DISCUSSION PAPER NO. 5

Disclaimer
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Capital Regional District

Core Area and West Shore Sewage Treatment
Wastewater Management Options

Issued: March 21, 2007

1 Objective

Previous discussion papers have examined the issues of community growth, wastewater flows, treatment goals, potential technologies and the triple bottom line (TBL) evaluation process. An overview of three possible strategic wastewater management directions, as well as potential areas for wastewater treatment plants, has also been provided.

This discussion paper builds on the previous work and presents five wastewater management options. These options were discussed in detail with the Steering Committee at Workshop No. 3, on March 10, 2007. The options have been developed, based on assumed locations for cost estimating purposes. With the exception of existing facilities at Macaulay Point and Clover Point, the CRD does not own or have legal use of the properties. Land tenure issues are discussed under each of the options.

2 Option Development

Discussion Paper No. 4 – Implementation Sequencing - discussed a number of option development considerations, potential wastewater treatment plant sites and three possible strategic directions. It is worthwhile to review these items, prior to reviewing the five options that have been developed. The previous discussion is summarized below.

2.1 Centralized, Decentralized and Integrated Management

Traditionally the wastewater treatment approach in urban areas has been to convey the collected wastewater to a single, large plant. This is termed the “centralized” approach. The two sewerage areas within the CRD system, Macaulay Point and Clover Point, would be considered a centralized wastewater management strategy. Here the wastewater treatment function would be provided at a wastewater treatment plant, located at the downstream end of the wastewater conveyance system.

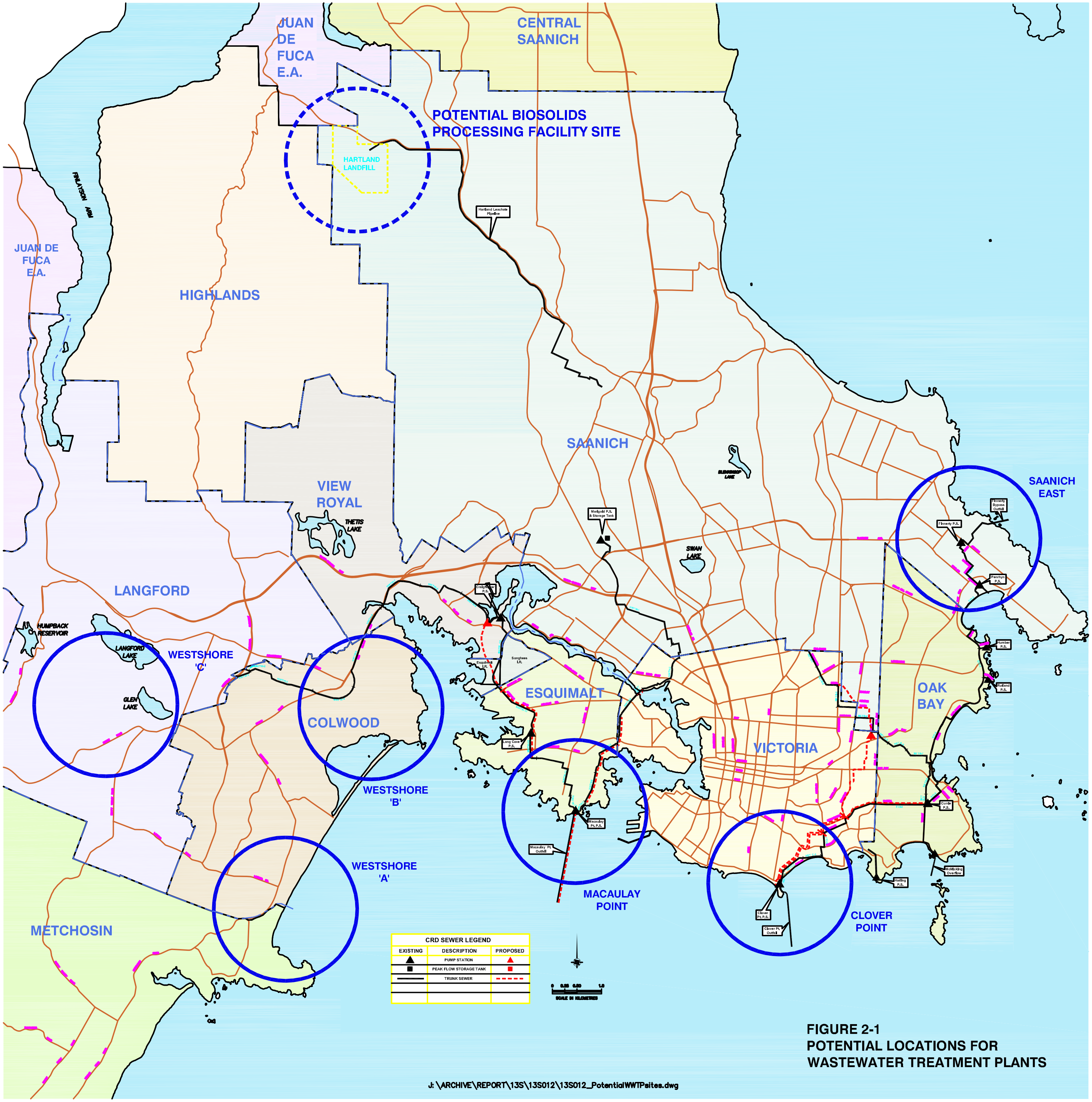

FIGURE 2-1
POTENTIAL LOCATIONS FOR WASTEWATER TREATMENT PLANTS

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 concept that utilizes "local" wastewater treatment plants. 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 this discussion paper, we are using the term in the broad sense – essentially "less centralized".

