R E P O R T

Capital Regional District

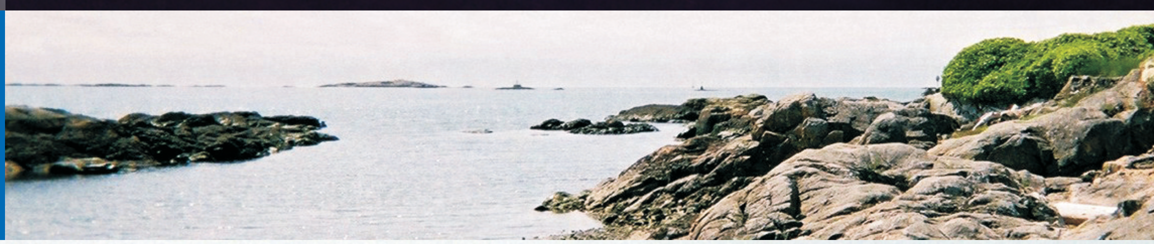
The Core Area Wastewater Management Program

Wastewater Treatment Made Clear

The Path Forward

The Supporting Report to the Response to the Minister of Environment

Approved by the Capital Regional District on June 13, 2007



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1 Introduction

The Provincial Minister of Environment has requested that the CRD provide details on the timing of additional treatment by June 30, 2007. The CRD developed a decision process to review alternative wastewater management strategies and develop a long term strategic direction.

1.1 THE BACKGROUND

The Capital Regional District (CRD) provides wastewater management to residential, commercial, industrial and institutional customers, equivalent to a population of approximately 330,000 persons, distributed throughout the Core Area and West Shore communities. These communities include the Cities of Victoria, Langford and Colwood, the Districts of Oak Bay and Saanich, the Township of Esquimalt, and the Town of View Royal. Over the next sixty years the Core Area and West Shore population is anticipated to grow to over 600,000 persons.

The wastewater system is operated under a Province of British Columbia Liquid Waste Management Plan (LWMP). The LWMP, originally approved in March 2003, authorizes the CRD to manage the wastewater collection, treatment and disposal system within a set of operating parameters and future environmental goals. Key features of the Plan include a source control program to control waste products entering the collection system, an inflow and infiltration (I/I) reduction program, preliminary wastewater treatment using 6 mm diameter fine screening, effluent disposal to the marine environment through two major outfalls and a marine monitoring program.

The subject of the degree of wastewater treatment has been an ongoing debate for many years. The current LWMP utilizes a “target based” approach using marine environmental indicators to assist in the determination on the timing of future wastewater treatment upgrades (CRD, 2000). In 2004, the CRD approached the Society of Environmental Toxicology and Chemistry (SETAC) to establish an independent Scientific and Technical Review Panel to carry out an independent review of the Core Area LWMP. The SETAC Panel submitted their report in July 2006. The Panel concluded that while the benefits of treatment cannot be described or calculated with any precision, this does not mean that the benefits of treatment would be insignificant (SETAC, 2006). The Panel suggested that the question of additional wastewater treatment is essentially a risk management decision and suggested that the CRD consider the three steps:

- Confirm the financial contributions from Senior Government,
- Identify sites for enhancement of waste treatment and sludge management, and
- Refine the estimates of the costs of different treatment options

During the same period, the Ministry of Environment retained an independent consultant, MacDonald Environmental Services Ltd. (MESL) to evaluate the sediment quality data associated with the two major outfalls at Macaulay Point and Clover Point. The study found that, based on the available monitoring data, contamination at the two outfalls is sufficient to warrant preliminary designation as contaminated sites under the Provincial Contaminated Sites Regulation. The study also showed that water quality guidelines are not being met outside of the initial dilution zone at Macaulay Point (MoE, 2006).

1.2 THE REQUEST FROM THE MINISTER

Based on the above two reports, the Minister of Environment, in a letter dated July 21, 2006, concluded that agreement on an acceptable trigger process to decide on the timing of additional wastewater treatment is not achievable. The Minister requested that the CRD provide an amendment to the Core Area LWMP, detailing a fixed schedule for the provision of wastewater treatment (MoE, 2006).

This amendment, to be submitted by June 30, 2007, is to outline options relating to the type, number and location of facilities, preliminary costs of treatment, and a proposed implementation schedule. In the letter, the Minister encouraged the CRD to consider new technologies and alternative financing and delivery options in order to ensure value for the taxpayers.

1.3 THE DECISION PROCESS

Upon receipt of the Minister's directive, the CRD had less than a year to review possible wastewater management strategies and set a direction for decades to come. This was acknowledged to be a complex undertaking – from both a technical and social viewpoint. The CRD also recognized that it could not work in isolation and would require the input of a number of stakeholder groups. In order to respond to the Minister's request within the time frame allotted, the CRD immediately embarked on four activities. These were:

- Engage a consulting engineering team to provide sufficient information to enable the Core Area LWMP Steering Committee to make decisions regarding a strategy for wastewater management.
- Solicit potential directions for new wastewater treatment technology through a global Request for Expressions of Interest (RFEI).
- Form a Technical and Community Advisory Committee (TCAC) to advise the Steering Committee in their discussions and directions on a wastewater management strategy.
- Formulate a communications plan that will be part of the LWMP amendment process.

An interim report on the progress of these activities was submitted to the Minister on December 14, 2006 (CRD, 2006).

1.4 ROLE OF THE CONSULTANT TEAM

In September 2006, the CRD issued a request for proposals (RFP) to consultants to solicit the expertise needed to assist the District in making the decisions required. As the outcome of the competitive RFP process, the CRD retained the consultant team of Associated Engineering, CH2M HILL and Kerr Wood Leidal in November 2006 to assist the District to make the decisions necessary to move forward in addressing the requirements contained in the request from the Minister.

The role of the consultant team was somewhat unique. In many wastewater management projects, the function of the consultant is to conduct a study and develop a report with specific recommendations. The client, in this case the CRD, subsequently adopts some or all of the recommendations to move the project or program to the next phase. In this framework, the consultant is often working in relative autonomy from the client.

For this assignment, the consultant team's mandate was to provide sufficient relevant and accurate information to adequately inform the CRD

Steering Committee and the public about the areas requiring specific decisions. In turn, this information enabled the CRD to make necessary decisions in response to the requirements of the MOE July 2006 letter. The process proposed by the consultant team involved three distinct steps: define criteria – identify options – assess options.

The decision process was conducted in a triple bottom line (TBL) framework that considered economic, social and environmental factors. Key to this approach was development of a series of eight discussion papers, interspersed with three workshops with the Steering Committee and meetings with the TCAC Committee, as well as Ministry of Environment (MoE) staff.

The effort will result in the Steering Committee, and ultimately the CRD Board, establishing a strategic direction for wastewater management over the coming decades. This direction is described in the Request for Amendment to the LWMP. The proposed program is called the *Core Area Wastewater Management Program*.

1.5 PURPOSE OF THIS REPORT

This report is termed the *Supporting Report to the Response to the Minister of Environment*. It is intended to provide additional background information to the proposed Amendment to the LWMP. The report synthesizes information in a concise format by clearly describing the existing wastewater management situation in the Core Area and West Shore Communities (Chapter 2), the decision process (Chapter 3), the resultant wastewater management strategy (Chapter 4), and lastly, the next steps to be taken by the CRD (Chapter 5).

This is only the starting point. As described in subsequent sections of this report, the CRD now needs to continue with the program development and facility planning process. This includes continuation of the communications strategy and the next stage of amendment to the LWMP.

1.6 ACKNOWLEDGEMENTS

Successful completion of this complex assignment required the coordinated effort of several groups and many individuals. To this end, CRD directors and staff and municipal and senior government staff and volunteers from the general public who participated on the TCAC are acknowledged for their participation and contributions to this project.

2 The Existing Situation

The wastewater infrastructure serving the Core Area dates back many decades. As with many sewerage systems of this vintage there are combined sewers as well as aging sanitary sewers that allow a significant amount of rainwater and groundwater to enter the system. This is one of the major challenge as wastewater treatment is implemented in the coming years.

