Based on the existing level of new building construction and considering recently approved development proposals and current OCP policies, the Town anticipates that the annual number of new units could increase in future years, particularly if more multi-family residential projects are built. If market conditions remain strong, there is the potential for up to 650 units to be built over the next five years; 550 between 2013 and

2018; 1500 ten to 20 years and 1250 twenty+ years. However, recent global economic conditions may impact the pace of new development in Ladysmith.

The Census and BC Stats populations reported for 2001 and 2006 are shown in Table 3-1. The estimated service population based on the development projections discussed above are included in Table 3-1 (assuming that the entire population is serviced by the WWTP). As shown, the 2006 WWTP service population of about 7,900 people is projected to increase to about 14,330 people by 2028, and to 17,200 people for the projected build-out development. For the purpose of planning wastewater facilities, a long-term future population beyond the current OCP horizon of 17,200 people should be allowed for in the LWMP.

TABLE 3-1
POPULATION GROWTH IN THE TOWN OF LADYSMITH

Year	Service Population[1,2]
2001	6,874
2002	7,036
2003	7,230
2004	7,375
2005	7,621
2006	7,885
2007	8,144
2008	8,551
2013	9,640
2018	10,930
2023	12,630
2028	14,330
Projected Build-out	17,200

[1] Population 2001 to 2007 from BC Stats, Service BC, Ministry of Labour and Citizens' Services, Government of British Columbia, December 2007.

[2] Population projections 2008 to Build-out: Town of Ladysmith, New Development Inventory, January 2008.

3.2.3 OCP Policies Related to the LWMP

The OCP lists the following environmental protection policies relating to development and to the wastewater system and stormwater system (Town of Ladysmith, 2007):

- Ecological features, particularly steep slopes, riparian areas, and Environmentally Sensitive Areas will be used to help determine suitable developable areas for new development.

- The Town will encourage protection of Environmentally Sensitive Areas and application of the Province of British Columbia's "Environmental Objectives, Best Management Practices Requirements for Land Developments and Streamside Protection Regulations" (note – the Streamside Protection Regulation has since been replaced by the Riparian Areas Regulation).

- Ladysmith will co-operate with forest management companies, First Nation and provincial government agencies to manage forest harvest in an environmentally and economically responsible way.

- Undertake environmental protection, enhancement and remediation of selected creeks, riparian habitat, wildlife corridors, steep slopes, viewscapes and other sensitive environmental features.

- Encourage the use of environmental indicators to determine how the community is managing the environment.

- Consider alternative design standards for the development of stormwater management systems such that site specific opportunities can be maximized.

- Create greenway linkages between and adjacent to neighbourhoods.

- The Town will develop Environmentally Sensitive Area Guidelines that integrate biophysical considerations in hillside planning, design and development.

- The Town will encourage community-based environmental stewardship by identifying stewardship opportunities and working with community groups, schools and citizens to develop integrated community stewardship programs.

- The Town will work with senior government to identify stewardship opportunities.

- The Town will encourage greenway designation and development at time of subdivision. Where possible greenways will be used for cycling and walking to link different neighbourhoods.

- Continue to enhance the urban environment and streetscape through tree planting under the "Green Streets" program.

- Watercourse riparian zones will be protected from unnecessary intrusion and development as per the Provincial "Riparian Area Regulation" formerly the "Streamside Protection Regulation." (Note that the Streamside Protection was repealed and replaced by the Riparian Areas Regulation in 2004).

- Future hillside development will be designed to fit landscape and natural features.

- Sustainable development considerations, with an emphasis upon encouraging complete neighbourhoods, will be incorporated into all future land use planning.

- Prior to development approval, the Town will require that development adjacent to or in proximity to sensitive areas, including steep slopes, as determined by the Town, is reviewed and approved by a geotechnical engineer and registered professional biologist.

- The Town will require that Environmentally Sensitive Area considerations are identified and incorporated into all future land use planning.
- Riparian corridors will be protected for their contribution as linkages between ecosystems.
- The Town will continue to encourage clean up of the Waterfront waterlots, foreshore and upland.
- The Town will complete a Master Drainage Plan for all watercourses within the Town to identify constraints and establish guidelines for future development.
- The Town will encourage protection of Environmentally Sensitive Areas and application of the Province of British Columbia's "Environmental Objectives, Best Management Practices and Requirements for Land Developments."
- The Town will review its existing Subdivision and Development Bylaw to update and provide the necessary controls in line with OCP.
- The Town should review and consider the application of alternative development standards that promote surface water infiltration and reduce surface runoff.
- The Town will work with forestry organizations to reduce the detrimental effects of logging within the Town's boundary.
- Economic development will respect environmental features and minimize detrimental environmental effects.

- Residents will be encouraged to reduce their reliance upon private vehicles by promoting alternative and multi-modal forms of transportation and complete neighbourhoods.

- The importance of Ladysmith's environmental heritage will be promoted in future planning and development. This will include the protection of natural water courses, and where possible, recovery and restoration (daylighting) of streams.

- The Town will prepare a tree protection and preservation bylaw.

- Watershed protection will be encouraged in the Holland Lake and Stocking Lake watersheds through cooperative efforts with landowners involved in forest management and recreation use.

- Complete the installation and operation of water metering as a conservation measure to reduce demand on the Town's water supply and to commence an education program for Town residents toward the objective of reduced water consumption. (These initiatives will help to reduce wastewater volume).

- Ladysmith will examine alternative wastewater treatment systems through partnerships with the private and public sector to provide for increased capacity and secondary treatment at the wastewater treatment plant.

- Incorporate a review of storm water retention/detention alternatives and erosion control practices for protection of fish-bearing watercourses, as well as reduction of property damage from rainfall events, into the Town's engineering standards.

- Direct urban development growth through sequential extensions to the existing infrastructure servicing distribution systems. Interim rural servicing standards are allowed in the recently incorporated South Ladysmith area for industrial and agricultural uses, with connection to full municipal services when made available.

- Through direct provision by the development industry, and through application of Development Cost Charges, require new development to provide for the extension of municipal infrastructure services and to share in the costs of new growth.

- Implement principles of sustainable development through consideration of alternative technologies for infrastructure.

The Town of Ladysmith Official Community Plan includes Development Permit Areas (DPAs) that require special measures for environmental protection that are designed to protect sensitive ecosystems and biological diversity; these areas are identified on Figure 3-2. OPA # 6 pays special attention to riparian areas.

3.2.4 Additions to the Service Population

Areas that may increase the service population such as Saltair and Diamond Improvement District are not currently within the Town of Ladysmith jurisdiction and are not under consideration; however, siting for a wastewater treatment plant recognizes the need for a facility layout that can manage greater than 17,200 people in one or more locations. Section 3.2.2 provides additional discussion on potential population increases.

3.3 Environmental Resources

A review of environmental resources within the study area was undertaken by Castor Consultants Ltd.; their report is attached as Appendix 4. A summary is provided below.

3.3.1 Aquatic Resources

The Town of Ladysmith is located on the east coast of Vancouver Island in the Ladysmith Harbour watershed, which it shares with adjacent CVRD lands including Area H, and the Chemainus First Nation lands. Within the town boundary, the upland, which is generally sloping down toward the east, is drained by several streams that discharge into Ladysmith Harbour. The upland area is characterized by zones of relatively steep gradient associated with zones of gentle topographic relief. The harbour has inner and outer areas which exhibit distinctive oceanographic differences, including a relatively shallow, long, narrow inner harbour and a deeper, wider outer harbour. The harbour lies in a southeast-northwest orientation, with the harbour entrance oriented toward the southeast and Stuart Channel, which forms part of the waterways around the nearby Gulf Islands in the southern Georgia Strait. The streams, which drain relatively small watersheds, have created delta fronts and associated estuarine features in the harbour that have modified the nearshore bathymetric characteristics. Recent and historic foreshore industrial development has modified the central waterfront through filling and deposition of wood debris and coal slack. The streams are illustrated on Figure 3-2.

The aquatic features are dominated by streams, which flow from the hinterland above and west of the Town of Ladysmith (Figure 3-2). Holland, Stocking and Russell Creeks all flow into the outer harbour, and Rocky Creek flows into the inner harbour. Holland Creek, which is a salmon-bearing stream, is the largest stream in the plan area. Stocking Creek transects a corner of the plan area and discharges into the outer harbour outside the plan area via Davis lagoon. Russell Creek flows to tidewater discharging south of Holland Creek near the south boundary of the plan area. Rocky Creek flows into the industrial area of the inner harbour. Stocking and Rocky Creeks support salmon (chum and coho), and cutthroat trout are reported to occur in the lower reaches. Rainbow trout are present in the upper reaches of Holland Creek and Stocking Creek. The presence of salmonids indicates that the streams are sensitive to environmental degradation, and require careful protection and management where potential inputs from stormwater and associated drainage occur.

A May 2008 field reconnaissance of the streams identified that many of the discharges into existing stream channels were rudimentary, and that some were points of erosion in the natural channels. Drain grates in the town were painted with warnings that fish are present.

Streams and associated upland areas which are outside the study area, but are tributary to the head of the harbour, include Bush and Thomas Creeks; these streams are important to consider because they appear to be major sources of fresh water to the harbour. Thomas Creek has been identified as a significant source of coliform bacteria; given the fairly intensive agricultural use in this watershed, Thomas Creek may be a significant source of nutrients to the harbour as well. High concentrations of nutrients including total phosphorus and total organic nitrogen have been noted in the inner harbour (see Section 3.4).

The oceanography of the study area is predominated by water from Stuart Channel, with local freshwater inputs from the nearby creeks. The harbour is a long shallow inlet with a constriction at Slack Point (Slag Pt), beyond which the harbour widens and deepens. The harbour water flushing is dominated by semi-diurnal tidal action. Tides exhibit a mean annual level of 8.8 ft and a large tide differential of 13.5 ft. The Intergovernmental Panel on Climate Change estimates that global average sea levels may rise by 18 cm to 58 cm by the year 2100 (IPCC, 2007).

A preliminary oceanographic study indicated that on the ebb tide water flows out of Ladysmith Harbour, and on the flood tide the water flows into the harbour. The regime tends to be characteristic of a stratified estuarine circulation, where saltier, cold marine water flows inward at depth from Stuart Channel, and the freshwater-dominated surface water flows seaward. Surface currents, which were observed to have very low velocities, exhibited greater velocities compared to the deeper (12 m) currents, and were noted to be markedly influenced by wind conditions. The inner harbour is characterized by extensive intertidal flats and water that is less than 10 m maximum in depth, and exhibits greater temperature variations than the outer harbour. In general, water exchange or flushing is considered to be poor in the inner harbour. Tidal conditions and winds were reported to affect wastewater distribution; it was suggested that the tidal flux results in an oscillation of effluent into and out of the harbour, and that southeast winds tend to move any surfaced effluent toward the head of the harbour.

The existing environment in Ladysmith Harbour consists of terrestrial, aquatic and marine elements. The terrestrial features are predominated by mixed-use urban areas with relatively large protected areas associated with streams and a shoreline park at Transfer Beach. Riparian zones along the streams provide wide areas of wildlife habitat as well as conduits for numerous species including amphibians, birds and mammals. Rare and endangered species, some of which are listed provincially as protected such as the red-legged frog, may occur in these areas.

3.3.2 Habitat

The marine environment exhibits a range of habitats and productivity, including marine and estuarine habitats comprised of intertidal and subtidal zones, and water column elements. The intertidal and subtidal zones can be categorized as undisturbed, disturbed or alienated. The disturbed and alienated habitats largely occur in the central waterfront area in existing and historic industrial zones, which extend from near the northern boundary of Ladysmith. The offshore areas of the harbour are relatively undisturbed, and are reported to provide important wintering habitat for waterfowl and habitat for marine mammals.

Natural nearshore habitats throughout the study area are characteristically made up of cobble with gravel and boulder elements in the mid to high intertidal with areas of sand

and mud flats. The rocky shore supports barnacles, limpets, littorine snails and oysters. Marine algae, including rockweed and sea lettuce, also occur in the mid to lower intertidal zones, and are an important habitat element on rocky shores. Numerous natural salt marsh pockets occur in the upper intertidal zone, particularly south of Transfer Beach. The sand and mud flat areas support a variety of shellfish including clams and oysters as well as other species such as gastropods, crustaceans and marine worms common to these environs.

There are concerns about discharges from live-aboard vessels in some areas of the inner harbour, and the potential for additional contamination of the water they pose.
Much of the core Ladysmith waterfront is alienated through current and historical industrial use as a result of intertidal fills exhibiting sloughing shores, and with areas of bulkheads and zones of riprap. Although the marine riparian zone is compromised in these and associated developed public park areas, it is more or less continuous in the middle area from south of the Holland Creek estuary to the south side of the development adjacent Transfer Beach, and in an area north of Slack point to the industrial zone and north of the Ladysmith Marina. The estuary areas provide productive and important habitat for fish and wildlife. While the Holland Creek estuary is relatively pristine, the Rocky Creek estuary is severely compromised by industrial encroachment.

A recent water and sediment quality assessment by the Ministry of Environment (McPherson et al 2006) indicated that the current sewage wastewater discharge is impacting the near-field marine environment. More detail regarding this study is provided in Section 3.4. The findings indicated that in the vicinity of the Ladysmith marine outfall, several sediment and water quality parameters measured in the 2004 assessment were poor and appear to have deteriorated since the 1993 assessment. The report recommended a treatment plant upgrade, particularly in light of this trend, the increasing population growth, and the Town’s interest in improving water quality conditions in the harbour for recreational and commercial purposes.

3.3.3 Shellfish

Shellfish production and harvesting constitute the major resource use in Ladysmith harbour and adjacent environs. There are several areas under shellfish production with water lot leases owned by local shellfish producers. The entire harbour is under a closure to recreational shellfish harvesting as illustrated on Figure 3-2 in Section 3.3.1; however, it is still acceptable for commercial harvest if shellfish are harvested and sent to a depuration plant, where they are placed in clean water for several days to expel bacterial contaminants.

The most recent Environment Canada growing area surveys for Ladysmith Harbour conducted between October 2003 and February 2006 have resulted in the recommendation that all shellfish closures in the area remain in effect (Figure 3-2). All stations at beaches utilized for depuration (cleanse or purify) harvests met the depuration standard. According to a recent Environment Canada report, Closure 17.1 is in place mainly due to bypass discharges of untreated wastewater from the Ladysmith Sewage Treatment Plant during wet weather; these bypass discharges are not disinfected, and therefore are a potential source of fecal contamination. As previously mentioned the Town of Ladysmith is making strides to reduce the number of bypasses by implementing upgrades to the treatment plant and reducing stormwater infiltration to the sewer collection system.

It is anticipated that the shellfish water quality criteria (Shellfish Growing Area Standard - median or geometric mean of 14 MPN/100 ml and not more than 10% to exceed the 43 MPN/100 ml or the Depuration Standard median not to exceed 88 and not more than 10% of the samples to exceed 260 MPN/100 ml) will not change in the near future. However, there are plans to modify the current shellfish management protocols to fall in step with international standards related to sewage treatment plant function.

Under the current regulations there are bi-valve harvesting prohibited zones where no harvesting shall take place:

1) Within 300 metres of industrial, municipal and sewage treatment plant outfall discharges (note – no known shellfish harvesting areas currently exist within a 300 m radius of the outfall terminus).

2) Within a minimum 125 metres of marinas, wharves, finfish net pens, float homes or other floating living accommodation facilities, including live-aboard boats.

A new process for the management of shellfish harvesting in areas in close proximity to sanitary discharges requires the establishment of conditional management plans (CMPs) for selected WWTPs located in shellfish harvesting areas. The management change is a result of local and international concerns regarding sewage treatment failures and the associated potential for increased bacterial and viral exposure to consumers. As a result, the plan follows an international standard as applied in other jurisdictions (US/EU). While bacteria are a concern, there is as great a concern relating to viral exposure for shellfish consumers.

The Ladysmith, Chemainus and Crofton areas have been identified as areas of priority and currently have CMPs in place. These sites were recently evaluated and chosen because of the sewage treatment systems, the type of shellfish production and the proximity to an export market (US). The CMPs involve monitoring wastewater treatment plant operational failures that result in the discharge of under-treated or raw sewage. During these occurrences, shellfish harvest areas subject to the potential effect of the discharge are under the CMP, which requires immediate notification of designated government agencies.

Upon identifying a failure at the wastewater treatment plant, the plant operator will immediately advise Fisheries and Oceans Canada (DFO) and the Provincial Emergency

Program (PEP), who will close the area to harvesting. Reopening will occur when specified criteria have been met.

3.3.4 Recreation

The Vancouver Island Health Authority (VIHA) has a program to routinely monitor recreational beaches within its jurisdiction. Beaches are monitored to protect swimmers from illnesses that may be linked to unacceptable bacteria levels. Swimming in water with unacceptable bacteria levels can increase the risk of ear, nose and throat infection or stomach illnesses. Beaches are classified according to the number of swimmers using them, risk of pollution, sampling history and other factors.

Water quality monitoring of recreational beach areas is identified as an important element in the Vancouver Island Health Authority's (VIHA) beach monitoring program. Recreational uses such as swimming and kayaking result in people coming into direct contact with water and potential pathogens. Beaches are classified according to the number of swimmers using them, risk of pollution, sampling history and other factors. The VIHA indicates that it is not possible to sample every beach or body of water where people may swim from time to time. Based on the reports, it would appear that the Ladysmith beach has few swimmers and as such has a low ranking. In spite of this, it may be prudent to request they conduct at least a modest program at beaches that are in common use.

3.3.5 Nutrient Inputs to Ladysmith Harbour

While nutrient levels are largely a concern in freshwater, marine areas that exhibit low flushing or poor exchange may be subject to impacts due to elevated nutrient levels as well. In some cases, these may be very localized and may result in algal blooms. In open water marine environs or areas that are well flushed by oceanic water, nutrients may be dispersed adequately. Nutrient data in the subject area from local sources may not be a problem at this stage; however, the growing number of inputs and associated loadings along the Ladysmith near shore coastal area should be examined in more detail.

The available nutrient data appear to be limited, and do not adequately characterize the current marine environment nor do they describe all of the potential input streams. Given the apparent low exchange rate in the harbour and the fact that the available data suggest there are some higher concentrations in the inner harbour (see Section 3.4), these issues should be addressed in more detail. A more comprehensive program is recommended to capture seasonal characteristics and point and non-point input sources for inclusion in a report on the nutrient mass balance for the area.

There are no data on stormwater quality from street, parking lot, residential, commercial or industrial runoff in the Ladysmith watershed area. These source inputs can provide significant contributions to stream and near shore pollution, impacting water and sediment quality.

3.4 Water Quality Monitoring in Ladysmith Harbour

The (italic) text contained in this section was adopted more or less verbatim from a report describing a water quality monitoring study conducted by the Ministry of Environment (McPherson et.al., 2006); note that minor editing and reorganization of the text was carried out in the interest of brevity and clarity for the layperson. Note that the sampling stations referred to in the text are shown on Figure 3-2 in Section 3.3.1.

3.4.1 General

Ladysmith Harbour is an important recreation area for boating, swimming and fishing. Transfer Beach Park is a central point on the waterfront for many of these activities. Shellfish harvesting has also been an important cultural, commercial and recreational activity in the area; however there is currently a sanitary closure to shellfish harvesting throughout the waters and intertidal foreshore of Ladysmith Harbour. There is an interest in improving the water quality of the Harbour, so that harvesting can resume. A few depuration sites exist which are exempt from the closure. At these sites, shellfish harvest is permitted if a purging and sterilization process occurs. The Chemainus First Nation are working with the assistance of the Environment Canada Shellfish Section towards re-opening areas within the Harbour for additional depuration sites or seasonal harvesting.

The Inner Harbour is characterized by extensive intertidal flatlands, water that is less than 10 m in depth, and greater variations in water temperature than the Outer Harbour. Four creeks drain into the Inner Harbour affecting surface salinity and water quality. There are also two sawmills on the west shore of the Inner Harbour. Flushing is poor and influenced by tidal action and wind mixing. Southeast winds tend to blow surfaced effluent from the STP (sewage treatment plant) outfall towards the head of the Harbour. Tidal activity causes this effluent water to return and re-enter the Inner Harbour. The Outer Harbour increases in depth to approximately 50 m and has a larger volume than the Inner Harbour. Only one creek drains into the Outer Harbour. Stuart Channel is the main influence on the physical oceanography, although water from the Inner Harbour also has an influence. There is a two-layer system of circulation within the Harbour due to the presence of freshwater. With this, outflows tend to occur in the upper layers and inflows occur in the lower layers.

3.4.2 1993 Monitoring Results

In order to gain an understanding of the environmental impacts of the Ladysmith wastewater treatment plant discharge on the Harbour, the Ministry of Environment Lands and Parks (now Ministry of Environment – MOE) conducted a study of the area in 1993. This study examined toxicity and water chemistry of both the discharge and the receiving environment at six sites in Ladysmith Harbour. The 1993 study provided the following conclusions:

- *while BOD (biochemical oxygen demand) and TSS (total suspended solids) values were well within their permitted limit for the wastewater treatment plant effluent, they were high enough to impact the receiving environment, contributing to apparent reduction of DO (dissolved oxygen) and sediment toxicity through the build-up of hydrogen sulphide;*
- *the wastewater treatment plant effluent was toxic to rainbow trout;*
- *the sediment immediately surrounding the treatment plant discharge was toxic to Macoma balthica (the Baltic macoma clam); and*
- *it was recommended that options be investigated for improving the quality of the effluent discharge from the wastewater treatment plant.*

3.4.3 2004 Monitoring Results

In July 2004, the MOE in partnership with the Town of Ladysmith repeated the 1993 study in order to identify the current state of the receiving environment and to identify if there were any changes since 1993. The 2004 study was also intended to provide additional baseline data, which could be compared with conditions once the STP was upgraded. To allow for a comparison of conditions, most of the procedures in 2004 were completed in accordance with the 1993 study. A summary of the findings of the 2004 study is given below.

The 2004 biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform and total nitrogen levels in the effluent were higher than the 1993 values. A review of historic data (1988-1991) compared with more recent data (2003-2005) also confirmed that BOD, TSS and fecal coliform levels have been increasing with time. Monthly monitoring data (2003-2005) collected by the permittee confirmed that BOD permit limit of 130 mg/L was often exceeded (19 out of 30 samples), and that total suspended solids (TSS) levels only occasionally exceeded the permit limit of 130 mg/L (4 out of 30 samples).

Bottom dissolved oxygen (DO) values in the Inner Harbour Sites (Sites 1-3) and Site 4 were higher than in 1993. The Outer Harbour Sites 5 and 6, located south of the outfall, had lower bottom DO levels than measured in 1993. The Water Quality Criteria for the protection of aquatic life is 5 mg O_2/L (instantaneous minimum). This minimum was not met at the 20 m depth (bottom sample) at Site 5, and at the 17 m depth to the 28 m depth (deepest sample collected) at Site 6.

Generally nutrient levels were highest at the bottom level for all sites, other than at Site 5, which had the highest levels at the mid depth. This is likely indicative of Site 5's proximity to the outfall and direction of the plume. Several of the parameters tested (ammonia, nitrate+nitrite, and total nitrogen) showed highest levels at Site 5 and/or Site 6 (the most southerly sites in the Outer Harbour), with Site 6 most often having the highest value overall. Total organic nitrogen was an anomaly, showing highest levels at the surface of the Inner Harbour Sites (Sites 1 and 2). A comparison of nutrient results between the 1993 and 2004 studies (only available for Sites 4 and 5) revealed that ammonia, nitrate+nitrite and total nitrogen were higher in 2004, particularly at Site 5. Total organic nitrogen and total phosphorus remained relatively constant between the two study periods.