The term "integrated management approach" was also introduced in the previous discussion. This concept is to consider the entire region on a "systems" basis, looking at where the wastewater management functions could be shared. An example of this is treatment of the dry weather wastewater flows at one location and treating a portion of the wet weather flows at a different location.

In reality, these management strategies are not black and white and can be blended to come up with the best overall approach.

2.2 Wet Weather Flow Management

As has been discussed, the management of wet weather flows that currently enter the sewerage system is a major challenge for the CRD. This issue cannot be resolved in a short period, but will take many decades to accomplish. The solutions will lie in a multi-pronged approach – separation of combined sewers, reduction of I/I in sanitary sewers, treatment of wet weather flows and development of source control approaches to better manage stormwater. A balance of regulatory policy, environmental impact and economics will govern specific solutions and timing. The options presented allow for different approaches to tackle the wet weather management issue.

2.3 Potential Wastewater Treatment Plant Sites

Potential areas for wastewater treatment plant sites were presented in Discussion Paper No. 4. Figure 2-1 shows these locations. This is not an exhaustive description of possible sites and is primarily presented for the development of potential options. One of the challenges at this point in the decision making process is that the CRD does not own or has limited legal tenure on properties that could be considered for wastewater treatment facilities. In order to carry out a credible economic analysis, the consultant team needed to assume locations to develop plant layouts. For this reason, the discussion of options in this paper is limited to the broad areas shown in Figure 2-1.

2.4 Biolsolids Management

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 for energy recovery and processing to produce biosolids that can be used in a beneficial manner. The details of this type of facility are described in Discussion Paper No. 7.

The options presented allow different strategies in the handling of sludges from the wastewater treatment process. In the case of the decentralized plants, dilute sludges could be discharged into the downstream sewerage system, for treatment at the central plant. This would eliminate the truck traffic associated with sludge trucking at the decentralized plants.

In the more detailed planning of the centralized plant, the option of pumping the dilute sludge to an intermediate site for dewatering and final trucking could be considered. This would reduce the truck traffic at the centralized plant. Under some of the options, the centralized plant has a smaller footprint due to the lower flow being handled at the plant. In the detailed planning, the CRD could consider the possibility of processing the biosolids at the central wastewater treatment plant, eliminating the remote biosolids processing facility.

2.5 Odour Control and Facility Appearance

All of the proposed wastewater treatment plants would meet the stringent odour management targets presented in Discussion Paper No. 1. Capital and O&M costs are included for this level of odour control.

We have assumed that all of the plant layouts would be integrated into the surrounding neighborhoods. In the case of the Clover Point wet weather plant, this will see the entire facility, with the exception of vehicle access roads, built underground. The other plants are assumed to be low profile structures, with the process works either below grade or at grade with covered tankage. Surface level structures and buildings would be architecturally styled to fit with the site theme. Capital cost estimates reflect this approach.

At some sites, the CRD may wish to integrate learning facilities or other neighborhood activities such as recreational fields. These types of additional uses have not been included in the cost estimates. Similarly, some plants have the opportunity for off-site water reuse or heat recovery. Allowances for off-site reuse or recovery works have not been included at this time, as these opportunities cannot be defined at this time.

2.6 Primary versus Secondary Treatment

The regulatory process has focused on the traditional definitions of primary, secondary and tertiary treatment. As has been discussed throughout the decision information process, there is in fact a blurring of these traditional definitions, both from a technology and a strategy approach. The options that have been developed incorporate a variety of technologies and strategies, ranging from primary treatment for surplus wet weather flows to very advanced technologies for water reuse, in some cases within the same option. This is described in detail under each option.

Table 2-1 shows the wastewater flows, under each treatment category, for each of the five options.

Table 2-1
Ultimate Design Flows – Year 2065

Option	Description	WWTP	DESIGN FLOWS m^3/d		
			Secondary Treatment Capacity	Primary Treatment Capacity	Bypass Screening Capacity
1-1	Macaulay Point / Clover Point	Macaulay Clover	185400 134600	354900 269200	0 299000
1-2	West Shore Regional WWTP	Regional	320000	640000	283100
2-1	Clover Point / Macaulay Point / Saanich E / West Shore B WWTPs	Macaulay Clover Saanich E West Shore B	220400 0 37800 62000	364200 193600 63300 87600	0 214700 0 0
2-2	Macaulay Point with Clover Point as Wet Weather Only	Macaulay Clover	320000 0	489500 269200	0 164500
3-1	Five Plant Scenario	Macaulay Clover Saanich E West Shore B Langford	220400 0 37800 47600 14400	364200 193600 63300 67400 19900	0 214700 0 0 0

In order to allow an equitable comparison of options, the following levels of treatment have been assumed based on the wastewater flow arriving at a discharge location.

