CITY OF REVELSTOKE

LIQUID WASTE MANAGEMENT PLAN - STAGE 2

DRAFT 5

AUGUST 2012

DAYTON & KNIGHT LTD.
Consulting Engineers

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CITY OF REVELSTOKE
LIQUID WASTE MANAGEMENT PLAN – STAGE 2

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CITY OF REVELSTOKE
LIQUID WASTE MANAGEMENT PLAN – STAGE 2

EXECUTIVE SUMMARY

The City of Revelstoke Liquid Waste Management Plan (LWMP) is to lay the groundwork for wastewater management over the next 20 to 30 years. The LWMP must address existing and future development, including servicing of areas that are not yet connected to the central wastewater collection system, greenfield developments, and the Revelstoke Mountain Resort (RMR). The City has updated its Official Community Plan (OCP) to address planned new development and the resulting service area expansions. An expanded service area is not considered to alter the wastewater character in any significant way, since the mix of land use will not change to any great extent. The LWMP is designed to minimize the adverse environmental impacts of development according to the OCP, as well as to address existing problems. To ensure the consistency between the two planning processes, liaison between the LWMP consulting team and the team updating the OCP was ongoing throughout the project.

The LWMP was developed using the Guidelines produced by the B.C. Ministry of Environment (MOE). In accordance with provincial guidelines, the LWMP includes consideration of source control of contaminants, wastewater volume reduction, stormwater management, wastewater collection and treatment, and beneficial reuse of treated wastewater and residual solids.

The study area for the LWMP encompasses the areas that are serviced by centralized collection and treatment of domestic wastewater at the Revelstoke Wastewater Treatment Plant (WWTP), which discharges secondary-treated effluent to the Illecillewaet River. Currently unserviced areas with development potential were also included in the study area. Development projections provided by the City and by the OCP update team were used to develop projected wastewater flows to the

year 2026 and to ultimate build-out capacity; these were used to develop concept options for wastewater collection and treatment in the study area.

If the existing WWTP is to continue in use for the long term, upgrading of this facility will be required to address development. During Stage 1 of the LWMP, the Project Team and the Joint Advisory Committee (JAC) initially developed a short list of draft options for collecting and treating wastewater. These options were then presented to the community at the Stage 1 Open House. The option that was selected for advancement to Stage 2 was to continue to upgrade and expand the treatment facilities at the existing site for the foreseeable future (this was designated Option 1). All of the other options involved the construction of new wastewater treatment facilities at alternative sites (near the Downie Street Mill, at Big Eddy, at Westside Road or near the Airport); these options were not advanced to Stage 2, due to a combination of poor ground conditions, environmental and habitat concerns, community recreation conflicts, and high costs. However, it was recommended by the JAC that the LWMP include a commitment by the City to undertake a formal investigation to determine if an alternative site for the wastewater treatment facilities might better serve the City's needs for the long term future.

An Environmental Impact Study (EIS) of the discharge from the existing treatment facility conducted in 2002 showed that the water quality downstream of the WWTP outfall at the edge of the initial dilution zone (IDZ) was satisfactory, and all Provincial Water Quality Guidelines were met. However, there were significant differences between the control (upstream) site and the downstream site for several parameters such as nitrate, dissolved chloride, sodium, *chlorophyll a* and benthic invertebrate community composition. The 2002 EIS was updated in 2008, and the evaluation was extended to include the impacts of projected future increases in discharge flow rate from the WWTP. It was noted that reducing the level of nutrients in the effluent, or increasing the available dilution through the use of a diffuser, might reduce the effect of the discharge on the receiving environment in the Illecillewaet River, and that continued use of this location is likely to depend on demonstrating that the level of impact remains limited to an increase in biological productivity. In general, the water quality downstream of the WWTP outfall at the edge of the initial dilution zone appeared to meet all the British Columbia Water

Quality Guidelines. Significant differences between upstream and downstream sites were observed for ammonia and phosphorus. Phosphorus from the effluent is suspected to be the primary cause of the increase in abundance found in the periphyton and benthic communities downstream of the outfall. It is expected that an increase in discharge volume would increase the impact of the discharge assuming the quality of the effluent remains unchanged. The 2008 EIS update showed that, if enhanced phosphorus removal were practiced at the wastewater treatment plant, any impacts due to phosphorus from the projected 2025 discharge would be expected to be less than those observed in 2007.

A regular monitoring program should be established, in order to satisfy the Ministry of Environment that the impact of the discharge on the Illecillewaet River is limited to an increase in productivity, and does not significantly alter the biological community composition.

The selected approach for wastewater collection and treatment (Option 1) is to upgrade and expand the existing wastewater treatment facilities at the present location. The expanded treatment plant can potentially serve the entire City of Revelstoke, including Big Eddy, Clearview Heights, Arrow Heights, as well as Revelstoke Mountain Resort. The existing aerated lagoon treatment system will have to be converted to a more space-efficient process as flows increase (estimated around the year 2014). The trunk sewer system and its pump stations will also have to be expanded.

Incremental improvements to the existing treatment facilities will be required as the service population increases. The Revelstoke Mountain Resort is expected to contribute the majority of new development. The following two alternative approaches for discharge of treated effluent to surface water were examined in the Stage 2 LWMP:

- Option 1A: Continue with secondary treatment at the existing site – add a diffuser to the existing outfall, and plan to add advanced treatment (phosphorus removal, and possibly nitrification of ammonia) if and when the recommended monitoring program shows it to be

necessary – for this option, the outfall would not be extended to the Columbia River in the foreseeable future.

- Option 1B: Continue with secondary treatment at the existing site, and plan to extend the outfall discharge to the Columbia River if and when the recommended monitoring program shows it to be necessary (a diffuser can be added to the existing outfall an as interim measure if needed).

A concept layout for Options 1A and 1B is illustrated on Figure E-1. In consultation with the Joint Advisory Committee, Option 1B was selected for advancement to the Stage 3 LWMP. However, input from the Ministry of Environment indicated that deferring extension of the outfall until monitoring in the Illecillewaet River shows it to be necessary would not be acceptable, and that a schedule for extending the outfall to the Columbia River would have to be included in the LWMP. Accordingly, this Stage 2 LWMP includes a recommendation for determining a schedule for extending the outfall in Stage 3 of the LWMP.

The collection system upgrades projected to support Option 1 (both 1A and 1B) for a 13,500 population (designated Stage II) have an estimated total capital cost of about $10.5 million, with an additional $0.3 million required for 17,700 people (Stage III) and a further $15.9 million required by the LWMP planning horizon of 2025 (assuming that Big Eddy is connected to the system by 2025). (This does not include $2.3 million either spent or committed for Downey Pump Station, Clearbrook Heights and related sewer work.)

The 20-year present value (life cycle) costs for the WWTP upgrades needed for Options 1A and 1B are shown in Table E-1. It is important to note that the costs are not all-inclusive, but are adequate for comparing the two options. As shown in Table E-1, Option 1B (maintain secondary treatment standards and relocate outfall discharge to the Columbia River) has the higher capital cost (i.e. $20 million compared to the $19.4 million for Option 1A), but it has a lower life cycle cost due to lower annual O&M costs ($26.5 million compared to $27.5 million for Option 1A). The higher annual O&M cost for Option 1A is primarily due to the need to purchase chemicals (alum) for enhanced phosphorus removal. Option 1A would also generate additional solids due to the addition of

EFFLUENT PUMPING OF DISCHARGE TO COLUMBIA RIVER (OPTION 1B ONLY)

UPGRADE EXISTING WWTP TO MECHANICAL TREATMENT AND EXPAND TO ACCOMMODATE ENTIRE SERVICE AREA

OPTION 1A - ADVANCED TREATMENT
OPTION 1B - SECONDARY TREATMENT

CONNECT CLEARVIEW HEIGHTS / CPR HILL TO EXISTING SYSTEM

CITY OF REVELSTOKE BOUNDARY

CLEARVIEW HEIGHTS CPR HILL

REVELSTOKE WASTEWATER TREATMENT PLANT

ADD DIFFUSER TO EXISTING OUTFALL (OPTION 1A ONLY)

EFFLUENT OUTFALL

OSCAR PUMP STATION

MOSS PUMP STATION

NEW PUMP STATION AND TWO FORCEMAINS TO WWTP

NEW GRAVITY SEWER SERVING ARROW HEIGHTS AND RMR

ARROW HEIGHTS

WALES PUMP STATION

BURKE PUMP STATION

NEW FORCEMAIN

EDWARD PUMP STATION

NEW PUMP STATION AND FORCEMAIN SERVING BIG EDDY

DOWNIE PUMP STATION

HOSPITAL OUTFALL

BIG EDDY

NEW OUTFALL TO COLUMBIA RIVER (OPTION 1B ONLY)

HOSPITAL WASTEWATER TREATMENT PLANT

REVELSTOKE MOUNTAIN RESORT (RMR)

CONNECT HOSPITAL TO ARROW HEIGHTS TRUNK SEWER AND ABANDON HOSPITAL WWTP

CONVERT EXISTING FORCEMAIN TO OUTFALL (OPTION 1B ONLY)

UPGRADE DOWNIE PUMP STATION

UPGRADE WALES PUMP STATION AND EXISTING SEWER SYSTEM TO CONVEY WASTEWATER FROM BIG EDDY TO DOWNIE PUMP STATION

TO ILLECILLEWAET RIVER

0 500 1000 1500 2000 METRES

1:30000

SYSTEM UPGRADES

OPTION 1A – UPGRADE WWTP TO ADVANCED TREATMENT (PHOUPHORUS REMOVAL) AND ADD DIFFUSER TO EXISTING OUTFALL

OPTION 1B – MAINTAIN SECONDARY TREATMENT AT WWTP AND RELOCATE OUTFALL DISCHARGE TO COLUMBIA RIVER

LEGEND

- STUDY AREA BOUNDARY
- WWTP SERVICE AREA BOUNDARY
- AREAS USING ONSITE SYSTEMS TODAY
- EXISTING PUMP STATION
- EXISTING FORCEMAIN
- EXISTING GRAVITY SEWER
- EXISTING WASTEWATER TREATMENT PLANT
- NEW PUMP STATION
- NEW FORCEMAIN

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CITY OF REVELSTOKE

STAGE 2 - LIQUID WASTE MANAGEMENT PLAN
OPTIONS FOR WASTEWATER COLLECTION AND TREATMENT

OPTION 1A AND 1B - EXPAND AND UPGRADE EXISTING WWTP TO ACCOMMODATE ENTIRE SERVICE AREA

FIGURE E-1

chemical, and so would have a higher solids handling cost than Option 1B (solids handling costs are not included on Table E-1).

TABLE E-1
LIFE CYCLE COST FOR OPTIONS 1A AND 1B

COST	OPTION 1A	OPTION 1B
CAPITAL COST	$19.35 M	$20.03 M
Discounted O&M COST	$8.3 M	$6.5 M
TOTAL	**$27.65 M**	**$26.53 M**

Discount Rate	**6%**
Base Year	**2012**

In consultation with the Joint Advisory Committee, the feasible option for reclaimed water use that was selected for advancement to the Stage 2 LWMP was reuse onsite at the wastewater treatment plant (WWTP) for non-potable applications. Potential applications for reclaimed water at the WWTP include washdown water, process water (polymer mixing etc.), bioscrubber irrigation, and landscape irrigation on grounds. Reclamation and reuse of treated effluent at the WWTP will account for only a portion of the wastewater flow. The majority of the wastewater will be treated to the appropriate standard and discharged to surface water.

Source control initiatives that were reviewed in the Stage 2 LWMP included a review of Sanitary Sewer Connection Bylaw No. 1683-2002 to ensure that all of the needed components are in place to protect biosolids quality, as well as to protect the biological processes at the WWTP and to enhance the quality of the WWTP discharge. A public and private sector education program was also recommended.

Wastewater volume reduction efforts should include water conservation to reduce sewage volumes. The City has identified a number of water conservation measures for implementation; those that will potentially affect wastewater volumes include a number of initiatives related to public education, use of water-saving fixtures, water metering and amended water rates.

Biosolids use options that were selected for advancement to the Stage 2 LWMP were manufacture of compost using biosolids, and reclamation of disturbed land or contaminated sites through land application of biosolids. The Columbia Shuswap Regional District is currently managing all septage and biosolids composting at the landfill site. The product is under the control of the Regional District. The City's prior involvement in septage composting at the Jordan Pit is now completed and no further composting by the City is planned. It was recommended in the Stage 1 LWMP that sampling and analysis be undertaken in Stage 2 to evaluate the concentration of trace metals in the biosolids that were removed from the WWTP in 2006.

Treatment of wastewater and biosolids presents opportunities for energy recovery. Opportunities include combustion of the gas produced by anaerobic digestion for heating and/or generation of electrical power, and heat recovery from the raw wastewater stream. The practical application of these options depends on such factors as the size of the treatment facilities and the location of potential energy users in relation to the plant. Options for energy recovery should be addressed during the pre-design and detailed design phases for WWTP upgrades and expansions.

Options for stormwater management that were evaluated in the Stage 2 LWMP included the preparation of a Master Stormwater Management Plan for the City, incorporation of protection of environmental resources into drainage planning (e.g., aquifers, stream corridors, etc.), development of a storm drainage bylaw and enforcement policy, encouraging on-site infiltration of precipitation, development of a source control program, and preparation of an inventory of potential contaminant sources.

The City sent approximately 3000 copies of an information brochure describing the LWMP process and findings to City residents in a mail-out on December 22, 2009 and posted the brochure on the website together with Draft 2, of the LWMP Report. No comments were received from the date of posting to January 28, 2010. A copy of the brochure is attached in Appendix D. The public consultation requirements of the LWMP were met through this final communication.

CITY OF REVELSTOKE
LIQUID WASTE MANAGEMENT PLAN – STAGE 2

1.0 SUMMARY OF STAGE 1 LWMP

This section provides a summary of the work undertaken in the Stage 1 LWMP, which was approved by the B.C. Ministry of Environment (Nelson Office) on May 26, 2008. More detail can be found in the Stage 1 LWMP report (Dayton & Knight Ltd., 2008). A copy of the approval letter for Stage 1 is attached as Appendix A.