Bacteriological levels (fecal coliform and enterococci) were highest at the bottom depths and values have increased since 1993 for all sites. The highest levels were recorded at

Sites 4 and 5 (just north and south of the outfall respectively). Fisheries and Oceans Canada has issued a sanitary closure to shellfish harvesting throughout the Inner and Outer Harbour, because of high bacteriological levels. The Water Quality Criteria for the protection of aquatic life (shellfish harvesting) for fecal coliforms is less than or equal to 43/100 mL 90th percentile or 14/100 mL median. Since multiple samples were not collected, 2004 values cannot be compared directly to the criteria; however, if the 2004 values were consistent and reflected typical values, much of the Harbour (bottom values at Site 2-5) would not meet the criteria. The Water Quality Criteria for recreation (primary contact) for fecal coliforms is less than or equal to 200/100 mL geometric mean. Although adequate numbers of samples were not collected to calculate the mean (5 samples in 30 days), the two 2004 values did not exceed the Criteria.

Similarly to fecal coliform, 2004 enterococci values were highest at Site 4 and Site 5. The Water Quality Criteria for the protection of aquatic life (shellfish harvesting) for enterococci are less than or equal to: 11/100 mL 90th percentile or 4/100 mL median. Again, since multiple samples were not collected, 2004 values cannot be compared directly to the Criteria; however, if the 2004 values reflected typical conditions, there would be shellfish harvesting concerns for much of the Harbour (Sites 3, 4 and 5).

Nutrient and metal levels in the sediments were higher at the Ladysmith Harbour Sites (A, B, D and E) than at the Control Site C. It should be noted that the sediment composition was slightly different at the control site. Site B, located just south of the outfall, tended to have the highest nutrient levels when compared to the other sites. Site B had the maximum value for available potassium, total phosphorus, and available sulfate. Site A, located just north of the outfall, had the highest levels of available ammonia. Site E, the most southerly point of the study, had the highest levels of available phosphorus. Of the Harbour Sites, Site B (located to the south of the outfall) appeared to be most influenced by the effluent, having the highest values of nutrient and metal parameters. Sediment quality at Site A (just north of the outfall) followed with parameters having the highest or second highest levels of all sites reviewed. There were *several exceedances to the Sediment Quality Working Guidelines for the protection of aquatic life. These included arsenic (Site B), cadmium (all harbour sites) and copper (all harbour sites). Site B had the highest levels of all these metals.*

Rainbow Trout bioassays indicated that the 2004 effluent (LC50 = 35%) have become more toxic since the 1993 study (LC50 = 75%). The 2004 bioassay results reveal that the effluent is deleterious to fish and in Contravention of the Federal Fisheries Act. Acute bioassay results indicated that adult marine amphipods, E. washingtonianus were not significantly impacted by the sediment and water quality in the Outer Harbour test sites. The lower survival (75%) at Site C, the control site, may have been the result of inappropriate sediment grain size. When the 2004 E. washingtonianus and M. balthica results for the Harbour area (Sites A, B, D and E) were compared with one another, results were poorest most often for Site A. It was recommended that future bioassays focus on E. washingtonianus rather than M. balthica, because E. washingtonianus is known to be more sensitive to poor conditions. If chronic bioassays are to be conducted more investigation is required for selection of the appropriate species to use.

The findings of this report highlight that several sediment and water quality parameters in and around the outfall discharge from the Ladysmith wastewater treatment plant are poor and appear to be deteriorating with time. Priority should be given to upgrading the treatment facility to provide secondary treatment, in accordance with legislation. An upgrade is particularly important in light of anticipated population growth in Ladysmith, and the Town's plans for improving and economically developing the waterfront area.

With secondary treatment, the effluent entering the marine environment is expected to be much improved, with the discharge containing lower levels of TSS, BOD, nutrients, pathogens and heavy metals. The results of this report will provide a baseline, from which improvements to the marine environment following upgrade of the wastewater treatment plant to secondary treatment can be measured. It is recommended that this study be repeated upon completion of the secondary treatment upgrades.

3.5 Groundwater Resources and Potential for Ground Disposal of Effluent

A review of groundwater resources and an assessment of the potential for ground disposal of treated effluent within the study area were undertaken by EBA Engineering Consultants Ltd.; their report is attached as Appendix 5. A summary is provided below.

The potential for ground disposal of wastewater effluent within the study area was assessed based on a review of ground slope, drainage conditions, soil texture, restrictive layers (e.g. bedrock), surface water, and groundwater aquifers; Figure 3-3 presents a composite of these parameter classifications. Specific areas are designated as good, moderate, poor and very poor potential for in ground liquid waste disposal, taking into consideration information regarding soil texture, overburden thickness and bedrock outcrops, slope, drainage and sensitive areas. The aquifers as environmentally sensitive areas were not included in this composite as they were not considered to constrain potential ground disposal of effluent.

The potential for in-ground liquid waste disposal was defined such that the potential was limited by the classification of the most constraining parameter. For example, areas that had one out of the four properties considered “very poor”, even if the reminder were “good”, were classified as “very poor”. Table 3-2 summarizes the constraining parameters and their associated potential for waste water ground disposal.

TABLE 3-2
POTENTIAL WASTEWATER GROUND DISPOSAL MODEL

Property	Good Potential	Moderate Potential	Poor Potential	Very Poor Potential
Soil Texture	sand, loamy sand, sand loam, loam, silt, silt loam	gravelly sand, very gravelly sand	sandy clay loam, silty clay loam, clay loam	sandy clay, silty clay, clay
Depth of Soil above Restrictive Layer	> 90 cm	60 to 90 cm	0.30 to 0.60 cm	0.15 to 0.30 cm
Slopes	0% to <15%	>15% to <25%	>25% to <35%	>35%
Drainage	well drained	moderately well drained	imperfectly or rapidly drained	poorly over very poorly drained
Sensitive Areas	Within 30 m setback (coastline) or as indicated on Town of Ladysmith OCP Map.			

As shown on Figure 3-3, no "good" areas exist for ground disposal based on the information reviewed. The majority of the area mapped as "moderate" is within the highly developed part of town and is already serviced by the central wastewater collection system. Some moderate potential areas for ground disposal exist in the undeveloped areas in South Ladysmith as long as the environmentally sensitive areas are considered (including water wells).

According to the Vancouver Island Health Authority, recent complaints regarding septic issues have only been received for properties along Chemanius Road (not within the Town boundary) near the waterfront (due to the steep slopes in this area). The Town of Ladysmith Public Works staff indicated that relatively few septic systems were in operation within the Town of Ladysmith boundaries and those systems were present in the south. They were not aware of any septic issues within the area.

Due to the regional level of information reviewed, areas that are mapped as poor or very poor may still have the potential for in-ground liquid waste disposal depending on the site specific conditions, discharge, size, type of system, and degree of treatment considered.

To assess a specific area or property within the Town of Ladysmith beyond the screening level provided in this document, the following site specific issues might be considered for field investigation or other evaluation:

- Topographic and percentage slopes on a local scale – care should be taken not to place a waste water disposal field near slopes or other features (pit, ditches) where breakout might occur;

- Soil Infiltration Capacity – in-situ testing is recommended within the proposed waste water disposal fields either through permeameter, infiltrometer or percolation testing methods;

- Characterization of site specific soils and depths to restrictive horizons, bedrock and water table under winter conditions;

- Presence or absence of potential environmentally sensitive features such as local wet areas, proximity to streams, tributaries or other water bodies. Establish appropriate setbacks;

- Survey water wells in the area – Note neighbor's wells or local community wells. Plan carefully if the property in question will have both a wastewater disposal field and water well. Ideally, wells should be upgradient with respect to the direction of groundwater flow with appropriate setbacks; and

- Degree of effluent loading in the area and potential deleterious impacts from increasing the load based on predictive modeling or monitoring of baseline water chemistry.

4.0 EXISTING WASTEWATER FACILITIES AND SERVICE AREAS

The existing study area with the sewer system and the Ladysmith wastewater treatment plant (WWTP) are illustrated on Figure 4-1. The WWTP is a primary treatment plant, which discharges effluent to the inlet of Ladysmith Harbour. The system serves the entire Town of Ladysmith. Most parts of the sanitary system flow by gravity, with four small pump stations serving areas that cannot be serviced by gravity. All components of the system are owned, operated and maintained by the Town of Ladysmith.

4.1 Sewer Collection System

Sanitary sewer systems are primarily intended to collect and transport wastewater to treatment facilities. However, most sanitary sewer systems are subject to the entry of stormwater during rainfall events, through infiltration of subsurface water into defects in the collection system, and through inflow of surface water through manholes and surface drainage systems that may be connected to the sewer. Inflow and Infiltration (I&I) can significantly increase the flow rate to collection and treatment facilities during wet weather; in some cases, this may cause spills of untreated wastewater.

From information provided by the Town of Ladysmith, no sanitary sewer overflows in the collection system have been reported. The old town site has had the combined sewers separated through the construction of sanitary sewers, however many of the private properties have not been separated.

4.2 Pump Stations

As noted above, the Town of Ladysmith owns and operates four pump stations; these are summarized in Table 4-1. The locations of the pump stations are shown on Figure 4-1.

TABLE 4-1
WASTEWATER PUMP STATIONS

Pump Stations	Number of Pumps	Pump Model	HP	Impeller Model	RPM	Capacity (L/s)	Age (years)
Gill Road	2	Flygt 3201	29	454	1800	55	27
Sandy Beach	2	Flygt CP3085	3	436	1700	13	27
Transfer Beach	2	Flygt CP3102	3	267	7440	<13	27
Ludlow Road	2	Myers 4VHX100M4-03	10	-	1750	Not Available	8

(1) Best Efficiency Point used from catalogue.

4.3 Wastewater Treatment Plant

4.3.1 Existing Facilities and Immediate Upgrade Needs

The existing wastewater treatment plant includes a new headworks building constructed in 2009/2010. The headworks include a rock trap, fine screening of influent sewage in two parallel channels, grit removal, and flow measurement.

A new pump station is included in the headworks building to pump influent to the proposed secondary treatment facilities. A storage reservoir and pump station for future use of reclaimed water is also included in the new headworks.

Primary treatment of screened wastewater is currently provided in the spiragester, which will continue to be used for storm bypass treatment in future. Prior to 2009, chlorine gas was added to disinfect the primary-treated wastewater, and sulphur dioxide was added to dechlorinate the final effluent. A new system was installed in 2008 to replace the chlorine gas system with liquid sodium hydochlorite (bleach), and sulphur dioxide gas with sodium bisulphite.

Two outfalls combine to convey the treated effluent and bypass flow to the inlet of Ladysmith Harbour. The capacity of the outfall pipes is about 6,500 m^3/d for the 300 mm diameter cast-iron and asbestos cement pipe that discharges treated wastewater from the spiragester, and about 55,000 m^3/d for the 710 mm polyethylene outfall for bypass flows.

Settled solids from the spiragester are stabilized in an autothermal thermophilic aerobic digester (ATAD), dewatered in a screwpress, and transported to the Town's Works Yard, where the biosolids are composted further in static piles. The ATAD digesters were designed to accommodate treatment of primary sludge for 8500 people. Addition of secondary sludge will reduce the ATAD capacity by one-half.

The existing treatment plant has primary treatment capacity for about 6,500 people. The treatment facilities are under capacity for the current service population (estimated at over 8,000 people – see Table 3-1 in Section 3.2.2). In addition, the existing facilities are in need of repair and replacement. A number of studies have been undertaken to develop a strategy for upgrading and expanding the treatment facilities (e.g. Dayton & Knight Ltd., 1991, 1999, 2004, 2007a, 2007b and 2008).

An upgrade to the WWTP to address immediate needs is currently underway; the following (Phase 1) upgrades were completed in 2009/2010:

- spiragester – internal metal structure required replacement;
- influent screen and grit removal – redundancy and additional capacity is required as well as future pumping for secondary or remote treatment;
- disinfection – the gas chlorination system required complete replacement and a hypochlorite solution treatment with sodium bisulphite is proposed; and
- electrical upgrades.

Phase 2 will provide primary treatment filters to replace the spiragester.

Phase 3 will provide the secondary plant in accordance with MSR requirements as well as standby power, water reuse, solids handling improvements and sustainable features.

Future phases may provide for UV treatment, tertiary treatment and/or outfall extension, plant expansion and additional integrated resource management.

The work described above will complement any secondary or advanced treatment solutions planned (see Section 4.3.3).

4.3.2 Discharge Permit

The Ladysmith WWTP operates under Ministry of Environment Pollution Control Permit No. PE-120 and its amendments (attached as Appendix 6), which specify the following requirements for the Sewage Treatment Plant Discharge:

- Maximum BOD_5 130 mg/L
- Maximum TSS 130 mg/L
- Maximum day discharge 6,100 m^3/d

- Annual average discharge 3,050 m^3/d
- Chlorine residual prior to dechlorination 0.1 mg/L to 1.0 mg/L
- Dechlorination prior to discharge to <detection limit

Permit PE-120 includes the following parameters for the screened Overflow Bypass Discharge:

- Combined stormwater and sewage maximum day discharge 8,500 m^3/d

Completion of the LWMP will result in replacement of the Ladysmith WWTP Permit PE-120 with an Operational Certificate.

4.3.3 Addition of Biological Treatment

A test program to investigate an innovative technology to meet secondary treatment standards was undertaken by the Town beginning around the year 2000. Based on the results of the testing, the Town concluded that the technology should not be implemented (Dayton & Knight Ltd., 2006), and decided to pursue alternative, but proven, technologies for secondary (biological) treatment. On behalf of the Town, Dayton and Knight recently assessed four process alternatives for upgrading the primary wastewater treatment to secondary treatment; these were the Biological Aerated Filter (BAF), Integrated Fixed Film Activated Sludge (IFAS), Moving Bed Biofilm Reactor (MBBR) and Membrane Bioreactor (MBR). As described in Section 2.1, the MBBR process was identified as the preferred option based on an evaluation that included capital and operating costs, space requirements, track record, reliability, operating characteristics, expandability, effluent quality and sludge production. The MBBR was found to be the most appropriate of the four processes to meet site constraints and treatment requirements, and since it could incorporate nutrient removal technologies as may be needed as a result of further environmental impact studies of the harbour (Dayton & Knight Ltd., 2008).

A potential process (Vertreat™) that uses a small footprint was briefly examined, but not further advanced since the process could not be shown to reliably meet nutrient removal standards. The Town is proceeding with a funding application to senior government to support the upgrade to secondary treatment based on the moving bed bioreactor (MBBR) process.

The upgraded secondary WWTP will meet the standards for secondary treatment as set out in the Municipal Sewage Regulation (MSR) for two times the average dry weather flow for a design population of 17,200 people. Secondary treatment requires removal of five-day biochemical oxygen demand (BOD_5), and total suspended solids (TSS) to less than 45 mg/L, compared to 130 mg/L in the existing WWTP discharge permit. Based on the discussion in Section 3 of this report regarding the sensitivity of Ladysmith Harbour and the importance of the shellfish resource, it was recommended that process selection ensure that design of the secondary treatment facilities be flexible to allow future upgrades to advanced biological and/or chemical treatment to achieve removal of nutrients (nitrogen and phosphorus) if needed in future. Filtration to achieve advanced removal of TSS may also be needed in future. The potential addition of these advanced treatment steps has implications for the space requirements and ultimate capacity of the upgraded WWTP, as well as capital and operating costs; these additional requirements have been considered in the design of the secondary treatment facilities.

In addition to or as an alternative to installing advanced treatment at the WWTP (if found to be necessary), the Town may extend the outfall discharge out of Ladysmith Harbour, past the embayment line into Stuart Channel (see Figure 3-2 in Section 3.3.1); this should allow protection of water quality and the shellfish resource in Ladysmith Harbour based on the use of secondary treatment at the WWTP.

The above alternatives were developed and discussed with the Joint Advisory Committee during development of the LWMP. Important issues addressed included protection of the receiving environment, fisheries resources (mainly shellfish), the capacity of the existing WWTP site to serve long-term future populations, economics, recovery and reuse of treated effluent and residual solids, and social issues such as odour and aesthetics.

4.4 Boat Holding Tank Pump-out Station

A boat holding tank pump-out station and a washroom are located at the Government Wharf near the Ludlow pump station. There is a holding tank for the washroom, which is pumped to the Ludlow pump station. The boat holding tank pump-out station, which is not yet connected to the washroom holding tank and therefore is not currently in use, is to be connected when reconfiguration of the wharf is completed. The Ladysmith Maritime Society intends to install a pump out station at the Ladysmith Maritime Marina below the machine shop in 2011; this will also be connected.

4.5 Un-serviced Areas

Properties that are not connected to sewer are typically serviced by onsite sewage disposal systems. Onsite systems are those designed for treatment and ground disposal of wastewater within the boundaries of individual lots or parcels. These systems typically include a septic tank followed by a subsurface disposal field. The useful life of ground disposal systems and the effectiveness of treatment vary widely according to local conditions (Dayton & Knight Ltd., 1994a). Solids that accumulate in septic tanks (normally referred to as “septage”) must be periodically removed by pumper trucks, to prevent clogging of the disposal field. Pumper truck discharges can include industrial and commercial wastes as well as septage generated by onsite systems. Town staff report that only a small number of properties within the municipal boundary are not serviced by the central sewage collection system. A discussion of the potential for serving new development with localized ground disposal systems is included in Section 3.5 of this report.

Until recently, a septage treatment facility located at Ladysmith accepted septage from the surrounding area and discharged treated wastewater to the Town sewer system; however, this facility was recently decommissioned.

4.6 Combined Sewer Overflows and Sanitary Sewer Overflows

Combined sewers are those that are designed to carry both wastewater and storm runoff. Combined sewer overflows (CSOs) generally involve designed spill points at designated locations on the sewer collection system to avoid exceeding the hydraulic capacity of the system. The Municipal Sewage Regulation prohibits CSOs for storm events less than the 5-year return period. There are no documented CSOs on the Ladysmith wastewater system.

Sanitary sewer overflows (SSOs) are overflows that occur on separate sewer systems that are designed to carry only wastewater. SSOs may occur due to excessive inflow and infiltration of stormwater into the collection system, or due to failures at wastewater pumping stations. There are no documented SSO occurrences on the Ladysmith system. The Town’s wastewater pump stations include plug-in connections so that portable generators can be used in the event of a power failure.

5.0 WASTEWATER AND BIOSOLIDS QUANTITY AND QUALITY

As noted in Section 3.0, long term planning for domestic wastewater collection and treatment is necessary to avoid costly duplication and/or relocation of existing facilities and to deal with future population increases and development. Reasonably accurate projections of the quantity and quality of domestic wastewater are necessary to determine future needs, so that trunk sewers can be designed with sufficient capacity to handle future development, and so that sufficient space is set aside for the construction and expansion of treatment works. Wastewater quantities and character within the study area described in this section will be used in developing and evaluating the waste management options developed later.

5.1 Wastewater Flows

5.1.1 Historic Data

The Town of Ladysmith does not maintain flow monitoring stations on the sewer collection system or at the pump stations. Flows are only monitored at the WWTP. The flow rate of the treated effluent at the WWTP is measured with a 90^0 V-notch weir located at the chlorine contact tank. Stormwater bypass flows are measured separately in a Parshall flume following screening. Flow data from 1998 to 2007 are summarized in Table 5-1; note that the flows shown in Table 5-1 include both the treated effluent and the bypass flows. The estimated service population for each year of record is included in

Table 5-1, along with the per capita flow rates. As shown, the per capita flow rates during the years 2003 to 2007 were significantly lower than those recorded during 1998 to 2002. This may be due to a reduction in water use by residents, and/or to a reduction in inflow and infiltration of precipitation into the sewer collection system (see Section 5.1.2). As shown in Table 5-1, the average day flow was about 335 litres per capita per day over the period 2003 to 2007, and the average dry weather flow, which was calculated as the minimum 30-day moving average flow for each year, was about 234 litres/capita/day over the same five years of record. The average of the maximum day flow recorded during the period 2003 to 2007 was about 1,390 litres/capita/day, with a maximum recorded value of 1,600 litres/capita/day. These values are slightly lower than the design parameters developed previously (i.e., ADF = 350 litres/capita/day and ADWF = 276 litres/capita/day – see Dayton & Knight Ltd., 2004).

TABLE 5-1
LADYSMITH WWTP EFFLUENT FLOWS 1998 TO 2007 (INCLUDING BYPASS)

Year	Service Population[1]	Average Day (ADF)[2]		Average Dry Weather (ADWF)[3]		Maximum Month (MMF)[4]		Maximum Day (MDF)[5]	
		cubic metres/day	litres/ capita/day	cubic metres/day	litres/ capita/day	cubic metres/day	litres/ capita/day	cubic metres/day	litres/ capita/day
1998	6,800	3,070	451	2,420	356	4,410	649	N/A	N/A
1999	6,861	3,180	463	2,290	334	4,640	676	N/A	N/A
2000	6,822	2,560	375	2,220	325	3,420	501	N/A	N/A
2001	6,874	2,470	359	2,060	300	3,910	569	N/A	N/A
2002	7,036	2,538	361	1,930	274	4,429	629	7,735	1,099
Average[6]	**6,879**	**2,764**	**402**	**2,184**	**318**	**4,162**	**605**	**7,735**	**1,099**
2003	7,230	2,610	361	1,826	253	4,040	559	8,276	1,145
2004	7,375	2,517	341	1,836	249	4,088	554	12,869	1,745
2005	7,621	2,421	318	1,555	204	4,744	622	10,722	1,407
2006	7,885	2,684	340	1,851	235	5,211	661	8,133	1,031
2007	8,144	2,580	317	1,864	229	4,272	525	13,048	1,602
Average[7]	**7,651**	**2,563**	**335**	**1,786**	**234**	**4,471**	**584**	**10,610**	**1,386**

1 Extrapolated from Table 3-1
2 Average daily flow from January 1 to December 31 of each year
3 Minimum 30-day moving average flow for each year
4 Maximum 30-day moving average flow for each year
5 Highest recorded single day flow from January 1 to December 31 for each year
6 For years 1998 to 2002
7 For years 2003 to 2007

The treated effluent flow data for the period 2002 to 2007 are illustrated on Figure 5-1, and the bypass flows are shown on Figure 5-2. As shown, the treated effluent flow occasionally exceeded the permitted maximum of 6,100 m^3/d (Figure 5-1), but the permitted maximum bypass flow of 8,500 m^3/d was not exceeded during the period of record (Figure 5-2). As shown in Table 5-1, the average day flow of the treated effluent was well below the permitted amount of 3,050 m^3/d.