Flow Range	**Level of Treatment**
0 to 2 times ADWF	Screening, primary and secondary treatment
2 to 4 times ADWF	Screening and primary treatment
Above 4 times ADWF	Screening

It should be noted that in the options that employ a wet weather treatment plant at Clover Point, an enhanced primary level of treatment is assumed for the flows between 2 and 4 times the ADWF. This is because of the very tight site footprint and the need for a more compact technology.

The options have been developed based on the premise that secondary treatment of all flows up to two times ADWF will be in place in the Stage 1, the next ten years. This is not intended as a decision on the timing of secondary treatment, but rather an assumption to allow an equitable comparison of options. The CRD may decide to phase the implementation of the capacity of secondary treatment to spread out the cost of the program over a longer period of time.

2.7 Capital and Life Cycle Costing Approach

The planning of the future direction for the CRD is at a very early stage. Time frames and allocated budget require that the engineering planning be at very conceptual level. The intent of the option development and the economic analysis is to show the Steering Committee the relative differences in the options. The approach that has been taken is as follows:

- Layout each wastewater treatment plant at an assumed location using "representative" technologies. The layout reflects the ultimate size of the facility in the year 2065. Base construction costs in 2007 were then developed. Indirect costs, reflecting various allowance and contingencies, as well as land costs, were then added.

- Determine required upgrading of the linear conveyance systems (interceptor sewers, pumping stations, outfalls etc.) required to accommodate the wastewater treatment and wet weather flow strategy. Costs are then developed in a similar manner to the wastewater treatment plants.

- Determine the phasing of both the wastewater treatment and conveyance system work, based to the existing flows and the ultimate flows. For the purpose of option development, three stages (termed Stages 1, 2 and 3) were considered: 2007 to 2017; 2018 to 2035; and 2036 to 2065.

- Life cycle costs were developed by extrapolating existing wastewater utility annual operating, maintenance and administrative costs to future years (up to 2065) based on the new works. Capital and annual O&M costs were then brought back to a present worth cost using a real discount rate. Variable discount rates ranging from 2% to 6% were utilized to look at the sensitivity of the relative ranking of the options to the discount rate.

Year 2007 costs were used in the comparative economic analysis. 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. This is critical prior to release of the budget information to the public.

The costing does not reflect all of the costs that will be incurred by the region in wastewater management over the next six decades. Items that are not included are local sewer costs incurred due to growth or replacement / rehabilitation of aging infrastructure. This would include any programs to separate combined sewers or reduce I/I. The costs also do not include any activities related to water reuse or energy recovery, outside of the wastewater treatment plant, as it is not possible to identify specific opportunities at this time. It is anticipated, of course, that these activities will either generate revenue or offset other water or energy supply costs. These can be considered at a more detailed planning level.

2.8 Wastewater Management Options

As discussed previously, the five options are developed within the shell of three “series of options”. There can be, of course, many variations of the options. The five options presented, however, are considered to give the Steering Committee a representative spectrum of potential directions. The five options are:

Series One – Centralized Management Approach

Option 1-1: Macaulay Point / Clover Point WWTPs
This option is a continuation of the current LWMP strategy. Secondary treatment would ultimately 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 treating the wet weather flows at the treatment plant.

Option 1-2: West Shore Regional WWTP
This option would see a single secondary wastewater treatment plant. Wastewater flows from the two sewerage areas would be pumped to a new site, which for purposes of this option, is sited on the West Shore. As in Option 1, the ultimate goal would be to route the wet weather flows to this plant for treatment.

Series Two – Integrated Management Approach

Option 2-1: Clover Point / Macaulay Point / Saanich East / West Shore B WWTPs
This option moves away from a centralized strategy towards a more decentralized approach. Two smaller wastewater treatment plants would be constructed - one near the upper area of the West Shore sewerage area and one near upper area of the East Coast sewerage area. These plants would utilize advanced – split flow technologies to allow opportunities for reuse and energy recovery at the nearby universities. The Clover Point site would see a wet weather treatment plant only. Dry weather flows from the Clover Point sewerage area would be pumped to a new secondary plant at Macaulay Point.

Option 2-2: Macaulay Point with Clover Point as Wet Weather Only
This option would be similar to Option 2-1, except the two smaller plants would not be implemented. The Clover Point wet weather plant and the Macaulay Point secondary plant would function as described above.

Series Three – Decentralized Management Approach

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 plant in Langford (termed the West Shore C site) would be constructed. This option is intended to demonstrate this concept. It could in fact move further in this direction by ultimately seeing additional decentralized plants constructed within the sewerage areas.

The five options are described in Tables 2-2 to 2-6. The tables include the capital costs and the life cycle cost for each option. The capital costs are in 2007 dollars and include the indirect costs noted above. Once a strategic direction has been selected, these costs should be inflated to the mid-point of construction (assumed to 2013). This will increase the cost by about 20%, based on an assumed 3% annual inflation rate. The life cycle cost is based on the 4% real discount rate. The life cycle cost model, run at 2% and 6% discount rates, did not change the relative ranking of the options.

3 Summary

A summary of the option costs is shown in Table 3-1.

TABLE 2-2

OPTION 1-1
MACAULEY POINT/CLOVER POINT WWTPS

1.0 DESCRIPTON

This option is a continuation of the current LWMP strategy. Secondary treatment would ultimately be provided at the Macaulay Point and Clover Point sites. The wet weather flows within each of the two sewerage areas would be managed within the sewerage area, with the ultimate goal of treating the wet weather flows at the treatment plants.