The City of Revelstoke Liquid Waste Management Plan (LWMP) is to lay the groundwork for wastewater management over the next 20 to 30 years. The LWMP must address existing and future development, including servicing of areas that are not yet connected to the central wastewater collection system, greenfield developments, and the Revelstoke Mountain Resort (RMR). The City has updated its Official Community Plan (OCP) to address planned new development and the resulting service area expansions. The LWMP is designed to minimize the adverse environmental impacts of development according to the OCP, as well as to address existing problems. To ensure the consistency between the two planning processes, liaison between the LWMP consulting team and the team updating the OCP was ongoing throughout the project.

The LWMP was developed using the Guidelines produced by the B.C. Ministry of Environment (MOE). In accordance with provincial guidelines, the LWMP includes consideration of source control of contaminants, wastewater volume reduction, stormwater management, wastewater collection and treatment, and beneficial reuse of treated wastewater and residual solids.

The Guidelines for developing a LWMP produced by the MOE require a three-stage process, each involving meaningful public consultation. Stage 1 included identification of existing

conditions, development projections, and consideration of a range of treatment, reuse and disposal options. The treatment, reuse and disposal options that passed an initial technical evaluation and public review were advanced to Stage 2 for more detailed evaluation. In Stage 3, the selected option is described and costed, the implementation schedule is developed, and draft Operational Certificates are prepared. When the Stage 3 LWMP is approved by the Ministry of Environment (MOE), the local government has the authority to implement the Plan.

The MOE Guidelines require the local government to strike a Technical Advisory Committee comprising municipal staff and representatives from senior government agencies, and a Local Advisory Committee comprising local government staff, at least one elected official, and a cross-section of community interests. Adequate consultation with the public while preparing a LWMP is essential, since there is no mechanism to appeal a Plan once approved by the Minister. The process is intended to give the public open access to liquid waste planning within their own community.

A consulting team led by Opus DaytonKnight (formerly Dayton & Knight Ltd.) was retained by the City of Revelstoke to assist with preparation of the three-stage LWMP. The consulting team included specialty assistance from sub-consultants in the fields of environmental protection (Masse and Miller Consulting Ltd. of Nelson, B.C.), and hydrogeological services (Golder Associates Ltd. of Kamloops, B.C.).

The study area for the LWMP encompasses the areas serviced by centralized collection and treatment of domestic wastewater at the Revelstoke Wastewater Treatment Plant (WWTP), which discharges secondary-treated effluent to the Illecillewaet River. Currently unserviced areas with development potential were also included in the study area. Development projections provided by the City and by the OCP update team were used to develop projected wastewater flows to the year 2026 and to ultimate build-out capacity; these were used to develop concept options for wastewater collection and treatment in the study area.

If the existing WWTP is to continue in use for the long term, upgrading of this facility will be required to address development. As an alternative to upgrading the existing facility, the City recently evaluated the potential for relocating the central WWTP. The Stage 1 LWMP included a review of this process, and evaluation of the feasibility of developing one or more additional sites for WWTPs to serve all or parts of the City. The Project Team and the Joint Advisory Committee (JAC) initially developed a short list of draft options for collecting and treating wastewater. These options were then presented to the community at the Stage 1 Open House. The option that was selected for advancement to Stage 2 was to continue to upgrade and expand the treatment facilities at the existing site for the foreseeable future (this was designated Option 1). All of the other options involved the construction of new wastewater treatment facilities at alternative sites (near the Downie Street Mill, at Big Eddy, at Westside Road or near the Airport); these options were not advanced to Stage 2, due to a combination of poor ground conditions, environmental and habitat concerns, community recreation conflicts, and high costs (see the Stage 1 LWMP report for more detail). However, it was recommended by the JAC that the LWMP include a commitment by the City to undertake a formal investigation to determine if an alternative site for the wastewater treatment facilities might better serve the City's needs for the long term future. Additional input from the public was solicited in Stage 2 (see Appendix B).

The selected approach for wastewater collection and treatment was to upgrade and expand the existing wastewater treatment facilities at the present location (Option 1). The expanded treatment plant could potentially serve the entire City of Revelstoke, including Big Eddy, Clearview Heights, Arrow Heights, as well as Revelstoke Mountain Resort. The existing aerated lagoon treatment system would have to be converted to a more space-efficient process as flows increase. The trunk sewer system and its pump stations would also have to be expanded. A new outfall extending the discharge location to the Columbia River would have to be constructed with the schedule for this work to be determined. The feasible option for reclaimed water use that was selected for advancement to the Stage 2 LWMP was reuse at the wastewater treatment facility for non-potable applications.

An Environmental Impact Study of the discharge from the existing treatment facility conducted in 2002 showed that the water quality downstream of the sewage treatment plant outfall at the edge of the initial dilution zone (IDZ) was satisfactory, and all Provincial Water Quality Guidelines were met. However, there were significant differences between the control (upstream) site and the downstream site for several parameters such as nitrate, dissolved chloride, sodium, *chlorophyll a* and benthic invertebrate community composition. It was concluded that the changes in species composition and increase in algal growth might be indicative of low chronic exposure. To increase the dilution capacity during extreme low flows in the river and to ensure that the outflow is submerged all year round, it was recommended that the bank discharge outfall be replaced with a diffuser securely fixed to the bottom of the Illecillewaet River.

The 2002 EIS was updated in 2008, and the evaluation was extended to include the impacts of projected future increases in discharge flow rate from the WWTP. It was noted that reducing the level of nutrients in the effluent, or increasing the available dilution through the use of a diffuser, might reduce the effect of the discharge on the receiving environment in the Illecillewaet River, and that continued use of this location is likely to depend on demonstrating that the level of impact remains limited to an increase in biological productivity. In general, the water quality downstream of the sewage treatment plant outfall at the edge of the initial dilution zone appeared to meet all the British Columbia Water Quality Guidelines. Although the final sampling schedule used in the 2008 EIS update did not allow direct comparison with the Guidelines, the range of values obtained for each parameter were all well within the relevant Guideline. Significant differences between upstream and downstream sites were observed for ammonia and phosphorus. Phosphorus from the effluent is suspected to be the primary cause of the increase in abundance found in the *periphyton* and benthic communities downstream of the outfall. The effluent did not appear to have an effect on the community composition at the downstream site. Hence, the input of nutrients from the discharge has increased productivity but has not led to any sign of eutrophication. It is expected that an increase in discharge volume would increase the impact of the discharge assuming the quality of the effluent remains unchanged. The 2008 EIS update showed that, if enhanced phosphorus removal were practiced at the wastewater treatment

plant, any impacts due to phosphorus from the projected 2025 discharge would be expected to be less than those observed in 2007.

A regular monitoring program was recommended, in order to satisfy the Ministry of Environment that the impact of the discharge on the Illecillewaet River is limited to an increase in productivity, and does not significantly alter the biological community composition. The program should involve two successive years of monitoring initially to provide a suitable baseline and to confirm that impact levels are limited to an increase in biological productivity. Subsequently, a reduced level of monitoring would be required to ensure that the level of impact does not increase significantly as discharge volumes increase in the future. The monitoring program should consist primarily of *periphyton* and benthic invertebrate monitoring, as these are able to assess the cumulative effect of the discharge of effluent over the preceding months.

Biosolids use options that were selected for advancement to the Stage 2 LWMP were manufacture of compost using biosolids, and reclamation of disturbed land or contaminated sites through land application of biosolids. The City was planning to construct a composting facility, possibly at the Jordan Pit to process waste solids from the WWTP as well as septage and possibly yard waste. The composting plan has now been taken over by the Columbia Shuswap Regional District and is currently ongoing at the landfill. The compost product can be used at City parks and recreation facilities and as cover material at the Regional District landfill. It was recommended in the Stage 1 LWMP that sampling and analysis be undertaken in Stage 2 to evaluate the concentration of trace metals in the biosolids that were removed from the WWTP in 2006.

Options for stormwater management that were recommended for advancement to Stage 2 were to undertake the preparation of a Master Stormwater Management Plan for the City, incorporate protection of environmental resources into drainage planning (e.g., aquifers, stream corridors, etc.), develop a storm drainage bylaw and enforcement policy, encourage on-site infiltration of precipitation, develop a containment source control program, and conduct an inventory of potential contaminant sources.

Treatment of wastewater and biosolids presents opportunities for energy recovery. Opportunities include combustion of the gas produced by anaerobic digestion for heating and/or generation of electrical power, and heat recovery from the raw wastewater stream. The practical application of these options depends on such factors as the size of the treatment facilities and the location of potential energy users in relation to the plant. Options for energy recovery should be addressed during the pre-design and detailed design phases for WWTP upgrades and expansions.

2.0 PUBLIC CONSULTATION

Public consultation is mandated as part of the LWMP. The Stage 1 Open House, Committee Meetings and Public Information are described in the Stage 1 LWMP Report.

Following the Stage 1 Open House, held on December 5, 2007 at the Revelstoke Community Centre, a Stage 2, Draft 1 of the LWMP report was provided to the JAC for consideration. Following the JAC meeting of February 18, 2009, a Stage 2 Draft 2 report was provided. A copy of the minutes from the JAC meeting is attached in Appendix D. The Stage 2, Draft 2 LWMP report was made available for public comment from December 18, 2009 to January 28, 2010. Approximately 3,000 copies of an information brochure describing the LWMP scope and findings was sent to the City residents on December 22, 2009 as part of a package mail-out. A copy of the brochure is provided in Appendix D. The brochure was posted on the City's website from December 22, 2009.

No comments in response to the flyer on the Stage 2 Draft 2 LWMP were received in the December 18, 2009 to January 28, 2010 prescribed period for comment.

As agreed with the MOE, the distribution of the brochure and availability of the Stage 2, Draft 2 LWMP report through the period from December 18, 2009 to January 28, 2010 completed the public consultation requirements for the Plan.

3.0 CRITERIA FOR STAGE 2 LWMP

3.1 Official Community Plan and Population Growth

The OCP for the City of Revelstoke from 1996 and other relevant information were reviewed during the Stage 1 LWMP, to determine land use planning and population growth projections in the study area. A 20-year planning horizon to 2025 was adopted for the LWMP. The study area boundary and land use planning within the study area according to the OCP are shown on Figure 3-1. The OCP was recently updated by the City. Available information from the OCP update was included in the LWMP as it became available.

The projected population growth according to the moderate growth scenario from the updated OCP is included in Table 3-1. Currently unserviced areas with development potential are Arrow Heights, Revelstoke Mountain Resort, Big Eddy, and Clearview Heights; service population projections for the wastewater collection and treatment system were based on the (conservative) assumption that all residents would eventually be connected to sewer. For the purposes of developing infrastructure capacity needs, it was judged advisable to assume 100% Resort occupancy to reduce the risk of encountering capacity shortfalls. This results in a projected total population of about 19,500 people by 2025, assuming the medium growth scenario (i.e., 9,900 City base population including Big Eddy, plus 1,300 in-migrant workers, plus 8,260 Resort guests); this compares to the 2025 service population of 17,100 estimated previously, which did not include Big Eddy in the service area (Dayton & Knight Ltd., 2006). For the build-out

service population of 29,000 people, the OCP high growth scenario was used, which assumes the Resort is fully constructed with 100% occupancy.

TABLE 3-1
POPULATION GROWTH IN THE CITY OF REVELSTOKE
(adapted from BHA, 2008)

Year	City Population[1] (including in-migrants)	WWTP Service Population[3]		
		City[1,3]	RMR[2]	City + RMR[2,3]
1995		5,815	-	5,815
1997	8,286	5,883	-	5,883
1998	8,123	5,952	-	5,952
1999	7,985	6,020	-	6,020
2000	7,888	6,088	-	6,088
2001	7,827	6,157	-	6,157
2002	7,913	6,225	-	6,225
2003	7,888	6,293	-	6,293
2004	7,932	6,362	-	6,362
2005	7,964	6,430	-	6,430
2006	8,029	6,430	-	6,430
2010	8,796	8,796	-	8,796
2015	9,666	9,666	5,085	14,751
2020	10,744	10,744	10,170	20,914
2025	11,201	11,201	15,256	26,457
Build-out[4]	12,513	12,513	21,256	33,769

1 1997 to 2006: BC Regional District and Municipal Population Estimates, 1996-2006 - Prepared by BC Stats, adjusted for Census undercount, 2010 to 2025 projections from BHA (2008), includes City base plus in-migrant workers

2 Resort equivalent population is shown on Bed Units (BU) taken from City of Revelstoke Resort (COR) "Transportation Study", Boulevard Transportation Group, November 2010, and does not reduce numbers for lower per capita flow assuming 100% occupancy, assumes resort is half built by 2025.