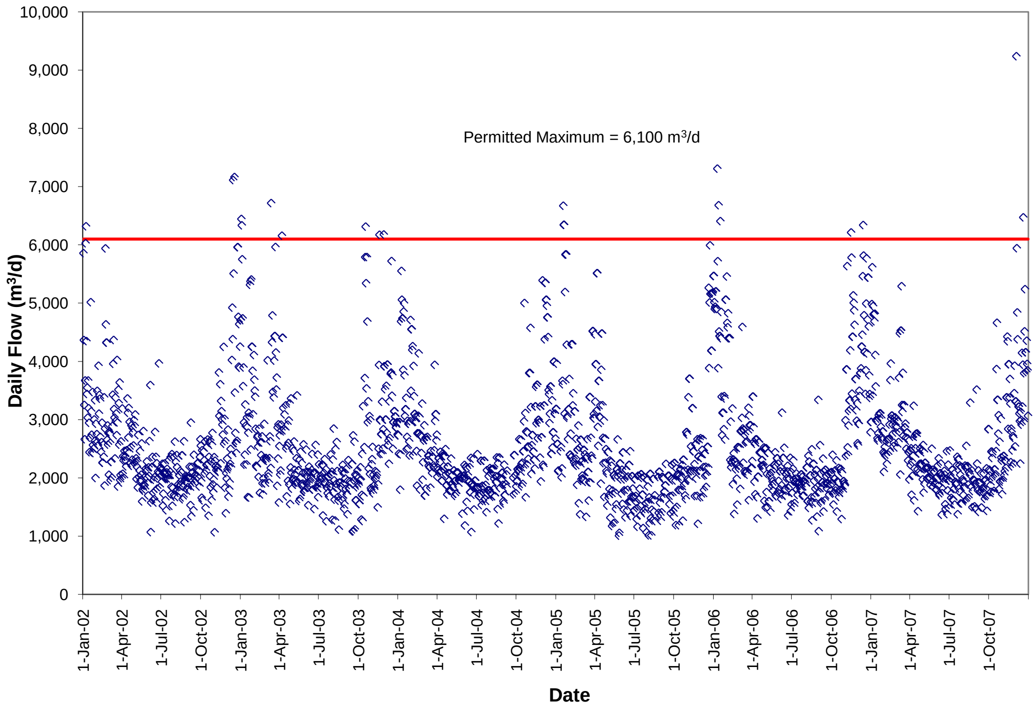

Figure 5-1: Ladysmith WWTP Treated Effluent Flow Rate 2002 to 2007

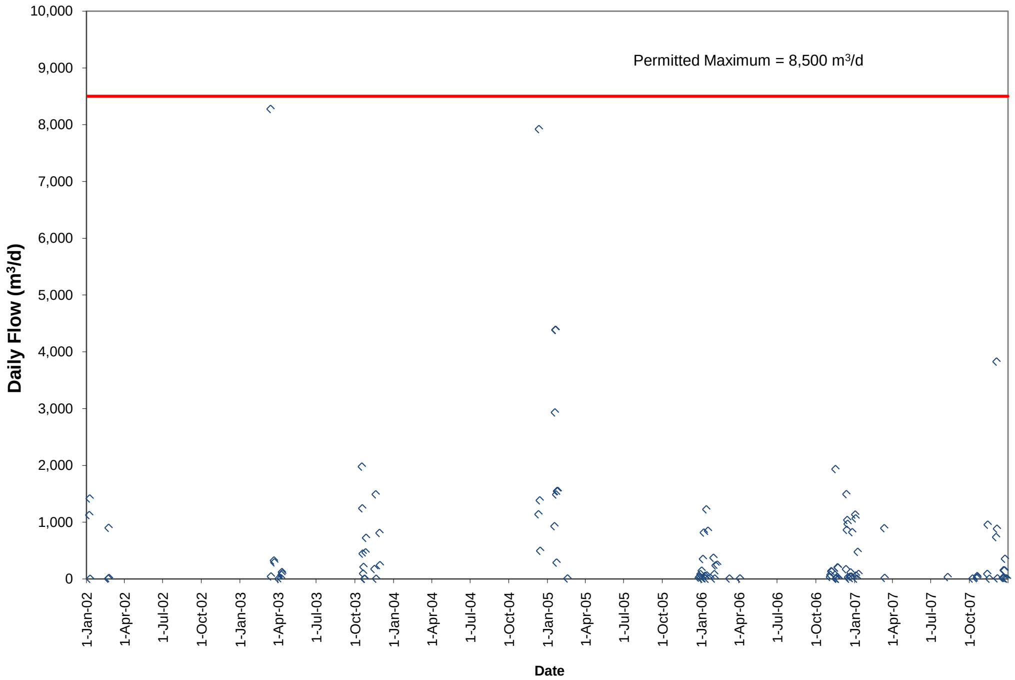

Figure 5-2: Ladysmith WWTP Bypass Flow Rate 2002 to 2007

5.1.2 <u>Inflow and Infiltration</u>

Inflow and Infiltration (I&I) into the sewer collection system can substantially increase the volume of wastewater arriving at treatment facilities. I&I varies depending on antecedent weather, soil moisture, groundwater levels, and the duration and intensity of storm events.

Infiltration can be divided into two components. Groundwater infiltration (GWI) enters the system through defects in pipes, which are located below the water table; GWI is relatively constant in intensity and is of long duration. Rainfall-derived infiltration (RDI) occurs during and immediately after rainfall events, and is caused by the seepage of percolating rainwater into defective pipes, which lie near the ground surface; RDI is typically of relatively short duration and high intensity, compared to GWI.

Inflow can also be divided into two components. Dry weather inflow (DWI) results from surface water not caused by rain that enters the sewer system (e.g., street and vehicle washing). Stormwater inflow (SWI) results from the diversion of storm surface runoff into sanitary sewers (e.g., roof downspouts that are connected to the sanitary sewer and surface runoff entering manholes). Some older systems are designed to carry both wastewater and storm surface runoff; these are commonly referred to as combined sewers. In parts of the Old Town area in Ladysmith the sewer separations are not completed on private property.

I&I affect the design of wastewater collection systems and treatment facilities. Collection systems must be designed to accommodate the peak instantaneous I&I that occurs during a precipitation (and/or snowmelt) event. At wastewater treatment facilities, hydraulic design must accommodate the peak instantaneous I&I, and the treatment processes must accommodate the sustained high hydraulic loads that occur over several hours or days during wet weather.

The Municipal Sewage Regulation (MSR) for British Columbia states that, where 2.0 times the average dry weather flow (ADWF) is exceeded at the treatment plant during rain or snowmelt events and if the contributory population exceeds 10,000 persons, the discharger should show how I&I can be reduced as part of a LWMP. The intent of this clause in the MSR is to avoid requiring local governments to construct secondary treatment facilities with the capacity to treat high wet weather flows that occur infrequently. The MSR requires secondary treatment for all flows up to 2.0 times ADWF, and allows flows in excess of this amount to receive only primary treatment, provided that a plan and schedule is in place to achieve full secondary treatment.

The service population for the Ladysmith WWTP is currently less than 10,000 people; however, the wet weather flows were evaluated according to the MSR criterion as a means of determining the degree of I&I in the system. The ratio of maximum day flow

(MDF) to ADWF at the Ladysmith WWTP for the years 2003 to 2007 is summarized in Table 5-2, together with the flow ratios comparing the average day flow (ADF) and maximum month flow (MMF) to the ADWF. As shown, the ratio of MDF:ADWF was in the range 4.5:1 to 7:1, indicating that I&I to the WWTP collection system is excessive according to the MSR criterion.

TABLE 5-2
LADYSMITH WWTP RATIO OF MDF TO ADWF 2003 TO 2007

Year	ADWF (m^3/d)	Ratio MDF:ADWF	Ratio MMF: ADWF	Ratio ADF: ADWF
2003	1,825	4.53	2.21	1.43
2004	1,855	7.01	2.23	1.37
2005	1,528	6.89	3.05	1.56
2006	1,860	7.00	2.82	1.45
2007	1,883	7.00	2.29	1.38
Average	**-**	**6.49**	**2.52**	**1.44**

One source for inflow is a large area in the Old Town area that was formerly on a combined sewer system (see Figure 4-1 in Section 4.1). The storm and sanitary sewer systems have now been separated, except for the service connections on private property. In addition, parts of the Old Town collector sewer system consist of vitrified clay pipes that were built at the beginning of the 20th century. A study of I&I was conducted by the Town as a component of ongoing I&I reduction (Dayton & Knight Ltd., 1992).

The Town has made significant improvements in reducing infiltration and inflow (I&I) to the sewer collection system by replacing old sewers with PVC pipes in 1996 and 1997 (Dayton & Knight Ltd., 1999). Per capita flows during the past five years (2003 to 2007) were significantly lower than previously (see Section 5.1.1). Currently no sewer overflow events are reported. A large part of the existing I&I problems are believed to be from sewers on private property. In spite of these efforts, I&I at the WWTP continues to be a problem. The Town has identified a budget of $150,000 per year for I&I reduction, to be continued until the problem has been resolved.

5.1.3 Projected Wastewater Flows

The average dry weather per capita unit flow rate over the period 2003 to 2007 of 234 L/c/d (from Table 5-1 in Section 5.1.1) was used along with the projected population growth (from Table 3-1 in Section 3.2.2) to project future wastewater flows. The flow ratios over the same period (2003 to 2007) from Table 5-2 were then used to project the average day flow (ADF), maximum month flow (MMF) and maximum day flow (MDF). The projected wastewater flows are summarized in Table 5-3; note that these flows do not account for any flow reductions from water conservation. As shown, the plant average day flow is projected to increase from 3,000 m^3/d in 2008 to about 5,000 m^3/d in 2028, and to about 6,000 m^3/d at build-out, if no water conservation measures (or further I&I reduction) are undertaken.

As described later in Section 6.2.1, water conservation measures aimed at in-home water use can potentially reduce dry weather (base) wastewater flows. Projected wastewater flows with water conservation in place are summarized in Table 5-4. With water conservation measures implemented, the average dry weather flow could potentially be reduced to about 2,950 m^3/d in 2028 (Table 5-4) compared to 3,350 m^3/d without water conservation (Table 5-3). Assumptions regarding the impacts of water conservation on dry weather wastewater flows are discussed in Section 6.2.1 of this report, and are listed in the footnotes to Table 5-4. The potential effect of water conservation on dry weather flow is illustrated on Figure 5-3. The ADF, MMF and MDF with water conservation in place were estimated using the reduced ADWF and the flow ratios shown earlier in Table 5-2; note that additional I&I reduction could potentially further reduce wet weather flows (i.e., MDF and MMF).

The peak I&I flow for a particular system is normally developed from flow measurements, or, if accurate flow data are not available, typical design values may be adopted. For the Ladysmith system, accurate flow records were available only at the WWTP; these data reflect only the 24-hour (daily) flow rates, and do not provide the peak instantaneous flows for the various collection areas. The design I&I allowance of 0.17 L/s/ha (14,700 L/ha/d) as recommended in the Master Municipal Construction Documents (MMCD) was adopted for the purpose of projecting future flows in the Ladysmith wastewater collection system; however, it is important to note that actual peak flows may be significantly higher than those shown in Tables 5-3 and 5-4, due to the high degree of I&I from the private combined sewer connections in the Ladysmith system. The projected peak wet weather flows included in Tables 5-3 and 5-4 were based on the assumption that peak I&I will be reduced to the MMCD design amount of 14,700 L/ha/d (see Sections 6.2.2 and 10.2 for additional discussion of I&I reduction).

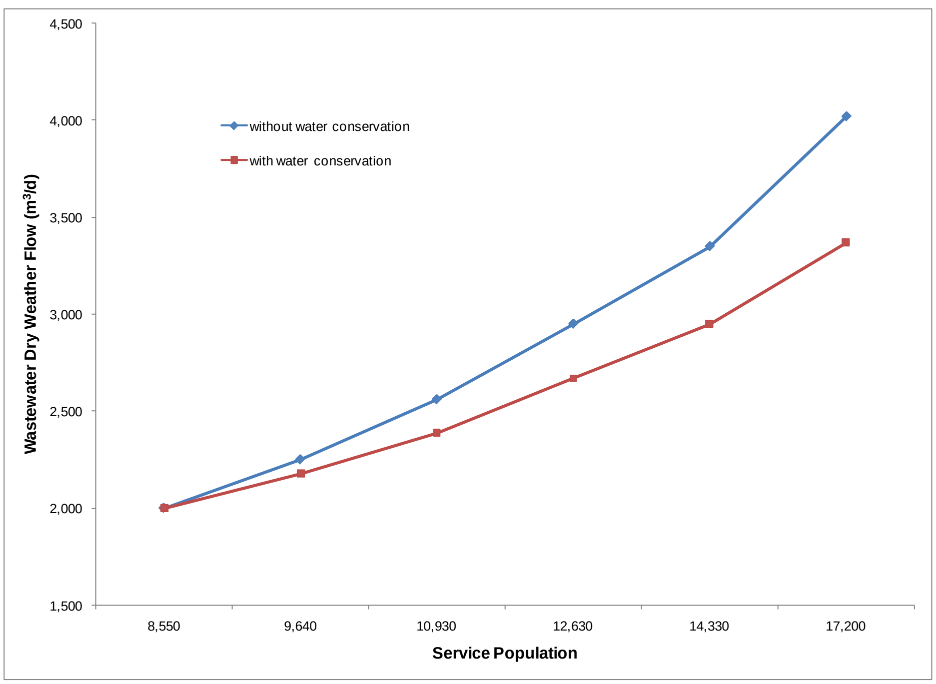

Figure 5-3
Potential Impact of Water Conservation on Dry Weather Wastewater Flows

TABLE 5-3
PROJECTED WASTEWATER FLOWS WITHOUT WATER CONSERVATION

Year	Service Population	Average Day Flow (ADF) (m^3/d)	Average Dry Weather Flow (ADWF)[1] (m^3/d)	Maximum Month Flow MMF) (m^3/d)	Maximum Day Flow (MDF) (m^3/d)	Peaking Factor (PF)	Service Area[2] (ha)	Peak I&I Allowance[3] (m^3/d)	Peak Wet Weather (Peak Hour) Flow (PWWF)[4] (m^3/d)	Peak Wet Weather (Peak Hour) Flow (PWWF)[4] (L/s)
2008	8,550	2,880	2,000	5,040	12,970	2.55	590	8,670	13,780	159
2013	9,640	3,240	2,250	5,280	14,180	2.52	800	11,760	17,450	202
2018	10,930	3,680	2,560	5,770	15,620	2.49	900	13,230	19,590	227
2023	12,630	4,240	2,950	6,370	17,410	2.45	1,050	15,440	22,680	262
2028	14,330	4,820	3,350	6,910	19,100	2.42	1,200	17,640	25,750	298
Projected Build-out	17,200	5,780	4,020	7,770	21,790	2.37	1,200	17,640	27,190	315
Future	30,000	10,100	7,020	10,530	31,590	2.24	1,200	17,640	33,347	386

1 ADWF = 234 L/c/d based on historic data 2003 to 2007 (see Table 5-1)

2 Assumes linear increase with population growth

3 Peak I&I allowance = service area x 14,700 L/Ha/d (from MMCD Design Guideline)

4 Peak Hr Flow = (ADWF)(PF) + I&I allowance, where PF (Peaking Factor) = 3.2 divided by population in thousands to the power 0.105

TABLE 5-4
PROJECTED WASTEWATER FLOWS WITH WATER CONSERVATION

Year	Service Population	Average Day Flow (ADF) (m³/d)	Average Dry Weather Flow (ADWF)[1] (m³/d)	Maximum Month Flow MMF) (m³/d)	Maximum Day Flow (MDF) (m³/d)	Peaking Factor (PF)	Service Area[2] (ha)	Peak I&I Allowance[3] (m³/d)	Peak Wet Weather (Peak Hour) Flow (PWWF)[4]	
									(m³/d)	(L/s)
2008	8,550	2,880	2,000	5,040	12,970	2.55	590	8,670	13,780	159
2013	9,640	3,140	2,180	5,110	13,730	2.52	800	11,760	17,450	202
2018	10,930	3,440	2,390	5,380	14,580	2.49	900	13,230	19,590	227
2023	12,630	3,840	2,670	5,760	15,750	2.45	1,050	15,440	22,680	262
2028	14,330	4,240	2,950	6,090	16,820	2.42	1,200	17,640	25,750	298
Projected Build-out	17,200	4,850	3,370	6,510	18,270	2.37	1,200	17,640	27,190	315
Future	30,000	7,970	5,540	8,310	24,930	2.24	1,200	17,640	33,347	386

1 ADWF = 234 L/c/d in 2008, assume 25% reduction for new construction after 2008 and 15% reduction for retrofitting existing buildings, with 20% market penetration by 2028, 50% by OCP Development and 75% for Future

2 Assumes linear increase with population growth

3 Peak I&I allowance = service area x 14,700 L/Ha/d (from MMCD Design Guideline)

4 Peak Hr Flow = (ADWF)(PF) + I&I allowance, where PF (Peaking Factor) = 3.2 divided by population in thousands to the power 0.105

5.2 Wastewater Quality

5.2.1 Historic Data

The WWTP treated effluent quality is tested on a monthly basis by the Town as required by Permit PE-120. The quality of the influent at the Ladysmith WWTP is also monitored monthly. The influent and effluent concentrations of five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) for 2006 and 2007 are illustrated on Figures 5-4 and 5-5. As shown, the effluent BOD_5 has exceeded the allowable maximum of 130 mg/L several times (Figure 5-4), and the effluent TSS has exceeded the maximum permitted levels of 130 mg/L twice (Figure 5-5) during the period of record.

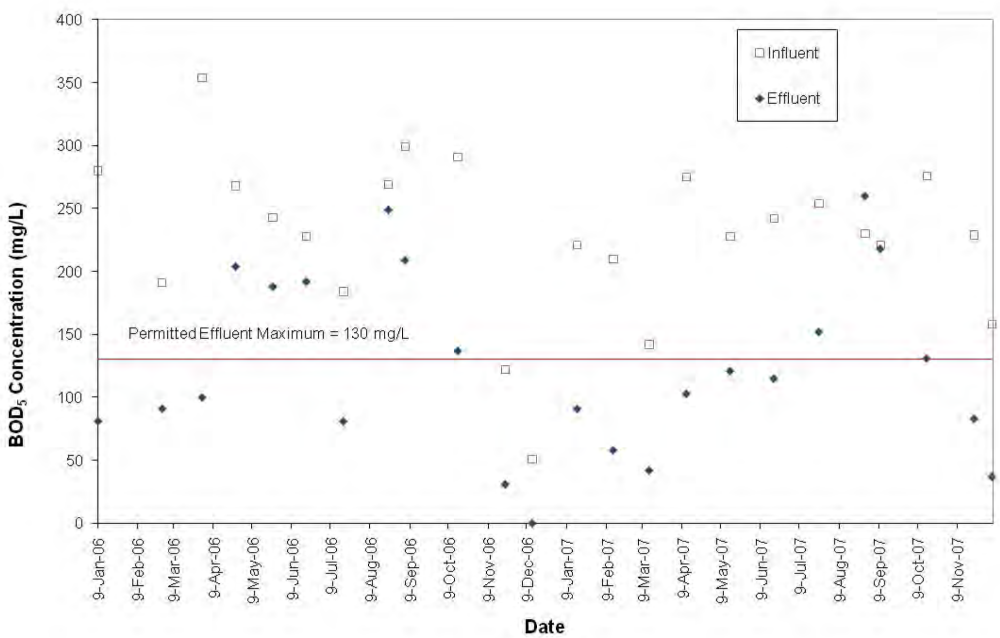

Figure 5-4 Ladysmith WWTP BOD_5 Concentration 2006 to 2007

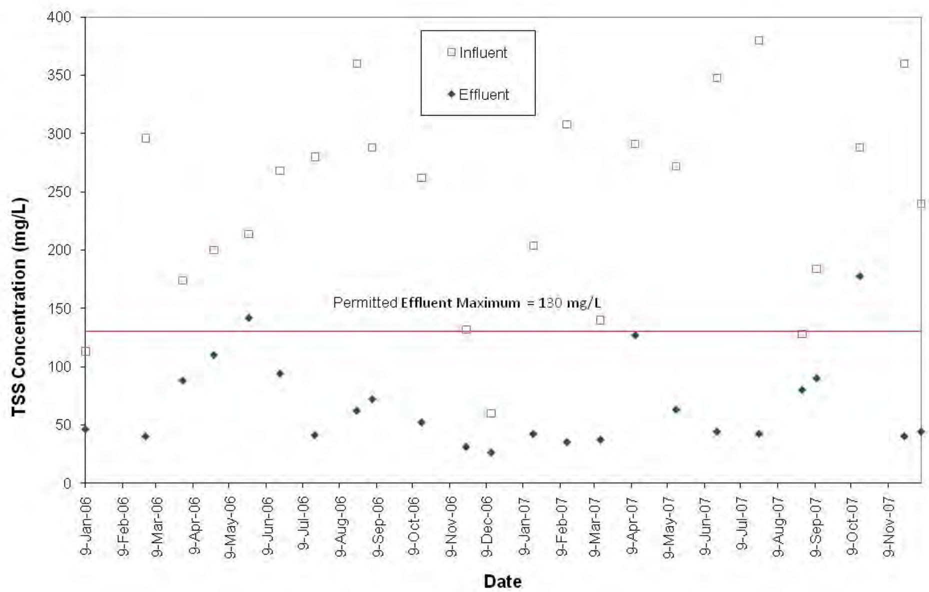

Figure 5-5 Ladysmith WWTP TSS Concentration 2006 to 2007

During the years 2006 and 2007, the plant influent average concentrations were 241 mg/L TSS and 228 mg/L BOD_5, with a maximum of 380 mg/L TSS and 354 mg/L BOD_5. For the purposes of this study, design values of 74 grams per capita per day TSS and 90 grams per capita per day BOD_5 were used to project historic wastewater loads (from Dayton & Knight Ltd., 2004 and 2008).

Composite sampling of the WWTP influent should be implemented, to confirm wastewater quality; this information is important to ensure cost-effective design of future treatment facilities.

5.2.2 Projected Wastewater Loads

The influent to the wastewater treatment plant has historically been sampled once per month to assess concentrations of five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS). It is important to emphasize that the data are based on grab samples (i.e., a single sample taken from the wastewater stream). Grab samples offer a "snapshot" of wastewater character at a given instant. Due to the wide variations in wastewater quality that are typically experienced over the course of a day, composite samples composed of several grab samples taken at regular (e.g., hourly) intervals over a 24-hour period are preferred for assessing wastewater character.

The wastewater quality data (BOD_5 and TSS concentration) based on monthly grab samples taken from the influent to the wastewater treatment plant from 2003 through 2007 are shown in Table 5-5. The estimated mass load of BOD_5 and TSS (calculated by multiplying the concentration measured on a particular day by the wastewater flow volume for that day) is included in Table 5-5.

TABLE 5-5
HISTORIC WASTEWATER QUALITY

Year	WWTP Influent							
	Concentration (mg/L)				Mass Load (kg/d)			
	BOD_5		TSS		BOD_5		TSS	
	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
2003	256	400	235	344	448	761	429	651
2004	336	689	217	290	871	1,507	622	726
2005	325	578	208	310	855	3,100	521	897
2006	232	354	221	360	594	1,373	536	744
2007	224	276	262	380	521	763	630	1,160
Average	**275**	**459**	**229**	**337**	**658**	**1,101**[1]	**548**	**836**

1 Maximum BOD_5 value for 2005 appears to be an anomaly – not included in average

The estimated unit (per capita) mass loads of BOD_5 and TSS for the period 2003 through 2007 are shown in Table 5-6. As shown, the average per capita contributions over the period of record were 86 grams per capita per day for BOD_5 and 71 grams per capita per day for TSS. These values are similar to those derived from previous work at the wastewater plant (i.e. average 90 grams per capita per day for BOD_5 and 74 grams per capita per day for TSS, from Dayton & Knight Ltd., 2004).