2.1 WASTEWATER MANAGEMENT HISTORY

Wastewater management in the Core Area and West Shore Communities extends back as far as the late 1800s and early 1900s, when sewer pipes were installed in portions of various municipalities (CRD, 2000). By the mid-1960s, when the first comprehensive plan to manage the regions wastewater was developed and prior to implementation of the regional wastewater system, sewer systems were conveying collected wastewater to almost twenty outfalls (AESL, 1966). The outfalls discharged raw wastewater to the near-shore marine environment. At that time, the main wastewater discharge points included Macaulay Point, Clover Point, McMicking Point and Finnerty Cove.

Eventually, the construction of two major regional trunk sewer systems provided conveyance of collected wastewater to their terminus points at Macaulay Point and Clover Point. The systems, and the areas they service, were named the Macaulay Point Sewerage Area and the Clover Point Sewerage Area. Figure 2-1 illustrates the extent of the two areas and related infrastructure.

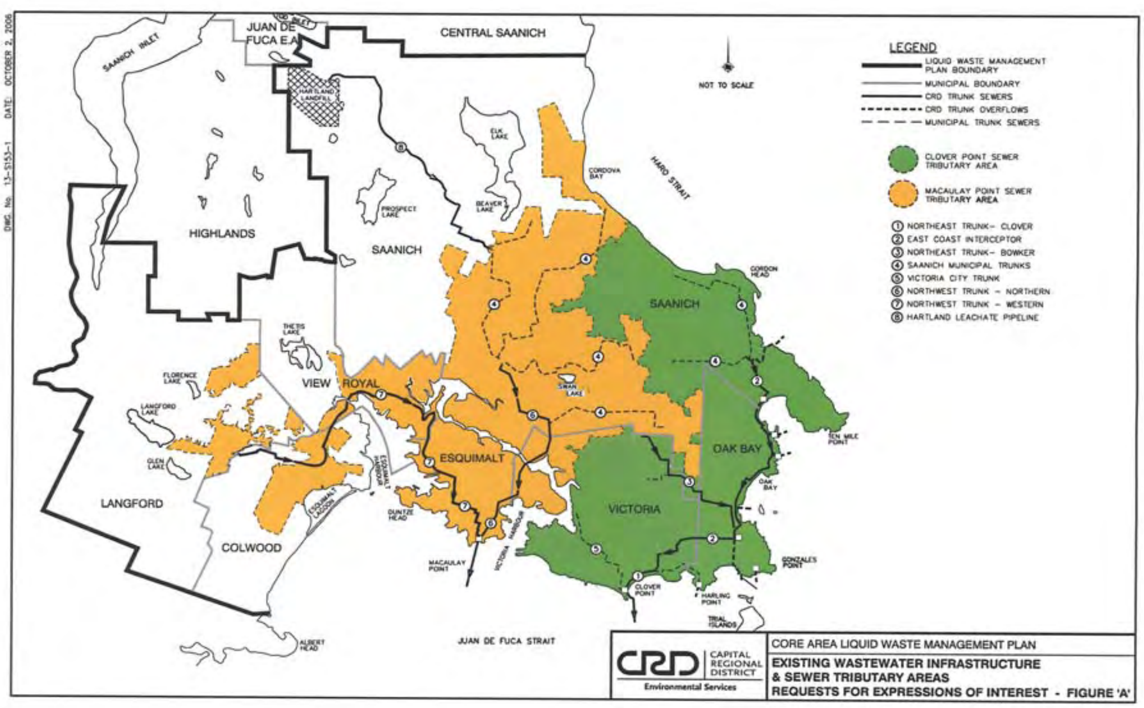
The Macaulay Point pump station and marine outfall was built in 1971, transporting raw wastewater 1700 m offshore, before being released to the ocean at a depth of 60 m (CRD, 2000). Fine screens were installed at the pump station in 1989, providing a preliminary level of treatment through removal of wastewater solids, plastics and floatable materials larger than 6 mm in dimension. The screenings are trucked to the Hartland Landfill for disposal.The second regional trunk sewer system drains to Clover Point, where a pump station and marine outfall constructed in 1981, discharges wastewater 1200 m off-shore at a depth of 65 m (CRD, 2000). Similar to the Macaulay Point facility, the wastewater arriving at Clover Point receives preliminary treatment via 6 mm fine screens.

A critical component of the CRD's wastewater management strategy has been source control. Source control is a pollution prevention strategy aimed at reducing the amounts of chemical contaminants that industries, commercial businesses, institutions and households discharge to sewers. Over the last decade, the CRD has implemented both sewer use legislation and codes of practice for specific industries and commercial operations. Other communities in Canada have used the success of this program as a model.

2.2 WET WEATHER FLOW MANAGEMENT

Wet weather flow management is one of the key challenges the CRD must address in developing an overall wastewater management strategy.

Figure 2-1
Existing Wastewater Infrastructure & Sewer Tributary Areas



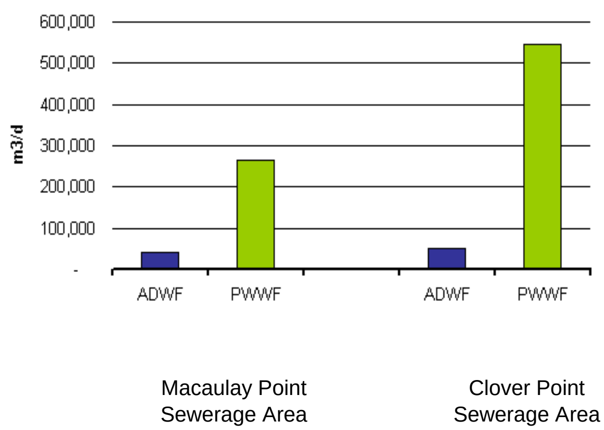
Typical of communities with wastewater systems dating back many decades, a small portion of the CRD system uses what is called a *combined sewer system*. These systems collect and convey both wastewater and storm water run-off, hence the combined system terminology. One can easily recognize that the amount of wastewater/storm water flowing in the sewer system during periods of precipitation could be quite high relative to the wastewater flow during dry weather periods

The *separate* sanitary sewer system, which is intended to collect and convey only wastewater generated by human activity, can also be impacted by precipitation events through rainfall-induced inflow and infiltration (I/I). In this situation, for example, extraneous rainwater can enter the sewer system through cracks in pipes and manhole covers. Aging system components are one of the primary factors in reduced system integrity with respect to I/I.

The significance of the wet weather flow management issue is best illustrated using data for several defined terms. The *average dry weather flow (ADWF)* consists of wastewater generated by human activity, and includes a relatively small fraction of groundwater that infiltrates into the sewer system during dry weather periods. The *peak wet weather flow (PWWF)* includes the additional rainfall-induced storm water and groundwater that enters the sewer system during a precipitation event. The *peaking factor (PF)* is simply the numeric ratio of the PWWF to the ADWF.

Figure 2-2 illustrates Year 2005 ADWF and PWWF estimates for both the Macaulay Point and Clover Point Sewerage Areas, where the PWWF estimates were based on a storm event that could occur once every 25 years. Effects of precipitation and resulting storm water run-off on the wastewater flow are clearly shown in the figure. From a numeric perspective, the Macaulay Point and Clover Point Sewerage Area wet-weather peaking factors are 6.3 and 10.4, respectively. Looked at another way, during this storm event the water flowing in the Clover Point sewer system, for example, would be made up of about one part wastewater and nine parts rain water.

Figure 2-2
Year 2005 Wastewater Flow Estimates



A key assumption of the preceding analysis is that the sewer systems actually have sufficient hydraulic capacity to transport all of the wastewater flow to the Macaulay Point and Clover Point outfalls during storm events. In reality, neither system has sufficient capacity for the scenario described. This situation results in wastewater overflows from the system, which occurs at specific locations.