3 Service population 1996 to 2006 from D&K report WWTP Upgrades, Draft No. 2, March 2007, service population for 2025 assumes all residents connected to sewer, including Big Eddy

4 High growth scenario, assumes resort is fully constructed and fully occupied at build-out.

3.1.1 Arrow Heights

The City of Revelstoke has updated the OCP and a DCC policy for anticipated growth in the City, in particular the Arrow Heights subdivision. Although Arrow Heights has good conditions for ground disposal of wastewater, the increase in density from the present

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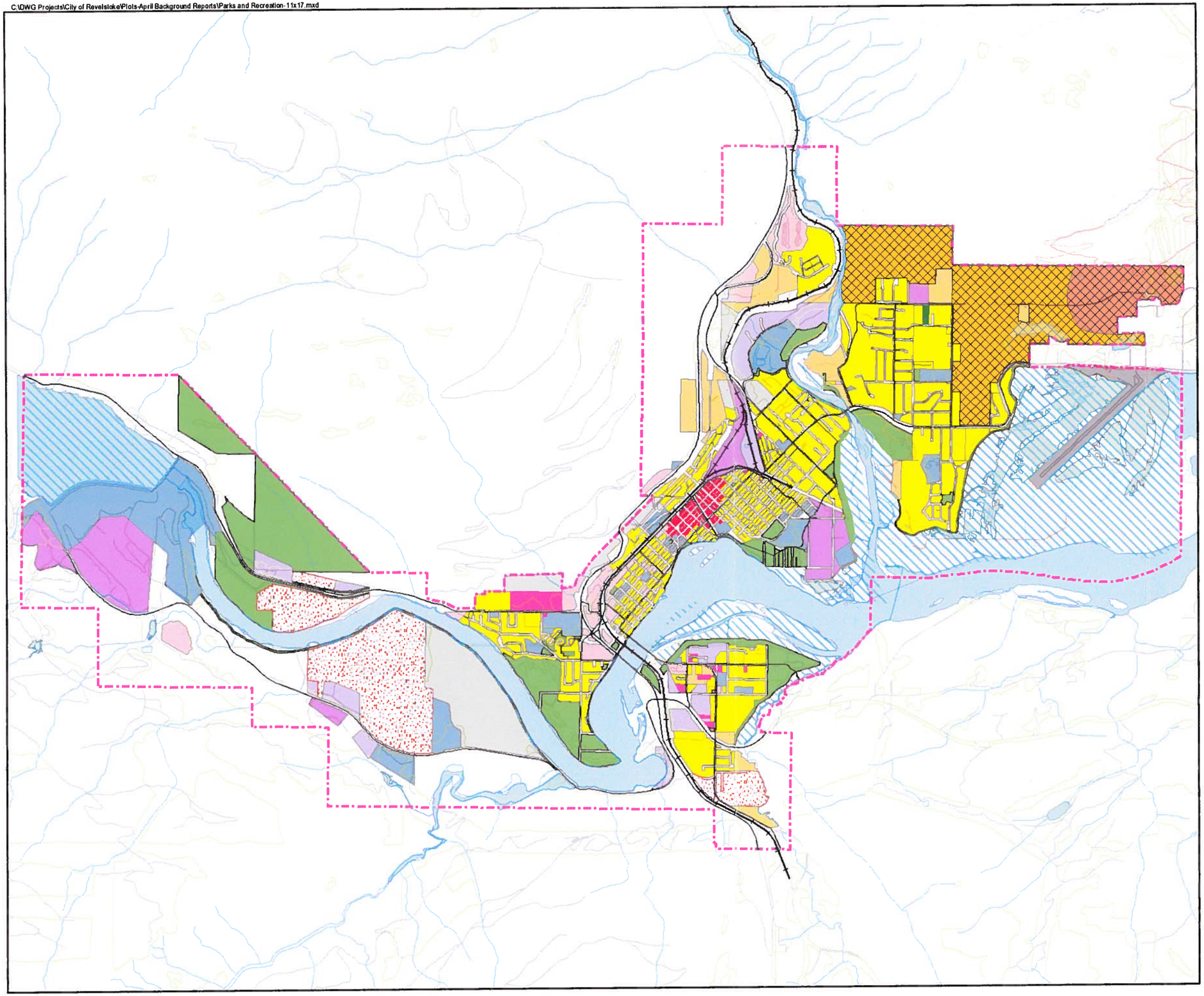


City of Revelstoke

City of Revelstoke
OCP Comprehensive Review
May 2007

Legend

- City Boundary-2007
- Main Transportation Routes
- Rail Line
- Lakes, Rivers and Creeks
- Marshes

OCP Land Use

- Residential
- Rural Residential
- Neighbourhoods
- Resort Cores
- Resort Lands
- Public & Institutional
- Central Business District Commercial
- Neighbourhood Commercial
- Highway Commercial
- Service Commercial
- Light Industrial
- Heavy Industrial
- Airport Industrial
- Urban Reserve
- Parks and Trails
- Agricultural
- Sand & Gravel
- Reservoir Drawdown

BHA The Resort Planning Group
Brent Harley and Associates Inc.

N

1:40,000

0 500 1,000 1,500 2,000 2,500
Meters

Existing Land Use

FIGURE 3-1

population of 3,100 to 5,000 or 6,000 people will require sewer servicing of this area. Servicing of Arrow Heights will be facilitated by the trunk sewer that will be constructed to service the Revelstoke Mountain Resort and the lift station at the Illecillewaet River (see Section 3.1.2 below).

3.1.2 Revelstoke Mountain Resort (RMR)

Considerable development is expected to occur in the near future at Revelstoke Mountain Resort (RMR). The recreational area is about 4,450 ha (USL 1990), adjacent to the Arrow Heights area on the west slope of Mt. Mackenzie. The resort area includes about 200 ha (OCP). Several studies were conducted for the development of RMR including use of the City treatment facility, or construction of an independent treatment facility that discharged to ground (rapid infiltration) or to the Columbia River, or produced reclaimed water for snowmaking.

The City recently completed a formal agreement to accept the RMR wastewater at the City of Revelstoke WWTP. Since the trunk sewer will pass through the Arrow Heights area, this will facilitate servicing of Arrow Heights.

3.1.3 Big Eddy

The Big Eddy area has poor drainage conditions and is potentially unsuitable for ground disposal of wastewater. Sewer servicing of this area would allow potential development. The City is currently evaluating provision of sewers to the Big Eddy area.

For the purpose of the LWMP, Big Eddy was included in the service population projections (Table 3-1 in Section 3.1). In previous sewage treatment planning for the City, Big Eddy was not included as part of the wastewater treatment or water service area until after 2025 (see Stage 1 LWMP, references Dayton & Knight Ltd., 2006c, 2006d, 2006e, 2006f, 2007). The timing for servicing of Big Eddy has not been determined.

3.1.4 Clearview Heights, CPR Hill

The City of Revelstoke determined that septic tank failures are potentially occurring in the Clearview Heights development. The City examined the drainage from the area and found it to contain high numbers of coliforms that suggest failure of the septic drainage system. The City then completed a study to explore the feasibility and cost of providing sewer service to the Clearview Heights area. The residents of Clearview Heights have petitioned the City for sewer service. Detailed design of sewer service for Clearview Heights has been completed; construction of the sewers was cancelled based on the results of a survey of property owners. Recent funding provided by the Province of B.C. however, allowed the construction to go forward in 2010.

3.2 Existing and Projected Wastewater Quantity and Quality

Influent flow data at the WWTP from 2000 to 2006 were analyzed in the Stage 1 LWMP to develop per capita flow rates for the City of Revelstoke. The average day influent flow was about 470 litres per capita per day over the period of record. The average dry weather flow, which was calculated as the minimum 60-day moving average flow for each year, was about 410 litres/capita/day over the six years of record. The average of the maximum day flow recorded during this period was about 790 litres/capita/day.

The projected wastewater flows to the planning horizon of 2025 based on the per capita flow rates developed in the Stage 1 LWMP and the projected populations from Table 3-1 are summarized in Table 3-2. As shown, the plant average day flow is projected to increase from 2,940 m^3/d in 2006 to about 7,400 m^3/d in 2025 (including flows from RMR), and to 10,000 m^3/d at build-out. Flows from the Queen Victoria Hospital are estimated to increase from about 45 m^3/d in 2006 to 65 m^3/d in 2025 (these flows have been included in the City flows in Table 3-2).

TABLE 3-2
PROJECTED WASTEWATER FLOWS 2006 TO BUILD-OUT

Year	Service Population[1]		Wastewater Flow Rate, City[2] (m^3/d)				Wastewater Flow Rate, City + RMR[3] (m^3/d)			
	City	City + RMR	Average Day	Average Dry Weather	Average Wet Weather	Maximum Day	Average Day	Average Dry Weather	Average Wet Weather	Maximum Day
2006	6,430	6,430	2,940	2,660	3,410	4,830	2,940	2,660	3,410	4,830
2010	8,800	10,300	4,190	3,660	4,710	7,000	4,560	3,980	5,220	7,690
2015	9,700	13,500	4,610	4,030	5,200	7,720	5,560	4,850	6,470	9,450
2020	10,700	17,700	5,090	4,450	5,730	8,510	6,840	5,960	8,080	11,700
2025	11,200	19,500	5,330	4,660	6,000	8,910	7,400	6,450	8,790	12,700
Build-out	12,500	29,000	5,880	5,130	6,630	9,880	10,000	8,690	12,170	17,400

1 from Table 3-1

2 using average of per capita flows from Stage 1 LWMP plus allowance for Queen Victoria Hospital

3 using average of per capita flows from Stage 1 LWMP, with the exception of RMR: The unit wastewater flows from ten years of flow data recorded at the Whistler WWTP (1993 through 2002) were used for the RMR: ADWF = 216 L/c/d, AWWF = 336 L/c/d, MDF = 456 L/c/d. AAF = 250 L/c/d (D&K 2006).

For the purposes of this LWMP, the design influent concentrations of 200 mg/L TSS and 200 mg/L BOD_5 were adopted for projecting future wastewater mass loads of BOD_5 and TSS. Composite sampling of the WWTP influent should be implemented as proposed in earlier studies, to confirm wastewater quality; this information is important to ensure cost-effective design of future treatment facilities.

The alkalinity in the influent wastewater is about 150 mg/L. The effluent alkalinity is less than 60 mg/L during the fall. Destruction of alkalinity through the lagoon system is attributed to bacterial oxidation of ammonia (nitrification) during warm summer weather, which produces acidity; this has caused low pH in the plant effluent (less than pH 6 during summer). Future upgrades may need to include consideration of biological denitrification to recover alkalinity or chemical addition (e.g. lime) to ensure that acidic conditions do not develop during summer and negatively impact biological treatment.

3.3 Inflow and Infiltration

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

The Municipal Wastewater Regulation (MWR) for British Columbia states that, where the maximum day flow at the WWTP exceeds 2.0 times the average dry weather flow (ADWF) during rain or snowmelt events, and if the contributory population exceeds 10,000 persons, the discharger should show how I&I can be reduced as part of a LWMP. The ADWF in the City system for the six year period from 2000 to 2006 was analyzed in the Stage 1 LWMP. The ADWF was estimated as the minimum 60-day moving average of the daily flows recorded in a given year. The ADWF occurs between November and April, and the high flows typically occur during July or August. The ratio of MDF and ADWF for the years 2000 to 2006 exceeded 2:1 in 2003 and 2005. This indicates that I&I to the collection system based on the flows recorded at the WWTP is high according to the MWR criterion.

A recent study of I&I in the City system was based on flow data collected for six sites from February 21 to March 10, 2006 and from March 24 to April 17, 2006. The study showed that ground water infiltration made up 34% to 77% of the dry weather flow. This is in line with observations of high groundwater within the City. The I&I rate averaged 17,500 L/ha/d, which is relatively high compared to the value of 5,620 L/ha/d contained in City of Revelstoke Bylaw No. 1270, and to the typical design value of 0.17 L/s/ha (or 14,700 L/ha/d) for new sewers (from the Master Municipal Construction Documents, Design Guideline Manual). The high observed I&I may be due to the fact that some sections of the City's sewer collection system use combined sewer lines (e.g., the downtown part of the Downie sub-area), or it may be due to the age of the system (Dayton & Knight., 2007).

3.4 Onsite Systems and Commercial/Industrial Wastewater

In the City of Revelstoke, approximately 2,300 residents, as well as some commercial and tourist facilities, have onsite wastewater treatment systems (i.e., septic tanks with ground disposal fields). Residents with onsite treatment systems in 2001 were distributed as follows: Arrow Heights 1,200; Big Eddy 1,000; Clearview Heights (CPR Hill) 50 to 100;

and Alpine Lane 50. The annual septage disposal volumes are not known, but have been estimated at about 1,800 m^3/year with 3.4 % solids content (USL, 2001).

No data regarding the characteristics of septage in the study area were available. Typical characteristics for septage from properly functioning residential onsite systems are shown in Table 3-3. According to USEPA (1984), "Septage facility designers should be cognizant of the fact that highly contaminated industrial sludges, sometimes disposed of together with domestic septage, can severely upset treatment processes. Monitoring programs aimed at detecting such illegal discharges should be strongly encouraged. The treatment facility should be designed to minimize the effects of such upsets".

TABLE 3-3
TYPICAL CHARACTERISTICS OF DISCHARGES FROM RESIDENTIAL ONSITE SYSTEMS (FROM METCALF & EDDY, 1991)

Parameter	Septage (milligrams/litre)
BOD_5	6,000
Total Suspended Solids	15,000
Total Nitrogen as N	700
Ammonia Nitrogen as N	400
Total Phosphorus as P	250
Grease	8,000
Heavy Metals (primarily iron, zinc, and aluminum)	300
Fecal Coliforms	NR

3.5 Criteria for Treated Wastewater

The criteria for treated wastewater as set out in the B.C. Municipal Wastewater Regulation (MWR) and the new federal Wastewater Systems Effluent Regulations (now in force) are proposed for adoption in the Stage 2 LWMP; (see Stage 1 LWMP Dayton & Knight Ltd. report for more detail). The MWR includes criteria for discharges to surface water and to ground, as well as for reclaimed water. The MWR criteria were summarized in the Stage 1 LWMP report (Dayton & Knight Ltd., 2008 – note that at that time the regulation was called the Municipal Sewage Regulation). Additional restrictions may be

imposed by the Ministry of Environment (MOE) if warranted by environmental studies. An Environmental Impact Study (EIS) for the existing effluent discharge to the Illecillewaet River was carried out in 2002 (Masse, 2002); the EIS was recently updated and expanded as a component of the Stage 2 LWMP (Masse & Miller, 2008); the results of these studies are discussed in Sections 6.3 and 6.4 of this report.

Since the completion of Stage 1, the CCME Canada-wide Strategy for the Management of Municipal Wastewater Effluent was published and effluent discharge criteria and monitoring requirements must also meet the new federal Wastewater System Effluent Regulations. Table 3-4 provides a comparison of the current Permit, MWR and the federal standards as they apply to the Revelstoke WWTP effluent. Once the Stage 3 LWMP is approved, the WWTP Permit will be replaced by an Operational Certificate.

TABLE 3-4
EFFLUENT REQUIREMENTS FOR DISCHARGES TO SURFACE WATERS

Flows m^3/d Dilution	Permit PE 02147			Provincial MWR (2012)			Federal WSER (2012)	
		Type	Frequency		Type Cont	Frequency Daily		Frequency Daily
BOD_5 mg/L	45 max	Grab	Monthly	45[1] max	Grab	Weekly	25 (2 week average)	Every 2 weeks
TSS mg/L	60[3] max	Grab	Monthly	60[1, 3] max	Grab	Weekly	25 (2 week average)[(4)]	Every 2 weeks
NH_3-N mg/L	Not Required	-			Grab	6 times / year	Not specified	
PO_4-P mg/L	Not Required	-		0.5[(1)]	Grab	6 times / year	Not specified	
TP mg/L	Not Required	-		1.0[(1)]	-	-	Not specified	
Coliforms (see Stage 1 Table 9-2)	Not specified	Grab	Monthly	200 MPN/100 mL	Grab	Monthly	Not specified	
Toxicity	Not Required	-	-	96 hr LC 50	Grab	Annual	Chronic and toxic	Quarterly
Residual Chlorine mg/L	0.5 to 1 mg/L	-	-	-	-	-	0.02	Daily
Reporting	-	-	Monthly	-	-	Twice annually	-	Quarterly

1 To achieve 45 mg/L maximum as 99.7% effluent quality, the average should not exceed 16 mg/L
To achieve 60 mg/L maximum as 99.7% effluent quality, the average should not exceed 22 mg/L
2 If dilution is less than 100:1 but greater than 10:1, an environmental impact study is required to demonstrate allowable discharge.
3 TSS is 60 mg/L for Lagoon discharge only; all other 45 mg/L.
4 Total TSS may exceed 25 mg/L if exceedence is caused by algae.