Sludge would be dewatered at both plants and trucked to the Biosolids Management Facility at the Hartland Road Landfill for further processing.

2.0 WASTEWATER TREATMENT PLANTS

Macaulay Point WWTP

Additional property would be acquired from the DND to construct a new secondary treatment plant. This plant would handle all of the future flow from the Macaulay sewerage area. Representative technologies include:

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

Secondary treatment capacity would be provided for up to two times the ultimate (2065) average dry weather flow (ADWF) or 185 ML/d. Primary treatment would be provided for the 2065 peak wet weather flow (PWWF) of 355 ML/d. Space would be provided for inclusion of UV disinfection. Sludge dewatering is provided by gravity thickening on the primary sludge, dissolved air floatation (DAF) on the secondary sludge and centrifuge dewatering of the blended thickened sludge.

The technologies have been selected to provide a compact plant footprint. The facility design will be low profile with much of the plant below grade. Surface structures will be attractively designed buildings or will be blended into the surrounding land features.

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. Stage 1 capacity would be about 75% of the ultimate capacity.

Stage 2, completed in about 2035, would see the construction of the remaining 25% of the primary and secondary facilities.

Clover Point WWTP

Development of a secondary plant at the Clover Point site will require that the CRD acquire the majority of the Point. This plant would handle all of the future flows from the Clover Point sewerage area. The technologies employed would be the same as for the Macaulay Point Plant. These are:

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

Secondary treatment capacity would be provided for up to two times the ultimate (2065) ADWF or 135 ML/d. Primary treatment would be provided for four times ADWF or 269 ML/d. Flows above this amount (299 ML/d) would be provided with screening only. Space for UV disinfection would be provided for the primary and secondary treated flows. Sludge thickening and dewatering would be the same as at the Macaulay Point Plant.

The layout is based on a low profile design with the process tankage at or below the existing ground contours. Access roads, the tankage surface and surface level buildings would be visible from Dallas Road. Public access to the western part of the Point would be restricted. The structures could be constructed further below grade and a tunnel from near Beacon Hill Park used for vehicle access; however, this would significantly increase the plant capital cost.

Stages 1-A and 1-B would be the initial construction of the primary and secondary facility, representing about 90% of the ultimate capacity. The second stage of construction (Stage 2), built in about 2035, would ad the remaining 10% of the ultimate capacity.

3.0 WET WEATHER FLOW MANAGEMENT

The ultimate goal would be to eliminate sanitary sewer overflows and combined sewer overflows by directing the wet weather flows to the two plants. This approach entails increasing the capacity of the interceptor sewers and pump stations in both the Macaulay Point and Clover Point sewerage areas over the next several decades.

This increase in conveyance capacity would be combined with a continued program of combined sewer separation and I/I reduction.

4.0 PROS AND CONS

The advantages of this option are:

- The treatment facilities are at the two existing sites. No additional sites are required.

The disadvantages of this option are:

- The construction of a secondary treatment plant at Clover Point will be a major disruption to the existing park area, including loss of public access and the change in the current views from Dallas Road and the adjacent residential properties.

- Continued upgrading of the wastewater conveyance system is required to ultimately direct the wet weather flows to the two wastewater treatment plant sites.

- The potential for water reuse at both plants is limited, given their locations.

5.0 RISKS

The principal risks of this option are:

- Additional property from DND is required at the Macaulay Point site. The availability of this property and the timing to acquire the property has not been confirmed.

- The purchase of all or most Clover Point will be required. There is an existing covenant on the property designating it as park use. There is thus a risk that the property will not be available.

- The loss of the existing use of Clover Point may be unacceptable to the community.

6.0 COSTS

The capital costs for this option are:

Stage 1 $1067 million
Stage 2 $115 million

The life cycle cost is $1233 million.

TABLE 2-3

OPTION 1-2
WEST SHORE REGIONAL WWTP

1.0 DESCRIPTON

This option would see a single centralized wastewater treatment plant. For the purpose of developing this option, a site located in the vicinity of the West Shore B area, is assumed. Other sites, located to the north of the core urban area, may also be feasible.

The wastewater from the Clover Point Sewerage area would be pumped from a new pump station, located at Clover Point, to Macaulay Point. From Macaulay Point, the wastewater from the Clover Point sewerage area, as well as the wastewater from the majority of the Macaulay Point sewerage area, would be pumped via a new pump station to the new regional wastewater treatment plant. The western portion of the flow from the Macaulay sewerage area would reach the new regional plant by gravity flow.

Sludge would be dewatered at the new regional plant and trucked to the Biosolids Management Facility at the Hartland Road Landfill for further processing.

2.0 WASTEWATER TREATMENT PLANTS

Regional WWTP

A property with an overall area of 15 ha is required. A potential site location is on the west side of Esquimalt Harbour. Most of the property in this area are federally owned. The majority of the wastewater flow would require pumping to this site. Effluent discharge would be via gravity flow out a new outfall to Juan de Fuca Strait. Representative technologies include:

- Screening and grit removal
- Primary clarification
- Biological Aerated Filtration (BAF)

Secondary treatment capacity would be provided for up to two times the ultimate (2065) average dry weather flow (ADWF) or 320 ML/d. Primary treatment would be provided for the 2065 peak wet weather flow (PWWF) of 640 ML/d. Space would be provided for inclusion of UV disinfection. Sludge dewatering is provided by gravity thickening on the primary sludge, dissolved air floatation (DAF) on the secondary sludge and centrifuge dewatering of the blended thickened sludge.