TABLE 5-6
HISTORIC WASTEWATER UNIT LOADING

Year	Service Population[1]	Per Capita Load (g/c/d)			
		BOD_5		TSS	
		Avg.	Max.	Avg.	Max.
2003	7,230	62	105	59	90
2004	7,375	118	204	84	98
2005	7,621	112	407	68	118
2006	7,885	75	174	68	94
2007	8,144	64	94	77	142
Average	**-**	**86**	**144[2]**	**71**	**100**

1 From Table 5-1

2 Maximum BOD_5 for 2005 appears to be an anomaly – not used in calculating average

As shown in Table 5-6, the maximum per capita contributions (based on the monthly grab samples) were 144 grams per capita per day for BOD_5 (1.7 times the average) and 100 grams per capita per day for TSS (1.4 times the average). These values differ from previous work, which showed that the maximum month BOD_5 load was about 1.5 times the average and maximum TSS load of 2.0 times the average (Dayton & Knight, 2004). As described at the beginning of this section, the results for grab samples are affected by wide variations in wastewater quality. For the purpose of the LWMP, the following per capita loadings are proposed (composite sampling should be undertaken to confirm these values):

- Average day BOD_5 load = 90 grams per capita per day
- Maximum Month BOD_5 load = 135 grams per capita per day
- Average day TSS load = 75 grams per capita per day
- Maximum month TSS load = 150 grams per capita per day

The projected wastewater mass loads of BOD_5 and TSS from 2008 to build-out based on the per capita contributions shown above are summarized in Table 5-7. As shown, the mass load to the plant is projected to increase by a factor of about 1.7 by 2028, and to about double the present level at build-out.

TABLE 5-7
PROJECTED WASTEWATER LOADING

Year	Service Population[1]	Per Capita Load (kg/d)			
		BOD_5[2]		TSS[3]	
		Avg.	Max.	Avg.	Max.
2008	8,550	770	1,150	640	1,280
2013	9,640	870	1,300	720	1,450
2018	10,930	980	1,480	820	1,640
2023	12,630	1,140	1,710	950	1,900
2028	14,330	1,290	1,940	1,080	2,150
Projected Build-out	17,200	1,550	2,320	1,290	2,580
FUTURE	30,000	2,700	4,050	2,250	4,500

1 From Table 5-1

2 Assumed per capita BOD_5 contribution = 90 g/c/d average and 135 g/c/d max. month

3 Assumed per capita TSS contribution = 75 g/c/d average and 150 g/c/d max. month

5.3 Biosolids Quantity and Quality

Wastewater solids that have been treated to the extent that they can be safely reused (subject to regulations) are referred to as "biosolids". The type of process used to treat biosolids can impact the quality of the final product, which in turn impacts reuse opportunities. Subject to regulatory restrictions, treated biosolids can be applied directly to land, or used to manufacture topsoil or compost. Untreated wastewater solids are generally referred to as sludge.

Appendix C-1 to Permit PE-120 (Appendix 6) specifies that a representative sample of the treated waste solids from the Ladysmith WWTP be obtained once per year and analyzed for the following parameters:

- arsenic, boron, cadmium, cobalt, lead, mercury, molybdenum, nickel and zinc
- Salmonella, Fecal Coliform; and
- Total Kjedahl Nitrogen

The Town is currently investigating opportunities for a sustainable use of the biosolids generated at the WWTP; this is discussed in detail later in this report.

Biosolids production from primary settling can be expected to increase more or less in direct proportion to the Ladysmith WWTP service population. Records from the Town show that the annual total mass of digested biosolids generated at the Ladysmith WWTP is currently about 520 bulk tonnes per year. At an assumed cake solids of 10% to 15% total solids by weight, the dry mass of solids would be in the range 52 dry tonnes to 78 dry tonnes per year. Plant records show that average removal of TSS from the plant influent during 2006 and 2007 was about 425 kg/d (155 tonnes/yr), which represents a per capita waste solids amount of about 50 g/c/d. Assuming 50% destruction of total solids in the digester, the amount of biosolids produced after digestion would be about 78 dry tonnes per year (27 g/c/d); this is consistent with the amount of biosolids trucked assuming cake solids of about 15% by weight.

The projected quantities of waste (undigested) solids produced for the study area are shown in Table 5-8. The estimated waste solids amount for the year 2008 was based on the current facilities (i.e. primary treatment only), assuming a waste solids amount of 50 g/c/d; the waste solids amounts shown from 2013 to 2028 and for the projected build-out population assume that secondary treatment would be implemented, and that this would approximately double the 2008 per capita production of waste solids (i.e. to 100 g/c/d). The amount of biosolids produced after digestion assuming 50% total solids destruction is included in Table 5-8. As shown, the quantity of waste (undigested) solids is projected to increase to about 520 dry tonnes/yr by the LWMP horizon of 2028, and to more than 600 dry tonnes/yr at ultimate build-out (compared to about 80 dry/tonnes/yr at present). As described later in this report (Section 8), the quality of the biosolids can limit potential reuse applications.

TABLE 5-8
LADYSMITH WWTP PROJECTED SOLIDS QUANTITIES

Year	Service[1] Population	Solids Produced			
		Waste Solids[2]		Digested Solids[3]	
		dry tonnes/yr	m^3/yr[4]	dry tonnes/yr	m^3/yr[4]
2008	8,551	160	800	80	400
2013	9,460	330	1650	175	825
2018	10,930	400	2,000	200	1,000
2023	12,630	460	2,300	230	1,150
2028	14,330	520	2,600	260	1,300
Projected Build-out	17,200	630	3,150	315	1,575
Future	30,000	1,095	5,475	548	2,738

1 from Table 3-1 in section 3.2.2
2 assumes waste produced in 2008= 50 g/c/d, increasing to 100 g/c/d before 2013 with the addition of secondary treatment
3 assumes 50% total solids destruction in digester
4 assumes 80% moisture content

6.0 SOURCE CONTROL AND WASTE VOLUME REDUCTION

6.1 Source Control

Regulation of waste discharges to sanitary sewers is essential for the protection of public health and the environment. These discharges may enter the system via service connections from buildings, or from pumper truck discharges at treatment facilities (e.g. septage and trucked liquid waste from private businesses). Toxic and hazardous materials that enter the sanitary system pose a risk to sewerage system workers, to the general public, to the collection and treatment works, and to the receiving environment. Toxic and hazardous materials in wastewater can upset biological treatment processes, heavy metals can accumulate in sediments and wastewater treatment plant residuals (biosolids), and waterborne contaminants can be discharged to surface waters; the result can be a negative impact on the environment from both liquid and solids discharges. Source control of trace metals is particularly important if the biosolids generated at wastewater treatment plants are to be used as a soil amendment/fertilizer now or in the future, since the use of biosolids in B.C. is restricted by the Provincial Organic Matter Recycling Regulation (OMRR) according to trace metals content and other factors.

Source controls can be implemented through either a regulatory or an educational approach, or a combination of the two. The regulatory approach is typically focused on non-domestic (i.e., commercial, industrial, and institutional) discharges through sewer use bylaws, also referred to as source control bylaws. A source control approach that includes a significant educational component is likely to be more effective than one of strict policing and enforcement. However, it must be emphasized that it is essential to prevent unauthorized discharges of industrial, toxic, and/or dangerous wastes to the wastewater collection and treatment system. Responsibilities for inspection and enforcement of source control regulations should be clearly defined.

This section contains a discussion of concept source control approaches for minimizing the discharge of contaminants to the sanitary sewer system. Source control elements (regulatory and educational) recommended for the Town's LWMP are contained in Section 10.1.

6.1.1 Source Control Bylaw

A bylaw regulating discharges to the sanitary sewer collection system is an essential component of a source control program. The Canadian Council of Ministers of the Environment (CCME) has developed a Model National Sewer Use Bylaw (Marbek Resource Consultants, 2006a and 2006b). The national study reviewed existing provincial sewer use bylaws, completed an analysis of potential contaminants and parameters to be covered in the CCME Model Bylaw, and provided recommendations for federal, provincial, and territorial governments to develop and implement effective sewer use bylaws. Forty-one substances and physical parameters were recommended for inclusion in the bylaw. Hazardous substances are typically prohibited and therefore do not require concentration limits. The Supplemental List contains substances that are of potential concern for environmental release or human health, and can be implemented in the municipal bylaw depending on existing industries in the community. The focus of the CCME for the Model Sewer Use Bylaw is on wastewater; however, prohibited substances for stormwater are to be identified and best management practices to protect stormwater quality (construction erosion, sediment control, outdoor storage of materials) are required.

Many communities require a Waste Discharge Permit for Restricted Wastes, High Volume Discharges, Stormwater or Cooling Waste. A Permit typically will apply to non-domestic discharges from the industrial, commercial and institutional (ICI) sectors. Waste Discharge Permits typically include the following:

- limits and restriction on the quantity, frequency and nature of the discharge; and
- requirements of the Permit holder (discharger) to:
    - construct the pre-treatment works if needed to meet the specified discharge limits,
    - monitor the discharge and provide reports to District, and
    - operate and maintain the pre-treatment and monitoring facilities.

The B.C. Hazardous Waste Regulation, MOE (2006) identifies wastes that are not permitted into the municipal sewers or treatment works without permit approval, order, regulation for waste management plant. Where hazardous wastes are suspected or found, an emergency action plan is needed for isolation and reporting.

The Town currently does not have a source control bylaw. However, in the Town of Ladysmith Sewer Connection Bylaw, 1966 (Bylaw No. 411) the following restrictions regulate discharges to sewer to a limited extent:

- The connection of surface water to the sanitary sewer is not allowed.
- "No gasoline, naphtha or other inflammable liquid or explosive substance, and no automotive wastes, oil, lye, acids, mud, grit, plaster of paris, lime, clay or any other trade or industrial waste which may injure or impair the efficiency or safety of any part of the sewer system in any way shall be discharged into any common sewer within the Town".
- An authorization to discharge noxious wastes as described above could be required for commercial or industrial premises. The installation of protective devices can be required to neutralize the discharge.

6.1.2 Source Control Education Programs

In order to eliminate or minimize waste generation, a comprehensive education program is required, to educate domestic and non-domestic dischargers about the causes and effects of pollution, the need for action, and practical alternatives to present practices.

A source control education program for sanitary sewers and storm drains should emphasize waste reduction through source reduction and in-process recycling, rather than treatment and disposal of waste products. Techniques which transfer pollutants from one medium to another (e.g. from liquid to solid waste) do not qualify as source control methods. Bylaws and regulations will be much easier to implement and enforce if industrial and commercial dischargers are aware of the benefits of pollution prevention, and of alternatives which might reduce waste generation. An education program should be designed to encourage commercial/industrial dischargers to assess and implement waste reduction practices within their own operations. Incentives to implement waste reduction practices include potential economic benefits derived from reductions in treatment and monitoring requirements, less raw material use, lower operation and maintenance costs, reduced or eliminated regulatory compliance costs, and fewer hazards to employees through exposure to toxic substances. Further benefits include improved public image and employee morale. Householders should be encouraged to use less hazardous products, and to properly store and dispose of wastes.

Education programs designed to reduce contaminant inputs to sanitary sewers have many elements in common with education programs aimed at protection of the storm drainage system. To minimize costs, a single program should be designed to serve both objectives. Further, an education program for source control of pollutant inputs to the sanitary sewer and storm drain systems should be one component of a broader educational program which includes other waste management issues such as solid waste and water conservation, where possible. All of the educational issues should be centrally coordinated, to ensure a consistent approach and to avoid duplication of effort. Sample educational materials are included in Appendix 7.

Requirements for effective public involvement include the following:

- timely, understandable, and complete notice of pending actions;
- access early in any decision-making process;
- ease of access to the decision-making process; and
- response to citizens on how comments or recommendations are used.

Existing educational resources which might be suitable for delivering messages and information on liquid waste issues should be identified. Possible resources and methods which are generally suited to public education and involvement in liquid waste management planning issues are described below.

1. Mailing lists can be used for communicating liquid waste management planning activities to interested parties. Mailing lists can be developed from lists created for other purposes, from sign-up attendance sheets at public meetings, and from blanket mailings with return cards.

2. Brochures, flyers, fact sheets and newsletters can be used for providing information on project updates, meetings, workshops and events, and liquid waste management issues in general. Publications should be planned in advance as coordinated packages with similar graphics and style, and should be designed to capture the attention of readers and should explain the importance of the enclosed information.

3. Field trips can be used to provide first-hand demonstrations of liquid waste management problems and solutions within a study area. Field trips should be carefully planned and routes driven beforehand, and should take into account the physical condition of the

participants. Knowledgeable speakers with maps and handouts should be available to describe each stop, and time for questions and discussion should be allowed.

4. Displays at public functions and events, at conferences, and in schools can be used to describe liquid waste impacts and issues. Messages should be kept simple to encourage casual readers, and should be staffed if possible.

5. Surveys can be used to educate, gather information, and assess the level of understanding and support for liquid waste issues within the community. Some follow-up by letter or telephone will generally increase the response rate.

6. Meetings and workshops are valuable opportunities for two-way communication and public feedback. Issues can be debated or discussed in depth, and input from a variety of sources can be obtained. The location, timing and venue of public meetings should be chosen to maximize accessibility, convenience and comfort for the participants.

7. Involvement of the local news media can be important in educating the public on liquid waste issues and planning, gathering public support, and publicizing meetings and events. Personal contacts should be developed with members of the media for maximum effectiveness.

8. Education provided by appropriate experts to individuals can be effective in providing information about pollution problems and solutions, and in developing control strategies for a particular problem or pollution source.

9. Speaking engagements, including videos and slide shows, can be designed to inform large audiences about liquid waste problems and solutions.

10. Projects involving school children reach an important audience, and might include visiting classes, field trips, or specific projects dealing with problems within the study area.

Education programs should be designed to provide particular groups with appropriate messages and information, and should be uncomplicated, non-technical, and free of jargon. Specific audiences should be identified, and appropriate messages and information targeted for those audiences developed. A focus on local issues helps to promote a sense of place; however, a common direction for the entire study area should be apparent. Cooperation should be encouraged among all parties interested in or affected by the Liquid Waste Management Plan. Interesting and innovative activities which involve people and lead to action will encourage public support and participation. Local environmental groups should be encouraged to participate in the education program.

6.2 Wastewater Volume Reduction

Wastewater volume reduction may be undertaken through reduction in water use, and reduction of inflow and infiltration of stormwater and snowmelt into the sewer collection system; these are discussed below. Methods for wastewater volume reduction to be included in the Town of Ladysmith LWMP are included in Section 10.

6.2.1 Water Conservation

Although British Columbia has an abundance of rivers, streams and lakes, only a small number of these are available for water supply. Until recently, the perception was that the supply of water was unlimited. However, with increasing growth in population and economic development, there has been mounting pressure on all of the available water resources. Over 17% of British Columbia surface water sources have reached, or are nearing, their capacity to reliably supply water. To address this, the British Columbia Water and Waste Association (BCWWA) along with the Ministry of Environment and

Environment Canada formed a partnership to develop a Water Conservation Strategy for British Columbia (1998).

The goal of the Water Conservation Strategy for British Columbia is to develop and promote supply and demand-side management measures for application by municipalities, water purveyors, drawers and users throughout the province, recognizing regional differences. This strategy provides a common framework for water management activities and programs throughout the province. The strategy projects water as a valuable resource, which must be used efficiently, wisely, and cost-effectively.

In 2004, the BCWWA formed a Water Sustainability Committee. The mission of the committee was to facilitate more sustainable approaches to water resources at all levels, from the province to the household, and in all sectors, including domestic, resource, industrial, commercial, recreational and ecosystem support uses. The Water Sustainability Committee has now embarked on a partnership with the Province and other stakeholders to develop and implement a fully integrated Water Sustainability Action Plan. The Action Plan builds upon a Water Conservation Strategy for B.C., developed and promoted from 1998 through 2001. The Action Plan was established in 2002, and it recognized that the greatest impact on land and water resources occurs through our individual values, choices and behaviour. The goal of the Action Plan is to influence choices and encourage action by individuals and organizations so that water resources stewardship becomes an integral part of land use and daily living.

The uses of water delivered to residential homes can be categorized as "inside home" and "outside home." Water use inside the home has a significant impact on wastewater volumes, since most in-home water is directed to the sanitary sewer after use. Water conservation measures aimed at reducing in-home water use can reduce sewage flow volumes. Most of the water used outside the home is for irrigation, and does not impact wastewater flows, since it does not normally go to the sanitary sewer after use. Commercial establishments and large public institutions are often large users of water for irrigation and indoor uses. Water use inside commercial and institutional buildings is mainly for sanitation, and many of the water conservation techniques for domestic users are applicable to commercial and institutional users as well.

Wastewater flows consist of a base flow that varies over the course of each day. The base sanitary flow contribution includes grey water from household appliances (dishwashers, washing machines, sinks, showers), toilet (black water) discharges, and industrial, commercial and institutional (ICI) flows. The base flows normally fluctuate daily with water usage, with peaks occurring in the morning (6 a.m. to 10 a.m.) and evening (5 p.m. to 8 p.m.). Water use efficiency measures such as ultra low flow flush toilets, low flow faucets and shower heads, as well as water metering with an inclining rate structure can all contribute to the reduction of sanitary base flows. An inclining rate structure typically allows use of a base amount of water per month at the lowest rate, with amounts in excess of the base amount sold at increasing rates, depending on the amount used.

A reduction in water usage can potentially result in a reduction in wastewater treatment costs through deferment of expansions to facilities and lower operation and maintenance costs. However, it must be emphasized that a reduction in in-home water use will affect only those facilities that are related strictly to flow volume (i.e. hydraulic capacity), such as pumps, screens, etc. The design of secondary wastewater treatment facilities for removal of oxygen demand is governed mainly by the mass load of contaminants, and therefore water conservation will have a relatively low impact on the design of these facilities.

The Town of Ladysmith has jurisdiction over water supply within the study area.

The text shown below in italic font was taken from the Town of Ladysmith website.

The Town obtains its water from two sources: Holland Creek and Stocking Lake. The existing water supply system has the capacity to provide quality drinking water to a *population of up to 15,000. Water is a very precious resource, and therefore the Town is taking several measures to encourage citizens to reduce consumption, including:*

- *Implementation of water restrictions during the dry season;*
- *Installation of water meters at all residents and businesses to help determine and repair any leaks in the system and to monitor excess consumption;*
- *Distribution of educational water wise mail-outs to all households;*
- *Implementation of new regulations making low-flow toilets mandatory in all new construction and renovations;*
- *Installation of low-flow toilets in all municipal facilities; and*
- *Undertaking capital upgrades to the water supply system (construction of new covered reservoir).*

Of the water conservation measures listed above, those that can potentially reduce wastewater volumes are water metering, education, and use of low-flow toilets. Water metering is typically effective only if it is accompanied by an inclining rate structure to provide consumers with a financial incentive to minimize water use. Water conservation measures will typically effect only the dry weather base flow of wastewater. In cases where the collection system is subject to significant inflow and infiltration of stormwater during wet weather (e.g., the Ladysmith system – see Section 6.2.2 below), the overall impact of water conservation measures on wastewater flows will be reduced.

For the purpose of this study, the following potential reductions in dry weather (base) wastewater flows due to water conservation were assumed (compared to historic dry weather wastewater flows):

- <u>New construction</u> – 25% reduction of indoor use due to use of ultra low-flow toilets and other ultra low flow fixtures (requires supporting bylaw dictating the use of these fixtures); and

- Existing buildings – 15% reduction of indoor use due to retrofitting of low water use fixtures with 20% market penetration by 2028, increasing to 50% penetration at build-out and 75% penetration for the long-term future (this is supported by a rebate program of $75 per toilet for installation of these fixtures).

The wastewater flow reductions described above were incorporated into the wastewater flow projections developed earlier in Section 5.1.3.

6.2.2 Reduction of Inflow and Infiltration

As described in Section 5.2, inflow and infiltration (I&I) includes inflow to the sewer collection system due to rainfall plus groundwater infiltration. According to Dayton & Knight Ltd. (1994b), groundwater infiltration at Ladysmith occurs during winter due to the high groundwater table. Groundwater and flow monitoring at Ladysmith was undertaken in 1994/1995; this showed that the sewer system acted similar to a French drain, drawing down the water table and conveying groundwater to the WWTP. Infiltration rates were estimated to be between 24,000 L/ha/d and 74,000 L/ha/d (much higher than the MMCD design value of 14,700 L/ha/d – see Section 5.1.3). It was concluded that replacing the collector sewers and portions of service connections could reduce infiltration by about 75%. Between 1995 and 1998, the sanitary sewer system in the downtown area was upgraded, and the old sanitary sewer pipes that were no longer used for wastewater were connected to the storm system. Most cross-connections between sanitary and storm sewer have been eliminated since then. However, the storm and sanitary systems on private properties are not separated, and inflow to the sanitary sewer system remains high (Dayton & Knight Ltd., 1999). Figure 6-1 shows that the wastewater per capita unit flow rate is decreasing after the upgrade to the sewer system.

As noted earlier in this report, the Town of Ladysmith has identified a budget of up to $150,000 per year for I&I reduction.

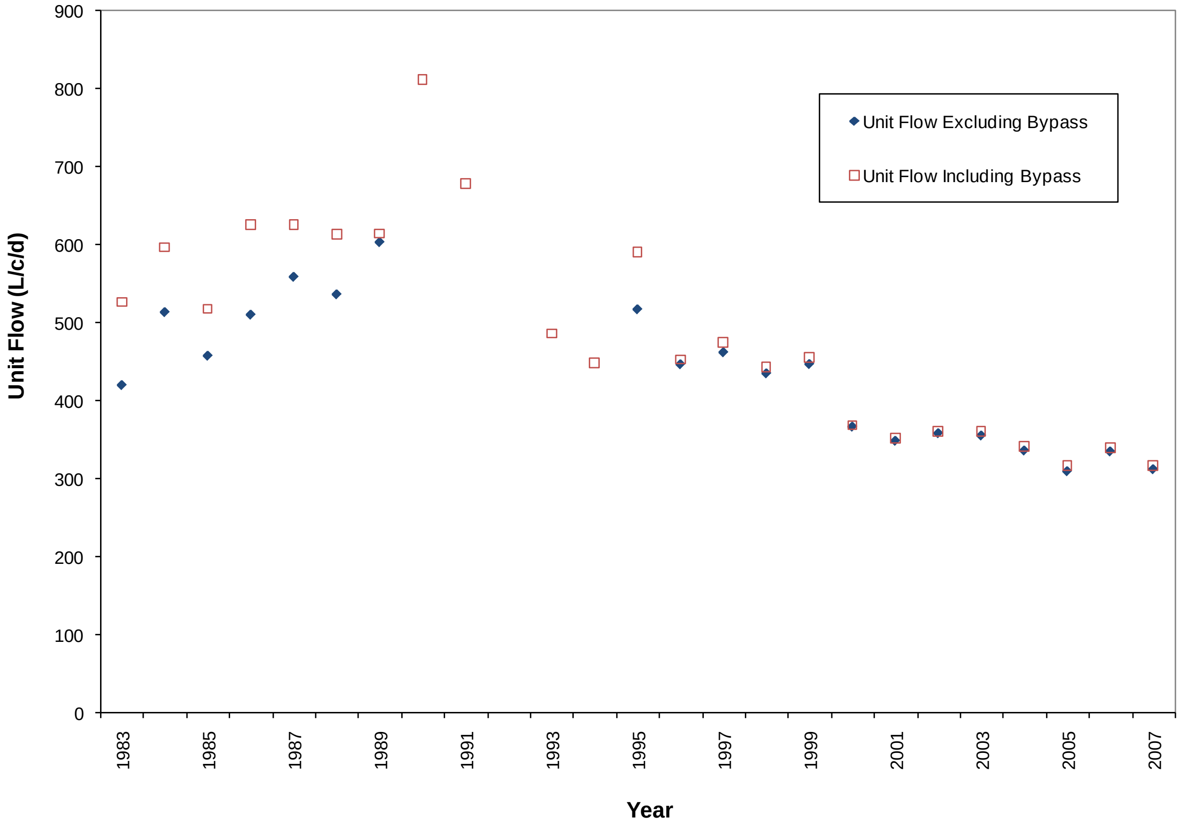

Figure 6-1 WWTP Flow

7.0 STORMWATER MANAGEMENT

Development generally increases the volume and rate of storm surface runoff, due to an increase in the amount of impervious area caused by the construction of roofs and paved surfaces. The increased runoff caused by development can cause flooding in downstream areas, increase erosion in watercourses, and reduce dry season stream flows due to lower groundwater reserves.