4.0 SOURCE CONTROL AND WASTEWATER VOLUME REDUCTION

This section contains a summary of options for source control of contaminants and reduction of wastewater volume that were advanced from the Stage 1 LWMP for evaluation and selection in Stage 2. The selected options were based on consultation among the Project Team, the Joint Advisory Committee and the public. More detail can be found in the Stage 1 report (Dayton & Knight Ltd., 2008).

4.1 Source Control

The City should undertake a review of Sanitary Sewer Connection Bylaw No. 1683-2002 to ensure that all of the needed components are in place to protect biosolids quality, as well as to protect the biological processes at the WWTP and to enhance the quality of the WWTP discharge. The review should include evaluation of Prohibited and Restricted Wastes as well as metals limits, and the outlining of a strategy to implement a monitoring and enforcement program that could include identification of industrial/commercial/ institutional discharges, the need for industry sector Codes of Practice, and education for business/industry and the public.

The alternatives listed below for review of Bylaw No. 1683-2002 should be considered for adoption in the Stage 2 LWMP.

1. Review the standards for prohibited and restricted wastes in comparison with the CCME Model Bylaw and those for other jurisdictions. Revise the standards if warranted.

2. Consider including a clause in Bylaw No. 1683-2002 setting out requirements for Discharge Permits for industrial, commercial and institutional discharges to the sanitary sewer system. This should include specifying surcharges for discharge of high strength wastes to the sanitary sewer system serving the WWTP based on the strength of the waste and the cost of treatment.

3. Consider undertaking an inventory of commercial and industrial dischargers to the sanitary sewers (and storm drainage systems), to assist in identifying potential dischargers of problem contaminants and in focusing regulatory and educational source control approaches (e.g., consideration of Codes of Practice). The inventory should coordinate with management of storm runoff.

4. Consider the development of Codes of Practice for specific categories of numerous small volume dischargers if these are identified within the City (e.g. restaurants for source control of oil and grease), to simplify regulation and enforcement of source control bylaws.

5. Continue to develop a public and private sector education program, to encourage source control of contaminated discharges to the sanitary sewer (and storm drain) systems. Include source controls in a broader education program that includes water conservation and solid wastes. Existing educational resources which might be suitable for delivering messages and information on liquid waste issues should be identified. Possible resources and methods which are suited to public education and involvement in liquid waste management planning issues are as follows:

    - mailing lists for communicating liquid waste management planning activities (to interested parties) can be developed from lists created for other purposes, from sign-

up attendance sheets at public meetings, and from blanket mailings with return cards;

- brochures, flyers, fact sheets and newsletters can be used for providing information on project updates, meetings, workshops and events, and liquid waste management issues in general, (should be planned in advance as a coordinated package with similar graphics and style, and should be designed to capture the readers' attention and explain the importance of the enclosed information);

- field trips to provide first hand demonstrations of liquid waste management problems and solutions within a study area (should be carefully planned and routes driven beforehand, and should take into account the physical condition of the participants - knowledgeable speakers and maps and handouts should be available to describe each stop, and time for questions and discussion should be allowed);

- displays at public functions and events, at conferences, and in schools can be used to describe liquid waste impacts and issues (messages should be kept simple to encourage casual readers, and displays should be staffed if possible);

- surveys to educate, gather information, and assess the level of understanding and support for liquid waste issues within the community (follow-up by letter or telephone will generally increase the response rate);

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

- involvement of the local news media can be important in educating the public on liquid waste issues and planning, gathering public support, and publicizing meetings

and events (personal contacts should be developed with members of the media for maximum effectiveness);

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

- speaking engagements, including videos and slide shows, can be designed to inform large audiences about liquid waste problems and solutions;

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

- education programs should be designed to provide particular groups with appropriate messages and information, and should be uncomplicated, non-technical, and free of jargon (specific audiences should be identified, and appropriate messages and information targeted for those audiences developed - a focus on local issues helps to promote a sense of place; but, a common direction for the entire study area should be apparent - cooperation should be encouraged among all parties interested in or affected by the Liquid Waste Management Plan); and

- interesting and innovative activities which involve people and lead to action will encourage public support and participation (local environmental groups should be encouraged to participate in the education program).

4.2 Wastewater Volume Reduction

Wastewater volume reduction efforts should include water conservation to reduce sewage volumes. The City has identified a number of water conservation measures for implementation; those that will potentially affect wastewater volumes are as follows:

- work with schools to undertake a water conservation awareness program;
- continue to publish the Water Works newsletter twice a year;
- attend the local trade show and farmers market (2-3 times a season) to provide education material and xeriscaping, landscape, irrigation, (retrofit kits, rain barrel program) various conservation initiatives, etc.;
- begin a "rebate program" commencing 2008, including a retrofit kit rebate ($75 per kit) and a rain barrel program (offer rain barrels at a subsidized cost) on a first come basis within the proposed budget, and work with Terasen Gas and BC Hydro in a joint project (budget $10,000 per year);
- include bill stuffers on water conservation in the annual tax notices ($1,500 to $2,000);
- establish annual and peak day reduction targets for the next five years, track daily demands and implement further conservation measures as needed;
- amend the Building Bylaw to require ultra low flush toilets and reduced water use fixtures for all new buildings;
- require all new development to install water meters and amend water rates to incorporate a two tier billing system (with or without meters); and
- encourage a voluntary meter installation program in existing buildings (e.g., residents pay the cost of the meter; the City pays the cost to install).

5.0 STORMWATER MANAGEMENT

The stormwater management initiatives listed below were advanced from the Stage 1 LWMP in consultation with the Joint Advisory Committee and the public. Suggested budgets are for consultant assistance and do not include City staff time.

1. Existing drainage studies and plans developed by the City should be updated and consolidated, with the ultimate objective of developing an up-to-date comprehensive Master Stormwater Management Plan (SMP) for the entire study area. The SMP should include consideration of land use according to the Updated Official Community Plan and drainage improvements already undertaken. The SMP should also set priorities for additional studies for individual watersheds, with the highest priority set on areas that are expected to undergo significant development or redevelopment and where sensitive environmental resources have been identified (see Item 2). Priorities for stormwater management planning should ensure that detailed watershed studies are conducted in advance of development. Planning should include consideration of the effects of frequent small storms as well as larger, infrequent storms. Budget $100,000 for the SMP. Detailed studies for designated (priority) areas and catchments can vary in cost from $5,000 to $50,000 or more, depending on the scope of work and level of detail required.

2. The environmental resources identified in the Stage 1 LWMP (e.g., unconfined aquifers, sensitive streams and habitat) should form an integral part of drainage planning and development planning within the City. Natural drainage features such as wetlands,

groundwater recharge/discharge areas, and stream corridors should continue to be preserved whenever possible. This approach will minimize the need for manmade drainage structures, thereby reducing costs, and helping to preserve the natural environment. Drainage planning and development planning should be undertaken together, so that drainage issues and protection of natural drainage features such as wetlands and groundwater recharge areas can be considered while the development site plan is being developed. The City should undertake a review of existing development application approval procedures to ensure that planning, engineering, and operations issues are all considered at an early stage in the development application process. Budget $25,000.

3. A storm drainage bylaw and accompanying enforcement policy should be developed, to ensure that the City has the authority to regulate all aspects of stormwater management, including flood control, erosion control, and water quality. The bylaw should consolidate drainage design criteria (see Item 2 above) as well as other aspects of drainage, and should also ensure that sensitive environmental resources such as fisheries streams and groundwater can be protected from spills and contaminated runoff (e.g., from commercial/industrial sites). The City's drainage design criteria for subdivision servicing should also be reviewed, to ensure that they are in accordance with current drainage practice and regulatory requirements. Detailed criteria should be developed for both major and minor drainage systems. Budget $30,000.

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

5. The source control education program described in Section 4.1(5) should include stormwater issues.

6. The inventory of non-domestic dischargers to the sanitary sewer system (see Section 4.1(3)) should include potential contaminant sources of storm runoff (e.g. vehicle repair yards, outdoor lumber storage, etc.).

6.0 WASTEWATER COLLECTION AND TREATMENT

6.1 Options Considered In Stage 1 LWMP

The options for wastewater collection and treatment described below were considered and discussed by the LWMP Joint Advisory Committee (JAC) and by interested members of the community at a Public Open House during the Stage 1 LWMP (see the LWMP Stage 1 report for detailed description of the options). The following elements were common to all of the options:

- areas within the City where the continued use of onsite (ground disposal) systems was considered feasible were Arrow Heights, Revelstoke Mountain Resort (RMR) and the Airport Bench;
- RMR is to be provided with a sewer collection system connecting to the City of Revelstoke system;
- wastewater from Queen Victoria Hospital to be connected to the trunk main that will serve RMR;
- since the main sewer connecting RMR to the City system passes through Arrow Heights, sewer service will be available to Arrow Heights;
- connect Big Bend to existing system (private development);
- connect Clearview Heights/CPR Hill to existing system (now completed); and

- there were reported concerns with water quality and shallow wells in the Airport Bench area, which may constrain the long term future use of onsite systems in this area.

Option 1: Expand and upgrade the existing collection system and the WWTP to serve the entire City of Revelstoke, including Big Bend and Clearview Heights developments, Big Eddy, Arrow Heights, and Revelstoke Mountain Resort (RMR). Convert the existing aerated lagoon process to a more space-efficient mechanical process when required to meet the needs of population growth (estimated to occur when the City and RMR service population reaches about 13,500); the schedule will depend on growth and the timing of connecting new service areas such as Big Eddy). Consider extending the outfall discharge to the Columbia River depending on the results of environmental studies.

Option 2: A new site for the WWTP would be identified near the Downie Street Mill. The new WWTP would accommodate the entire City of Revelstoke (including Big Bend and Clearview Heights developments), Big Eddy, Arrow Heights, and Revelstoke Mountain Resort (RMR).

Option 3: Maintain the existing WWTP aerated lagoon system to serve a part of the City of Revelstoke, Arrow Heights and RMR, and construct a new WWTP near the Downie Street Mill to accommodate the remainder of the service area (the Big Bend and Clearview Heights developments, and Big Eddy).

Option 4: Construct a new WWTP to serve only Big Eddy (site to be determined). The existing WWTP would be upgraded and expanded as in Option 1 to serve the remainder of the City of Revelstoke, including Big Bend and Clearview Heights developments, Arrow Heights, and Revelstoke Mountain Resort (RMR). As in Option 1, this would entail conversion of the aerated lagoons to a mechanical treatment plant as flows increase.

Option 5: Similar to Option 4, except that the new WWTP at Big Eddy would also serve the northern part of the City of Revelstoke.

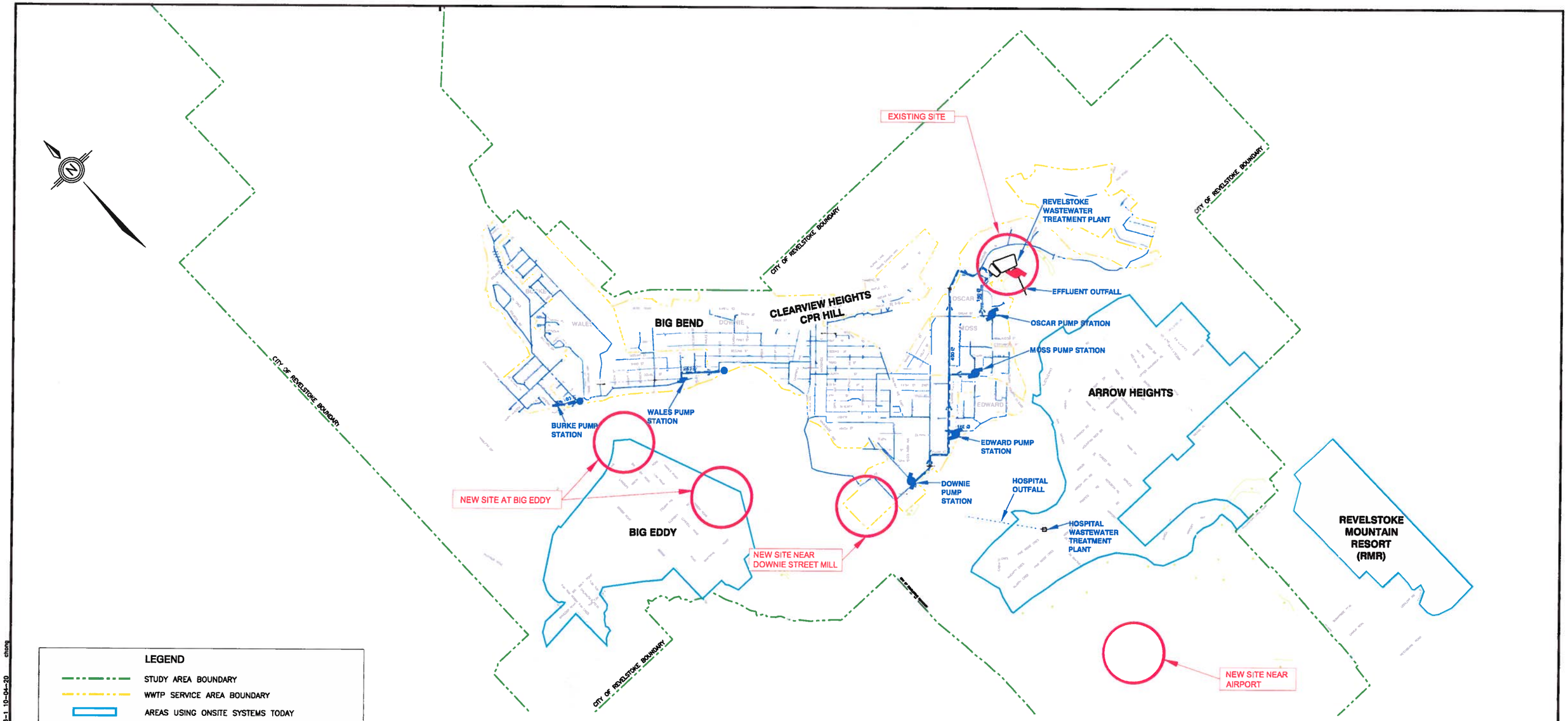
Option 6: Expand and upgrade the existing WWTP to mechanical treatment to serve the City of Revelstoke, including Big Bend, Clearview Heights and Big Eddy, and construct a new WWTP near the Airport to serve Arrow Heights and RMR.