The technologies have been selected to provide a compact plant footprint. The facility design will be low profile with much of the plant below grade. Surface structures will be attractively designed buildings or will be blended into the surrounding land features.

The primary treatment works (Stage 1-A) would be constructed first. Once this is commissioned, the secondary works would be constructed (Stage 1-B). This stage would represent about 85% of the ultimate capacity. Stage 2, completed by 2035, would see the completion of the remaining 15% of the primary and secondary treatment capacity.

3.0 WET WEATHER FLOW MANAGEMENT

The wet weather flow management strategy would be similar to in Option 1-1.

The ultimate goal would be to eliminate sanitary sewer overflows and combined sewer overflows by directing the wet weather flows to the regional plant. This approach entails increasing the capacity of the interceptor sewers and pump stations in both the Macaulay Point and Clover Point sewerage areas over the next several decades.

This increase in conveyance capacity would be combined with a continued program of combined sewer separation and I/I reduction.

4.0 PROS AND CONS

The advantage of this option are:

- There would be a single wastewater treatment plant site. The pump stations at Clover Point and Macaulay Point could be located mostly, or entirely, underground, eliminating the need to acquire more property.

- The larger site area would allow for the option of sludge stabilization and energy recovery process on the plant site, instead of at the remote Biosolids Management Facility.

The disadvantages of this option are:

- The capital costs to construct the conveyance works to transport all of the wastewater from the two sewerage areas to a regional plant are high, relative to the other options that utilize “local” plants.

- The energy costs to pump the wastewater flow to the regional site are significantly higher than the other options.

- Continued upgrading of the wastewater conveyance system is required to ultimately direct the wet weather flows to the two wastewater treatment plant sites.

- The potential for water reuse is limited, given the location of the plant.

5.0 RISKS

The principal risks of this option are:

- Given the urban development, it is difficult to locate a suitably large site within a reasonable distance from the terminus of the two sewerage areas. The required federally owned land may not be available.

- The acceptability of a large, regional wastewater treatment plant by the local public is not known.

- The transport of large quantities of wastewater via pump stations and forcemains increases the risk of a major spill event if an emergency situation such as the breakage of the pipe or the loss of pumping capacity occurs.

6.0 COSTS

The capital costs for this option are:

Stage 1 $1217 million
Stage 2 $166 million

The life cycle cost is $1368 million.

TABLE 2-4

OPTION 2-1
MACAULEY POINT/CLOVER POINT / SAANICH EAST / WEST SHORE WWTPS

1.0 DESCRIPTON

This option moves towards a more decentralized approach by adding two additional "decentralized" plants, as well as using a more distributed strategy for wet weather flow management. In this option, the Clover Point plant would treat wet weather flows only. The dry weather flows would be pumped from the Clover Point sewerage area, over to the secondary treatment plant at Macaulay Point.

The two "decentrallized" plants would be secondary treatment plants, focused on the potential for seasonal water reuse and heat recovery from the wastewater stream. One plant, the Saanich East facility, would be located near the University of Victoria. The second plant, West Shore B, would be near the Royal Roads University. As these plants would be located along the existing conveyance system, they would reduce the amount of downstream wastewater flows. This would allow the upgrading of the conveyance system, required in Options 1-1 and 1-2, to be deferred or eliminated.

The two decentralized plants would be "liquid stream only" treatment plants. Dilute sludges from the secondary treatment processes would be discharged into the conveyance system for treatment at the downstream Macaulay Point plant.

Sludge would be dewatered at the Macaulay Point plant and trucked to the Biosolids Management Facility at the Hartland Road Landfill for further processing.

2.0 WASTEWATER TREATMENT PLANTS

Macaulay Point WWTP

This plant would be as described in Option 1-1, except that the secondary treatment capacity would be about 20% higher to handle the additional dry weather wastewater flow from the Clover Point sewerage area. Representative technologies would be the same as Option 1-1 and would include:

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

Secondary treatment capacity would be provided for up to two times the ultimate (2065) average dry weather flow (ADWF) or 220 ML/d. Primary treatment would be provided for the 2065 peak wet weather flow (PWWF) of 364 ML/d. Space would be provided for inclusion of UV disinfection. Sludge dewatering is provided by gravity thickening on the primary sludge, dissolved air floatation (DAF) on the secondary sludge and centrifuge dewatering of the blended thickened sludge.

The technologies have been selected to provide a compact plant footprint. The facility design will be low profile with much of the plant below grade. Surface structures will be attractively designed buildings or will be blended into the surrounding land features.

As in Option 1-1, 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. This initial construction stage represents about 90% of the ultimate capacity. Stage 2, completed by 2035, would see the remaining 10% of the primary and secondary facilities constructed.