The field of stormwater management has evolved from an initial focus on collecting and removing runoff from urban areas as quickly as possible to a much wider view that includes protection of environmental resources as well as control of flooding. During the 1980s, extensive study in the USA and elsewhere showed that storm runoff from urban areas typically carries a significant contaminant load to receiving waters; therefore, mitigation measures to reduce the environmental damage caused by urbanization initially focused on water quality. Since that time, it has become apparent that protection of water quality will not adequately mitigate the environmental damage caused by development in most urban watersheds.

Changes to the natural hydrologic cycle caused by the creation of large amounts of impervious ground cover and the removal of streamside riparian vegetation result in increased erosion of streams, increased stream water temperature, reduced groundwater recharge, and reduced dry season base flows in streams. These changes typically result in significant environmental degradation (e.g., loss of habitat and food sources, reduced species diversity) that is not directly associated with water quality. As a result, the approach to urban stormwater management has evolved to include techniques that protect, restore, and mimic the natural (predevelopment) hydrology of a watershed as closely as possible.

Protection of the natural hydrology can include non-structural techniques designed to reduce the amount of impervious surface area created by development and to protect key components of the natural drainage system. This can be accomplished through clustering of housing in designated areas to leave relatively large amounts of land undisturbed, as well as the use of narrower streets, reduced setbacks from lot lines to reduce driveway lengths, reduced parking ratios and stall sizes, single-side sidewalks, and smaller cul-de-sacs. Structural techniques may also be used to mimic the predevelopment hydrology, by infiltrating collected runoff into the ground, temporarily detaining collected runoff to limit flow rates, and removing contaminants through physical and biological processes.

In the past, many storm drainage facilities were designed for flood control only, based on relatively large storms. It has now been recognized that frequently occurring smaller storms can cause more erosion damage to streams than occasional large events. The implementation of Best Management Practices (BMPs) and Low Impact Development (LID) techniques to reduce contamination of receiving waters by storm surface runoff and to preserve the natural hydrologic cycle is encouraged by the Province. The framework for a stormwater management program is outlined in the remainder of this section. Recommendations for stormwater management to be included in the Town of Ladysmith LWMP are included in Section 10.

7.1 Runoff Quantity

The amount and rate of runoff from a particular storm event are affected by the ground moisture conditions, soil and cover type, and the amount of pervious and impervious ground cover. Development causes a change of ground surface from pervious to impervious through the construction of roofs, streets, sidewalks and parking lots, and consequently speeds the runoff rate and increases the runoff volume, due to a reduction in rainfall losses from surface wetting, depression storage, and soil infiltration.

Improved or increased hydraulic capacity in the urban drainage system to prevent flooding of low-lying areas can significantly alter the runoff process. When natural channels are deepened, lined, and straightened or when storm sewers are installed, watershed storage time is reduced, and the peak rate of runoff is increased. Man-made structures can be provided to replace natural detention in stream channels, floodplains, and ponds.

Drainage design should incorporate a minor and major system. The minor system is usually designed to handle storm flows from 2 to 25 year rainfall recurrence intervals, and the major system is designed to handle excess flows up to 100 year recurrence intervals. The recurrence interval is a statistical parameter that describes the probable time interval between rainstorms of a given size (e.g., the 2 year recurrence rainfall is the relatively small rainstorm that will occur on average once every two years, and the 100 year recurrence rainfall is the much larger rainstorm that will occur on average only once every 100 years).

The minor system normally consists of catchbasins, manholes and pipes or ditches, handles local drainage from developed areas, and remains separate from the major system. The major system provides higher flood protection by routing large flows that overwhelm the minor system along streets, in major channels, in special floodways, and through large storm sewers. In some cases, an overland route is not feasible for the major system, and it must be combined with the minor system in a pipeline, particularly in areas of existing development which were not laid out with the two-system concept in mind. Erosion protection, provisions for sediment transport or reduction, and stream pollution also become important when the design method is selected.

If flood control for major storms by construction of drainage works is the desired solution, management options generally include the following:

- improved channel hydraulics;
- diversion of portions or all of the flow;

- temporary storage in detention facilities;
- policy changes to reduce runoff, such as land development policy changes;
- purchase of floodplain and use restrictions; and
- combinations of the above.

Runoff quantity control for smaller, more frequent (minor) storms is important to protect watercourses in cases where development results in increased frequency of erosive flows. This may be undertaken through the following techniques:

- diversion of portions of the flow around sensitive stream reaches;
- temporary storage in detention facilities;
- low impact development (LID) techniques (e.g., use of absorbent soils and vegetation for landscaping, infiltration of runoff into the ground where ground conditions allow, use of pervious paving); and
- land development policy changes (e.g., use of narrow streets to reduce impervious area, restrictions on lot coverage, replacement of curb-and-gutter systems with vegetated swales, requirements for on-lot LID techniques, etc.).

Hydrologic and hydraulic computer models can be used to determine the rates, volumes and effects of runoff for pre-development and post-development conditions, to identify potential problem areas, and to evaluate the effects of alternative drainage solutions.

7.2 Runoff Quality

Monitoring of urban runoff quality is a complex and costly undertaking, due to the transient nature of the flows and the number of water analyses required. Comprehensive long-term studies regarding the quality of urban surface runoff have been carried out in the U.S. and elsewhere. Constituents found in general urban runoff that frequently exceed the British Columbia water quality criteria include suspended solids, lead, copper, zinc, cadmium, chromium, nickel, arsenic, and phosphorus. Runoff from heavily-travelled highways and roads may exceed provincial water quality criteria for polynuclear aromatic hydrocarbons, in addition to the constituents listed above (B.C. Environment, 1992b and B.C. Research, 1991).

No studies describing the quality of storm surface runoff within the Town of Ladysmith are available. Based on data from other jurisdictions, potential sources of urban runoff contamination are as follows:

- pesticide use – harmful organic compounds;
- fertilizer use – nutrients, primarily nitrogen and phosphorus;
- construction activities – sediment, petroleum products, garbage, chemicals, concrete washwater;
- household activities – illicit dumping of hazardous chemicals, vehicle washing, pet washes, decaying yard wastes;
- motor vehicles – metals and hydrocarbons from fluid leaks, particles from clutch and brake linings, corrosion of parts;
- industrial and commercial activities – metals and organic contaminants;
- cross-connections with the sanitary sewer system; and
- roadway de-icers – salt, liquid de-icers (magnesium chloride, calcium chloride).

Regulation of storm surface runoff quality is difficult, due to the transient nature of storm events and the wide variations in contaminant concentrations typically observed. In general, source controls are preferred over treatment, due to the cost and the unproven nature of many stormwater treatment processes (Gibb et.al., 1991). Key elements in a source control program for stormwater quality management include maintenance and protection of the existing storm drain system (regular cleaning of catchbasins, elimination of illicit connections), modification of domestic and non-domestic practices to reduce or eliminate the production of pollutants or to prevent contact between pollutants and stormwater runoff, and on-site structural Best Management Practices (BMPs) to remove or reduce the pollutant load in surface runoff, before it enters the drainage system.

Management solutions for the enhancement of urban runoff quality should include both structural and non-structural approaches. Non-structural management solutions include source controls (regulatory and educational) land use regulations and low impact development (LID) techniques. Structural approaches may include the construction of one or more of the following stormwater treatment facilities:

- oil-water separators;
- swirl concentrators for sediment removal;
- dry detention ponds for sedimentation;
- physical-chemical treatment;
- wet detention ponds;
- wetlands;
- grassed swales;
- vegetated filter strips;
- infiltration basin and trenches; and
- porous pavement.

Non-structural approaches to eliminate the production of runoff pollutants or to prevent contact between pollutants and runoff are a practical first step, since these methods can have positive impacts and have a relatively low cost. In situations where non-structural approaches are insufficient (e.g., heavily-travelled roads, some industrial activities, vehicle storage and repair yards), structural BMPs may be required to achieve the desired runoff water quality. The use of stormwater treatment BMPs is highly site-specific; procedures for applying BMPs to specific situations are available (e.g., B.C. Environment, 1992b and Dayton & Knight Ltd. et.al, 1999). Both structural and non-structural approaches are usually evaluated when comprehensive drainage studies are carried out for individual catchments.

7.3 Existing Drainage Facilities

7.3.1 Overview of Existing Drainage System

The Town of Ladysmith provides an underground storm drainage system in most parts of the service area. The existing storm drainage system for the Town is illustrated on Figure 7-1. Storm water is directly discharged into Ladysmith Harbour. The Town does not monitor storm drain discharges.

7.3.2 Drainage Studies

In 1995, a storm drainage study was conducted for the Old Town area of Ladysmith (Dayton & Knight Ltd., 1995). The minor system was modelled for the 5-year return period, and the major system for the 100-year return period. Four areas were identified where major flows were anticipated to leave roadways and cross private property. Between 1995 and 1998, the sanitary sewer system in the downtown area was upgraded, and the old sanitary sewer pipes, which were no longer used for wastewater, were connected to the storm system. Most cross-connections between the sanitary and storm sewers have been eliminated since then. However, the two systems on private properties are old and are not separated. Some cross-connections between the storm sewer and the old abandoned sanitary sewer system exist to divert excess flows into the old system. Sections of this network are in poor condition, and therefore, other solutions such as upgrading the existing storm sewer system should be considered.

7.4 Drainage Policies and Regulations

7.4.1 Provincial and Federal Policies and Legislation

Regulations regarding the quality of surface runoff discharges have not been developed for British Columbia. The Province has published guidelines to assist municipalities in developing programs to improve the management of urban surface runoff for protection of life and property and the environment (e.g., B.C. Environment, 1992b and CH_2M Hill and Lanarc, 2002).

The Federal Fisheries Act influences any activity in and about watercourses that may affect fish and/or fish habitat. Fish habitat includes the stream channel and may also include upland areas associated with streamside vegetation. The Fisheries Act makes it an offence to conduct activities which may result in the obstruction of fish migration, the deposition of a deleterious substance, and/or the harmful alteration, disruption, or destruction (HADD) of fish habitat. The Water Act influences activities in and about watercourses that may affect water quality, habitat, and/or other water users.

The Land Development Guidelines (FOC/MELP, 1992) recommend the width of buffer (leave) strips adjacent to watercourses, as well as other measures to ensure that that quantity and quality of fish habitat is maintained. Generally the guidelines suggest that a 15 metre wide leave strip be maintained on streams where Residential/Low Density development is proposed, and a 30 metre wide leave strip be maintained where Commercial/High Density development is proposed. The leave strip guidelines are suggested minimum widths and may be altered by federal or provincial regulatory staff (e.g., increased to protect critical fish habitat).

The Fish-Stream Crossing Guidelines (Ministry of Forests) recommend the type of crossing for fish bearing streams. Although the Fish-Stream Crossing Guidelines were developed for the forestry sector, it is likely that similar recommendations will be made by the regulatory agencies for other activities such as urban development that involve stream crossings.

The Provincial *Streamside Protection Regulation* was repealed and replaced by the *Riparian Areas Regulation* by order of the Lieutenant Governor in Council on July 27, 2004. The new Regulation sets out requirements for streamside protection and enhancement areas; which are defined or areas adjacent to a stream that link aquatic to terrestrian ecosystems, including both existing and potential riparian vegetation and terrestrial vegetation that influences the stream. The size of the streamside protection and enhancement area is to be determined on the basis of an assessment report provided by a qualified professional. The new Regulation defines the riparian assessment area as a 30 metre strip on both sides of a stream, measured from the high water mark. For ravines less than 60 metres wide, the riparian assessment area extends on both sides of the stream from the high water mark to 30 metres beyond the top of the ravine bank. For ravines 60 metres wide or greater, the assessment area extends from the high water mark to 10 metres beyond the top of the ravine bank.

The Water Quality Guidelines developed by the Province of B.C. provide guidelines for numerous substances that are typically contained in storm surface runoff (e.g., MOE, 2006 and 2010).

7.4.2 Policies and Regulations in the Town of Ladysmith

The Town of Ladysmith Sewer Connection Bylaw, 1966 requires that surface water not be connected to the common sewer system. No other bylaws relating to storm runoff were identified. Policies that relate to management of stormwater are set out in the Town's Official Community Plan (see Section 3.2.3). The Town's OCP recognizes the need for integrated stormwater management that includes interactions among land use planning, environmental protection and engineering, and it includes a commitment to prepare a Master Drainage Plan.

Similarly, the Town's sustainability visioning report ("*Ladysmith Community Sustainability Vision for a West Coast Town*") includes an Infrastructure Strategy that recognizes the need to develop standards that promote ecologically friendly management of stormwater.

The text shown below in italic font was extracted from the Town of Ladysmith Official Community Plan (Town of Ladysmith, 2007a).

With the progression of development in previously undeveloped areas, the potential impact from increased stormwater runoff is of concern. Development will require careful attention to the management of stormwater runoff to minimize the risk to downstream properties and degradation of watercourses. The review of stormwater retention/detention alternatives and other Best Management Practices for the protection of fisheries habitat and downstream properties and infrastructure will need to be considered. The Community Plan will need to examine stormwater management issues and requirements.

7.5 Watershed Inventory

Drainage planning should begin with an inventory of existing watersheds, drainage facilities, known problems, and water quality data. The initial step in conducting an inventory of the watershed(s) is the delineation of drainage basin and sub-basin boundaries on a plan of the watershed area. Basins which encompass more than one political jurisdiction should be identified, so that governing agencies can cooperate to ensure a consistent and effective approach.

Some B.C. Municipalities and regional districts have developed comprehensive stormwater bylaws and/or policies that encompass flood protection, erosion protection, and water quality (e.g., City of Coquitlam, Capital Regional District). Guidance for developing such bylaws suitable for local conditions is available (e.g. Dayton & Knight Ltd., 1998).

7.6 Recommended Approach for Stormwater Management

Comprehensive stormwater management planning involves the formulation of a clear set of site-specific goals and objectives for flood control and pollution control, involving input from representatives of all interested and affected parties within the watershed. A flexible and iterative process of review and adjustment is required, to refine and focus the goals and objectives and the plan of action to achieve the objectives.

Formulation of the goals and objectives requires a general inventory of the watershed, including topography and drainage, soils and land use, and identification of interested and affected parties. The inventory is used to identify the most valuable receiving waters, to assess areas that are at the greatest risk of degradation due to stormwater runoff, and to identify the areas where stormwater management offers the greatest benefits and has the greatest chance of success. For priority drainage basins, more detailed inventories are then prepared to define site-specific, measurable hydrologic and environmental objectives. Hydrologic objectives may include groundwater recharge, flood and erosion control, stream baseflow preservation, and stabilization of water levels. Environmental objectives may include water and/or sediment quality parameters such as turbidity, dissolved oxygen, particulate and dissolved contaminant and nutrient levels, water temperature, indicator bacteria, and toxicity. An evaluation of hydrologic conditions (hydrology, hydrogeology) and environmental conditions (water and sediment quality) within the watershed through the assembly of existing data and the acquisition of new data is necessary to help define priorities, develop the plan of action, and establish baseline conditions to monitor improvements.

Stormwater issues are best addressed on a watershed basis, by considering drainage area boundaries rather than political boundaries. For effective stormwater management, the issues of flood control, erosion control, and pollution control should all be coordinated on a watershed-encompassing scale. Flood control works, which may improve the situation for a specific area, can actually increase flooding and erosion in downstream areas if modelling of flows to synchronize runoff events is not undertaken.

Regulatory and educational approaches for source control of pollutants entering the storm drainage system are similar in nature to those for sanitary sewer systems. A coordinated approach can avoid costly duplication of effort, and result in regulatory and educational programs that are consistent with water quality objectives.

Stormwater quality management is best accomplished through a combination of non-structural controls designed to prevent pollutants from being picked up by surface runoff (including source control through regulation and education), structural Best Management Practices (BMPs), and Low Impact Development (LID) techniques to provide pollutant removal and flow attenuation or infiltration at upstream (source) locations (e.g., vegetated swales and filter strips, infiltration practices, urban forestry, etc.). Treatment of larger volumes of collected stormwater may be accomplished in facilities such as wet detention ponds and constructed wetlands. It is important to consider structural BMPs at the planning stage for new developments, since their use can be severely restricted by space limitations in existing developments. Therefore, land use restrictions are a critical component of stormwater management for new developments and redevelopments.

Monitoring of stormwater quality is difficult, due to the transient nature of runoff events. Extensive sampling of runoff events using automated equipment capable of collecting flow-proportioned composite samples is required to assess pollutant loadings from specific areas with reasonable accuracy. Further, laboratory analyses for the pollutants of concern (particularly for toxic organic compounds) are expensive. Sources of toxic substances may be difficult to locate by water sampling, especially in cases where inputs of pollutants are periodic rather than continuous. Many toxic compounds, however, including some metals and organics and indicator bacteria, tend to associate with particulates. A few sediment grab samples taken from major tributaries may be used to trace pollutant sources upstream in storm drain systems, and to focus more intense monitoring and site visits. Initial sampling efforts should be designed to identify problem tributaries to the storm drain and surface drainage systems, through the collection and analysis of sediment samples taken from strategic locations. The need for a more comprehensive monitoring effort, including water quality sampling during runoff events, should be assessed on an ongoing basis.

8.0 PLAN CRITERIA

This section contains the criteria that are proposed for use in developing and evaluating liquid waste management alternatives.

8.1 Population

The present and projected design populations serviced by the Ladysmith Wastewater Treatment Plant are contained in Table 3-1 in Section 3.2.2 of this report. These population projections are proposed for use in the LWMP.

8.2 Wastewater Flow and Load Projections

For the Stage 1 and 2 concept designs, the per capita flow rates for wastewater proposed for use in the LWMP (developed from historical Ladysmith WWTP flows) are summarized in Table 5-1 of this report. Proposed wastewater flows and loads to 2028 and for ultimate build-out in the Ladysmith WWTP service area based on per capita flows and loads developed from plant operating data and OCP population projections as set out in Section 5.1.3, 5.2.2 and 5.3.

8.3 Discharges to Surface Water

Proposed criteria for treated wastewater discharges are based on existing provincial regulations and impending federal regulations.

8.3.1 Provincial Regulations and Guidelines

The Municipal Sewage Regulation (MSR) administered by the Ministry of Environment (MOE) applies to all discharges to surface water and to discharges to ground in excess of 22.75 m^3/d (MOE, 1999). The effluent criteria for discharges of treated wastewater to surface waters (based on the MSR) are summarized in Table 8-1. For the discharge from existing Ladysmith WWTP, the criteria for embayed marine waters are applicable.

Table 8-2 shows the allowable concentrations of microbiological indicators in accordance with the Ministry of Environment Water Quality Guidelines (British Columbia Approved Water Quality Guidelines, 2006 Edition) for recreational use and for the protection of shellfish waters.

The MSR further identifies requirements for infiltration and inflow reduction to ensure flows do not exceed 2xADWF. Where this is not economically feasible, or where the I&I program is in place but will take several years to complete, the wastewater plant is to provide primary treatment for all flows >2xADWF with use of the secondary plant maximized.

Environmental Impact Studies (EIS) are to be undertaken for all new discharge or greater than 20% flow increases, for existing discharges, and for reclaimed water use. Since the MOE has provided water quality studies by McPherson et.al. (2006) and recommendations suggested additional study be completed following the secondary plant expansion, the EIS has been proposed to allow the construction of the plant. The MOE

Manager is to provide a recommendation on this requirement (Dayton & Knight Ltd. 2009).

TABLE 8-1
EFFLUENT REQUIREMENTS FOR DISCHARGES TO SURFACE WATERS (MOE, 1999)

Parameter	Effluent Criteria for Discharges to Surface Waters[1]							
	Maximum Daily Flow 50 m^3/d or greater				Maximum Daily Flow less than 50 m^3/d			
	Streams, Rivers & Estuaries		Marine		Streams, Rivers & Estuaries		Marine	
	Dilution 40:1[2]	Dilution 10:1[2]	Open Marine Waters	Embayed Marine Waters	Dilution 40:1[2]	Dilution 10:1[2]	Open Marine Waters	Embayed Marine Waters
Treatment Requirement	Secondary	High Quality Secondary	Secondary	Secondary	Secondary	High Quality Secondary	Primary	Secondary
BOD_5 (milligrams/litre)	45	10	45	45	45	10	130	45
TSS (milligrams/litre)	45	10	45	45	45	10	130	45
pH	6.0-9.0	6.9 – 9.0	6.0 – 9.0	6.0 – 9.0	--	--	--	--
Disinfection	See [3]	See [3]	See[3]	See [3]	See [3]	See [3]	See [3]	See [3]
Total Phosphorus (mg P/L)	1.0[4]	1.0[4]	--	1.0[4]	--	--	--	--
Orthophosphate (mg P/L)	0.5[4]	0.5[4]	--	0.5[4]	--	--	--	--
Ammonia	see[5]	See [5]	see[5]	see[5]	--	--	--	--

1 Effluent quality standards for all receiving water discharges are based on the use of an outfall which provides a combination of depth and distance to produce a minimum 10:1 initial dilution within the mixing zone.

2 Dilutions less than 100:1 will require an environmental impact study to determine if effluent quality needs to be better than tabulated. Where the dilution ratio is below 40:1 and the receiving stream is used for recreational or domestic water extraction within the influence of the discharge, discharge will not be permitted unless an environmental impact study shows that the discharge is acceptable and no other solutions are available.

3 For discharges to recreational use waters, fecal coliform < 200 MPN/100 mL. Where domestic water extraction occurs within 300 m of a discharge, fecal coliform < 2.2 MPN/100 mL with no sample exceeding 14 MPN/100 mL. Where chlorine is used, dechlorination will be required. Wherever possible alternate forms of disinfection to chlorine should be implemented.

4 The total and orthophosphate criteria may be waived if it can be shown from an environmental impact study that receiving waters would not be subject to an undesirable degree of increased biological activity because of the phosphorus addition. Alternatively, an environmental impact study may show that lower effluent concentrations than are tabulated are necessary, or that a mass load criteria may be needed.

5 The allowable effluent ammonia concentrations at the "end of pipe" must be determined from a back calculation from the edge of the initial dilution zone. The back calculation must consider the ambient temperature and pH characteristics of the receiving water and known water quality guidelines.

TABLE 8-2
WATER QUALITY GUIDELINES FOR MICROBIOLOGICAL INDICATORS MPN/100 ML (MOE, 2010)

	Aquatic life – shellfish harvesting [1]		Recreation – secondary contact, crustacean harvesting	Recreation - primary contact
	90th percentile	median	geometric mean [2]	geometric mean [2]
Escherichia coli	< 43	< 14	< 385	< 77
Enterococci	< 11	< 4	< 100	< 20
Fecal coliforms	< 43	< 14	none applicable	< 200

[1] Measured outside the initial dilution zone.