Option 7: Upgrade the existing WWTP to ensure service to the City of Revelstoke including Arrow Heights and RMR for the short term future (until the service population reaches about13,500 (City + RMR); no expansion of the existing WWTP would be undertaken, and a new WWTP would be constructed near the Airport to eventually accommodate the entire service area: the City of Revelstoke (including Big Bend and Clearview Heights developments), Big Eddy, Arrow Heights, and Revelstoke Mountain Resort (RMR). A new outfall to Upper Arrow Lake would be required.

The alternative sites for a new WWTP that were considered in the Stage 1 LWMP as described above are illustrated on Figure 6-1.

Following extensive internal discussion and the Public Open House held during the Stage 1 LWMP, the Joint Advisory Committee selected Option 1 for advancement to the Stage 2 LWMP. Option 1 is to expand and upgrade the existing collection system and the WWTP at the existing site to serve the entire City of Revelstoke, including Big Bend, Clearview Heights, Big Eddy, Arrow Heights, and Revelstoke Mountain Resort (RMR). The other options were dropped from consideration for the following reasons:

- poor ground conditions, geo-tech work would be required;
- areas presently have high recreational use;
- environmental and habitat concerns;
- odour concerns with some sites (proximity to high population areas and prevailing winds in the area);
- high costs; and
- difficulty in gaining public support based on the above.



LEGEND

- STUDY AREA BOUNDARY
- WWTP SERVICE AREA BOUNDARY
- AREAS USING ONSITE SYSTEMS TODAY
- EXISTING PUMP STATION
- EXISTING FORCEMAIN
- EXISTING GRAVITY SEWER
- EXISTING WASTEWATER TREATMENT PLANT

CITY OF REVELSTOKE

STAGE 2- LIQUID WASTE MANAGEMENT PLAN

OPTIONS FOR WASTEWATER COLLECTION AND TREATMENT

ALTERNATIVE WWTP LOCATIONS CONSIDERED IN STAGE 1 - LWMP

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CONSULTING ENGINEERS
DRAWN BY: CWW
DWG. No. 1.50.201

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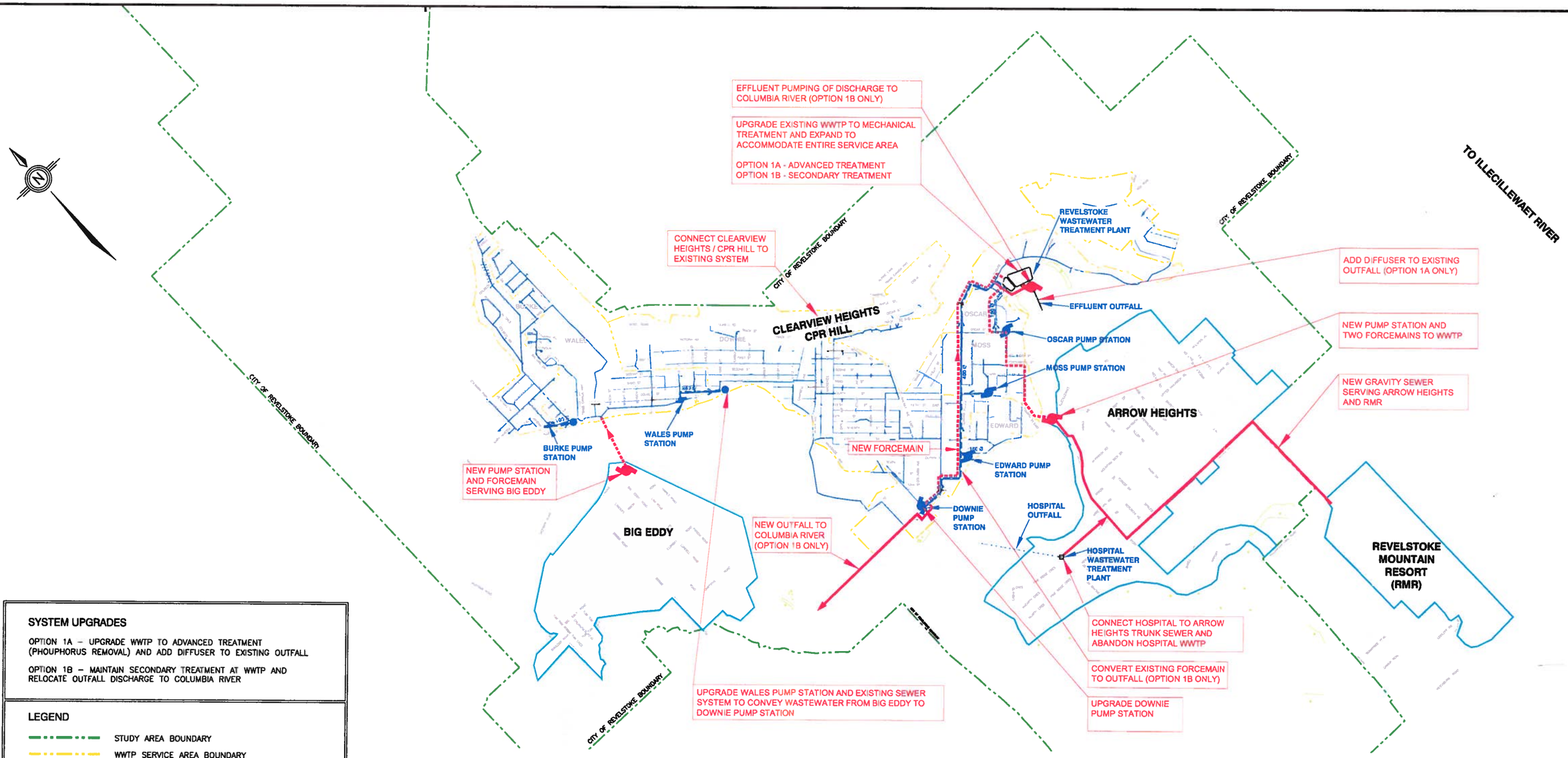
FIGURE 6-1

The JAC also identified the need to include a commitment in the LWMP for the City to carry out a formal WWTP siting study, to determine if an alternative site might better serve the City's needs for the long term future.

6.2 Selected Option 1: Expand and Upgrade Existing WWTP to Accommodate Entire Service Area

A concept layout for the selected Option 1 is illustrated on Figure 6-2. The Sub-Options 1A and 1B illustrated in Figure 6-2 are explained in Section 6.6. As noted in Section 6.1, Option 1 would require expansion and upgrading of the existing wastewater treatment process from aerated lagoons to a mechanical treatment plant to accommodate growth, since the site is not sufficient in size to use expanded lagoon technology for the long term future. Construction of the mechanical plant is estimated to be needed when the total service population (City + RMR) reaches about 13,500; the timing will depend on population growth and the addition of new service areas such as Big Eddy. The existing outfall to the Illecillewaet River may have to be abandoned because of the insufficient dilution of discharged water in the river; if this is the case, a new pump station and a new outfall may be required to discharge into the Columbia River. Alternatively, it may be possible to add an advanced level of treatment at the WWTP, and continue to discharge the treated wastewater at the existing outfall location. The two alternatives are examined on the basis of cost and environmental impact later in Section 6.

The main influent pump station at Downie Street has been upgraded to accommodate increasing flows and to protect the Columbia River from potential overflows of untreated wastewater from the pump station during wet weather (upgrading of the forcemain is still required). A new pump station at Arrow Heights with two forcemains of 300 mm diameter to the WWTP has now been constructed, with a gravity connection from RMR to Arrow Heights. A new pump station and forcemain will connect Big Eddy to the existing system; an upgrade of the existing Wales Pump Station and parts of the existing sewer system to convey additional wastewater from Big Eddy to the Downie Pump Station will also be required. Wastewater from Queen Victoria Hospital is connected to



SYSTEM UPGRADES

OPTION 1A – UPGRADE WWTP TO ADVANCED TREATMENT (PHOUPHORUS REMOVAL) AND ADD DIFFUSER TO EXISTING OUTFALL

OPTION 1B – MAINTAIN SECONDARY TREATMENT AT WWTP AND RELOCATE OUTFALL DISCHARGE TO COLUMBIA RIVER

LEGEND

- STUDY AREA BOUNDARY
- WWTP SERVICE AREA BOUNDARY
- AREAS USING ONSITE SYSTEMS TODAY
- EXISTING PUMP STATION
- EXISTING FORCEMAIN
- EXISTING GRAVITY SEWER
- EXISTING WASTEWATER TREATMENT PLANT
- NEW PUMP STATION
- NEW FORCEMAIN

Dayton & Knight Ltd.
CONSULTING ENGINEERS
DRAWN BY: CW
DWG. No. 1.50.201

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CITY OF REVELSTOKE
STAGE 2 - LIQUID WASTE MANAGEMENT PLAN
OPTIONS FOR WASTEWATER COLLECTION AND TREATMENT

OPTION 1A AND 1B - EXPAND AND UPGRADE EXISTING WWTP TO ACCOMMODATE ENTIRE SERVICE AREA

FIGURE 6-2

the trunk main that serves RMR. Big Bend will be connected to existing system (private development). Clearview Heights/CPR Hill has now been connected to the existing system.

Option 1 will require upgrades to some sections of the trunk sewer system to accommodate the flows associated with the LWMP horizon service population of 19,500; all upgrades should be designed to accommodate build-out flows (service population 29,000). Option 1 was previously investigated by the City, although Big Eddy was not included in the service area, and the population estimates that were used do not match the current OCP update. The estimated cost for the original concept Option 1 was $18.7 million (2006 dollars) to serve 17,000 population equivalents; this was subsequently updated for DCC use to $23.5 million (2008 dollars). These earlier cost estimates did not include extension of the outfall discharge to the Columbia River, or advanced treatment at the WWTP, although they did include the addition of a diffuser to the existing outfall discharging to the Illecillewaet River.

6.3 Environmental Impacts of Existing Outfall Discharge to the Illecillewaet River

An Environmental Impact Study (EIS) was conducted for the discharge from the existing WWTP in 2002. The findings of the 2002 EIS were as follows (Masse, 2002):

6.3.1 Dilution

The dilution ratio calculations were based on the existing bank discharge. Under the "worst case" scenario, the CORMIX model calculation resulted in a dilution ratio of 28:1. The Municipal Wastewater Regulation (MWR) states that "If the dilution ratio is below 40:1 and the receiving stream is used for recreational or domestic water extraction within the influence of the discharge, discharge is not authorized unless an environmental impact study shows that the discharge is acceptable, and, in the opinion of the manager, no other solutions are available, and written authorization from the manager is obtained"

(Schedule 3, Explanatory Notes 3). The MOE discharge permit for the WWTP authorizes the discharge.

6.3.2 Water Quality

In general, the water quality downstream of the sewage treatment plant outfall at the edge of the initial dilution zone (IDZ) was found to be satisfactory, and all Provincial Water Quality Guidelines were met. However, there were significant differences between the control (upstream) site and the downstream site for several parameters such as nitrate, dissolved chloride, sodium, *chlorophyll a* and benthic invertebrate community composition. Although the Provincial Water Quality Guidelines were met at the edge of the IDZ, the changes in species composition and increase in algal growth may be indicative of low chronic exposure.

6.3.3 Outfall Design

To increase the dilution capacity during extreme low flows in the river and to ensure that the outflow is submerged all year round, it was recommended that the bank discharge outfall be replaced with a diffuser securely fixed to the bottom of the Illecillewaet River.

6.4 Environmental Impacts of Projected Future Outfall Discharge to Illecillewaet River

The 2002 EIS was updated in 2008, and the evaluation was extended to include the impacts of projected future increases in discharge flow rate from the WWTP. The findings of the 2008 EIS update are summarized below:

6.4.1 Dilution

Increased sewage discharge volumes in the future will increase the nutrient load to the receiving environment, which is expected to increase the degree of impact. Reducing the

level of nutrients in the effluent, or increasing the available dilution through the use of a diffuser, are two ways that may reduce the effect of the discharge on the receiving environment in the Illecillewaet River. As the minimum available dilution in the Illecillewaet River is relatively low, and an impact due to the discharge is currently observed, some concern has been raised about the suitability of the current outfall location. Under the Municipal Wastewater Regulation (MOE, 2012), discharge to a receiving environment with a dilution ratio of <40:1 is prohibited '*unless no unacceptable environmental impact and that there are no other practical solutions*'. Continued use of this location is likely to depend on demonstrating that the level of impact remains limited to an increase in biological productivity.

While the characteristics of the wastewater are not expected to change significantly, effluent volumes at the sewage treatment plant are expected to increase in the future, with the addition of the Revelstoke Mountain Resort development and areas that are currently not serviced by the treatment plant. The projected effluent volume under a variety of scenarios is summarized in Table 6-1. It was assumed that a diffuser would be added to the outfall before 2015, which will allow for a higher dilution ratio in the receiving environment compared to the current bank discharge.

TABLE 6-1
PROJECTED EFFLUENT DISCHARGE VOLUME AND MINIMUM DILUTION IN THE ILLECILLEWAET RIVER

Year	Average Day Flow		Maximum Flow	
	Discharge (m^3/d)	Minimum Dilution[1]	Discharge (m^3/d)	Minimum Dilution[1]
Current	2,944	--	4,825 (max day)	28:1[2]
2015	5,560	38:1 (est)	7,000 (max week)	30:1
2025	7,400	27:1	10,320 (max week)	20:1

[1] assumes a diffuser is installed before 2015
[2] no diffuser is currently in use; discharge is perpendicular to the river bank (RHS) as a side water discharge

6.4.2 Water Quality

In general, the water quality downstream of the sewage treatment plant outfall at the edge of the initial dilution zone appeared to meet all the British Columbia Water Quality Guidelines. Although the final sampling schedule used in the 2008 EIS update did not allow direct comparison with the Guidelines, the range of values obtained for each parameter were all well within the relevant Guideline. Significant differences between upstream and downstream sites were observed for ammonia and phosphorus.