Clover Point WWTP

The process works at this location would consist of the following:

- Pump station and forcemain to pump the dry weather wastewater flow to Macaulay Point.
- Influent pump station for wet weather flows
- Screening for wet weather flows
- High rate enhanced primary clarification for wet weather flows
- Effluent pumping for wet weather flows

For most days of the year, the pump station and forcemain system would pump the wastewater arriving at this location to the Macaulay Point plant. This pump system would be sized for two times the average dry weather flow (ADWF) or about 97 ML/d by the year 2065. On the days where the flow arriving at this site exceeds this capacity, the surplus flow, up to four times the ADWF, would be routed through the wet weather flow plant. This plant would have an enhanced primary treatment capacity of 194 ML/d. On days with extremely high wet weather flow, the flow above the capacity of the enhanced primary treatment plant would be go through screening only and be blended with the enhanced primary treated effluent prior to being discharged out the Clover Point outfall system. The expected peak screened only flow is estimated at 215 ML/d.

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. 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, truck traffic to deliver chemicals to the site will be minimal as the wet weather plant will only operate during limited periods.

The plant would be constructed in a single stage (Stage 1).

Saanich East WWTP

This plant will function as a decentralized facility, reducing the downstream wastewater flows and providing a high quality effluent for water reuse. The assumed representative technologies are:

- Influent pumping
- Screening and grit removal
- Primary clarification
- Membrane bioreactors (MBR)
- UV disinfection

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 would be extended to move the discharge point further off-shore. The plant would be constructed in two stages. Stage 1 would see 75% of the ultimate capacity constructed. The remaining 25% would be constructed in about 2030.

The facility design would be low profile and architecturally designed to fit with the surrounding neighborhood. The potential water reuse and heat recovery opportunities have not been explored at this time.

West Shore B WWTP

The concept and representative technology would be the same as for the Saanich East plant. The West Shore B 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 three stages, with the first stage at 50% of the ultimate capacity. Stage 2, constructed in 2030, would add an additional 25% capacity. Stage 3, in 2050, would add the remaining 25% capacity.

The proposed plant could be attractively blended into the existing landscape. As this plant is away from the existing West Shore Interceptor, a sewer extension that would allow gravity flow to the plant would be required. Dilute sludge would be pumped back to the Interceptor.

Surplus effluent, not required for water reuse, would be discharged out a new outfall extending into the Juan de Fuca Strait.

3.0 WET WEATHER FLOW MANAGEMENT

The wet weather flow management strategy is different than for Options 1-1 and 1-2. First, the wet weather flows reaching the Clover Point site will be treated and discharged at that point. This is more efficient than pumping the infrequent but high volume dilute wastewater to another location. Second, the use of the two decentralized plants reduce the amount of wet weather flow continuing downstream. This allows the conveyance capacity system upgrading, required under Options 1-1 and 1-2, to be deferred or eliminated.

The wet weather flow management strategy would still be combined with a continued program of combined sewer separation and I/I reduction.

4.0 PROS AND CONS

The advantages of this option are:

- It eliminates the need to construct a large secondary treatment plant at Clover Point. All the proposed works under this option would be underground, in the same manner as the existing works. It is assumed that this can be done without purchasing additional property or changing the existing covenants regarding park use.

- It makes efficient use of existing flow capacity in the conveyance system by treating and discharging wet weather flow at multiple points.

- The use of upstream decentralized plant allows the size of the Macaulay Point secondary plant to be reduced (by about 30%), relative to Option 2-2.

- As all of the sludge is directed to the Macaulay Point plant, further processing (digestion and energy recovery) of the sludge at this location could be considered. This would eliminate the need for the remote biosolids management facility and would result in an overall cost savings.

- The use of decentralized plants opens the door for localized water reuse and heat recovery opportunities, particularly in partnership with the two universities. This option allows the use of decentralized treatment facilities to be expanded, if desired, in the future.

The disadvantages of this option are:

- The implementation and operation and maintenance of four plants is more complex than one or two centralized wastewater treatment plants.

5.0 RISKS

The principal risks of this option are:

- Additional property from DND is required at the Macaulay Point site. The availability of this property and the timing to acquire the property has not been confirmed.

- The construction of the wet weather plant at Clover Point will disrupt the existing public access for about 18 to 24 months. The acceptance of this is not known. There is a possibility that the existing property covenant could impact implementation.

- The CRD does not own the two proposed decentralized plant sites. Availability and timing of acquiring these sites is thus uncertain.

- Discussions have not been carried out on potential opportunities for water reuse and heat recovery. These opportunities may thus not proceed in the near term. The advantage of these plants from a wet weather flow management viewpoint, however, is still significant in terms of delaying or deferring conveyance system capacity upgrades.

6.0 COSTS

The capital costs for this option are:

Stage 1 $999 million
Stage 2 $101 million
Stage 3 $20 million

The life cycle cost is $1143 million.

TABLE 2-5

OPTION 2-2
MACAULEY POINT WITH CLOVER POINT AS WET WEATHER ONLY

1.0 DESCRIPTON

This option is similar to Option 2-1, except the two decentralized wastewater treatment plants would not be implemented. In this option, the Clover Point plant would treat wet weather flows only. The dry weather flows would be pumped from the Clover Point sewerage area, over to the secondary treatment plant at Macaulay Point.