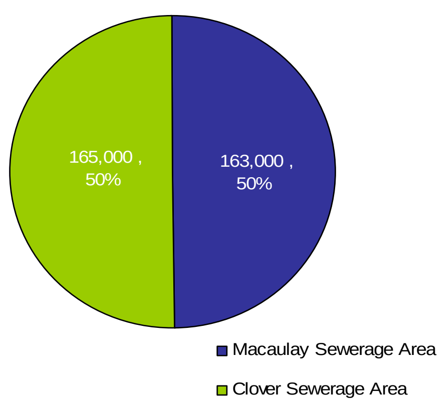
Figure 2-3 shows the various overflow points, including the water bodies that receive the overflows. In the month of January 2007, for example, the CRD recorded 42 sanitary sewer overflow events (CRD, 2007).

2.3 COMMUNITY DEVELOPMENT

Currently, as shown in Figure 2-4, the Core Area and West Shore communities' population is distributed somewhat evenly between the Macaulay Point and Clover Point Sewerage Areas. However, Figure 2-1 illustrates a notable difference in the spatial dimensions of each area. For example, the distance between extremities of the Macaulay area is greater than that of the Clover area. The Macaulay area also contains serviced subareas that are relatively isolated from other

Figure 2-4

Relative Equivalent Population Distribution (2005)

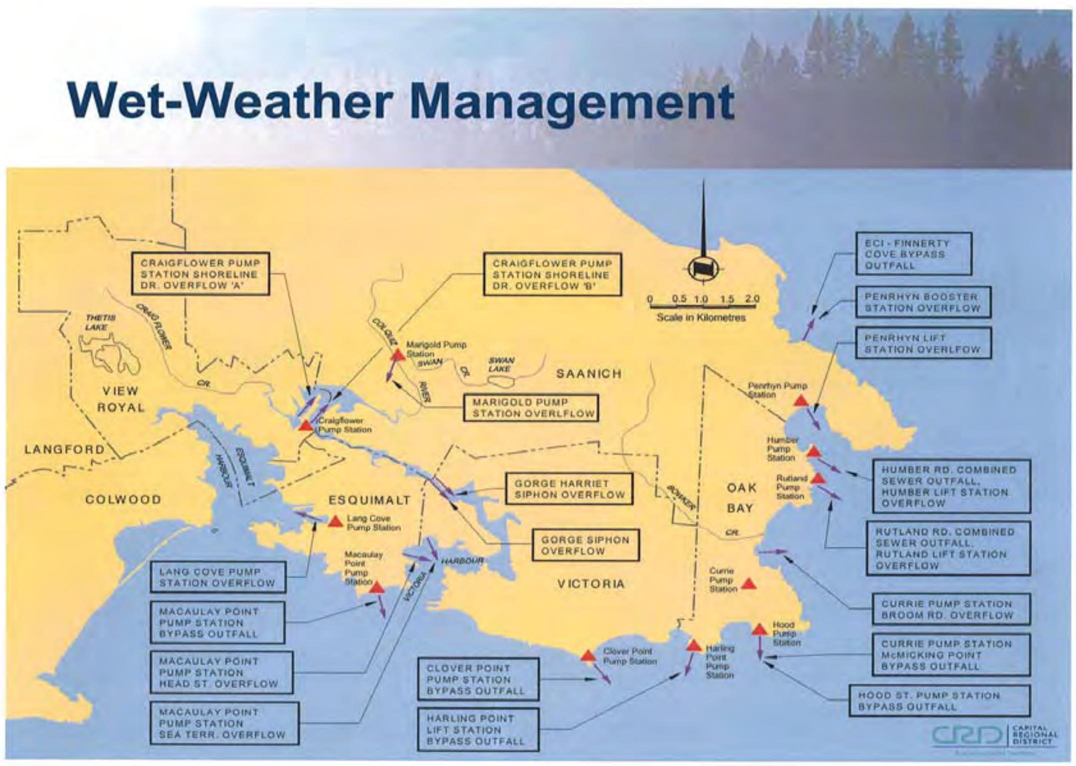


subareas. This aspect will be important in the future as infill development accommodates some of the population growth.

The Macaulay Point Sewerage Area has significant room to expand in the future to service a growing population. Population growth within the Clover Sewerage Point Sewerage Area will be accommodated largely through higher density redevelopment, as well as some in-fill development. Not surprising, the majority of future population growth is expected to occur in the Macaulay area.

Figure 2-3

Wet-Weather Management



For the purpose of developing a wastewater management strategy, the CRD chose a planning horizon of 2065, or almost six decades in the future. Figure 2-5 shows population estimates for both the Macaulay and Clover Sewerage Areas through to Year 2065 (AE et al, 2007b).

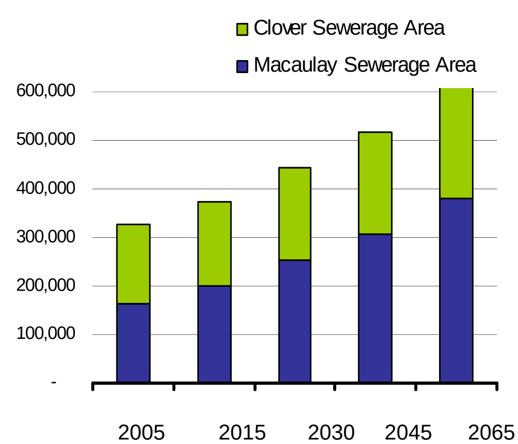
Based on the points described, it can be recognized that some characteristics of existing community development will indeed have a direct influence on the future, both in terms of community development and the wastewater infrastructure that will serve the associated population.

2.4 WASTEWATER MANAGEMENT – CHANGING DIRECTIONS

Traditionally the wastewater management and treatment approach in urban areas has been to convey collected wastewater to a single, large treatment facility, and subsequently dispose effluent to a nearby aquatic environment. This is termed a "centralized" wastewater management

Figure 2-5

Equivalent Population



approach. The two existing sewerage areas within the CRD system, Macaulay Point and Clover Point, would be considered part of a centralized wastewater management system. Here the wastewater treatment function, preliminary treatment in the case of the CRD, is provided at the effluent outfall pump stations, located at the downstream end of the wastewater collection systems.

Within the industry and general public, there is increasing recognition of wastewater as a potential resource. Technology evolution has produced processes and systems to transform this potential resource to a real resource. Similarly, the quality of effluent discharged to marine environments to ensure their protection, and the level of treatment needed to produce such effluent, has undergone continued debate and evolution. Energy use and the impact on greenhouse gas emissions are also issues that play a role in technology decisions.

Wastewater treatment technology will continue to evolve in the decades to come. In general, this means increased levels of treatment performance, often on a smaller footprint. This higher performance, however, can come at a higher capital cost with increased energy costs. Is this the right direction for the CRD? What is becoming equally important is the issue of wastewater management sustainability. Essentially this means – determining what level of treatment and technology is required based on the management goals. This has and will continue to lead to a blending of technologies. A high level of treatment may be employed where the goal is water reuse. A lower level of treatment may be used on the portion of the wastewater stream that has been diluted by wet weather flows and is being discharged to the marine environment. In this manner, wastewater management decisions can be made that are both environmentally responsible and cost effective.

3 The Decision Process

The decision process employed by the CRD Steering Committee involved a three step process – defining criteria, identifying options and assessing options. The process culminated with a triple bottom line (TBL) assessment to decide on a preferred long term wastewater management strategy.

3.1 A DECISION PROCESS – NOT AN ENGINEERING REPORT

As previously discussed, the CRD initiated and executed a process for making high-level decisions needed to satisfy the Minister's requirements in the context of developing, in essence, a wastewater management strategy. The process was led by the CRD Core Area LWMP Steering Committee, with support from CRD staff, the Technical and Community Advisory Committee (TCAC) and the consultant team.

The intent of the effort was not to prepare an engineering report. Instead, the intent was to assist the Steering Committee to move through a decision making process. This process has been interactive, with the Steering Committee receiving input from the consulting team, the TCAC, the results of the global technology search, as well as other sources of information.