The WWTP effluent currently meets or exceeds the standards required under the MWR (MOE,2012), with the exception of the total phosphorus and orthophosphate standards. Phosphorus from the effluent is suspected to be the primary cause of the increase in abundance found in the *periphyton* and benthic communities downstream of the outfall. *Periphyton* biomass and benthic invertebrate abundance were all higher at the downstream site compared to the upstream site. In addition, analysis of N:P ratios indicated that the downstream site was largely nitrogen limited, whereas the upstream site was phosphorus limited. The increased productivity downstream of the outfall was consistent with the input of nitrogen and phosphorus nutrients from the effluent, while the change in the limiting nutrient was consistent with the relatively higher levels of phosphorus in the effluent. Although the main effect of the effluent was an increase in productivity, the effluent did not appear to have an effect on the community composition at the downstream site. This was probably because the Illecillewaet River is a cold, fast flowing river with naturally low levels of nutrients. Hence, the input of nutrients from the discharge has increased productivity but has not led to any sign of eutrophication. The WWTP discharge volume is expected to increase in the future.

The 2002 EIS identified replacing the current outfall with a diffuser secured to the bottom of the Illecillewaet River as a means of increasing the available dilution. As the main effect of the discharge seems to be increased productivity due to the input of nitrogen and phosphorus nutrients from the effluent, a reduction in these nutrients would also reduce some of the observed effects. As the available dilution is less than 100:1 and the

discharge does have an effect on the receiving environment, a toxicity test on the effluent is recommended. This sample should be collected during the summer, when ammonia concentrations in the effluent are expected to be the highest.

Projected effluent quality is summarized in Table 6-2. Given that the effluent quality is expected to be similar to that observed at present, and the minimum available dilution with a diffuser is similar to what was calculated in the original study (Masse, 2002), it is unlikely that any water quality guidelines would be exceeded at the edge of the initial dilution zone under the proposed future effluent flows. However, since an impact (increased productivity) has already been observed in the Illecillewaet River downstream of the outfall, it is expected that an increase in discharge volume would increase this impact. The current impacts appear to be of limited consequence for the biological community residing in the river, although this must be confirmed under late winter/early spring conditions, when the available dilution is lowest. It should be noted that large-scale fertilization projects, primarily supplying phosphorus, are on-going in both Kootenay Lake and the Arrow Lake Reservoirs. However, as effluent volumes increase, the capacity of the environment to absorb excess nutrients may decline and reach a threshold. From a biological perspective, an unacceptable impact is one where the community composition begins to change.

TABLE 6-2
PROJECTED EFFLUENT QUALITY

Effluent Parameters	Effluent Concentration
Phosphorus without P removal (mg/L P)	Total = 4, ortho = 3.5
Phosphorus with P removal (mg/L P)	Total = 1, ortho = 0.5
Nitrite (mg/L N)	Below detection limits
Nitrate (mg/L N)	Summer = 25, winter = 5
Ammonia (mg/L N)	Summer = 5, winter = 35
Fecal Coliforms (CFU / 100 mL)	< 200

Rather than estimate future total phosphorus concentrations, daily total phosphorus loads contributed by the Illecillewaet River and by the effluent discharge were estimated, since there is no water quality reference guideline for comparison of total phosphorus concentration. Early fall (October) and early spring (April) were identified as critical periods for the analysis. October is a period when biological productivity may be expected to be highest, as environmental conditions in the river have stabilized after the high summer flows, and the temperatures are relatively high. Flows during this time of year are estimated to be 20 m^3/s. April is also a critical period, since flows are generally lowest at this time of year. Low flows at this time of year are reported to be 6.33 m^3/s. The total phosphorus concentration was assumed to average 4 mg/L in the effluent and 0.02 mg/L in the Illecillewaet River. These values are expected to be at the higher end of the range expected, and hence represent a 'worst case' scenario approach. The phosphorus loads to the Illecillewaet River resulting from current and projected future outfall discharges from the WWTP (assuming that enhanced phosphorus removal at the WWTP is not practiced) are summarized in Table 6-3; the background phosphorus mass load in the river upstream of the outfall discharge is included for comparison.

TABLE 6-3
PHOSPHORUS LOADING TO THE ILLECILLEWAET RIVER

WWTP Effluent	Daily Flow (m^3/d)	Secondary Treatment		Advanced Treatment	
		Total P (mg/L)[1]	Total P Load (kg/day)	Total P (mg/L)[1]	Total P Load (kg/day)
Service Population 6,430 (Average)	2,940	4.0	12	1.0	3
Service Population 6,340 (Max.)	4,830	4.0	19	1.0	5
Service Population 13,500 (Average)	5,560	4.0	22	1.0	6
Service Population 13,500 (Max.)	7,000	4.0	28	1.0	7
Service Population 19,500 (Average)	7,400	4.0	30	1.0	8
Service Population 19,500 (Max.)	10,320	4.0	41	1.0	10
Illecillewaet River	**Daily Flow (m^3/d)**	**Secondary Treatment**		**Advanced Treatment**	
		Total P (mg/L)[1]	Total P Load (kg/day)	Total P (mg/L)	Total P Load (kg/day)
April	547,000	0.02	11	0.02	11
October	1,728,000	0.02	35	0.02	35

[1] assuming conventional secondary treatment without enhanced phosphorus removal

As shown in Table 6-3, under the 13,500 service population discharge scenario the effluent would contribute an average of 22 kg of total phosphorus per day to the river, which represents approximately twice the background load in the river in April, and

approximately 60% of the background load in the river during October. For the 19,500 service population scenario, this would increase to an average of about 30 kg P/day from the effluent (again assuming that enhanced phosphorus removal is not practiced). If enhanced phosphorus removal were implemented at the WWTP, the total phosphorus concentration in the effluent would be reduced from 4 mg/L to 1 mg/L or less, resulting in an average mass phosphorus discharge from the WWTP of no more than 5.5 kg P/day(6) shown in Table 6-3 for the 13,500 service population, increasing to 7.5 kg P/day (8) shown in Table 6-3 by the time the service population reaches 19,500. Based on the above analysis, if enhanced phosphorus removal were added to the WWTP, it is estimated that any expected impacts due to phosphorus load from the projected 19,500 population discharge would be less than what was observed in 2006, when the estimated average phosphorus discharge load was 11.8 kg P/day (Table 6-3).

6.5 Receiving Environment Monitoring

A regular monitoring program should be established, in order to satisfy the Ministry of Environment that the impact of the discharge on the Illecillewaet River is limited to an increase in productivity, and does not significantly alter the biological community composition. The program should involve two successive years of monitoring initially to provide a suitable baseline and to confirm that impact levels are limited to an increase in biological productivity. Subsequently, a reduced level of monitoring would be required to ensure that the level of impact does not increase significantly as discharge volumes increase in the future. The monitoring program should consist primarily of *periphyton* and benthic invertebrate monitoring, as these are able to assess the cumulative effect of the discharge of effluent over the preceding months. Water quality monitoring in the Illecillewaet River and of the discharge would be required to provide the necessary information, and to determine whether or not the water quality guidelines at the edge of the initial dilution zone are being exceeded. A summary of the recommended monitoring program is provided in Table 6-4.

TABLE 6-4
SUMMARY OF PROPOSED RECEIVING ENVIRONMENT MONITORING PROGRAM

Initial Monitoring	Receiving Environment Duration	Time of Year
Periphtyon and benthic	2 years	October / April
Effluent, Water Quality Receiving Environment	2 years	Monthly
Biological Receiving Environment	2 years	October / April
Periodic Monitoring	**Duration**	**Time of Year**
Periphtyon and benthic	Every 3 – 5 years provided effluent volume/quality remain the same	October / April
Effluent, Water Quality Receiving Environment	Yearly	Monthly
Biological Receiving Environment	Every 3 – 5 years provided effluent volume/quality remain the same	October / April

As shown in Table 6-4, biological monitoring should be conducted in early October and in early April. The early October sampling would provide continuity with the historical sampling in 2002 and 2007. Sampling should also be conducted in mid to late April since the ice would be gone and this is the low flow period in the Illecillewaet River. It integrates the effects of the effluent discharge during the winter months, when environmental conditions in the river are most stable and a reasonable amount of biological activity occurs. The Illecillewait River is glacial fed, and hence turbid for most of the summer (growing season). The discharge of effluent during the winter months is also expected to increase due to the development of the Revelstoke Mountain Resort. Water sampling of the effluent should be conducted monthly during the year so that the results of biological sampling can be compared with nutrient levels in the effluent during the preceding six months. Effluent sampling should include total and ortho (dissolved) phosphorus, total nitrogen, nitrite, nitrate and ammonia. Provided that the effluent quality meets the requirements outlined in the discharge permit, it is unlikely that water quality parameters at the edge of the initial dilution zone are exceeded.

Water sampling of the receiving environment would be required at three to five year intervals, to periodically assess water quality parameters at the edge of the initial dilution zone. Sampling should be conducted during March/April when flows in the Illecillewaet River are lowest. The sampling frequency may need to be modified if effluent discharges increase rapidly or if modifications are made to the treatment process or the diffuser. For example, if a diffuser is installed on the outfall, or if additional service areas are incorporated into the sewage treatment plant, water sampling should occur during the subsequent March/April and occur concurrently with environmental water quality sampling..

The monitoring program described above should define standards with which to judge the significance of any impact. The assumption at present is that the only impact of the WWTP discharge is an increase in productivity, but not a change in overall community composition or function; the assumed increase in the discharge is in accordance with the projections of the OCP and the planned service area increase from the Revelstoke Mountain Resort.. Since the Illecillewaet River is considered a low productivity system with low nutrient levels and cold temperatures, with some capacity to absorb excess nutrients, this level of impact is considered acceptable from a biological point of view. An increase in the impact on the receiving environment would be identified in two ways. First, an increasing difference in biological productivity, without any changes to the community composition, between upstream and downstream sites would indicate that the impacts to the receiving environment are increasing, but that the capacity of the receiving environment to absorb the excess nutrients has not been exceeded. Second, a change in community structure or function at the benthic invertebrate level would indicate that the level of impact has increased sufficiently that it has begun to exceed the capacity of the receiving environment. Since the increase in effluent volumes is expected to be incremental, it is expected that any increase in the level of impact could be identified early, while the receiving environment still has the capacity to absorb the excess nutrients.

The estimated cost of the monitoring program is about $20,000 annually including sampling for water and benthic quality, and reporting.

6.6 Options for Treatment, Reclamation, Reuse and Disposal of Treated Wastewater

Potential options for use of reclaimed water were reviewed in the Stage 1 LWMP; these included irrigation of agricultural and forest lands, non-potable applications at the WWTP, landscape and golf course irrigation, industrial process water, landscape impoundments and wetlands, snow making, and groundwater recharge; (see Stage 1 LWMP report for more detail).

In consultation with the Joint Advisory Committee, the feasible option for reclaimed water use that was selected for advancement to the Stage 2 LWMP was reuse at the wastewater treatment plant (WWTP) for non-potable applications. Potential applications for reclaimed water at the WWTP include washdown water, process water (polymer mixing etc.), bioscrubber irrigation, and landscape irrigation on grounds. Experience at other facilities shows that at least 80% of potable water consumption at some WWTPs can be replaced with reclaimed water (excluding biofilter irrigation and pump seal water applications, which are normally undertaken using potable water). In general, this option is the most cost effective approach for use of reclaimed water, since pumping to remote sites is not required. Additional potential users of reclaimed water may be identified in future.

Reclamation and reuse of treated effluent at the WWTP will account for only a portion of the wastewater flow. The majority of the wastewater will be treated to the appropriate standard and discharged to surface water. As described in the previous sections, the Stage 2 LWMP is based on continued treatment at the existing WWTP site for the foreseeable future, with a commitment to investigate alternative sites to serve the City's long term future needs. Incremental improvements to the existing treatment facilities will be required as the service population increases, with the Revelstoke Mountain Resort expected to contribute the majority of new development. Based on the discussion in Section 6.5, the

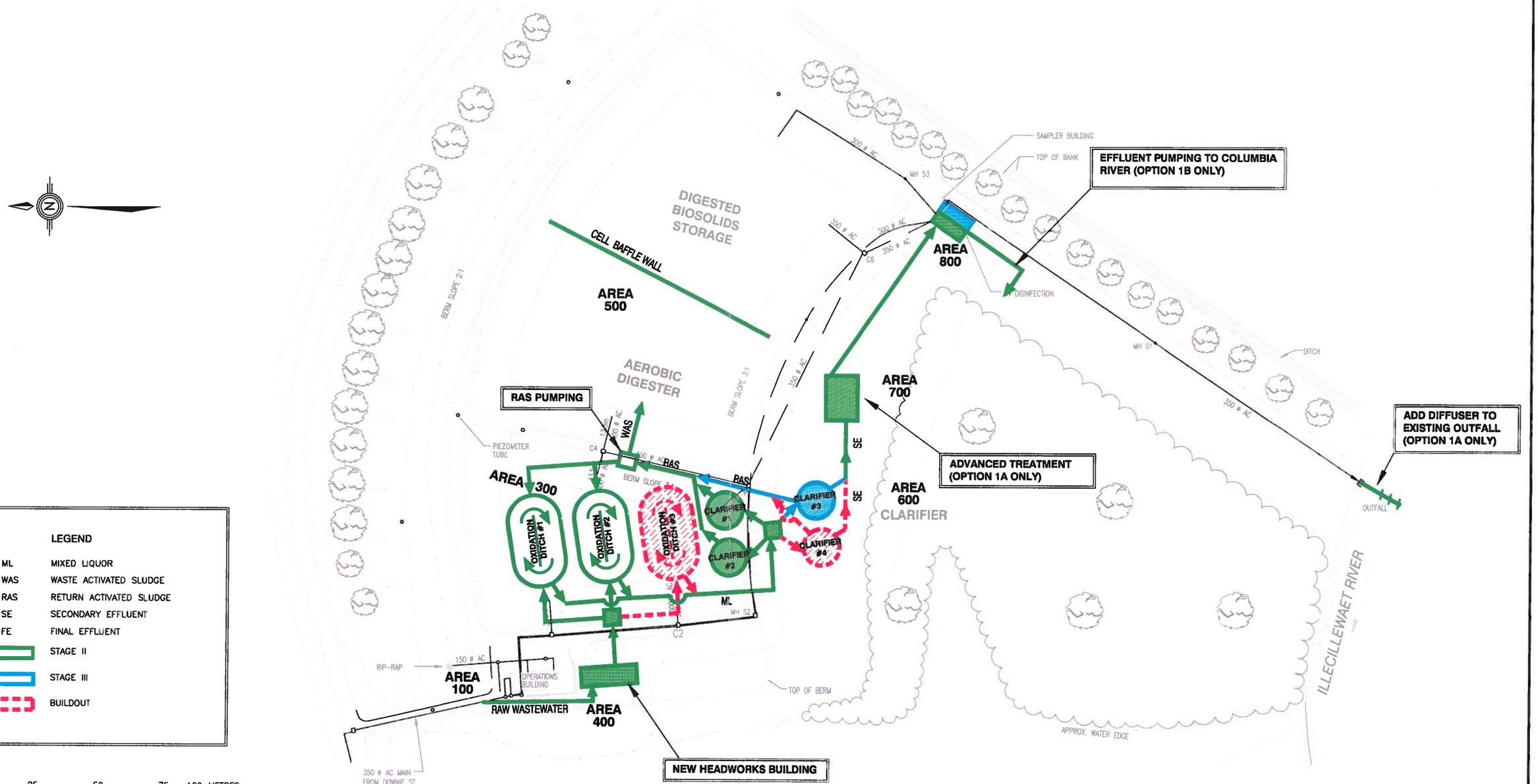
JAC concluded that the two alternative approaches for discharge of treated effluent to surface water are as follows:

- Option 1A: Continue with secondary treatment at the existing site – add a diffuser to the existing outfall, and plan to add advanced treatment (phosphorus removal, and possibly nitrification of ammonia) if and when the recommended monitoring program shows it to be necessary – for this option, the outfall would not be extended to the Columbia River in the foreseeable future.