[2] The geometric mean is a type of mean or average, which indicates the central tendency or typical value of set of numbers. The n numbers are multiplied and then the nth root of the resulting product is taken, where n = count of numbers in the set.

The following toxicity standards are based on the MSR, Part 4 Standards for Effluent Reuse and Discharges to the Environment.

9 (1) A person must not discharge effluent, unless

(a) the discharge passes a 96 hour LC50 bioassay test as defined by Environment Canada's Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, Reference Method, EPS 1/RM/13, or

(b) if the discharge fails a bioassay test described in paragraph (a), the discharge passes a test conducted as a follow up according to requirements set out in Schedule 6 of the MSR.

(2) Subsection (1) does not apply if

(a) the discharge is to ground,

(b) the discharge quality meets a maximum BOD_5 not exceeding 10 mg/L and a maximum TSS not exceeding 10 mg/L,

(c) the discharge does not exceed a maximum daily flow of 5,000 m^3/d and the discharger demonstrates to the satisfaction of a director that the discharge does not adversely affect the receiving environment,

(d) the discharge is to open marine waters,

(e) the discharge is diluted such that at the outside boundary of the initial dilution zone the dilution ratio exceeds 100:1 and the discharger demonstrates to the satisfaction of a director that the discharge does not adversely affect the receiving environment,

(f) reclaimed water is being provided or used in accordance with this regulation, or

(g) the discharger demonstrates to the satisfaction of a director that the discharge does not adversely affect the receiving environment.

(3) If subsection (1) applies, a person must not discharge effluent unless the discharge is monitored for toxicity in accordance with the requirements of Schedule 6, Table 3 in the MSR.

8.3.2 Federal Regulations and Guidelines

The Canadian Council of Ministers of the Environment has developed a Canada-wide Strategy for the Management of Municipal Wastewater Effluent (CCME, 2007 and Environment Canada, 2007). At the same time, the B.C. Ministry of Environment is reviewing the Municipal Sewage Regulation (MSR) of the Environmental Management Act. The CCME strategy focuses on effluents released from wastewater treatment systems and overflows from sewer collection systems. National performance standards will be regulated under the Fisheries Act and in provincial and territorial regulatory instruments. The following discharge levels will be defined in these regulations:

- BOD_5 — maximum effluent average discharge level 25 mg/L
- TSS — maximum effluent average discharge level 25 mg/L
- residual chlorine — maximum 0.02 mg/L
- acute toxicity — include specific requirements and timelines to identify and reduce toxicity in cases of acute toxicity test failure

- ammonia — include specific requirements if acute toxicity test failure is due to ammonia that would authorize discharge of ammonia in effluent based on receiving environment considerations.

Monitoring of the environment and timelines to achieve effluent discharge levels are based on risk while considering elements such as sensitivity of the receiving environment, size and composition of the effluent release. In the long-term, the wastewater effluent discharge levels require wastewater treatment systems equivalent in performance to secondary treatment with advanced treatment if required.

The strategy also includes source control measures to preventing the entry of pollutants into the wastewater system (see Section 6 in this report). An action plan for wastewater systems on how to manage overflows from the combined sewers and how to achieve the effluent discharge levels within a 30 year timeline would be required.

8.3.3 Sanitary Sewer Overflows

Requirements for control of combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) are set out in the MSR, Schedule 1, Parts 15 and 16, respectively. The requirements are that an SSO (or CSO) shall not be allowed to occur during storm or snow melt events with less than a 5-year return period.

8.3.4 Canadian Shellfish Sanitation Program

The federal, provincial and municipal governments are currently engaged in an initiative to strengthen the Canadian Shellfish Sanitation Program (CSSP), which will result in enhanced food safety for consumers of shellfish harvested from areas that may be affected by failures of wastewater treatment plants. Where operational failures of wastewater treatment plants can occur and potentially contaminate nearby harvest areas, it is critical that timely and effective response measures are in place to prevent any affected shellfish from reaching domestic and international companies.

The CSSP partners have developed an implementation protocol with the following key elements: i) the development of area-specific Conditional Management Plans (CMPs) which will outline collective responsibilities and a process for timely failure detection, notification, and response, and ii) enhanced food safety controls by shellfish processing plants.

Three shellfish harvesting areas in British Columbia (around the Ladysmith, Crofton and Chemainus wastewater treatment plants), currently have CMPs (see Section 3.3.3 for more detail).

8.3.5 Proposed Discharge Criteria

As described in the preceding sections, minimum standards for secondary treatment are set out in provincial and (impending) federal legislation. For the purpose of the Ladysmith LWMP, the provincial and federal standards for secondary treatment for discharge to embayed marine waters (whichever is the more stringent) are proposed as a minimum for discharges to Ladysmith Harbour. Disinfection to meet the shellfish standards set out in the Provincial Municipal Sewage Regulation, the British Columbia Approved Water Quality Guidelines (criteria), and the Canadian Shellfish Sanitation Program will be necessary if the outfall discharge is to remain at its current location; alternatively, the outfall could be extended out of the Harbour and past the embayment line, a distance of about 4.5 km from the wastewater treatment plant (see Figure 3-2 in Section 3.3.1). If the outfall were extended, disinfection standards for the discharge could potentially be less stringent (i.e., meet the standard for recreation rather than shellfish harvesting), or possibly disinfection may not be required. Phosphorus reduction would probably not be required since discharge would be to open marine waters.

It is judged advisable to consider the potential for the need to meet more stringent discharge standards in future. In the case of Ladysmith Harbour, advanced treatment might include removal of nutrients (nitrogen and phosphorous) and filtration to remove residual suspended solids (see also Section 4.3.3 of this report). As with disinfection, an alternative to potential future advanced treatment may be extension of the outfall out of the Harbour and past the embayment line. These options will be examined as the LWMP goes forward.

8.4 Discharges to Land

Disposal of treated wastewater effluent to land is normally accomplished by the use of a network of buried, perforated pipes (commonly referred to as drain fields, disposal fields, or tile fields) that allow the effluent to seep into the surrounding soil. This type of system is designated "onsite", since wastewater is treated and disposed of within individual lots or parcels. The level of treatment required prior to ground disposal depends on the nature of the site and on the sensitivity of the receiving environment (e.g., the potential for groundwater contamination). Treatment systems vary in complexity from simple septic tanks to small off-the-shelf treatment facilities (commonly called "package plants").

Ground disposal systems with design flows of less than 22.75 m^3/d (i.e., single home systems up to community systems servicing 50 to 60 homes) are administered by local Health Authorities under the Health Act. Larger discharges to ground are administered by the Ministry of Environment under the Municipal Sewage Regulation. The MSR sets out water quality standards for discharges to ground disposal systems. Systems administered under the Health Act are not regulated on the basis of water quality standards, but the systems are to be designed and installed in accordance with the Sewerage System Standard Practice Manual published by the Ministry of Health.

The Ministry of Community Services requires that local governments meet the following requirements in order to be eligible for infrastructure funding assistance for wastewater projects from the Province:

- enact a bylaw which applies to all areas within the boundaries under jurisdiction of the applicant that requires community sewer service to all new lots of less than one hectare; or

- an approved (by Minister of Environment) Liquid Waste Management Plan (LWMP) for decentralized wastewater - the LWMP must address on-site sewage in a sustainable fashion, with the understanding that on-site sewage systems will be considered as permanent infrastructure - the LWMP must be supported by appropriate bylaws (OCPs, zoning, subdivision standards, etc.), and at a minimum, the LWMP will address:

  - where the recipient is proposing development of new properties that will not receive community sewer, and the cumulative hydraulic loading from onsite sewage disposal systems can be safely and sustainably handled by the overall soils environment,
  - a community plan for the management and maintenance of onsite septic systems,
  - a biosolids management plan, and
  - a septage collection plan.

8.5 Reclaimed Water

8.5.1 Reclaimed Wastewater

Historically in British Columbia, and generally throughout North America, the emphasis in wastewater management in the past has been to provide sufficient treatment to allow disposal of effluent in order to protect public health and the environment. With the exception of some arid southern states in the U.S., the emphasis has been on disposal of effluent to water or to land. Treated wastewater is now being looked upon as a resource that should be beneficially reused where feasible. This evolving approach contrasts with wastewater disposal practices that currently prevail. An appropriate level of treatment and monitoring for various reuse applications is important for protection of public health and the receiving environment. With effective source control programs coupled with adequate and reliable treatment, effluent can be beneficially reused. Treatment plants designed for water reuse are more appropriately classified as water reclamation plants.

Standards for the use of reclaimed effluent in British Columbia were adopted in July 1999, and are administered by the MOE under the standards set out in the MSR. The MSR standards for water reuse in British Columbia dictate that effluent used as reclaimed water must meet either of the two requirements described in Table 8-3, depending on the use of the reclaimed water; these standards are proposed for use in the LWMP. Environmental impact studies are required for both categories of reclaimed water. Use of reclaimed water must be authorized in writing by the local health authority having jurisdiction.

TABLE 8-3
RECLAIMED WATER CATEGORY AND PERMITTED USES

Unrestricted Public Access Category	Restricted Public Access Category
EFFLUENT QUALITY REQUIREMENTS $6 \leq pH \leq 9$ $BOD_5 \leq 10$ milligrams/litre Turbidity $\leq$ 2 NTU Fecal coliforms $\leq$ 2.2/100 millilitres	EFFUENT QUALITY REQUIREMENTS $6 \leq pH \leq 9$ $BOD_5 \leq 45$ milligrams/litre TSS $\leq$ 45 milligrams/litre TSS Fecal coliforms $\leq$ 200/100 millilitres
URBAN - Parks - Playgrounds - Cemeteries - Golf Courses - Road Rights-of-Way - School Grounds - Residential Lawns - Greenbelts - Vehicle and Driveway Washing - Landscaping around Buildings - Toilet Flushing - Outside Landscape Fountains - Outside Fire Protection - Street Cleaning	AGRICULTURAL - Commercially processed food crops - Fodder, Fibre - Pasture - Silviculture - Nurseries - Sod Farms - Spring Frost Protection - Chemical Spray - Trickle Drip Irrigation of Orchards and Vineyards
AGRICULTURAL - Aquaculture - Food Crops Eaten Raw - Orchards and Vineyard - Pasture (no lag time for animal grazing) - Frost Protection, Crop Cooling and Chemical Spraying on crops eaten raw - Seed crops	URBAN/RECREATIONAL - Landscape Impoundments - Landscape Waterfalls - Snow Making not for skiing or snowboarding - Golf Courses (providing health and environmental issues resolved to manager's satisfaction) - remote areas of parks, school grounds during vacation period (providing health and environmental issues resolved to manager's satisfaction)
RECREATIONAL - Stream Augmentation - Impoundments for Boating and Fishing - Snow Making for skiing and snowboarding	CONSTRUCTION - Soil Compaction - Dust Control - Aggregate Washing - Making Concrete - Equipment Washdown
	INDUSTRIAL - Cooling Towers - Process Water - Stack Scrubbing - Boiler Feed
	ENVIRONMENTAL - Wetlands

According to the MSR, the use of reclaimed water requires the following:

- provide in addition to seasonal storage an alternative method of disposing of the reclaimed water or satisfy the manager that no such alternative is required to assure public health protection and treatment reliability.
- in the absence of seasonal storage, the provision of at least 20 days emergency storage (the storage volume may be reduced to 2 days if multiple treatment units are used);
- the system for conveying reclaimed water must incorporate safeguards to prevent cross connection with the potable water system;
- authorization in writing by the local health authority or the establishment of a local service area under which a municipality, or a private corporation under contract to a municipality, assumes responsibility for the system;
- the provision of user information when Unrestricted Public Access Category uses are proposed;
- where frequent worker contact with reclaimed water occurs, disinfection must achieve a fecal coliform level of <14/100 millilitres;
- the reclaimed water provider must demonstrate that reclaimed water does not contain pathogens or parasites at levels which are a concern to local health authorities;
- reclaimed water must be clean, odourless, non-irritating to skin and eyes, and must contain no substances that are toxic on ingestion;
- where available, agricultural (crop) limits must govern criteria for metals;
- high nutrient levels may adversely affect some crops during certain growth stages, consequently crop limits and season must govern nutrient application; and
- the reclaimed water provider must obtain monitoring results, and confirm that water quality requirements are met, prior to distribution.

According to definitions contained in the MSR, water-carried wastes from liquid or non-liquid culinary purposes, washing, cleansing, laundering, food processing or ice production (i.e., grey water) are classified as domestic sewage, regardless of whether or not toilet wastes (black water) are included; however, the government of B.C. has committed to investigating ways that grey water can be reused for non-potable purposes such as toilet flushing and landscape irrigation as a component of Living Water Smart – B.C.'s Water Plan.

As the provincial regulations currently stand, the MSR standards for use of reclaimed sewage effluent apply to treated and recycled grey water as well as to reclaimed sewage. According to the MSR, water reuse projects must be approved in consultation with the Ministry of Health (MOH). The MOH has allowed demonstration projects for grey water recycling (e.g., CK Choi Building and Quayside Village in North Vancouver). These projects required special permission from health authorities. Procedures and facilities must be in place to ensure that systems will be monitored and operated properly, so that it can be demonstrated that there is no danger to the public health. Each demonstration project is carefully considered on a case-by-case basis, before receiving approval.

8.5.2 Reuse Standards and Permitted Uses for Rainwater in British Columbia

There are no water quality standards or permitting requirements specifically aimed at rainwater harvesting and reuse in British Columbia. It can be assumed that, in cases where captured rainwater is to be used for potable purposes, health officials would recommend that water quality meet the British Columbia Approved Water Quality Guidelines or the Canadian Water Quality Guidelines for Drinking Water; these are summarized in Table 8-4.

The B.C. Ministry of Health has few concerns with non-potable reuse of collected rainwater. Since fecal contamination of collection surfaces by bird or animal droppings is possible, disinfection should be practiced if direct human contact with the reuse water is possible. In this case, the British Columbia Water Quality Guidelines for primary contact recreation would likely be the most appropriate, and these are included in Table 8-4. Building inspectors accept a cistern as a proven source of potable water in B.C.

TABLE 8-4
SELECTED WATER QUALITY GUIDELINES AND CRITERIA FOR DRINKING AND PRIMARY CONTACT RECREATION

Parameter	Maximum Allowable			
	Drinking Water		Recreation and Aesthetics (e.g., Swimming)	
	British Columbia[1]	Canada[2]	British Columbia[1]	Canada[2]
Dissolved Aluminum	0.2 mg/L	Not Applicable	0.2 mg/L	Not Applicable
Total Cadmium	5 ug/L	5 ug/L	Not Applicable	Not Applicable
Chloramines	3 mg/L	3 mg/L	Not Applicable	Not Applicable
Total Chromium	50 ug/L	50 ug/L	Not Applicable	Not Applicable
Clarity (secchi disk)	Not Applicable	Not Applicable	1.2 m	1.2 m
True Color	15 TCU	15 TCU	Should not impede visibility	Not Applicable
Specific Conductivity	700 uS/cm	Not Applicable	Not Applicable	Not Applicable
Copper	1 mg/L	1 mg/L	Not Applicable	Not Applicable
Iron	0.3 mg/L	0.3 mg/L	Not Applicable	Not Applicable
Lead	10 ug/L	50 ug/L	Not Applicable	Not Applicable
Microbial	10 TC/100 mL 0 FC/100 mL	10 TC/100 mL 0 FC/100 mL	2000 E coli/L (geometric mean)	2000 E.coli/L (30 day geometric mean)
Odour	Inoffensive	Not Applicable	Not Applicable	Inoffensive
pH	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	5.0 to 9.0
Temperature	15ºC	15ºC	Not applicable	Not applicable
Total Dissolved Solids	500 mg/L	500 mg/L	Not Applicable	Not Applicable
Turbidity	1 NTU	5 NTU	50 NTU	50 NTU
Zinc	5 mg/L	5 mg/L	Not Applicable	Not Applicable
Oil and Grease	Not Applicable	Not Applicable	Not Applicable	Not detectable by sight or smell

[1] British Columbia Approved Water Quality Guidelines

[2] Canadian Water Quality Guidelines

8.6 Beneficial Use of Biosolids

The beneficial use and disposal of biosolids in British Columbia is regulated by the B.C. Ministry of Environment (MOE) under the Organic Matter Recycling Regulation (OMRR). The OMRR defines allowable uses for treated biosolids in British Columbia.

The MOE developed the OMRR in concert with various stakeholders, to establish requirements for the reuse of treated biosolids. The OMRR defines three products that incorporate biosolids, with different quality classifications for each product. Biosolids are defined in the OMRR as: "*stabilized municipal sewage sludge resulting from a municipal waste water treatment process or septage treatment process which has been sufficiently treated to reduce pathogen densities and vector attraction to allow the sludge to be beneficially recycled in accordance with the requirements of this regulation*."

The three biosolids products described in the OMRR are designated "biosolids" (treated wastewater organic soils), "compost" (biosolids composted with or without other organic wastes), and "biosolids growing medium" (topsoil manufactured using treated biosolids). Compost and biosolids are further designated Class A or Class B, with the higher quality product being Class A. Classification depends on trace element (metal) concentrations, treatment method, pathogen content, and vector attraction reduction (vectors are carriers such as insects that are capable of transmitting disease-causing organisms commonly referred to as pathogens). According to the definitions contained in the OMRR, Class A compost and biosolids growing medium are defined as "retail grade organic matter". Class B compost, Class A biosolids and Class B biosolids are defined as "managed organic matter." The OMRR also lays out requirements for sampling, analysis and record keeping, as well as maximum cumulative limits for designated trace metals at biosolids application sites. The solids treatment facilities at the Ladysmith WWTP are designed to produce Class A biosolids; however, the facilities are currently overloaded and require expansion and refurbishment if they are to continue in service.

Categories for biosolids reuse according to OMRR are as follows:

<u>Class B</u>

- land applied in accordance with a Land Application Plan to sites with restricted public access and visible signage (e.g., for silviculture, mine reclamation, agriculture)

- distribution to composting facilities

Class A

- land applied in accordance with a Land Application Plan to sites with unrestricted public access (e.g., parks, play fields, etc.)
- distribution to composting facilities
- manufacture of topsoil (biosolids growing media)
- sale or give away in amounts not exceeding 5 m^3 per vehicle per day, or in sealed bags each not exceeding 5 m^3 with no restriction on number of bags per vehicle per day

The principal difference between Class A and Class B biosolids is that Class A has been pasteurized (heat treated) to reduce the risk of disease caused by pathogenic microorganisms. For Class B biosolids and Class B compost, a biosolids treatment or composting process must be used whereby fecal coliform are reduced to levels < 2,000,000 MPN per gram of total solids (dry weight basis). Fecal coliform levels must be determined to be < 1 000 MPN per gram of total solids (dry weight basis) for Class A biosolids, and Class A compost (not produced from yard waste alone). In addition, the maximum allowable mercury content of Class A biosolids is 5 mg/kg, compared to 15 mg/kg for Class B biosolids. The trace metals standards contained in the OMRR for the various biosolids products are shown in Table 8-4; the results of testing two samples of the biosolids generated at the Ladysmith WWTP are included for comparison. As shown in Table 8-4, the biosolids samples were well within trace metal limits for both Class A and B biosolids.

TABLE 8-5
OMRR TRACE METAL LIMITS

Parameter (milligrams/kilogram dry weight unless otherwise noted)	B.C. Organic Matter Recycling Regulation				Ladysmith Biosolids	
	Managed Organic Matter		Retail Grade Organic Matter			
	Class B Compost and Class B Biosolids	Class A[1] Biosolids	Biosolids Growing Medium (Topsoil)[2]	Class A Compost Containing Biosolids	May 31/04	Dec. 6/07
Arsenic	75	75	13	13	<0.05	<10
Cadmium	20	20	1.5	3	0.705	1.0
Chromium	1060	--	100	100	14.5	21
Cobalt	150	150	34	34	<0.500	2
Copper	2200	--	150	400	283	468
Lead	500	500	150	150	<0.050	44
Mercury	15	5	0.8	2	<0.010	1.2
Molybdenum	20	20	5	5	<0.500	6
Nickel	180	180	62	62	7.50	11
Selenium	14	14	2	2	<0.100	2
Zinc	1850	1850	150	500	283	457

1 As specified in Trade Memorandum T-4-93 (September, 1993), Standards for Metals in Fertilizers and Supplements, as amended from time to time, as adopted by Agriculture and Agri-Food Canada under the Fertilizers Act (Canada) and regulations.

2 Biosolids growing medium must be derived from Class A biosolids or Class B biosolids that meet Class A fecal coliform and vector attraction reduction requirements.

9.0 WASTEWATER TREATMENT AND REUSE ALTERNATIVES

This section contains background discussion regarding wastewater treatment technologies (Sections 9.1 and 9.2), followed by an outline of initial concept wastewater collection and treatment options for the Town of Ladysmith (Section 9.3). Options for reclamation of treated wastewater and beneficial use of biosolids are contained in Sections 9.4 and 9.5, respectively. The draft concept options were further developed and refined through discussion among the project technical team, the Joint Advisory Committee (JAC), regulatory agencies, and the public (see Section 2.0).

The basic processes for wastewater treatment may include the following components, depending on the process objectives and the nature of the receiving environment:

- preliminary treatment – screening, grit removal;
- primary treatment – removal of crude solids by gravity settling, removal of oil and grease and other floatable material by skimming;
- secondary treatment – removal of dissolved and fine particulate oxygen-demanding organic material by a community of microorganisms (mainly bacteria) that are cultured in a bioreactor, followed by gravity separation of the microorganisms from the treated wastewater;

- advanced treatment – may include removal of phosphorus by chemical addition, removal of phosphorus and/or nitrogen by a community of microorganisms (similar to secondary treatment), and filtering to remove fine solids escaping secondary treatment; and
- disinfection – destruction or inactivation of disease-causing organisms by chlorination, ozonation, or ultra violet light (if chlorination is practiced, de-chlorination is normally required).

9.1 Wastewater Treatment Technologies for Larger Regional Plants

The Town of Ladysmith has a legal obligation to provide reliable and effective wastewater treatment for its citizens. An important consideration in meeting this obligation is the selection of treatment technologies that are reliable and cost effective, and that can consistently meet mandated effluent quality criteria. Larger plants typically utilize mechanical forms of treatment, mainly because natural systems and less mechanized forms occupy too much land, which frequently is not available. Both mechanical and natural treatment facilities rely mainly on bacteria for removal of contaminants.

Appropriate technologies for larger treatment facilities can be generalized into suspended growth and fixed growth systems. Suspended growth systems generally include variations of the activated sludge process (e.g., conventional activated sludge, contact stabilization, pure oxygen, oxidation ditch, sequencing batch reactor, extended aeration, membrane bioreactor). Fixed growth systems include trickling filters, rotating biological contactors (RBC), and systems that incorporate a submerged media such as the moving bed bioreactor (MBBR) process. Combined systems contain both fixed and suspended growth components.

The only major wastewater treatment facility within the study area is the existing Ladysmith WWTP. As described earlier in this report, the Ladysmith WWTP currently provides primary treatment and disinfection of wastewater prior to discharge to Ladysmith Harbour.

Space is available at the Ladysmith WWTP to increase the capacity of the existing primary treatment and solids handling facilities and to add secondary treatment facilities to ultimately serve about 30,000 population equivalents if space efficient technologies are used (this includes space for potential future upgrades for nutrient removal and effluent filtration if found to be necessary).