This process has been very effective. It has allowed the Steering Committee to consider the planning elements, the technologies and alternative strategies in a step-by-step fashion, with opportunities for questioning, discussions and debate.

3.2 THE THREE STEPS

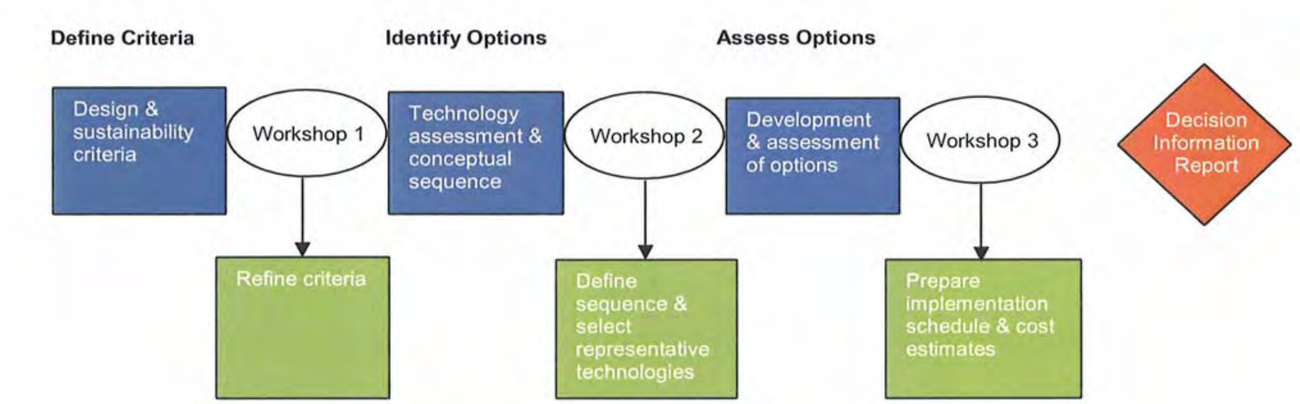
In developing a response to the MoE, the CRD decision information process involved three distinct steps, as shown in **Figure 3-1**.

The execution of these steps involved a series of events. The consultant team first prepared information discussion papers (AE et al, 2007a). These papers provided the Steering Committee and TCAC with information on specific areas and topics requiring a decision.

The discussion papers were then presented to the Steering Committee (via three workshops) and to the TCAC. Presentation of the material provided an opportunity for workshop and meeting participants to engage the consultant team in dialogue on the topics. This dialogue provided feedback and direction to the consultant team to move the process forward. The process also included the opportunity for participants to submit written responses to discussion paper material.

Finally, the Steering committee came to conclusions on the various areas and topics. The conclusions reached in this third step led to the Wastewater Management Strategy, described in Section 4.

Figure 3-1
Three Step Decision Information Process



3.3 THE DISCUSSION PAPERS

As highlighted previously, the consultant team mandate was to provide sufficient relevant and accurate information to adequately inform the CRD Steering Committee and the public about the areas requiring specific decisions. The discussion papers prepared by the consultant team provided the vehicle for communicating the information to these groups. A total of eight discussion papers were prepared for the project, as summarized in **Table 3-1**.

Table 3-1
Discussion Paper Summary

Discussion Paper	Subject
1	Design Criteria
2	Triple Bottom Line Criteria
3	Technology Assessment
4	Implementation Sequencing
5	Wastewater Management Options
6	Triple Bottom Line Analysis
7	Biosolids Management
8	RFEI Technology Review

Discussion Papers Nos.1 through 4 were prepared in the order as numbered. The order of the remaining discussion papers varied from the numeric labelling, since a “feed-back loop” within the decision process provided the opportunity to update these papers as decisions were made based on information provided. Once the discussion papers were finalized and approved by the Steering Committee, the CRD posted the papers on the CRD website (www.crd.bc.ca) for public information.

3.4 TECHNOLOGY ASSESSMENT

A *wastewater management strategy* is just that – a strategy that sets the overall direction of implementation. The tangible *elements* of a strategy include physical facilities and infrastructure, such as wastewater treatment facilities and conveyance sewers. Wastewater treatment, resource recovery and biosolids management facilities utilize a combination of *unit processes* to accomplish the overall objective of the facility. Each of the individual unit processes is associated with a *technology* that provides the intended function.

It is easiest to use an example to illustrate the interrelationship between the described terms. Consider a wastewater management *strategy* that prescribes wastewater will receive what is defined as secondary treatment to produce effluent of a specific quality. A wastewater treatment plant (WWTP) will need to be provided to meet this requirement. Let us assume, for this example, that among all the different unit processes that are part of the WWTP, the process that provides the secondary treatment level is a biological aerated filter (BAF). The BAF is thus the *technology* that provides the intended secondary treatment process function within the overall WWTP.

There are many technologies, besides a BAF, that could potentially be used in this situation. The technology assessment contained in Discussion Paper No. 3 thus considered the range of established, innovative and embryonic-defined technologies that the CRD could consider for its specific situation. The listed technologies were subjected to a pass/fail assessment, with the passing technologies further evaluated using a weighted-scoring system.

This same approach was applied to the key unit processes that could be included in wastewater treatment, resource recovery and biosolids management facilities. In addition, to ensure a comprehensive initial list of potentially suitable technologies, the CRD issued a global request for expressions of interest (RFEI) for innovative technology to industry. The RFEI technology review contained in Discussion Paper No. 8 documented the submissions received and subjected them to the same pass/fail assessment and weighted scoring system used in Discussion Paper No. 3.

The combined technology assessment effort was aimed at selecting representative process technology, which was used subsequently to develop cost estimates for the various components that formed the elements of potential wastewater management strategies.

3.5 SELECTION OF REPRESENTATIVE TECHNOLOGY

One of the key challenges in a high-level decision making process, that is considering alternate wastewater management strategies, is ensuring that the economic aspect, of the overall triple bottom line analysis, is not biased in an inappropriate manner by the technologies selected for developing the basis of the cost estimates.

As noted, the objective of the technology assessment was to determine what technologies are most applicable to the CRD situation. In other words, what technologies will the CRD likely ultimately chose? These representative technologies were then used in the next phase of the decision making to develop overall wastewater management strategy options. The use of "representative" technologies in this manner reduces the possibility of technology bias, which otherwise could impact the overall decision. It should be noted that "representative" does not necessarily mean the highest scoring technology. In the assessments contained in Discussion Paper Nos. 3 and No. 8, the selection by the consultant team used the scoring as a guide but also reflected the judgment of the team in the combination of technologies for a particular application.

3.6 POTENTIAL WASTEWATER MANAGEMENT STRATEGIES

As presented in Discussion Paper No. 5, five wastewater management strategy options were developed within the shell of three "options series" and in consideration of a planning horizon extending to Year 2065. The option series reflect three different approaches to wastewater management, ranging from the current centralized approach to a more decentralized or "distributed" approach. While there could be many variations of any particular option, the five options presented were intended to provide the Steering Committee with a representative spectrum of potential directions. Table 3-2 summarizes the options, including listing the various treatment facilities envisioned for each option.

Table 3-2
Potential Wastewater Management Strategy Summary

Series	Approach	Option	Treatment Facilities
1	Centralized Management	1-1	Macaulay Point Clover Point
		1-2	West Shore Regional
2	Integrated Management	2-1	Macaulay Point Saanich East West Shore B Clover Point Wet Weather
		2-2	Macaulay Point Clover Point Wet-Weather
3	Decentralized Management	3-1	Macaulay Point Saanich East West Shore B West Shore C Clover Point Wet Weather

As discussed in Section 2, the existing CRD system could be considered a centralized management approach. Over the last two decades, the concept of "decentralized" wastewater management has gained acceptance. While there are different degrees of decentralization, in general, the concept refers to a wastewater management strategy that utilizes "local" wastewater treatment facilities. This definition can apply to individual homes or buildings or to areas of the community. Other terms that refer to similar concepts are distributed or satellite treatment, water mining, or "the soft path". In the context of this report, the term is used in a broad sense – essentially "less centralized". This is also commonly termed a "distributed" approach.