- Option 1B: Continue with secondary treatment at the existing site, and plan to extend the outfall discharge to the Columbia River if and when the recommended monitoring program shows it to be necessary (a diffuser can be added to the existing outfall as an interim measure if needed). Note that the MOE subsequently requested that a schedule for extending the outfall be developed as part of the LWMP, and this will be addressed in Stage 3 of the Plan.

6.7 Cost Estimates for Wastewater Management

Cost estimates for wastewater management Options 1A and 1B are presented below. The cost estimates were developed and adapted from previous work (e.g., Dayton & Knight Ltd., 2007a, 2007b, and 2007c). Details regarding the criteria used in developing cost estimates for pump station upgrading and replacement, forcemains and gravity sewers, and wastewater treatment facilities are included in Appendix B. As discussed previously, the biological (secondary) treatment process will have to be converted to a more space-efficient process by the time the service population (City + RMR) reaches about 13,500 population equivalents. The timing will depend on the rate of population growth and the addition of new service areas such as Big Eddy. For cost estimating purposes, this was assumed to be an oxidation ditch process (other processes could also be used, and should be considered at the pre-design stage). A possible site layout for upgrading of the existing treatment plant using the oxidation ditch process is shown on Figure 6-3; this would entail construction of three oxidation ditches with four secondary clarifiers in the area of existing Lagoon #1 to



LEGEND

ML	MIXED LIQUOR
WAS	WASTE ACTIVATED SLUDGE
RAS	RETURN ACTIVATED SLUDGE
SE	SECONDARY EFFLUENT
FE	FINAL EFFLUENT
	STAGE II
	STAGE III
	BUILDOUT

0 25 50 75 100 METRES

1:1500

FILE: P:\PROJECTS\Revelstoke\1.50.201\1.50.201 FIGURE 6-3.dwg Tab FIGURE 6-3 10-04-20 chang

Dayton & Knight Ltd.
CONSULTING ENGINEERS
DRAWN BY: CWW
DWG. No. 1.50.201

CITY OF REVELSTOKE
WASTEWATER TREATMENT PLANT
LIQUID WASTE MANAGEMENT PLAN
STAGE II AND III IMPROVEMENTS

FIGURE 6-3

serve the OCP build-out population of about 30,000 people, with conversion of Lagoon #2 to an aerobic digester and biosolids storage pond. For the longer-term future, a more space-efficient sludge digestion process (or off-site composting of waste solids) could be employed; this would free up additional space within the existing Lagoon #2 area, and the oxidation ditch process could be doubled to serve a total of 60,000 people if needed.

6.7.1 Wastewater Collection

As described earlier, upgrades to the wastewater collection system are needed now and in the future, to correct existing deficiencies and to accommodate increasing wastewater flows. Pump station upgrades required to address limited capacity were based on previous work (see Stage 1 LWMP report, references Dayton & Knight Ltd., 2006 a, 2006, 2007); these included the upgrades for Downie, Edward and Moss pump stations. The required upgrades to the Downie pump station have now been completed, although upgrading of the forcemain remains to be done. Similarly, larger pumps have been added to Edward and Moss pump stations to allow for the higher pumping heads to accommodate the Downie pump station upgrade. Where capacity issues were not identified, it was assumed that pump stations would require replacement of the pumps and related equipment at 20-year intervals. The estimated costs for upgrading the sanitary sewers and pumping stations for Option 1 (both 1A and 1B) are summarized in Table 6-5. Additional detail can be found in Appendix B.

TABLE 6-5
CAPITAL COST FOR WASTEWATER COLLECTION SYSTEM UPGRADES

Item		Today	Stage 2 (Service Population 13,500)	Stage 3 (Service Population 17,700)	Service Population 19,500	TOTAL Cost (ENR 8800)
1. Pump Stations Upgrade or Replacement						
1.1	**Downie PS**					
1.1.1	Replace pump station	$1,444,000	$0	$0	$0	$1,444,000
1.1.2	New Forcemain from Downie PS to WWTP	$0	$1,057,000	$0	$0	$1,057,000
1.2	**Burke PS**	$0	$0	$93,000	$0	$93,000
1.3	**Wales PS**	$0	$0	$0	$82,000	$82,000
1.4	**Moss PS**	$40,000	$0	$28,500	$0	$68,500
1.5	**Edward PS**	$40,000	$0	$48,000	$0	$88,000
1.6	**Oscar PS**	$0	$0	$57,000	$0	$57,000
	Subtotal - Item 1	**$1,444,000**	**$1,057,000**	**$226,500**	**$82,000**	**$2,889,500**
2. Sanitary Sewer System						
2.1	Upgrade Existing System for Current Flows	$302,000	$0	$0	$0	$302,000
2.2	Connection cost of Clearview Heights, CPR Hill	$1,102,963	$0	$0	$873,000	$1,975,963
2.3	Connection cost of Arrow Heights and RMR	$300,000[1]	$6,699,000[2]	$0	$2,308,000	$9,307,000
2.4	Connection cost of Big Eddy	$0	$0	$0	$8,507,000	$8,507,000
2.5	Big Bend	$0	$0	$0	$0	$0
	Subtotal - Item 2	**$1,704,963**	**$6,699,000**	**$0**	**$11,688,000**	**$20,091,963**
	Subtotal Items 1 and 2	**$3,148,963**	**$7,756,000**	**$226,500**	**$11,770,000**	**$22,981,463**
	35% Engineering and Contingencies	$1,102,137	$2,715,000	$79,000	$4,120,000	$8,016,137
	Total Capital Cost	**$4,251,100**	**$10,471,000**	**$305,500**	**$15,890,000**	**$30,917,600**

[1] Cost for oversize of forcemain and pump station.

[2] Cost does not include forcemain or RMR pump station.

As shown in Table 6-5, the collection system upgrades projected for the period beyond 2012 for 13,500 people (designated Stage 2 in Table 6-5) have an estimated total capital cost of about $10.5 million, with an additional $0.3 M required by Stage 3 or 17,700 people. This cost includes Arrow Heights sewers less the pump station and forcemain $0.3 million upsize cost provided in today's cost by RMR. An additional $15.9 million may be required by the LWMP planning horizon for 19,500 people; note that the majority of this cost is for servicing of Big Eddy, and the timing of this has yet to be determined.

6.7.2 Wastewater Treatment

The capital cost of upgrades to the WWTP for Option 1A (implement advanced treatment for phosphorus removal and possibly nitrification of ammonia at the WWTP and add a diffuser to the existing outfall) are summarized in Table 6-6. As shown, the total capital cost of the WWTP upgrades for Option 1A would be about $19.4 million, with $15.1 million of this amount required by the time the service population (City + RMR) reaches about 13,500 people (Stage 2) and the remainder by the time the population reaches 17,700 people (Stage 3). Additional detail regarding the nature and timing of the upgrades can be found in a series of Technical Memorandums developed previously (see Stage 1 LWMP report, references Dayton & Knight Ltd., 2006c, 2006d, 2006e, 2006f and 2007).

TABLE 6-6
CAPITAL COSTS FOR WWTP UPGRADE – OPTION 1A

Item	Stage 2 (Construction for Service Population 13,500)	Stage 3 (Construction for Service Population 17,700)	TOTAL
Upgrades common to Both Options			
1 Headworks screen and grit removal	$254,000	$60,000	$314,000
2 Odour control (headworks)	$67,000	$18,000	$85,000
3 Construction of Two Oxidation Ditches in Cell No. 1	$954,000	$0	$954,000
4 Additional blower(s), MCC and instrumentation	$254,000	$91,000	$345,000
5 Aeration piping and valves	$387,000	$60,000	$447,000
6 Outside piping	$967,000	$242,000	$1,209,000
7 Clarifiers (2) and RBS/WBS pumps	$1,933,000	$604,000	$2,537,000
8 Sludge Digestion and Storage, Cell No 2	$1,789,000	$604,000	$2,393,000
9 Disinfection Upgrade	$315,000	$242,000	$557,000
10 Administration, PDC, MCC and Laboratory	$1,389,000	$242,000	$1,631,000
11 Standby Power	$302,000	$0	$302,000
Subtotal - Common Upgrades	**$8,611,000**	**$2,163,000**	**$10,774,000**
Upgrades - Option 1A - Add Diffuser to existing outfall, Future advanced treatment			
12 Chemical addition and Final filtration for continued discharge, Illecillewaet	$2,416,000	$966,000	$3,382,000
13 Outfall and Diffuser Illecillewaet	$176,000	$0	$176,000
Subtotal - Option 1A Upgrades	**$2,592,000**	**$966,000**	**$3,558,000**
Subtotal - Option 1A + Common Upgrades	$11,203,000	$3,129,000	$14,332,000
35% Engineering & Contingencies	$3,922,000	$1,096,000	$5,018,000
Total Capital Cost	**$15,125,000**	**$4,225,000**	**$19,350,000**

ENRc = 9300, 2012 year

The capital cost of upgrades to the WWTP for Option 1B (maintain secondary treatment standards at the WWTP and relocate the outfall discharge to the Columbia River) are shown in Table 6-7. As shown, the total capital cost of the WWTP upgrades for Option 1B would be about $20 million, with $17 million required for a population of 13,500 people (Stage 2) and the remainder when the population increases to 17,200 people (Stage 3).

TABLE 6-7
CAPITAL COST FOR WWTP UPGRADES – OPTION 1B

Item	Stage 2 (Construction by Service Population 13,500)	Stage 3 (Construction for Service Population 17,700)	TOTAL
Upgrades common to Both Options			
1 Headworks screen and grit removal	$254,000	$60,000	$314,000
2 Odour control (headworks)	$67,000	$18,000	$85,000
3 Construction of Two Oxidation Ditches in Cell No. 1	$954,000	$0	$954,000
4 Additional blower(s), MCC and instrumentation	$254,000	$91,000	$345,000
5 Aeration piping and valves	$387,000	$60,000	$447,000
6 Outside piping	$967,000	$242,000	$1,209,000
7 Clarifiers (2) and RBS/WBS pumps	$1,933,000	$604,000	$2,537,000
8 Sludge Digestion and Storage, Cell No 2	$1,789,000	$604,000	$2,393,000
9 Disinfection Upgrade	$315,000	$242,000	$557,000
10 Administration, PDC, MCC and Laboratory	$1,389,000	$242,000	$1,631,000
11 Standby Power	$302,000	$0	$302,000
Subtotal - Common Upgrades	**$8,611,000**	**$2,163,000**	**$10,774,000**
Upgrades - Option 1B - Add diffuser to existing outfall; Future outfall to Columbia River			
12 Effluent Pumping and Forcemain to Columbia River. (2700 m 600 mm outfall)	$3,938,000	$121,000	$4,059,000
Subtotal - Option 1B Upgrades	**$3,938,000**	**$121,000**	**$4,059,000**
Subtotal - Option 1B + Common Upgrades	$12,549,000	$2,284,000	$14,833,000
35% Engineering & Contingencies	$4,393,000	$800,000	$5,193,000
Total Capital Cost	**$16,942,000**	**$3,084,000**	**$20,026,000**

ENRc = 9,300, 2012 year

The 20-year present value (life cycle) costs for the WWTP upgrades needed for Options 1A and 1B are shown in Table 6-8. The incremental operation and maintenance (O&M) costs shown in Table 6-8 do not include the O&M cost for the existing facilities. It is important to note that the costs are not all-inclusive, but are adequate for comparing the two options.

As shown in Table 6-8, Option 1B (maintain secondary treatment standards and relocate outfall discharge to the Columbia River) has the higher capital cost (i.e. $20.0 million compared to the $19.3 million for Option 1A), but it has a lower life cycle cost due to lower annual O&M costs ($26.5 million compared to $27.6 million for Option 1A). (The difference is however, less than 10% and is within existing limits of the analysis.) The higher annual O&M cost for Option 1A is primarily due to the need to purchase chemicals (alum) for enhanced phosphorus removal. Option 1A would also generate additional solids due to the addition of chemical, and so would have a higher solids handling cost than Option 1B (solids handling costs are not included on Table 6-8).

TABLE 6-8
STAGE II LIFE CYCLE COST FOR OPTIONS 1A AND 1B

COST	OPTION 1A	OPTION 1B
CAPITAL COST	$19,350,000	$20,026,000
Present Worth O&M Cost	$8,298,000	$6,516,000
TOTAL	**$27,648,000**	**$26,542,000**

Discount Rate	**6%**
Base Year	**2012**
Amortization Period	**20 years**

6.8 Beneficial Use of Biosolids

Potential opportunities to use biosolids within the study area were reviewed in the Stage 1 LWMP; these included silviculture, agriculture, and land reclamation initiatives, as well as feedstock in composting operations and landfill cover. Beneficial uses for treated biosolids will have to meet provincial standards as set out in the Organic Matter Recycling Regulation (OMRR).

The existing Revelstoke WWTP does not incorporate biosolids treatment. Solids accumulate over time in the quiescent (settling) section of the aerated lagoon system. These solids must periodically be removed and disposed of or beneficially used. Since the biosolids have not been treated to meet the standards set out in the OMRR, a Permit would be required for beneficial use, or the biosolids must be further treated to meet OMRR requirements (e.g., composting).