9.2 Wastewater Treatment Technologies for Smaller Community Plants

For communities such as Ladysmith that already have a centralized wastewater collection and treatment system, smaller systems that are designed to serve a particular subdivision or other pocket of development are sometimes used. Small community systems that serve pockets of development are sometimes referred to as "satellite systems". Satellite systems may be used where pockets of development are remote from the centralized sewer collection system, or to reduce the wastewater load on the centralized system, or to produce reclaimed water for local use. Source control measures developed for the central system could also be applied to satellite systems (see Section 6).

Suspended growth, fixed growth, or combined systems suitable for small plants are similar to those used in larger plants (Section 9.1). Discharge of treated effluent may be to surface water, to ground, or the water may be reclaimed and reused (e.g. for irrigation), depending on the situation.

In addition to small mechanical facilities incorporating suspended and/or fixed growth systems, natural systems may be appropriate for smaller communities. Natural systems include various lagoon options such as anaerobic, facultative, aerobic and aerated (fully and partially mixed). Natural systems for wastewater treatment include natural wetlands, constructed wetlands and aquatic plant systems. Wetlands are normally used for polishing effluent following secondary treatment, but they may also be used as a secondary treatment process if sufficient space is available. An additional function is to use effluent to supplement flows into natural wetlands that are water-short, possibly due to development pressures.

In general, suspended growth and fixed growth technologies have a proven record and capital and operating costs are well documented. The same is true for lagoon systems. Data are limited for wetland systems.

9.3 Stage 1 LWMP Wastewater Collection and Treatment Options

9.3.1 Effluent Quality

As discussed in Section 8 of this report, standards for treated wastewater discharged to surface waters in British Columbia are set out in the Municipal Sewage Regulation (MSR). The minimum requirements are removal of total suspended solids (TSS) and five-day biochemical oxygen demand (BOD_5) to achieve a maximum allowable (worst-day) concentration of 45 mg/L for each parameter. Federal regulations specify an allowable average effluent concentration of 25 mg/L for BOD_5 and TSS. Treatment of wastewater to these standards, which typically removes about 90% of the BOD_5 and TSS from raw wastewater, is referred to as "secondary treatment" and is considered adequate to protect receiving waters in most cases. The planned upgrade to secondary treatment for the existing Ladysmith WWTP will meet both the provincial (MSR) and federal minimum standards for wastewater discharges.

The MSR sets out more stringent standards that apply in cases where secondary treatment may not be sufficient to adequately protect the receiving environment. The more stringent standards may include maximum allowable effluent concentrations of BOD_5 and TSS of 10 mg/L, removal of nutrients (phosphorus and/or nitrogen), and disinfection to protect recreational or shellfish resources. If one or more of these additional levels of treatment is required, the standard may be referred to as advanced or tertiary treatment.

As discussed elsewhere in this report, the Ladysmith WWTP discharges treated effluent to Ladysmith Harbour, which is classified as an "embayed" receiving environment according to the MSR. Further, the Harbour contains commercial shellfish beds, and the waters of the Harbour are poorly flushed by tidal action. This means that more stringent effluent quality standards apply to a Harbour discharge compared to a discharge to well-flushed, open marine waters, and this is reflected in the MSR standards. A comparison of the MSR standards for open and embayed marine waters is shown in Table 8-1 in Section 8.3.1. All reclaimed water would meet the appropriate MSR standards as set out in Section 8.5.

9.3.2 Preliminary Option Development

Concept options for wastewater management in the Ladysmith area are outlined in this section. As described in Section 2 of this report, the LWMP options were developed in consultation with the Joint Advisory Committee (six JAC meetings) and the community at large (Public Open House No. 1). The overall goals and strategies outlined in the Community Sustainability Vision were also considered, as discussed in Section 2 – Public Consultation.

Three concept options were initially developed as follows:

1. Continue to expand the existing WWTP to serve an ultimate population in excess of the OCP population limit of 17,200 people. The upgrade currently underway will provide secondary treatment for a service population of 17,200 people. If additional measures are deemed necessary to protect sensitive (embayed) Ladysmith Harbour, the WWTP could be upgraded to tertiary treatment (nutrient removal, effluent filtration), and/or the outfall could be extended to open marine waters.

2. Develop one or more satellite (scalping) water reclamation plants in selected areas, beginning with a facility to serve new development in the Holland Creek area.

3. Construct a new WWTP at an alternate location (e.g. in the Industrial Park in South Ladysmith or elsewhere as appropriate) with a long-term view to eventually decommissioning the existing WWTP and using the site for other purposes. The existing WWTP would continue in service for a population of 17,200 people, with new development beyond that serviced by the new facilities constructed at the Industrial Park. The facility at the current site could be decommissioned at the end of its service life and be replaced by a pump station and forcemain conveying untreated wastewater to the new site. Treated effluent would be discharged via a pipe connecting to the existing outfall, since an alternative route for the outfall directly from the Industrial Park to open marine waters was deemed infeasible due to need to cross numerous private properties. As with Item 1 above, the new plant could be a secondary treatment facility, with future upgrades added if necessary (i.e. tertiary treatment and/or extension of the outfall to open marine waters).

Based on input from JAC meetings and the Public Open House No. 1, the above options were refined as listed below:

- Option 1A:
  - continue to expand and upgrade WWTP at existing site to serve 17,200 population with secondary treatment (present site suitable for up to 30,000 service population using current technologies)
  - continue to discharge to Ladysmith Harbour
- Option 1B: same as 1A but assume tertiary treatment needed (nutrient removal, effluent filtration)
- Option 1C: same as 1A but extend outfall discharge to open marine water.
- Option 2A:
  - do not expand existing WWTP beyond 17,200 population

- construct new secondary treatment plant for population greater than 17,200 at another location when service population reaches 17,200 (around 2035)
- eventually decommission existing WWTP (construct large pump station with forcemain to new site)
- continue to discharge to Ladysmith Harbour (connect to existing outfall)

- Option 2B: same as 2A but assume tertiary treatment needed (nutrient removal, effluent filtration).
- Option 2C: same as 2A but extend outfall discharge to open marine water.
- Satellite Water Reclamation Plant(s):
  - construct satellite water reclamation plant to serve new development in Holland Creek area (2,500 population) and elsewhere as appropriate;
  - local use of reclaimed effluent (landscape irrigation, toilet flushing, fire protection);
  - excess wastewater and waste solids piped to central collection system;
  - reclamation plant(s) compatible with Options 1 and 2.

Additional details regarding the options together with advantages and disadvantages and cost estimates are provided below. Cost estimates are provided in Section 9.3.8 following option descriptions.

9.3.3 Option 1 – Single Central Treatment Plant at Existing Location

Option 1 would be to upgrade the existing WWTP to secondary treatment and expand treatment capacity to serve all sewered development within the study area. (see Figure 9-1). The commercial and industrial zoned areas of South Ladysmith may or may not be sewered, depending on the development density. As shown on Figure 3-3 in Section 3.5 (Wastewater Ground Disposal Potential) and Figure 9-1, most of the areas zoned highway commercial and residential in South Ladysmith generally have moderate conditions for ground disposal, while most of the area zoned industrial has poor to very poor conditions.

Most of these areas would probably have to be sewered, depending on the nature and density of development.

Because the plant upgrade is an immediate requirement, the Town of Ladysmith is currently developing a secondary treatment facility to serve 17,200 people. This evaluation was undertaken in a process confirmation report in which the JAC evaluated options. Four options were investigated, and the moving bed biological reactor (MBBR) was selected by the JAC Committee and adopted by Council (see Appendix 9 for option evaluation). The selection of this initial treatment does not affect the long term solutions but provides a treatment solution for the next 25 years or more as a stage in developing the long term plan.

As discussed earlier in Section 3.2, the Saltair area to the west of South Ladysmith may potentially be serviced by the Town wastewater system as far as the Lagoon bridge in the foreseeable future. The Timberwest lands to the east as well as areas to the north (e.g. the Diamond Improvement District) may also be serviced in the long-term future.

The area at the existing WWTP site is estimated to be adequate to serve about 30,000 people, assuming secondary treatment and allowing space for future addition of partial nitrogen removal and effluent filtration (if this is found to be necessary to protect Ladysmith Harbour water quality – alternatively, the outfall could be extended beyond the embayment line to remove the discharge from Ladysmith Harbour as described previously). Waste solids could continue to be treated onsite, or they could be removed to another site for composting (see Section 9.5 for more detail). In either case, odour control will be required, due to the proximity of residential development. The capacity of the existing site could potentially be expanded beyond 30,000 people, if the property could be enlarged by adding fill and other necessary structures along the foreshore; this would require consultation with regulatory agencies to determine feasibility.

The current upgrade design to secondary treatment is configured such that the facilities can be upgraded to tertiary (advanced) treatment if deemed necessary to protect sensitive Ladysmith Harbour (e.g., phosphorus and/or nitrogen removal, filtration of effluent). Alternatively, the outfall could be extended to relocate the discharge out of the existing embayed location to open marine waters, where the risk detrimental impacts would be reduced (see Section 9.3.6).

Advantages of Option 1:

- maximum use of existing infrastructure;
- lowest cost option;
- does not require siting of new treatment facilities

Disadvantages of Option 1:

- existing site is desirable waterfront property and is close to residential development;
- existing outfall may have to be extended and/or advanced treatment implemented in future to protect Ladysmith Harbour
- space restrictions for expansion

9.3.4 Option 2 – New Central Treatment Plant

Option 2 would be to identify a site for a new central wastewater treatment plant; this option would be designed to accommodate long-term future development beyond 17,200 people. For Option 2, the existing WWTP would be upgraded to secondary treatment for a service population of about 17,200 people as currently planned. A site for a new treatment facility would be identified, with a view to servicing new development in the long-term future. The existing plant could be maintained for a service population of 17,200 people, or it could eventually be decommissioned when it reaches the end of its design life, and the site could then be used for other purposes. Alternatively, the existing

WWTP could continue in service for the long-term future up to a service a population of greater than 17,200, and the new site could be used primarily as a facility for processing waste solids transported from the existing WWTP (e.g., digestion and/or composting). The new site could also include liquid treatment facilities to treat the portion of the localized service area not serviced by the existing WWTP.

The following four sites were considered for Option 2 (see Figure 9-1 for approximate locations – note that additional sites could also be considered):

- Site 2A – North area of Stocking Creek in industrial zoned area;
- Site 2B – Near Rocky Creek in north industrial site;
- Site 2C – In the lower Holland Creek residential zoning; and
- Site 2D – Near northwestern corner of Town boundary near Lot 108.

Site 2A is remote from residential development. Site 2B would require considerable reconstruction of the Town's infrastructure and a long effluent discharge pipe making it less desirable economically. Site 2C is in a residential zoned area and may not be as acceptable as the industrial sites. Site 2D is near existing and planned residential development.

Due to practical difficulties associated with identifying a right-of-way for the land section of a new outfall to open marine waters (mainly due to crossing numerous private properties), the new WWTP discharge was assumed to connect to the outfall at the existing WWTP site, which could be extended to open marine water if necessary (see Section 9.3.6).

Advantages of Option 2:

- may ultimately allow redevelopment of existing WWTP site for other purposes;
- relocation of facilities would remove odour source from existing WWTP site;

- new site can be sized to avoid space restrictions;
- allows siting of the new treatment facilities further away from residential areas (i.e., in areas zoned for industrial or commercial use).

Disadvantages of Option 2:

- would require modification of wastewater trunk sewers and pumping system;
- siting of new wastewater treatment facilities would be problematic (typically requires many years of study and consultation); and
- relocation of treatment facilities away from the waterfront will likely require additional pumping of wastewater (increased energy demand).
- existing outfall may have to be extended and/or advanced treatment implemented in future to protect Ladysmith Harbour

9.3.5 Satellite Treatment with Water Reclamation

Water reclamation and reuse is supported by the JAC, the public, and the Province. The most practical applications are normally in new developments rather than attempting to retrofit existing infrastructure. For Ladysmith, new residential development is expected to be concentrated in the Holland Creek area for the immediate future. New development in the Holland Creek area could be serviced by a separate (satellite) wastewater treatment plant designed to produce a treated effluent that meets provincial standards for reclaimed water use in areas accessible to the public (see Section 8.5). Reclaimed water could potentially be used for non-potable applications such as landscape irrigation, toilet flushing and fire protection. Excess that could not be reused and waste solids from the water reclamation plant would be piped to the central system for treatment and disposal at the Ladysmith WWTP (see Figure 9-1).

Additional water reclamation plants could potentially be located in South Ladysmith (see Figure 9-1) or elsewhere as appropriate depending on how development in the Town and adjacent areas unfolds. Irrigation of ALR lands (including the potential golf course) and possibly use by industry might allow 100% use of reclaimed effluent in South Ladysmith, depending on the nature of the development in this area.

Two piping systems for water distribution would be required for the new development, one for potable water and the other for non-potable (reclaimed) water. A second water distribution system for reclaimed water can be relatively economical if it is included in planning and design from the outset; however, retrofitting this type of system to existing urban development is much more costly. A summary of potential water reuse options is contained in Section 9.5.

Advantages of water reclamation:

- reduced wastewater load to existing treatment plant will extend design life of facilities;
- reduced consumption of potable water due to water reclamation and reuse for non-potable applications;
- reduced volume of discharge to Ladysmith Harbour; and
- meets provincial objectives for resource conservation and recovery.

Disadvantages of water reclamation:

- water reclamation will increase capital costs of wastewater treatment (this must be balanced against potential cost savings realized from reduce demand on the potable water system);
- use of multiple treatment plants will increase costs of wastewater treatment compared to a single plant; and
- increased costs for development due to need for a dedicated reclaimed water distribution system.
- requires siting of new treatment facilities.

9.3.6 Outfall Extension

The Federal Department of Fisheries and Oceans recently completed a Conditional Management Plan (CMP) for commercial shellfish harvesting at Oyster Cove in Ladysmith Harbour. According to the CMP, commercial shellfish harvesting must be closed for a minimum period of 7 days following a discharge of undisinfected wastewater (and minimum 21 days unless samples of marine water and shellfish verify that standards have been met after the 7 days). Extension of the outfall discharge to an open marine location could essentially eliminate this concern.

In addition, the potential requirements for phosphorus removal could be offset by an extension of the existing outfall to open marine waters. The outfall extension could apply to any of the options. For cost estimating purposes, it was assumed that an outfall extension would include the addition of about 3,000 m of 800 mm diameter pipe to outside of the embayment line shown on Figure 9-1. Additional studies would be required to identify a suitable location for the discharge and to refine the cost estimate.

Advantages of outfall extension:

- removes WWTP discharge from highly sensitive (embayed) receiving environment
  - reduced risk to commercial and recreational shellfish beds in Laydsmith Harbour and associated economic impacts in light of international requirements and reduced risk of shellfish harvesting closures
  - reduced risk of nutrient enrichment in Ladysmith Harbour
  - reduced environmental impact in the event of WWTP upset/failure
- less costly than tertiary treatment

Disadvantages:

- increased capital costs (assuming tertiary treatment not required)
- studies required to identify discharge location (drogue studies, dispersion modeling, stakeholder consultation)

9.3.7 Cost Estimates

Cost estimates were developed for the options described above based on concept designs, and are summarized in Table 9-1. The cost estimates are not all-inclusive and should not be used for budgeting purposes, but they are considered adequate for the purpose of comparing options. A capital cost estimate for the upgrade to secondary treatment at the existing WWTP site for a service population of 17,200 people is included in Table 9-1, together with the estimated annual operating and maintenance (O&M) cost and the net present value (NPV) of the capital plus O&M until the year 2034 when the population is expected to reach about 17,200 people. The estimated costs for upgrading the secondary plant to provide advanced treatment for chemical phosphorus removal to an effluent concentration of 1 mg P/L (as set out in the Municipal Sewage Regulation for embayed marine waters – see Section 8.3.1), partial biological removal of nitrogen, and filtration of the effluent (Option 1B) are included in Table 9-1 for comparison with the base (Option 1A - secondary treatment) case. The estimated costs for extension of the outfall (Option 1C - advanced treatment not required) are also included in Table 9-1. For the purpose of estimating cost, the new outfall from the WWTP site reaching approximately 300 m beyond the embayment line was assumed, a total length of about 3,000 m (see Figure 9-1). If the existing outfall can be extended, the cost could potentially be reduced. The actual discharge location would have to be confirmed based on environmental studies if this option were selected. Note that the costs shown in Table 9-1 do not include sustainability features such as recovery of heat and power, reclamation and reuse of treated wastewater, beneficial use of solid residuals, etc.

TABLE 9-1
COST SUMMARY OF CONCEPT OPTIONS FOR WASTEWATER MANAGEMENT

Option	Capital Cost[1]	Annual O&M Cost[1]	NPV (Capital plus O&M to 2034)[1,4]
1A – Secondary treatment for 17,200 population at existing site[2]	$15,700,000	$700,000	$26,700,000
1B – Advanced (tertiary) treatment for 17,200 people at existing site[2]	$22,100,000	$1,100,000	$38,600,000
1C – Option 1A plus outfall extension[3]	$20,800,000	$700,000	$31,800,000
Satellite Water Reclamation Plant for 2,500 population	$3,400,000	$200,000	$6,600,000

[1] 2007 dollars (to be updated in Stage 3)
[2] capital includes an allowance of $100,000 for Stage 2 EIS for Options 1A and 1B
[3] capital cost includes an allowance of $250,000 for EIS and drogue studies for Option 1C
[4] assumed annual discount rate – 4% for 25 year of service

For Options 1A and 1B, the estimated cost of the Stage 2 Environmental Impact Study (EIS) required by the Ministry of Environment was included in the capital cost (see letter from MOE dated April 17, 2009 in Appendix 10). The Stage 2 EIS is to be conducted after commissioning of the secondary treatment facilities, with the objective of determining if additional measures beyond secondary treatment are needed to meet water quality requirements for Ladysmith Harbour. For Option 1C, an allowance of $250,000 was included for an EIS and drogue studies to identify a suitable location for an open marine discharge. The costs do not include separate Environmental Impact Studies that may be required to demonstrate that construction of the facilities will not adversely affect the environment, archaeological sites, First Nations lands, or adjacent neighborhoods.

Capital cost estimates for the secondary plant (Option 1A) were developed as a component of the WWTP upgrade pre-design studies. Capital cost estimates for the addition of advanced (tertiary) treatment to the existing WWTP (Option 1B), the new outfall (Option 1C), and associated annual O&M costs were based on experience with similar projects. More detail on the cost estimates is provided in Appendix 8.

For Option 1A, the cost estimates were based on the completion of the upgrade currently underway to provide secondary treatment for service population of 17,200 people. Assuming that new development in the Holland Creek area (up to 2,500 people) would be serviced by a satellite water reclamation plant, the 17,200 service population for the central WWTP would be reached around the year 2034 (see Section 3.2.2). At that point, either the existing WWTP would have to be expanded (continue with Option 1), or a new WWTP would have to be constructed at another site (Option 2).

As shown in Table 9-1, the overall cost of a longer outfall is considerably less costly than implementing advanced treatment at the WWTP. However, it is important to note that the cost estimate for the new outfall could change based on the results of environmental studies designed to identify a suitable location for the discharge (i.e., the outfall might have to be longer than 3,000 m).

The costs for a satellite water reclamation plant designed to serve up to 2,500 people are included in Table 9-1 (this would be compatible with any of Option 1A, 1B or 1C). The costs include a piped connection to the existing WWTP for disposal of waste solids and unused (reclaimed) water.

Costs for Option 2 can be developed when the service population approaches 17,200 people; at that time, the decision will have to be made whether to begin construction of a new plant or to expand the existing plant. In the meantime, the Town should pursue selection and purchase of a suitable property in the event that Option 2 is selected. The property should be at least 4 ha and preferably 10 ha in area, to serve the long term needs of the Town. Selection of a larger site will allow potential use of technologies such as the oxidation ditch process, which are relatively low-cost but require more space than other technologies (note space requirements include 30 m buffer zones around all facilities). A larger site may also allow the addition of composting facilities to produce a marketable product from waste solids.

9.4 Use of Reclaimed Water

Criteria for effluent reuse in British Columbia are set out in the MSR (see Section 8.5). Reuse programs must be designed to make beneficial use of effluent (to provide water and nutrients to crops or other beneficial use), and also to protect human health and the environment. Water reuse in British Columbia is currently practiced at Vernon, Cranbrook, 100 Mile House (all range, pasture or crop spray irrigation projects) and at Osoyoos and French Creek (golf course irrigation). Onsite use of reclaimed water is currently undertaken at several wastewater treatment facilities in British Columbia for site irrigation, washdown water, and process water; this has resulted in a significant reduction in the consumption of potable water (e.g. from $32,000/yr to $6,000/yr at the J.A.M.E.S. facility at Abbotsford). Metro Vancouver recently undertook a study to evaluate options for the reuse of treated effluent; onsite reuse at wastewater treatment facilities was found to be the most cost effective reuse option.

Leaders in the wastewater reuse field include utilities in California, Florida, Israel and Arizona, and utilities in Japan and Colorado in more temperate climates. Recent programs are motivated by economics, pollution reduction, and alleviating water shortages. Past international trends in dual distribution have been to provide such systems only for new growth and development areas. More recently, No. 1 quality (drinking) water supply is becoming increasingly scarce, and No. 2 quality irrigation systems are being extended into already established neighbourhoods for irrigation purposes in some cases.

Alternatives for use of treated effluent which can be considered for application within the study area are summarized below.

9.4.1 Agricultural Irrigation

Because effluent irrigation is regulated by the MSR, no permit is required from the B.C. Ministry of Environment (MOE). Instead, the discharger must register the intention to use the reclaimed water with the appropriate Regional Manager of MOE, and undertake the required environmental studies and effluent analyses. Municipalities intending to begin effluent irrigation must begin the process well in advance by registering their intent with the MOE. Prior to starting construction of an effluent irrigation system, an Environmental Impact Study (EIS) of the proposed application sites is required. The study must assess the potential impact of the effluent on the environment and human health.

The capacity of agricultural areas to accept irrigation of reclaimed wastewater would have to be assessed once potential irrigation sites were identified in consultation with the Joint Advisory Committee. The feasibility of this option will depend in part upon the distance between the wastewater treatment facility and the reuse site, and on the relative abundance or scarcity of irrigation water. Seasonal impoundments for storage of reclaimed effluent during the non-irrigation season or an alternative means of disposing of effluent during the wet season would be required. There is a large amount of land zoned as Agricultural Land Reserve (ALR) in the South Ladysmith area, although much of this land is currently forested (see Figure 3-1 in Section 3).

9.4.2 Forest Irrigation

There is a limited amount of forested land within the study area; much of this is located on steeply sloping terrain that is not in close proximity to the existing WWTP. As noted above, the area zoned as ALR in South Ladysmith is currently forested. The requirements and constraints associated with this option would be similar to those for agricultural irrigation, although the costs would be higher than for agricultural irrigation. The Resort Municipality of Whistler considered this approach, but did not implement forest irrigation using effluent due to the high costs.

9.4.3 Reuse at Wastewater Treatment Facilities

Potential applications for reclaimed water at wastewater treatment plants (WWTPs) include washdown water, process water (polymer mixing etc.), bioscrubber irrigation, and landscape irrigation. Experience at the Salmon Arm WPCC, J.A.M.E.S. (Abbotsford) and French Creek facilities shows that at least 80% of potable water consumption at some WWTPs can be replaced with reclaimed water (excluding biofilter irrigation and pump seal water applications, which are not normally undertaken using potable water). In general, this option is the most cost effective approach for use of reclaimed water, since pumping to remote sites is not required.

9.4.4 Landscape and Golf Course Irrigation

Golf course irrigation would be possible using tertiary treated effluent provided that health and environmental concerns of MOE and the Ministry of Health were met (e.g., irrigation at night only). This option would be potentially suitable for satellite systems located near golf courses.