The term "integrated management approach" was used in the decision process to describe a "middle ground" between centralized and decentralized. It describes a situation where an entire region is considered on a "systems" basis, looking at where the wastewater management functions could be shared. An example within this context is treatment of the dry weather wastewater flow at one location and treating a portion of the wet weather flow at a different location.

The five options, developed within the series approach, are as described below. Figure 3-2 shows the relative location of site areas.

Option 1-1: Macaulay Point / Clover Point WWTPs

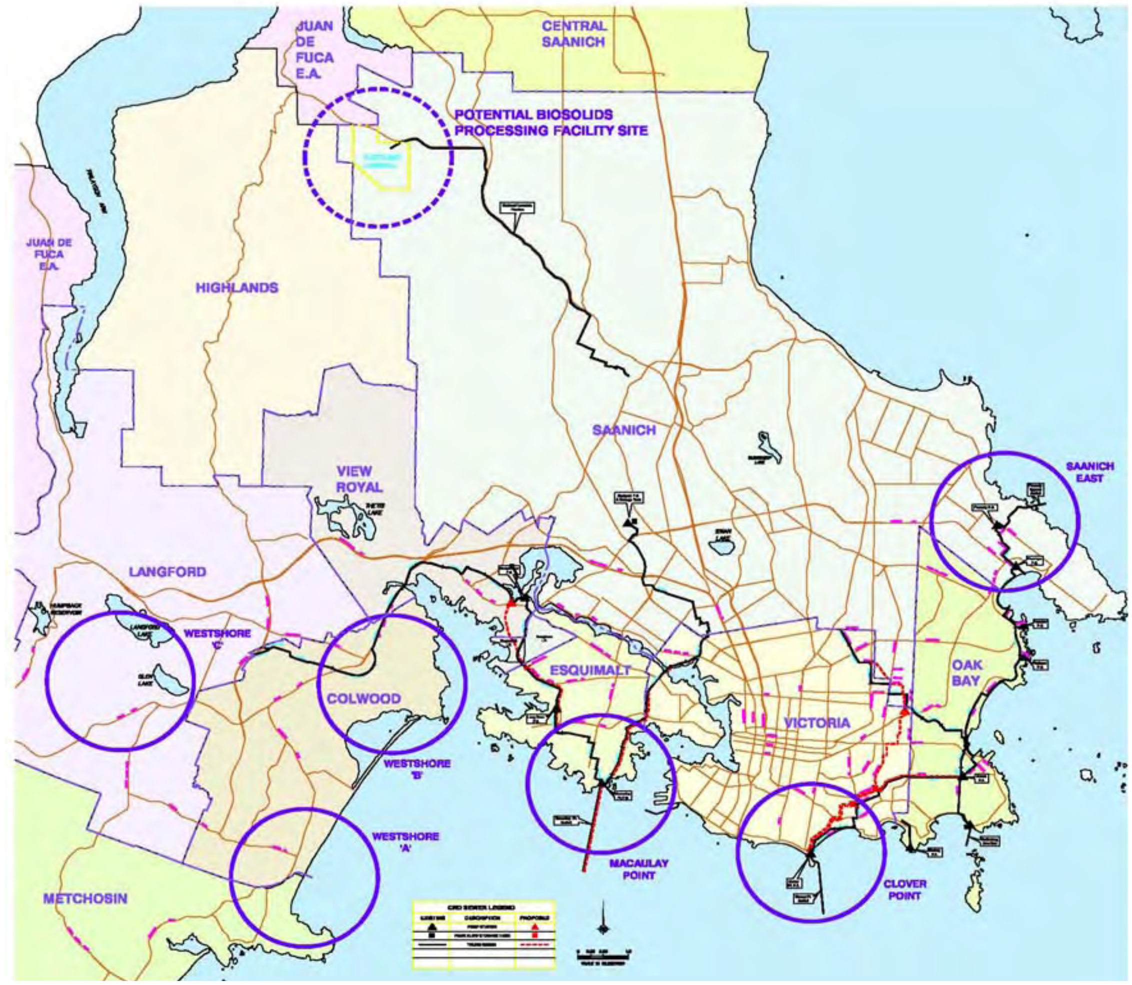
This option is a continuation of the current LWMP strategy. Secondary treatment would be provided at the two existing sites. The wet weather flows within each of the two sewerage areas would be managed within the sewerage area, with the ultimate goal of eliminating the SSOs and treating the wet weather flows at the treatment facilities.

Option 1-2: West Shore Regional WWTP

This option would see a single secondary wastewater treatment facility. Wastewater from the two sewerage areas would be pumped to a new site, which for analysis purposes, is sited on the West Shore. As in Option 1, the ultimate goal would be to route the wet weather flows to this facility for treatment.

Figure 3-2

Potential Locations for Wastewater Treatment Facilities



Option 2-1: Macaulay Point / Saanich East / West Shore B WWTPs, Clover Point Wet Weather Plant

This option moves away from a centralized strategy towards a more decentralized approach. Two smaller wastewater treatment facilities would be constructed - one in the upper area of the West Shore sewerage area and one in the upper area of the East Coast sewerage area. These facilities would utilize advanced – split flow technologies to achieve secondary treatment. This approach would also allow opportunities for effluent reuse and energy recovery at the nearby universities. The Clover Point site would house a wet weather treatment facility only. Dry weather flow from the Clover Point Sewerage Area would be pumped to a new secondary facility at Macaulay Point.

Option 2-2: Macaulay Point WWTP, Clover Point Wet Weather Plant

This option would be similar to Option 2-1, except the two smaller facilities would not be implemented. The Clover Point wet weather facility and the Macaulay Point secondary treatment facility would function as described above.

Option 3-1: Five Plant Scenario

This option moves further towards a more decentralized approach. The approach would be similar to Option 2-1, except a fifth wastewater treatment facility would be constructed in Langford (termed the West Shore C site). This option is intended to demonstrate a decentralized approach. It could in fact move further in this direction by ultimately seeing additional decentralized facilities constructed within the various sewerage areas.

The biosolids management strategy, presented in Discussion Paper No. 7, was common to all five wastewater management options. Given the limited available land area at potential wastewater treatment facility sites, the existing LWMP assumes a remote biosolids processing facility, most likely near the Hartland Landfill. This approach would see dewatered sludges trucked to the facility for energy recovery and processing to produce biosolids that can be used in a beneficial manner.

3.7 CAPITAL AND LIFE CYCLE COSTS

Capital and life cycle costs were developed for the various options. The capital costs are in 2007 dollars and include indirect costs, as well as biosolids management costs, trunk sewer system costs and effluent outfall costs.

The life cycle costs were based on a 4% real discount rate and covered the entire planning horizon until Year 2065. This cost data was used by the Steering Committee in the triple bottom line (TBL) analysis.

3.8 THE TRIPLE BOTTOM LINE ASSESSMENT

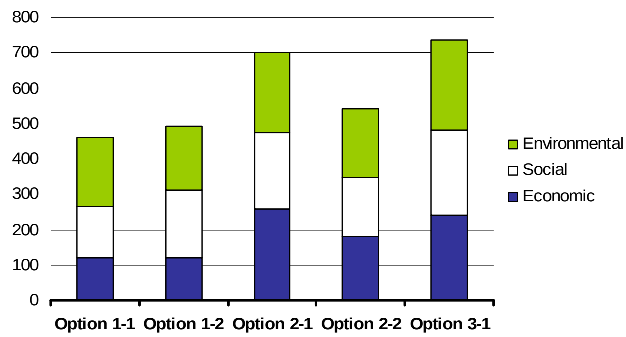
Following the development of the potential options, the Steering Committee utilized a triple bottom line (TBL) framework that considered economic, social and environmental factors. The TBL framework provides a very robust structure for evaluating wastewater management options. It is designed to provide decision makers with a framework to understand the cost and benefits of alternatives across a spectrum of social, economic, and environmental goals and objectives. In this way, a more balanced view of alternatives is created, rather than one that relies on cost or easily quantifiable factors.