Compared to Option 2-1, both the Clover Point wet weather plant and the Macaulay Point plant would be larger capacity, as the flows are not being reduced by the upstream decentralized plants. This also requires that the capacity of the conveyance system to move the peak wet weather flows to the central wastewater treatment plants be increased.

Sludge would be dewatered at the Macaulay Point plant and trucked to the Biosolids Management Facility at the Hartland Road Landfill for further processing.

2.0 WASTEWATER TREATMENT PLANTS

Macaulay Point WWTP

This plant would be as described in Option 2-1, except that the secondary treatment capacity would be about 45% higher to handle the additional dry weather wastewater flow due to the elimination of the upstream decentralized plants. Representative technologies would be the same as Option 2-1 and would include:

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

Secondary treatment capacity would be provided for up to two times the ultimate (2065) average dry weather flow (ADWF) or 320 ML/d. Primary treatment would be provided for the 2065 peak wet weather flow (PWWF) of 490 ML/d. Space would be provided for inclusion of UV disinfection. Sludge dewatering is provided by gravity thickening on the primary sludge, dissolved air floatation (DAF) on the secondary sludge and centrifuge dewatering of the blended thickened sludge.

As the facility is larger than in Option 2-1, it would be necessary to encroach into the ocean, if the proposed northern site boundary was maintained. The process tankage would thus extend outwards from the existing high water mark, necessitating reconstruction of the shoreline.

As in Option 2-1, 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. This initial construction stage represents about 75% of the ultimate capacity. Stage 2, completed by 2035, would see the remaining 25% of the primary and secondary facilities constructed.

Clover Point WWTP

This plant would be the same as in Option 2-1, except the PWWF would be higher. The process works would consist of the following:

- Pump station and forcemain to pump the dry weather wastewater flow to Macaulay Point.
- Influent pump station for wet weather flows
- Screening for wet weather flows
- High rate enhanced primary clarification for wet weather flows
- Effluent pumping for wet weather flows

For most days of the year, the pump station and forcemain system would pump the wastewater, arriving at this location, to the Macaulay Point plant. This pump system would be sized for two times the average dry weather flow (ADWF) or about 135 ML/d by the year 2065. On the days where the flow arriving at this site exceeds this capacity, the surplus flow, up to four times the ADWF, would be routed through the wet weather flow plant. This plant would have an enhanced primary treatment capacity of 269 ML/d. This is about 40% larger than Option 2-1. On days with extremely high wet weather flow, the flow above the capacity of the enhanced primary treatment plant would be go through screening only and be blended with the enhanced primary treated effluent prior to being discharged out the Clover Point outfall system. The expected peak screened only flow is estimated at 165 ML/d.

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. 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, truck traffic to deliver chemicals to the site will be minimal as the wet weather plant will only operate during limited periods.

The plant would be constructed in a single stage (Stage 1).

3.0 WET WEATHER FLOW MANAGEMENT

The wet weather flow management strategy is similar to Option 2-1, except the upstream decentralized plants are not in place to reduce the peak wet weather flows arriving at the two central plants. This requires that the capacity of the conveyance systems be increased in a similar manner to Options 1-1 and 1-2.

The wet weather flow management strategy would still be combined with a continued program of combined sewer separation and I/I reduction.

4.0 PROS AND CONS

The advantages of this option are:

- It eliminates the need to construct a large secondary treatment plant at Clover Point. All the proposed works under this option would be underground, in the same manner to the existing works. It is assumed that this can be done without purchasing additional property or changing the existing covenants regarding park use.

- There would only be two plants – Clover Point and Macaulay Point – eliminating the need to secure other sites.

- If this option was selected it would still be possible to implement the decentralized plants in the future. This could, however, result in redundant costs, if additional capacity at the Macaulay Point and Clover Point plants has been constructed.

The disadvantages of this option are:

- Continued upgrading of the wastewater conveyance system is required to ultimately direct the wet weather flows to the two wastewater treatment plant sites.

- The potential for water reuse at both plants is limited, given their locations.

5.0 RISKS

The principal risks of this option are:

- Additional property from DND is required at the Macaulay Point site. The availability of this property and the timing to acquire the property has not been confirmed.

- The construction of the wet weather plant at Clover Point will disrupt the existing public access for about 18 to 24 months. The acceptance of this is not known. There is a possibility that the existing property covenant could impact implementation.

6.0 COSTS

The capital costs for this option are:

Stage 1 $1011 million
Stage 2 $117 million

The life cycle cost is $1172 million.

TABLE 2-6

OPTION 3-1
FIVE PLANT SCENARIO

1.0 DESCRIPTON

This option moves further towards a more decentralized approach, then Option 2-1, by using three “decentralized” plants, in addition to the two centralized plants. The three decentralized plants are Saanich East, West Shore B and West Shore C. The Saanich East plant would be identical to Option 2-1. The West Shore B plant would be smaller than in Option 2-1, due to the upstream West Shore C plant. The West Shore C plant, located in the upstream area of the sewerage area, would handle the wastewater generated in the Langford area.

The three decentralized plants would be “liquid stream only” treatment plants. Dilute sludges from the secondary treatment processes would be discharged into the conveyance system for treatment at the downstream Macaulay Point plant, as in Option 2-1. Sludge would be dewatered at the Macaulay Point plant and trucked to the Biosolids Management Facility at the Hartland Road Landfill for further processing.