The feasibility of irrigation depends mainly upon the distance between the treatment facility and the golf course (or other landscaped area) and on the amount of irrigation water required. Since the irrigation season in the study area is relatively short, extensive off-season storage and/or an alternative means of disposing of the treated water would be required.

For the Ladysmith LWMP, if the option of constructing a water reclamation facility in the Holland Creek area (or elsewhere) were selected, some of the reclaimed water could potentially be used for irrigation of the existing 9-hole golf course and the playing fields located just below Dogwood Drive in the Holland Creek catchment. Off season storage of reclaimed water would not be required, since the system would include a connection to the central WWTP.

9.4.5 Watering of Town Street Trees

The Town currently waters street trees using potable water transported and applied by a water truck. Reclaimed effluent from the WWTP could potentially be used for this purpose.

9.4.6 Industrial Process Water

Uses of reclaimed water are industry-specific (e.g. cooling water, concrete ready-mix). There may be potential for use of reclaimed water at industrial locations in the study area. An inventory of local industry would be needed to assess potential reuse locations, volumes and the costs of providing reclaimed water of the necessary quality.

The undeveloped area in South Ladysmith zoned for industrial use (Figure 3-1 in Section 3) may present opportunities for reclaimed water use by industry particularly if a water reclamation plant is located in that area.

9.4.7 Landscape Impoundments and Wetlands

There may be potential for discharge of reclaimed-quality water to engineered wetland areas in the study area; these wetland areas could be designed as public amenities with walking trails and rest areas that include educational displays. Landscape impoundments could be incorporated into golf courses and parks. This option would require site-specific Environmental Impact Studies.

9.4.8 Exfiltration Basins for Groundwater Recharge

This application is extensively practiced in the drier areas of the U.S.A. where potable water is in short supply and aquifers are a major source of potable water (i.e., indirect potable reuse). The MSR does not identify this reuse category (see Table 8-2). Hydrogeological and environmental impact studies would be required to identify suitable locations for injection wells and to evaluate potential impacts on groundwater. The feasibility of infiltration basins is highly dependant upon slope stability, local aquifer hydraulics, the distance to water supply wells (i.e. vertical and lateral permeability, distance to hydraulic boundary conditions), and the potential for groundwater contamination.

9.5 Beneficial Use of Biosolids

Treatment of liquid wastewater produces solid byproducts (commonly referred to as sludge), regardless of the technology used. At larger facilities, both primary (crude) and secondary (biological) solids are usually produced. These solids normally require further processing before disposal or reuse. Stabilization of waste solids reduces the putrescible and odourous (volatile) fraction of the solids, with a consequent reduction in mass, odours and vector (insect) attraction. After stabilization, waste solids are commonly referred to as biosolids. Pasteurization (heat treatment) coupled with stabilization reduces or eliminates disease causing organisms (pathogens) in the biosolids, and allows a wider range of beneficial reuse options to be considered (see Section 8.6).

For larger plants, anaerobic digestion with energy (methane gas) recovery is normally used for the stabilization process. Because of the large, gas-tight reactors needed for anaerobic digestion, this technology is cost-effective only for larger facilities, typically with an average daily flow of at least 7,500 m^3/d (service population about 20,000 people). The existing biosolids treatment facility at the Ladysmith WWTP is based on autothermal thermophilic aerobic digestion (ATAD), which may be used at smaller plants to produce Class A biosolids; the ATAD process produces low grade waste heat which can be used, but not the more valuable methane gas. Other methods of stabilization (and pasteurization) include composting and pH adjustment (usually by adding lime). In general, solids stabilization processes are one of the principal odour sources at wastewater treatment facilities, particularly those that involve high temperature (thermophilic) treatment.

Potential opportunities to use biosolids within the study area include use as a soil conditioner and slow-release fertilizer for silviculture, agriculture, and land reclamation initiatives, as well as feed stock in composting operations and landfill cover. All of the options with the exception of composting would require treatment (digestion) of waste solids from the WWTP to achieve the standards set out in the Organic Matter Recycling Regulation (see Section 8.6.). The solids treatment (digestion) process could be located at the existing WWTP site, or at an alternative location (see discussion of wastewater collection and treatment options in Section 9.3). Options for beneficial use of biosolids are described below. Operational costs for the treatment and beneficial use of biosolids will vary widely, depending on the nature of the solids treatment facility, the requirements for the final product, and the transportation distance to end users. Recommendations for biosolids management are included in Section 10.

9.5.1 Silviculture

The use of biosolids in forest fertilization (silviculture) is well established. Class B biosolids are suitable for forestry applications, provided that public access to the site is restricted (see Section 8.4). Previous experience at the Resort Municipality of Whistler, Malaspina University College Forest on Vancouver Island, and elsewhere has demonstrated the increased forest productivity associated with biosolids applications (e.g. for reforestation, fertilization of second growth, etc).

Biosolids use in silviculture involves the application of biosolids in either a liquid (5% total solids as described above) or dewatered form (20% to 30% total solids typical) to forest stands as a slow release organic fertilizer. The application rate of biosolids depends on numerous factors, including tree species, stand age, previous stand management, soil conditions, slope, aspect, and biosolids characteristics. Biosolids applications to natural forest can include fertilization of existing stands, and regeneration of harvested areas or forest fire burn sites.

Cultivation of hybrid poplars onsite at wastewater treatment facilities has been undertaken at the City of Campbell River and the City of Abbotsford. Harvesting of the trees when mature may help to recover the costs of the program. Biosolids applications to hybrid poplar plantations are less technically complicated than applications to natural forest, since the hybrid poplars are planted in rows with machinery access in mind. The City of Campbell River is currently converting the poplar plantation to produce crops suitable for biofuels or other environmental uses, partly due to the existing poor market for the poplar trees.

Based on an assumed biosolids annual application rate of 10 to 20 dry tonnes/hectare for silviculture, we estimate that the area required to accommodate the estimated annual digested biosolids production from the study area would be about 4 ha to 8 ha for the 2008 (8,500) population (primary treatment only), increasing to 30 ha to 60 ha for the build-out (17,200) population (secondary treatment).

Vancouver Island University has indicated that the biosolids may be applied to forest land in a current program. The biosolids would need to be treated to Class B standards. The reported cost is $63 per wet tonne plus trucking to the site on Jingle Pot Road past the prison. Cake solids would vary between 10% and 30% total solids by weight. Application is proposed at 82 wet tonnes per hectare on a wood lot.

9.5.2 Agriculture

Biosolids applications to agricultural land are one of the most common, and typically the most cost effective method (depending on biosolids form) for beneficial use of biosolids. As with silviculture, Class B biosolids can be used for application to agricultural soils (depending on crop type), provided that public access is restricted. Biosolids from the Metro Vancouver area are applied to rangeland throughout the interior of the Province, and biosolids from the Capital Regional District (CRD) were applied to Woodwynn Farms on the Saanich peninsula. A demonstration project for application of Class A biosolids to agricultural land to enhance corn production for livestock feed has been undertaken by the City of Salmon Arm. The City of Prince George currently produces Class B biosolids for agricultural applications.

The potential for biosolids applications to agricultural land in the study area would have to be explored through meetings and consultations with local agricultural organizations. The area required to accommodate the annual biosolids output from the study area would be similar to that for silviculture (Section 9.5.2).

9.5.3 Land Reclamation

Biosolids have been used within the Province in the reclamation of gravel pits and mineral mines. Class B biosolids are suitable for both types of application, provided that public access to the site is restricted.

Contact with the B.C. Ministry of Transportation (MOT) in the past has indicated that there is little potential for use of Class B biosolids for landscaping and reclamation activities on road right-of-ways; this is due to unrestricted public access to these areas.

There may be potential for the use of Class B biosolids for reclamation activities at gravel and borrow pits. The proximity to the wastewater facilities and site conditions will be the determining factors in assessing the environmental suitability and economics of this type of application. Relatively high biosolids application rates can typically be used for land reclamation. Assuming a biosolids one-time application rate of about 40 tonnes/hectare, the required site area would be about 2 hectares for the 2008 biosolids production (8,500 people with primary treatment only), increasing to about 8 hectares for the build-out production (17,200 people with secondary treatment).

Mine reclamation offers the ability to use large quantities of biosolids. In some cases, dewatered biosolids may be stored onsite and later applied to assist in the reclamation of tailings dams and piles. Biosolids can also be applied to waste rock dumps and slopes.

Operational biosolids mine reclamation programs are challenging to initiate, with mine partners usually requiring a series of monitored demonstration plots prior to the implementation of a large-scale program. Biosolids used in mineral mine reclamation are typically used as a dewatered product (at least 20% total solids by weight), due to long transportation distances to the mine site.

9.5.4 Composting Operations

Composting using digested or undigested biosolids as one component of the feed stream can be used to produce a more marketable product than biosolids alone. Composting using undigested biosolids is undertaken by the City of Kelowna and the Comox-Strathcona Regional District on Vancouver Island among others.

Class A or B biosolids and/or undigested biosolids can be used for composting feedstock, and the compost produced has no restrictions or end use, provided that regulatory requirements are met (e.g., OMRR). Biosolids generally have to be dewatered before being incorporated into composting operations, to avoid excessive generation of leachate. Tipping fees are typically charged to receive biosolids at composting sites if these are privately owned operations. The Town has held informal discussions regarding the invessel commercial composting operation at Duke Point but no agreements are underway. Permits may be needed to sanction hauling of undigested waste solids to the private compost operation at Duke Point if this option is pursued.

The Town is currently considering the development of its own publicly owned composting facility, possibly in cooperation with other local governments such as the Cowichan Valley Regional District. The biosolids could be one component of a feed stream that could potentially include yard waste, compostable municipal garbage, and other components. A potential location for a publically operated biosolids composting operation might be identified in the area zoned for industrial use in South Ladysmith, or at the old incinerator site on Peerless Road owned by the Cowichan Valley Regional District (see Figure 9-1).

9.5.5 Topsoil Manufacture

Manufacture of topsoil (defined as biosolids growing media in OMRR) can be undertaken using biosolids, provided that Class A pasteurization requirements are met. The City of Salmon Arm and the City of Abbotsford currently manufacture topsoil using Class A biosolids. This produces a very marketable product that has no end use restrictions under OMRR. Since the ATAD digestion process used at the Ladysmith WWTP is listed in Schedule 1 of the OMRR as a Class A pathogen reduction process, the biosolids produced could potentially be used for topsoil manufacture (requires upgrading and expansion of existing ATAD facilities). Potential locations for top soil manufacture could include the sites identified in Section 9.5.5 for composting, or privately-owned properties.

9.5.6 Landfill

Landfills may accept dewatered biosolids for cover and reclamation material. Class B biosolids are normally suitable for this purpose. Storage of dewatered biosolids at landfills for future beneficial reuse as daily cover, and as capping material when the landfill closes, is potentially a viable option for short-term and long-term biosolids management. The District of Hope currently transports biosolids to a landfill site for use as cover material. Landfill sites in the study area may offer a potential for application for biosolids, depending on location and site conditions.

10.0 RECOMMENDATIONS FOR COMPLETION OF STAGE 1 AND 2 LWMP

This section contains recommendations for the Town of Ladysmith LWMP components to be selected for the Stage 1 and 2 LWMP and subsequently advanced to Stage 3, as well as an outline of the recommended scope of work for the Stage 3 LWMP. More detail regarding the LWMP options considered can be found earlier in this report.

10.1 Source Control

The following items for the advancement of source control measures are recommended for inclusion in the Stage 1 and 2 Ladysmith LWMP. Cost estimates are included for preliminary budgeting purposes; the cost estimates for each item are based on experience by others or on the preliminary estimated level of effort required and do not include municipal staff time.

1) The Town of Ladysmith should develop a Sanitary Sewer Source Control Bylaw to protect biosolids quality, as well as to protect the processes at the wastewater treatment plant and to enhance the quality of the plant discharge. The bylaw should be modelled on the CCME Model Bylaw and on those recently developed and/or updated by other B.C. communities (e.g., Metro Vancouver, the Capital Regional District, the City of Campbell River, the City of Kelowna, etc.) and it should include Prohibited and Restricted wastes. The Town should also develop a strategy to

implement a monitoring and enforcement program that could include identification of industrial/commercial/institutional discharges, the need for industry sector Codes of Practice, and education for business/industry and the public. Budget $15,000 for developing the bylaw. Budget $10,000 for developing a monitoring/enforcement program.

2) The Town of Ladysmith should begin developing an education program to inform domestic and non-domestic dischargers about the need for source controls, and what specific groups can do to ensure that the program results in reduced contaminant loadings to receiving waters and land within the Town service area. The education program should include source controls for the sanitary sewer systems and water conservation. These educational issues should be centrally coordinated. A budget of $15,000 for the initial five-year period should be provided (technical and public consultation) for the education program for sanitary sewers. The cost of educational materials and facilities (e.g., printing costs, rental of community centers for workshops, etc.) should be budgeted at $15,000 in the initial 5 years of program development.

3) The Town of Ladysmith should take steps to publicize the source control program, particularly when successful results are achieved. Budget $10,000 in the initial 5 years for consultant and media services.

4) The Town of Ladysmith should establish and maintain contact with knowledgeable representatives of other jurisdictions (e.g., the Capital Regional District, Metro Vancouver, the City of Kelowna, and provincial, state and federal agencies in Canada and the US), to share information on successful and unsuccessful source control regulatory strategies, educational approaches, data collection and management, and possible funding sources.

5) The Town of Ladysmith should consider additional source control program elements that include the following:

- continue routine testing of the biosolids produced at the WWTP to monitor metals content and assist in identifying contaminants of concern;
- undertake a sampling program in the sanitary sewer collection system to assist in identifying the source(s) of contaminants (e.g. problem metals);
- conduct an inventory of non-domestic discharges that are connected to the sanitary sewer system, to assist in identifying potential discharges of problem contaminants;
- using the findings of the inventory, identify industry sectors and determine the benefit of providing Codes of Practice for various industry sectors; and
- monitoring of influent and effluent quality at the WWTP and monitoring of receiving water quality to provide a database to identify any problem contaminants.

10.2 Wastewater Volume Reduction

The Town of Ladysmith should continue to promote the use of low-flow water fixtures by homeowners, to reduce water use and resulting wastewater volume. This can include public education, financial incentives for retro-fits to existing homes, and requirements for new developments. The Town is taking the following measures for water conservation:

- Implementation of water restrictions during dry season;
- Installation of water meters at all residences and businesses to help determine and repair any leaks in the system and to monitor excess consumption (an inclining rate structure should also be implemented);
- Distribution of educational water wise mail-outs to all households;

- Implementation of new regulations making low-flow toilets mandatory in all new construction and renovations;
- Installation of low-flow toilets in all municipal facilities; and
- Undertaking capital upgrades to the water supply system (construction of new covered reservoir).

The Town of Ladysmith is committed to reducing inflow and infiltration (I&I) on an ongoing basis, and to maintaining the wastewater collection system in good working condition. The Town should continue with the ongoing program to identify and eliminate sources of I&I during routine sewer maintenance, including elimination of cross connections between the storm and sanitary sewer systems. A budget of up to $150,000 per year has been identified by the Town for I&I reduction. Separation of the storm and sanitary connections on private property should be the number one priority. Further investigation is also needed to assess the degree and location(s) of surface inflow and of groundwater infiltration into the collection system during both wet and dry weather.

10.3 Stormwater Management

It is recommended that the following stormwater management initiatives included in the Town of Ladysmith Stage 1 and 2 LWMP. Suggested budgets are for consultant assistance and do not include municipal staff time.

1. Existing drainage studies and plans developed by the Town should be updated and consolidated, with the ultimate objective of developing an up-to-date comprehensive Master Drainage Plan (MDP) for the study area (per policy statements in the Town's OCP). The MDP should include consideration of land use according to the Official Community Plan and drainage improvements already undertaken. The MDP should also set priorities for additional studies for individual watersheds, with the highest priority set on areas that are expected to undergo significant development or redevelopment and where sensitive environmental resources have been identified (see

Item 2). Priorities for drainage planning should ensure that detailed watershed studies are conducted in advance of development. Drainage planning should include consideration of the effects of frequent small storms as well as larger, infrequent storms. Budget $150,000 for the MDP.

2. The environmental resources identified in the LWMP (e.g., unconfined aquifers, sensitive streams and habitat) should form an integral part of drainage planning and development planning within the Town. Natural drainage features such as wetlands, groundwater recharge/discharge areas, and stream corridors should continue to be preserved whenever possible. This approach will minimize the need for manmade drainage structures, thereby reducing costs, and helping to preserve the natural environment. Drainage planning and development planning should be undertaken together, so that drainage issues and protection of natural drainage features such as wetlands and groundwater recharge areas can be considered while the development site plan is being developed. The Town should undertake a review of existing development application approval procedures to ensure that planning, engineering, and operations issues are all considered at an early stage in the development application process. Budget $15,000.

3. A storm drainage bylaw and accompanying enforcement policy should be developed, to ensure that the Town has the authority to regulate all aspects of stormwater management, including flood control, erosion control, and water quality. The bylaw should consolidate drainage design criteria as well as other aspects of drainage, and should also ensure that sensitive environmental resources such as fisheries streams and groundwater can be protected from spills and contaminated runoff (e.g., from commercial/industrial sites). The Town's drainage design criteria for subdivision servicing should also be reviewed, to ensure that they are in accordance with current drainage practice and regulatory requirements. Detailed criteria should be developed for both major and minor drainage systems. Budget $20,000.

4. Onsite infiltration of precipitation rather than collection and offsite conveyance of runoff should be encouraged in areas where ground conditions are shown to be suitable. Before onsite infiltration is undertaken, hydrogeological studies to evaluate both site-specific conditions and regional effects on the groundwater regime and drainage should be completed.

5. The source control education program described in Section 10.1 should include stormwater issues.

10.4 Wastewater Management

Options for wastewater treatment and disposal or reuse are discussed in detail in Section 9 of this report. The recommended approach for advancement to the Stage 3 LWMP is summarized below.

1. Complete the current upgrade at the WWTP to achieve secondary treatment for a design flow of two times the average dry weather flow for a service population of 17,200 people, with any flows in excess of this amount receiving primary treatment. Include consideration of resource recovery in designing the upgraded facilities (e.g., heat recovery). Monitor the effectiveness of I&I reduction efforts (Section 10.2) so that a realistic schedule can be developed for eliminating the bypass to primary treatment.

2. Once the WWTP upgrade to secondary treatment has been commissioned, conduct environmental studies of Ladysmith Harbour (Stage 2 EIS) to determine if additional action is needed to protect the environment. The Stage 2 EIS should include partnerships with senior governments, other local governments, and other area stakeholders (e.g. First Nations) to address water quality and inputs to the entire harbour. If additional action to meet water quality objectives is needed, determine whether the addition of tertiary treatment and/or extension of the outfall to open

marine waters is the preferred solution. Note that the current WWTP upgrade to secondary treatment is designed to accommodate the addition of tertiary treatment (nutrient removal, enhanced removal of suspended solids) if found to be necessary. If the outfall is to be extended, additional investigation will be required to identify a suitable discharge location (e.g., drogue studies, dispersion modelling, stakeholder consultation).

3. Identify and secure a property suitable for construction of wastewater treatment facilities in future (possibly in the Industrial Park). The site should be at least 4 hectares in area (preferably 10 ha), and should not be in close proximity to residential development. New facilities may include treatment for waste solids generated at the existing WWTP (e.g., composting), as well as future facilities for treating liquid wastewater. When the existing (upgraded) WWTP reaches capacity at 17,200 population, the decision can be made to either expand the existing plant, or to initiate construction of a second facility for treatment of wastewater at the new site.

4. Pursue the implementation of satellite water reclamation plants for pockets of new development, with localized use of the reclaimed water (e.g. for planned development in the Holland Creek area and other developments as appropriate). Connections to the central wastewater collection system will be needed, to dispose of wastewater that cannot be reused, and to transport waste solids to the central facility.

10.5 Biosolids Management

The following options are currently under consideration for management of residual solids produced at the Town's WWTP:

i) cooperative composting of waste solids with the Cowichan Valley Regional District (requires only dewatering and untreated waste solids);

ii) woodlot application through Vancouver Island University Program (requires minimum of Class B treatment of waste solids at the WWTP);

iii) partnership(s) with the private sector (e.g., commercial reuse at a private facility at Duke Point which requires minimum of Class B treatment at WWTP, or involve private sector in request for proposals to manage the resource).

The Town is currently pursuing a partnership with the Cowichan Valley Regional District to construct a composting facility for waste solids produced at the WWTP. The composting facility could be located at the Peerless site, or at another mutually agreeable site (e.g., the property identified for future use described in Item 3 above). If a composting facility operated by local government(s) can be secured, then construction of solids treatment facilities (other than dewatering) at the WWTP may not be necessary. Once a site has been identified, a concept design and cost estimate for the composting facility should be developed, so that it can be compared to the cost of onsite solids treatment at the WWTP with subsequent beneficial reuse (e.g., woodlot application, private sector reuse). The cost comparison should include onsite treatment and handling at the WWTP, transportation, any additional processing at sites other than the WWTP (e.g. composting at the Peerless site), and end use (e.g. land application).

10.6 Water Reclamation and Reuse

Reclamation and reuse of treated wastewater should be focused on internal use for non-potable purposes at the (upgraded) WWTP, and on localized satellite reclamation plants in new developments for seasonal landscape irrigation as described above in Section 10.4.

10.7 Completion of Stage 1 and 2 LWMP

The following steps are required for completion of the Stage 1 and 2 LWMP.

1. This revised draft of the Stage 1 and 2 LWMP report should be reviewed by members of the Joint Advisory Committee (JAC), and discussed at a follow-up meeting. Consensus should be reached regarding any revisions required, to allow the JAC to recommend adoption of the Stage 1 and 2 report to Council.

2. After the JAC has recommended adoption of the Stage 1 and 2 report, it should be submitted to Council for review. Once Council is satisfied with the report, it should be submitted to the regional manager of MOE Nanaimo for approval. Subsequent to approval by MOE, the Town can then proceed with Stage 3 of the LWMP.

10.8 Official Community Plan

In order to properly plan for wastewater and drainage facilities, it is necessary to project future land use and populations within the Plan area. The LWMP guidelines require that the Official Community Plan (OCP) completed by the municipal or regional government(s) form the basis of the LWMP (B.C. Environment, 1992a). Like the Community Energy Plan (2008) and the Community Sustainability Vision (2009), the LWMP should then be incorporated as part of the OCP.

10.9 Scope of Work for Stage 3 LWMP

The recommended scope of work for the Stage 3 LWMP is outlined below:

1. Prepare summary of Stage 1 and 2 LWMP for inclusion in the Stage 3 report.

2. Proceed with public and First Nations consultation based on the LWMP components advanced from Stage 1 and 2. Prepare mail-out information package and questionnaire for public and First Nations consultation and incorporate results into the Stage 3 report. Schedule additional meeting(s) with First Nations group if required to obtain feedback.

3. Prepare a list of LWMP commitments to be included in the Stage 3 LWMP, complete with cost estimates, an implementation schedule, and proposed funding/revenue sources.

4. Provide technical details required to allow preparation of the Operational Certificate for the WWTP.

5. Submit the draft Stage 3 report to the Joint Advisory Committee (JAC) for review and comment, and revise as needed to obtain JAC consensus and recommendation to Council for formal adoption.

6. Submit Stage 3 report to Council for adoption.

7. Submit Stage 3 LWMP report to the Minister for approval.

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