Early in the project, and ahead of developing potential wastewater management strategies, the Steering Committee established goals and criteria to be used in the evaluation and screening of subsequently developed options using the TBL methodology. Discussion Paper No. 2 documented the CRD goals and criteria. As the project moved forward, the developed wastewater management options were then subjected to the TBL analysis, the detailed findings of which are contained in Discussion Paper No. 6.

Figure 3-3 illustrates the TBL scores for the various options for the “base case” where all TBL elements (i.e. social, economic, environmental) were weighted equal. Options 2-1 and 3-1 clearly scored higher than the remaining three options. In addition, the relative TBL scores of the options were found to be insensitive to changes in the element weighting, when any one of the elements was weighted 20% higher than either of the two other elements.

The five options that have developed are not definitive schemes, but rather possible strategies. It is important to realize that they are not “black and

Figure 3-3
Triple Bottom Line Analysis Summary



white" and in fact may well be blended in terms of the concepts they represent. With this in mind, it is possible to draw several conclusions from the high ranking of Options 2-1 and 3-1:

- The development patterns, the coastal geography, the existing infrastructure with its significant wet weather flow issue and opportunities for future effluent reuse all make a more decentralized approach attractive. This is reinforced by the economic analysis that shows that this approach is cost effective.

- The Clover Point facility should be a wet weather treatment facility only. This will allow the site to continue with its current usage as a public park. All works would be located underground, in a similar manner to the existing preliminary treatment works.

- A secondary treatment facility at the Macaulay Point site is the most realistic option for the "centralized" facility. Based on a decentralized wastewater management strategy, this facility would be smaller, as the wastewater flow reaching it would be reduced. Additional land is required from the Department of National Defence (DND). The timing of negotiations and outcome are uncertain at this point. It will be very important that the CRD work with the Township of Esquimalt and DND to develop a site layout that accommodates both the needs for wastewater treatment, as well as the needs of the community and DND activities.

- The number of decentralized "liquid stream treatment only" facilities needs to be considered in more detail in the latter stages of planning. This strategic direction provides the flexibility to incorporate concepts of effluent reuse / recycling in local developments in the future decades. The critical component of this direction is to ensure that decisions on the conveyance system and "centralized" treatment facilities are compatible with the concept that decentralized facilities will accommodate the major share of the future growth.

The wastewater management strategy, adopted by the CRD, incorporates these conclusions. The proposed wastewater management program is described in detail in the following section.

4 The Wastewater Management Strategy

The key elements of the Core Area Wastewater Management Strategy are source control, distributed treatment, water reuse and resource recovery and wet weather flow management. The first stage of the Program will cost $1.2 billion and extend over the next ten years.

4.1 THE WASTEWATER MANAGEMENT PROGRAM

The decision process adopted by the Core Area LWMP Steering Committee resulted in not a selected option, but rather a strategy for a direction forward for wastewater management for decades to come. It is a departure from the previous centralized approach to a more distributed wastewater management strategy. This will allow the CRD to implement wastewater treatment in the near term, as well as position the CRD to take full advantage of water reuse and energy recovery opportunities in the future.

This section of the Supporting Report describes the Core Area Wastewater Management Program. The four key elements of the wastewater management program are as follows:

- Source control
- Distributed wastewater treatment
- Water reuse and resource recovery
- Wet weather flow management

These are discussed below.

4.1.1 Source Control

The CRD has been a leader in *source control* – keeping undesirable waste products out of the sewerage system. As per the current LWMP, this very effective program will continue. This will ensure that the future wastewater treatment works will be able to operate at a high level of performance and resource products such as reuse water and biosolids will meet stringent quality goals.

4.1.2 Distributed Wastewater Treatment

The CRD has historically had a centralized approach to wastewater management – the wastewater is collected and directed to a central location (in this case two central locations – Clover Point and Macaulay Point) for treatment and discharge to the marine environment.

The proposed wastewater management program will change this direction and embark on a more decentralized or *distributed wastewater treatment* strategy. Distributed wastewater management is not tied to any specific form of wastewater treatment, but is rather the concept of utilizing a variety of wastewater treatment strategies to best manage the wastewater resource, based on risks, costs and desired outcomes.

As applied to the Core Area and West Shore communities, distributed wastewater management will include a centralized secondary wastewater treatment plant at Macaulay Point, two or more decentralized water reclamation plants within the wastewater collection system and a wet weather flow management strategy that will see surplus wet weather flows managed on a more local basis. Why move towards a distributed wastewater treatment approach? The answer, coming out of the Decision Information Process, lies in a combination of future development patterns, the coastal geography, the existing wastewater collection infrastructure and the need and opportunities to manage wastewater as a future resource. Simply put, a distributed wastewater management approach is not only the most cost effective strategy for the CRD but will also provide a foundation for water reuse and resource recovery in the decades to come.

4.1.3 Water Reuse and Resource Recovery

During the winter rains, it is hard to imagine that the use of wastewater as a non-potable water source is an attractive proposition; this indeed may be the case in the future. Increasing population and longer, dryer summers due to climatic change will put a burden on existing freshwater resources. The principle issue will be the ability to store adequate quantities through the summer. Why not use highly treated wastewater to supplement the water demands through this period? This is the concept behind *the decentralized water reclamation plants and water reuse.*

These plants would be located within the wastewater collection system. They would be very compact and would utilize advanced membrane and UV disinfection technologies. The plants would produce water suitable for direct non-potable reuse in the local area. When the reuse water is not required, it is discharged either to the marine environment via an outfall or to augment flow in local watercourses.

Resource recovery is also part of the wastewater management strategy. This can take a number of forms. One would be through the recovery of heat from the wastewater. This heat can be used on the plant site or perhaps in a community or institutional heating system. The second form would be in the recovery of energy and end byproducts from the residual sludges from the wastewater treatment process.

The current plan calls for a remote Biosolids Management Facility near the Hartland Road Landfill. This facility would incorporate processes to recover biogas, heat energy and electrical power. It would also produce a finished biosolids product suitable for land application as a soil amendment or further energy recovery in a waste-to-energy process.

4.1.4 Wet Weather Flow Management

The management of *wet weather flows* is a critical part of the proposed wastewater management strategy. As discussed, the majority of the CRD wastewater collection system is composed of a separated sanitary system and storm water system. Rainwater inflow and groundwater infiltration enters the sanitary sewer system through unauthorized connections or cracks in the pipes or manholes. During extreme events, this water overwhelms the wastewater collection system resulting in sanitary sewer overflows (SSOs) at various points in the collection system. A small portion of the overall collection system, in Oak Bay, is a combined system – handling sanitary and storm water flows in a single pipe system.

The policy of the Provincial Government is to ultimately eliminate SSOs and CSOs. It is recognized that this is a significant undertaking and that will take decades to achieve. The CRD has previously committed to this goal through a combination of sewer separation, inflow and infiltration reduction and increased wastewater conveyance capacity.

The proposed Program will focus on managing the surplus wet weather flows on a more local basis. This will be done in conjunction with the distributed treatment approach, where wet weather flows from the upper reaches of the wastewater collection system will be treated and reused or discharged at a decentralized water reclamation plant. This not only reduces the amount of wet weather flow continuing down the wastewater conveyance system, but also frees up capacity to handle additional wet weather flows in the downstream interceptor sewer. In the case of the District of Oak Bay, this opens up further opportunities for CSO management. The reduced flows in the CRD East Coast Interceptor would allow Oak Bay to more effectively use temporary storage of flows and gradual pumping of the stored volumes to the Interceptor. This, combined with a consideration of current CSO management practices elsewhere in North America, will allow Oak Bay to determine the most applicable solution to the issue of local combined sewers.