The representative technology assumed for the West Shore C Plant consists of membrane bioreactors and wetlands. Discharge of effluent not used for water reuse would be through the wetlands, ultimately flowing to the surface watercourses. This approach is used to show how an advanced technology, such as membranes, can be combined with a “soft” approach such as wetlands to create a wastewater management system that can enhance the local land use.

This option is presented as one example of a decentralized approach. Additional neighborhood plants could be constructed in the same manner, providing local water reuse opportunities.

2.0 WASTEWATER TREATMENT PLANTS

Macaulay Point WWTP

This plant would be identical to Option 2-1.

Clover Point WWTP

This wet weather plant would be identical to Option 2-1.

Saanich East WWTP

This plant would be identical to Option 2-1.

West Shore C WWTP

The West Shore C plant would employ the following technologies:

- Influent pumping
- Primary clarification with intermittent chemical addition
- Membrane bioreactors (MBR)
- UV disinfection
- Wetlands polishing

Dilute sludge would be pumped to the West Shore interceptor for ultimate treatment at the Macaulay Point plant. Secondary treatment capacity would be provided for up to two times the ADWF for the year 2065 or 14.4 ML/d. Primary treatment only would be provided for flows above this amount. The primary treatment capacity would be about 20 ML/d. The wetland capacity would be about 3.6 ML/d. The plant would be constructed in two stages. Stage 1 would see 75% of the ultimate capacity constructed. The remaining 25% would be constructed in about 2040.

The plant and wetlands would function as follows. For the summer period, the wastewater (flows up to 14.4 ML/d) would be treated through the primary works, the MBR and the UV disinfection process. This high quality effluent would go to water reuse. Any surplus water would be directed to the head of the wetlands. The discharge from the wetlands would go to Glen Lake and ultimately drain to Saanich Inlet. During the wetter period of the year, there will likely be less opportunity for water reuse. Under this scenario, additional effluent from the MBR process will be directed to the wetlands, up to its capacity of 3.6 ML/d. During wet weather events, the surplus primary effluent would go to the wetlands and the MBR effluent would be bypassed around the wetlands. Chemical addition to reduce phosphorus levels would be used, as required, to supplement the phosphorus removal provided by the wetlands polishing.

3.0 WET WEATHER FLOW MANAGEMENT

The wet weather flow management strategy would be similar to Option 2-1.

4.0 PROS AND CONS

The advantages of this option are:

- It eliminates the need to construct a large secondary treatment plant at Clover Point. All the proposed works under this option would be underground, in the same manner as the existing works. It is assumed that this can be done with purchasing additional property or changing the existing covenants regarding park use.

- It makes efficient use of existing flow capacity in the conveyance system by treating and discharging wet weather flow at multiple points.

- The use of upstream decentralized plants allows the size of the Macaulay Point secondary plant to be reduced (by about 30%), relative to Option 2-2.

- As all of the sludge is directed to the Macaulay Point plant, further processing (digestion and energy recovery) of the sludge at this location could be considered. This would eliminate the need for the remote biosolids management facility and would result in an overall cost savings.

- The use of decentralized plants opens the door for localized water reuse and heat recovery opportunities, particularly in partnership with the two universities. This option allows the use of decentralized treatment facilities to be expanded, if desired, in the future.

The disadvantages of this option are:

- The implementation and operation and maintenance of five plants is more complex than one or two centralized wastewater treatment plants.

5.0 RISKS

The principal risks of this option are:

- Additional property from DND is required at the Macaulay Point site. The availability of this property and the timing to acquire the property has not been confirmed.
- The construction of the wet weather plant at Clover Point will disrupt the existing public access for about 18 to 24 months. The acceptance of this is not known. There is a possibility that the existing property covenant could impact implementation.
- The CRD does not own the three proposed decentralized plant sites. Availability and timing of acquiring these sites is thus uncertain.
- The West Shore C plant would have an intermittent discharge via surface watercourses to Saanich Inlet. As this inlet has been previously identified as being sensitive to nutrient inputs, environmental assessments will be required and there may be opposition to this plant concept.
- Discussions have not been carried out on potential opportunities for water reuse and heat recovery. These opportunities may thus not proceed in the near term. The advantage of these plants from a wet weather flow management viewpoint, however, is still significant in terms of delaying or deferring conveyance system capacity upgrades.

6.0 COSTS

The capital costs for this option are:

Stage 1 $1050 million
Stage 2 $104 million
Stage 3 $17 million

The life cycle cost is $1194 million.

TABLE 3-1

SUMMARY OF COST ESTIMATES[1]

OPTION	DESCRIPTION	CAPITAL COST ($M)			LIFE CYCLE COST[2] ($M)
		STAGE 1	STAGE 2	STAGE 3	
1-1	Macaulay Point/Clover Point WWTPs	1067	115	--	1233
1-2	West Shore Regional WWTP	1217	166	--	1368
2-1	Macaulay Point/Clover Point/Saanich East/West Shore B WWTPs	999	101	20	1143
2-2	Macaulay Point with Clover Point as Wet-Weather Only	1011	117	--	1172
3-1	Five Plant Scenario	1050	104	17	1194

Notes:
1. Costs are in 2007 dollars and include indirect costs.
2. Life cycle costs are based on a 4% real discount rate.