The components of the proposed wastewater management program are discussed below.

4.2 MACAULAY POINT WASTEWATER TREATMENT PLANT

While the Macaulay Point wastewater treatment plant would be the largest plant, the adoption of the distributed treatment strategy means that the plant is about 30% smaller than with a centralized treatment approach. Secondary treatment would be provided for up to two times the ultimate (2065) average dry weather (ADWF) or 220 ML/d. Primary treatment would be provided for a 2065 peak wet weather flow (PWWF) of 364 ML/d. These capacities would be constructed in stages over the planning horizon for the plant.

Representative technologies include:

- Influent pumping
- Screening and grit removal
- Biological Aerated Filtration (BAF)
- Effluent pumping

Space would be provided for the inclusion of UV disinfection, should it be required. Treated wastewater would be discharged out an expanded marine outfall system. While effluent reuse is not planned in the short term for this plant, reuse for irrigation or industrial process water at the adjacent DND properties is a future possibility. Similarly, opportunities for heat recovery from the wastewater for use at the DND facilities could be considered.

There are several approaches that the CRD can explore for sludge management. These include:

- *Dewatering the sludge on-site with truck haul to a remote Biosolids Management Facility at the Hartland Road Landfill*. This would utilize gravity thickening of the primary sludge, dissolved air floatation (DAF) on the secondary sludge and centrifuge dewatering of the blended thickened sludge. At the ultimate plant capacity, this would require up to 6 one-way truck hauls per day.

- *Pumping the dilute sludges to a sludge dewatering facility located a few kilometres from Macaulay Point.* This would require a sludge pumping station and a forcemain to the dewatering facility. The sludge thickening and dewatering processes would be located at a new, enclosed facility located in an industrial area. The residual liquid from the dewatering process would be discharged to the sewer system for return the Macaulay Point plant. This approach would eliminate the sludge hauling from the Macaulay Point, but would increase the overall cost.

- *Locating the resource recovery processes at the Macaulay Point site*. This would see the sludge digestion, biogas recovery and cogeneration operations at the Macaulay Point site. The processed biosolids, reduced in volume relative to the undigested sludge, would be trucked off-site for ultimate reuse as a soil amendment. This option would eliminate the need for a remote Biosolids Management Facility at Hartland Road.

The secondary plant at Macaulay Point will require a site area of about 5.0 ha, without the resource recovery processing. Incorporating this at the site would add about 1.8 ha. Currently the CRD owns a small parcel, where the existing preliminary treatment / pumping works are located. The land required for the new plant is owned by the DND. Discussions have been ongoing for some years on acquiring additional land. These have not reached conclusion.

The primary treatment works (Stage 1-A) would be constructed first. Once this is commissioned, the secondary works (Stage 1-B) would be constructed. This staging is necessary as these works encroach on the area of the existing fine screening / effluent pump station area. The capacity of the plant would be increased in further construction stages, as required in the future.

The successful implementation of a secondary plant at the Macaulay Point site will require the cooperation of several stakeholders – the CRD, the Township of Esquimalt, the Provincial Government and the DND / Federal Government. From the DND point of view, property will be lost but there may well be an opportunity to mitigate this loss through improvements to surrounding land or to gain the benefits of reuse / resource recovery. The Township of Esquimalt will require that the plant is a “good neighbour” – that potential odours are managed and viewscapes are attractive. This can be accomplished through the right technology choices and proper architectural design of a low profile facility. Other opportunities may exist to enhance the surrounding properties and incorporate a learning institute or other community features within the wastewater management function.

4.3 CLOVER POINT WET WEATHER PLANT

Under the proposed wastewater management program, the function of the Clover Point site will change – but the appearance will remain the same.

The Clover Point facility will be a wet weather plant only. The dry weather flows (up to two times the ADWF or 97 ML/d) arriving at the site through the existing wastewater conveyance system will be pumped to the Macaulay Point plant via a new pump station and forcemain. For the vast majority of the time, there will thus be no flow out the Clover Point outfall. During wet weather events where the flow exceeds the pumping capacity to Macaulay Point, the surplus wastewater flow, up to four times ADWF, will receive high-rate enhanced primary treatment and be discharged out the Clover Point outfall. The capacity of the enhanced primary treatment facility would be about 194 ML/d. Flows above this amount would go through screening only and be blended with the enhanced primary treated effluent. The actual quantity of the screened-only flows depends upon the detailed planning of the wet weather flow management strategy. Given the significant reduction in flow out of the outfall and use of enhanced primary treatment technology, the pollutant loading at this location should be reduced by more than 95%.

The residual sludge from the enhanced primary clarification wet weather treatment process would be returned to the dry weather pump station for transport to the Macaulay Point plant for sludge processing. This eliminates the need for the haulage of sludge from the Clover Point site.

The new dry weather pump station and the wet weather treatment facility can be located underground in a similar manner to the existing works. The plant would be constructed in a single stage. Some disruption of public access will be required during the construction period, as it will be necessary to employ a “cut and cover” construction process. Once in operation, the site would appear essentially as it currently looks. Truck traffic to deliver chemicals to the site will be minimal, as the wet weather plant will only operate during limited periods.

The Clover Point site is currently owned by the City of Victoria and a legal covenant exists, defining portions of the site as park use. The proposed strategy will keep the final appearance and use of the existing park area as is, however, neighbourhood consultation, as in the case of the Macaulay Point site, will be a key part of the implementation process.

4.4 DECENTRALIZED WATER RECLAMATION PLANTS

The ultimate number of decentralized water reclamation plants needs more detailed planning. At this time, it is envisioned that there would be at least two plants. One would be located in the District of Saanich (termed Saanich East), near the University of Victoria. The second would be sited in the District of Colwood (termed West Shore A or B), near Royal Roads University. The objective of these locations is to provide opportunities for water reuse and heat recovery from the wastewater over the planning horizon. The plants are also part of the wet weather flow management strategy.

The two decentralized plants could employ the concept of “liquid stream only” treatment plants. If this approach was used, dilute sludges from the secondary treatment processes could be discharged into the conveyance system for treatment at the downstream Macaulay Point plant. A secondary treatment level would be provided by using a blended technology strategy. Both plants would employ the following representative technologies:

- Influent pumping
- Screening and grit removal
- Enhanced primary treatment
- Membrane bioreactors (MBR)
- UV disinfection

At the Saanich East plant, secondary treatment capacity would be provided for up to two times the ADWF for the year 2065 or 38 ML/d. Primary treatment only would be provided for flows above this amount. The primary treatment capacity would be about 63 ML/d. Effluent not required for reuse would be discharged out the existing Finnerty Cove outfall. This outfall could be extended to move the discharge point further offshore. The plant would be constructed in stages. Stage 1 would see 75% of the ultimate capacity constructed. The facility design would be low profile and architecturally designed to fit with the surrounding neighbourhood.

The concept and representative technology for the West Shore A or B plant would be the same as for the Saanich East plant. The plant primary and secondary capacities would be 88 ML/d and 62 ML/d for the year 2065, respectively. The plant would be constructed in stages, with the first stage at 50% of the ultimate capacity. The proposed plant could be attractively blended into the existing landscape. The plant should be located as close to the existing interceptor sewer as possible, to minimize new conveyance costs. Surplus effluent, not required for water reuse, would be discharged out a new outfall extending into the Juan de Fuca Strait.

The above descriptions are provided primarily to demonstrate the intent of decentralized water reclamation plants. The CRD does not currently own any land in these areas. A detailed siting and facility planning exercise, including neighbourhood consultation, is required. In addition, if additional plants are determined to be desirable, the above noted capacities of the plants will change.

4.5 THE BIOSOLIDS MANAGEMENT FACILITY

Given the limited areas at potential wastewater treatment plant sites, the existing LWMP assumes a remote biosolids processing facility, most likely near the Hartland Landfill. This approach would see dewatered sludges trucked to the facility. As noted previously, the option of locating these works at the Macaulay Point site is also an approach that can be considered. At this time, the wastewater management strategy assumes that the Biosolids Management Facility at or near the Hartland Road Landfill site will proceed.

The goal of the facility is to both recover energy and create a product that can be used in a beneficial reuse program. The representative technology for the facility is thermophilic anaerobic digestion followed by dewatering and land application of the digested biosolids. The produced biogas would be used for cogeneration of electricity and heat. Specific processes include:

- Dewatered sludge cake rewatering and conditioning
- Primary digesters, fed in parallel
- Secondary digesters, fed in series from the primary digesters
- Biosolids dewatering
- Odour control
- Cogeneration biogas utilization

Biosolids management is an area of the wastewater management program where significant technology change can be expected over the coming years. While the above representative technology is considered robust, well proven and cost effective, it will be necessary to plan the facility to allow flexibility for process and technology change. The location at the Hartland Landfill is attractive for a number of reasons. One, it will allow the possibility of the incorporation of source separated municipal waste in the overall resource recovery process. This may provide a number of advantages including the reduction of greenhouse gases from the current landfill operations. Second, the presence of energy use opportunities may encourage the location of industries in the vicinity of the Biosolids Management Facility.

The wastewater management strategy assumes that the final biosolids product will be used in a beneficial manner in agricultural, land remediation and forestry applications. However, this will need to be confirmed through a comprehensive market analysis at an early stage of program planning. It is key that this land application program is developed in concert with the planning on sludge processing technologies. As an alternative or a supplement to land application, further processing of the biosolids in a waste-to-energy facility could be considered.

4.6 THE SCHEDULE

It is expected to take about 10 years to complete the required first stage works including land acquisition and zoning, program development, facility planning, design, construction and commissioning. Subject to land availability and decisions on sludge management at the plants, one or more of the decentralized plants is expected to be in operation by early 2013 with the Macaulay Point and Clover Point plants and the biosolids management facility in operation by the end of 2016.

4.7 COST ESTIMATES

The estimated costs for the first stage of the Core Area Wastewater Management Program are shown in Table 4-1.

The costs shown are in 2007 dollars. Capital costs are calculated on base construction costs, with additional allowances for design and construction contingencies and indirect costs (engineering, administration, miscellaneous and interim financing). These additional allowances result in a multiplier of 1.56 on the base construction costs. Once the CRD has established a direction, it is important the capital costs, particularly in the first stage, be inflated to reflect the actual period of construction. For the purpose of budget planning at this time, an inflation allowance of about 2.5% per year has been used to escalate the costs to the expected mid-point of construction. This results in an overall Core Area Wastewater Management Program Cost of $1.2 billion.

Table 4-1
Core Area Wastewater Management Program – Estimated Costs

Item	Cost ($million)
WASTEWATER TREATMENT	
Macaulay Point WWTP	572
Clover Point Wet Weather Plant	92
Decentralized Water Reclamation Plants	110
WASTEWATER CONVEYANCE	
Clover Point Forcemain	29
West Shore Interceptor	26
Northeast Interceptor	15
OUTFALLS	
Macaulay Point Twinning	9
Water Reclamation Plant Outfalls	15
BIOSOLIDS MANAGEMENT	
Hartland Road Landfill Biosolids Management Facility	86
LAND PURCHASE	46
TOTAL ESTIMATED CAPITAL COSTS (Note 1)	1000
PROGAM BUDGET (Note 2)	1200

Notes:

1 Costs are in 2007 dollars and include indirect cost factors. Stage 1 costs only are shown.

2 Budget costs are inflated to the expected mid-point of construction

5 The Next Steps

The CRD has embraced the opportunity to look ahead and has chosen a path of sustainable wastewater management that will address both the near term goals, as well as provide the flexibility to meet environmental challenges of the future.

5.1 THE LWMP AMENDMENT PROCESS

The proposed LWMP Amendment and this Supporting Report form the first part of the Amendment to the current LWMP. These documents provide the strategy for the proposed program to move forward with wastewater treatment. What is now required is to further develop the details of the Core Area Wastewater Management Program.

Key to this process is further facility planning and community consultation. It is expected that this will progress through the remainder of 2007 and into 2008. Once the final decisions on the components of the wastewater management program have been developed and community consultation has demonstrated that the public is on-board, the final LWMP Amendment documents will be prepared and submitted to the Ministry of Environment. This is expected to occur in mid to late 2008.

5.2 PROGRAM DEVELOPMENT

The Core Area Wastewater Management Program will be implemented in the following phases:

- Phase 1: The Decision Process
- Phase 2: Program Development and Facility Planning
- Phase 3: Design
- Phase 4: Construction / Commissioning
- Phase 5: Operation

The *Phase 1 – Decision Process* is now completed.

The CRD is currently moving into *Phase 2 – Program Development and Facility Planning*. This phase will see the development of an internal team and mechanism for decision making, as well as an external consulting team. This external team will include professionals in the areas of wastewater engineering, business / finance, environmental science, architecture, community planning and First Nations consultation. Their role will be to assist the CRD staff in the detailed planning of the Program.

Phase 3 – Design and *Phase 4 – Construction / Commissioning* will depend upon the analysis and conclusions from the work in Program Development. Given the complexity and the scale of this Program, the CRD needs to consider all of the avenues available for implementation, particularly given the active construction market in Western Canada. Traditionally projects of this type have been implemented as design-bid-build (DBB) with these phases bid separately. While the CRD will explore this approach, they will consider other implementation approaches involving greater use of public-private-partnerships (P3). This could include design-build (DB) where the designer and builder join forces or design-build-operate (DBO) where an operator also joins the team. Other approaches include Construction Management (CM) or Alliances. In all cases, the CRD will retain ownership of the facilities that are constructed.

Phase 5 – Operation could see either the CRD operate the entire wastewater management system or could involve the use of a private sector partner to operate specific components. An example of this could be the operation of the Biosolids Management Facility. In this case, the CRD may combine the design and construction with a defined operational period, under a DBO delivery.

5.3 PUBLIC CONSULTATION

A comprehensive public consultation process will continue to be an integral part of the entire project, particularly related to facility siting. This process will provide the public with a variety of opportunities for input into the development of the wastewater management program. Public outreach will include a specific component for engaging First Nations stakeholders.

5.4 THE PATH FORWARD

The CRD is faced with both a challenge and an opportunity. Implementing a wastewater management program at this scale is complex. It requires communication with a number of stakeholders – most importantly the public. It requires assembly of a program implementation team and considerable planning of all the project components. It requires a well thought out implementation process to ensure that the design and construction proceeds as planned in a cost effective manner.

The opportunity is that the CRD has not yet made a significant investment in wastewater treatment. It is thus able to look ahead at what the key issues will be in the coming decades. It is able to look at what strategies and technologies are available now and what may be available in the future. It is able to pay special attention throughout the program to minimizing the generation of greenhouse gases and to optimizing the use and recovery of energy.

In reviewing the potential strategies that could be followed, the CRD Board has embraced this opportunity and has chosen a path that will address both near term goals as well as provide the flexibility to meet the environmental challenges of the future. With this program, the CRD, and its senior government partners, have the opportunity to implement a strategy that will be a model for sustainable wastewater management in North America.

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Acronyms and Abbreviations

ADWF	Average dry weather flow
BAF	Biological Aerated Filter
CSO	Combined sewer overflow
CRD	Capital Regional District
DAF	Dissolved Air Flotation
DND	Department of National Defence
I/I	Inflow and infiltration
LWMP	Liquid Waste Management Plan
MBR	Membrane bioreactors
MoE	Ministry of Environment (Provincial)
ML/d	Mega liters per day
mm	Millimetre
PF	Peaking factor
PWWF	Peak wet weather flow
RFP	Request for Proposals
RFEI	Request for Expressions of Interest
SETAC	Society of Environmental Toxicology and Chemistry
SSO	Sanitary sewer overflow
TBL	Triple Bottom Line
TCAC	Technical and Community Advisory Committee
UV	Ultraviolet
WWTP	Wastewater treatment plant