Class B biosolids and/or undigested biosolids can be used for composting feedstock, and the compost produced has no restrictions on end use, provided that regulatory requirements are met (e.g., OMRR). Biosolids generally have to be dewatered before being incorporated into composting operations, to avoid excessive generation of leachate.

The City plans to use the Columbia Shuswap Regional District (CSRD) composting facility that will meet the requirements of the OMRR to process waste solids from the WWTP, septage, and possibly yard waste. The facility is located at the CSRD landfill. A

study to examine design options and OMRR compliance requirements for the CSRD facility was recently completed (Sylvis, 2008); a copy of the executive summary from the study report is attached as Appendix B.

Sampling and analysis should be undertaken to evaluate the concentration of trace metals in the biosolids that were removed from Lagoon #2 of the WWTP in 2006.

6.9 Energy Recovery

Treatment of wastewater and biosolids presents opportunities for energy recovery. Opportunities include combustion of the gas produced by anaerobic digestion for heating and/or generation of electrical power. Heat recovery from the raw wastewater stream is also possible. The practical application of these options depends on such factors as the size of the treatment facilities and the location of potential energy users in relation to the plant. Options for energy recovery should be addressed during the pre-design and detailed design phases for WWTP upgrades and expansions.

7.0 RECOMMENDATIONS

The following recommendations are based on the findings of the Stage 2 LWMP for the City of Revelstoke.

1. This Stage 2 LWMP should be reviewed and adopted by Council before submitting it to the Ministry of Environment for approval.

2. After the Stage 2 LWMP report has been adopted by Council, a copy of the report should be forwarded to the Ministry of Environment Nelson office with a request for review and approval to proceed to Stage 3.

3. The Stage 3 LWMP would include a schedule for extending the outfall discharge to the Columbia River (pipeline routing to be determined).

CITY OF REVELSTOKE
LIQUID WASTE MANAGEMENT PLAN – STAGE 2

REFERENCES

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CITY OF REVELSTOKE
LIQUID WASTE MANAGEMENT PLAN – STAGE 2

APPENDIX A

COPY OF APPROVAL LETTER FOR STAGE 1 LWMP

BRITISH COLUMBIA
The Best Place on Earth

May 26, 2008

Files: PE- 02147
76780-30/RDCS

City of Revelstoke
Box 170 - 216 Mackenzie Avenue
Revelstoke BC V0E 2S0

Attention, Chair of the Advisory Committee

Dear Advisory Committee Chair:

Re: Acceptance of the Final Report for Stage 1 of the City of Revelstoke Liquid Waste Management Plan (LWMP)

We have received the final report for the City of Revelstoke Stage 1 LWMP as prepared by Dayton & Knight Consulting Engineers. We have no concerns with the report and therefore approve it. The City of Revelstoke may now proceed with Stage 2 of the plan.

If you have any questions, please contact Chris Stroich at 250-354-6387.

Yours truly,

Robyn Roome
Regional Manager
Ministry of Environment
Environmental Protection Division
Kootenay and Okanagan Regions

cc: Chris Stroich, Environmental Management Section Head, Nelson
Dayton & Knight Ltd., #210-889 Harbourside Drive, North Vancouver BC V7P 3S1
ATT: Allan Gibb, Environmental Engineer

TM:lkm

Ministry of Environment | Environmental Protection, Kootenay and Okanagan Regions | Mailing/Location Address: #401 333 Victoria Street, Nelson BC V1L 4K3 | Telephone: (250) 354-6355, Facsimile: (250) 354-6332, Website: www.gov.bc.ca/env

CITY OF REVELSTOKE
LIQUID WASTE MANAGEMENT PLAN – STAGE 2

APPENDIX B

CRITERIA FOR DEVELOPING WASTEWATER COLLECTION AND TREATMENT COST ESTIMATES

Revelstoke WWTP
Liquid Waste Management Plan - Stage 2

Capital Costs for Collection System Upgrade (ENR9300)

Item	Today	Stage II	Stage III	Build out	TOTAL Cost	Notes
ENRc					9300	
1. Pump Stations Upgrade or Replacement						
1.1 Downie PS						
1.1.1 Replace pump station	$1,444,000	$0	$0	$0	$1,444,000	Replacement of Pump Station Completed 2011
1.1.2 New Forcemain from Downie PS to WWTP	$0	$1,057,000	$0	$0	$1,057,000	
1.2 Burke PS	$0	$0	$93,000	$0	$93,000	Replacement of Existing Pumps
1.3 Wales PS	$0	$0	$0	$82,000	$82,000	New pumps and motors; VFDs; 600V Service
1.4 Moss PS	$40,000	$0	$28,500	$0	$68,500	Replacement of Existing Pumps completed 2011
1.5 Edward PS	$40,000	$0	$48,000	$0	$88,000	Replacement of Existing Pumps completed 2011
1.6 Oscar PS	$0	$0	$57,000	$0	$57,000	Replacement of Existing Pumps
Subtotal - Item 1	**$1,444,000**	**$1,057,000**	**$226,500**	**$82,000**	**$2,889,500**	
2. Sanitary Sewer System						
2.1 Upgrade Existing System for Current Flows	$302,000	$0	$0	$0	$302,000	Sanitary Sewer Model 2008
2.2 Connection cost of Clearview Heights, CPR Hill	$1,102,963	$0	$0	$873,000	$1,975,963	Sewer installed 2011
2.3 Connection cost of Arrow Heights and RMR Note 1,2	$300,000	$6,699,000	$0	$2,308,000	$9,307,000	From Arrow Heights Option 2 Report
2.4 Connection cost of Big Eddy	$0	$0	$0	$8,507,000	$8,507,000	Includes downstream system upgrades
2.5 Big Bend	$0	$0	$0	$0	$0	All developer cost
Subtotal - Item 2	**$1,704,963**	**$6,699,000**	**$0**	**$11,688,000**	**$20,091,963**	
Subtotal Items 1 and 2	**$3,148,963**	**$7,756,000**	**$226,500**	**$11,770,000**	**$22,981,463**	
35% Engineering and Contingencies	$1,102,137	$2,715,000	$79,000	$4,120,000	$8,016,137	
Total Capital Cost	**$4,251,100**	**$10,471,000**	**$305,500**	**$15,890,000**	**$30,917,600**	

Note 1 $300,00 for oversize of forcemain
Note 2 $6,699,000 does not include forcmain and pump station

Revelstoke WWTP
Liquid Waste Management Plan - Stage 2

Capital Costs for WWTP Upgrade at Current Site - Option 1A (ENR 9300)

	Item	Stage II (construction 13,500)	Stage III (construction 17,700)	TOTAL
Upgrades common to Both Options				
1	Headworks screen and grit removal	$254,000	$60,000	$314,000
2	Odour control (headworks)	$67,000	$18,000	$85,000
3	Construction of Two Oxidation Ditches in Cell No. 1	$954,000	$0	$954,000
4	Additional blower(s), MCC and instrumentation	$254,000	$91,000	$345,000
5	Aeration piping and valves	$387,000	$60,000	$447,000
6	Outside piping	$967,000	$242,000	$1,209,000
7	Clarifiers (2) and RBS/WBS pumps	$1,933,000	$604,000	$2,537,000
8	Sludge Digestion and Storage, Cell No 2	$1,789,000	$604,000	$2,393,000
9	Disinfection Upgrade	$315,000	$242,000	$557,000
10	Administration, PDC, MCC and Laboratory	$1,389,000	$242,000	$1,631,000
11	Standby Power	$302,000	$0	$302,000
	Subtotal - Common Upgrades	**$8,611,000**	**$2,163,000**	**$10,774,000**
Upgrades - Option 1A - Add Diffuser to existing outfall, Future advanced treatment				
12	Chemical addition and Final filtration for continued discharge, Illecillewaet	$2,416,000	$966,000	$3,382,000
13	Outfall and Diffuser Illecillewaet	$176,000	$0	$176,000
	Subtotal - Option 1A Upgrades	**$2,592,000**	**$966,000**	**$3,558,000**
	Subtotal - Option 1A + Common Upgrades	$11,203,000	$3,129,000	$14,332,000
	35% Engineering & Contingencies	$3,922,000	$1,096,000	$5,018,000
	Total Capital Cost	**$15,125,000**	**$4,225,000**	**$19,350,000**
	Check	$1,000	$1,000	

Option 1A
Cost of Alum to remove P

O&M Costs for WWTP Upgrade at Current Site - Option 1A

Assume Power Cost = $0.08/kWh

Year	O&M Cost - Common to both options	Additional Maintenance cost for 1A (2%)	Additional Chemical Cost for Alum (Phosphorus Removal)	Additional Labour Cost	Additional Power Cost for Effluent Pumping	Total
1	$372,000	$0	$0	$0	$0	$372,000
2	$379,440	$0	$0	$0	$0	$380,000
3	$387,029	$0	$0	$0	$0	$388,000
4	$394,769	$0	$0	$0	$0	$395,000
5	$402,665	$0	$0	$0	$0	$403,000
6	$410,718	$0	$0	$0	$0	$411,000
7	$418,932	$69,984	$226,300	$65,000	$0	$781,000
8	$427,311	$69,984	$233,600	$66,300	$0	$798,000
9	$435,857	$69,984	$244,550	$67,626	$0	$819,000
10	$444,574	$69,984	$255,500	$68,979	$0	$840,000
11	$453,466	$69,984	$266,450	$70,358	$0	$861,000
12	$462,535	$96,066	$277,400	$71,765	$0	$908,000
13	$471,786	$96,066	$288,350	$73,201	$0	$930,000
14	$481,222	$96,066	$295,650	$74,665	$0	$948,000
15	$490,846	$96,066	$299,300	$76,158	$0	$963,000
16	$500,663	$96,066	$302,950	$77,681	$0	$978,000
17	$510,676	$96,066	$306,600	$79,235	$0	$993,000
18	$520,890	$96,066	$313,900	$80,819	$0	$1,012,000
19	$531,308	$96,066	$317,550	$82,436	$0	$1,028,000
20	$541,934	$96,066	$321,200	$84,084	$0	$1,044,000

2%

Assume **5** mg/L of P removed at WWTP
Assume Alum Cost **$23** to remove 1 kg of P

Year	AAF (m^3/d)	P to be removed (kg/d)	Cost of Alum per day
1	3,729	19	$430
2	4,141	21	$480
3	4,563	23	$530
4	4,763	24	$550
5	4,964	25	$580
6	5,164	26	$600
7	5,364	27	$620
8	5,564	28	$640
9	5,823	29	$670
10	6,081	30	$700
11	6,340	32	$730
12	6,599	33	$760
13	6,858	34	$790
14	6,966	35	$810
15	7,073	35	$820
16	7,181	36	$830
17	7,289	36	$840
18	7,396	37	$860
19	7,505	38	$870
20	7,616	38	$880

Revelstoke WWTP
Liquid Waste Management Plan - Stage 2

Capital Costs for WWTP Upgrade at Current Site - Option 1B (ENR 9300)

	Item	Stage II (construction 13,500)	Stage III (construction 17,700)	TOTAL
Upgrades common to Both Options				
1	Headworks screen and grit removal	$254,000	$60,000	$314,000
2	Odour control (headworks)	$67,000	$18,000	$85,000
3	Construction of Two Oxidation Ditches in Cell No. 1	$954,000	$0	$954,000
4	Additional blower(s), MCC and instrumentation	$254,000	$91,000	$345,000
5	Aeration piping and valves	$387,000	$60,000	$447,000
6	Outside piping	$967,000	$242,000	$1,209,000
7	Clarifiers (2) and RBS/WBS pumps	$1,933,000	$604,000	$2,537,000
8	Sludge Digestion and Storage, Cell No 2	$1,789,000	$604,000	$2,393,000
9	Disinfection Upgrade	$315,000	$242,000	$557,000
10	Administration, PDC, MCC and Laboratory	$1,389,000	$242,000	$1,631,000
11	Standby Power	$302,000	$0	$302,000
	Subtotal - Common Upgrades	**$8,611,000**	**$2,163,000**	**$10,774,000**
Upgrades - Option 1B - Add diffuser to existing outfall; Future outfall to Columbia River				
12	Effluent Pumping and Forcemain to Columbia River. (2700 m 600 mm outfall)	$3,938,000	$121,000	$4,059,000
	Subtotal - Option 1B Upgrades	**$3,938,000**	**$121,000**	**$4,059,000**
	Subtotal - Option 1B + Common Upgrades	$12,549,000	$2,284,000	$14,833,000
	35% Engineering & Contingencies	$4,393,000	$800,000	$5,193,000
	Total Construction Cost	**$16,942,000**	**$3,084,000**	**$20,026,000**
	Check	$1,000	$1,000	

O&M Costs for WWTP Upgrade at Current Site - Option 1B

Assume Power Cost = $0.08/kWh

Year	O&M Cost - Common to both options	Additional Maintenance cost for 1B (2%)	Additional Chemical Cost for Alum (Phosphorus Removal)	Additional Labour Cost	Additional Power Cost for Effluent Pumping	Total
1	$372,000	$0	$0	$0	$0	$372,000
2	$379,440	$0	$0	$0	$0	$380,000
3	$387,029	$0	$0	$0	$0	$388,000
4	$394,769	$0	$0	$0	$0	$395,000
5	$402,665	$0	$0	$0	$0	$403,000
6	$410,718	$0	$0	$0	$0	$411,000
7	$418,932	$106,326	$0	$55,000	$5,228	$586,000
8	$427,311	$106,326	$0	$56,100	$5,333	$596,000
9	$435,857	$106,326	$0	$57,222	$5,439	$605,000
10	$444,574	$106,326	$0	$58,366	$5,548	$615,000
11	$453,466	$106,326	$0	$59,534	$5,659	$625,000
12	$462,535	$109,593	$0	$60,724	$5,772	$639,000
13	$471,786	$109,593	$0	$61,939	$5,888	$650,000
14	$481,222	$109,593	$0	$63,178	$6,005	$660,000
15	$490,846	$109,593	$0	$64,441	$6,125	$672,000
16	$500,663	$109,593	$0	$65,730	$6,248	$683,000
17	$510,676	$109,593	$0	$67,045	$6,373	$694,000
18	$520,890	$109,593	$0	$68,386	$6,500	$706,000
19	$531,308	$109,593	$0	$69,753	$6,630	$718,000
20	$541,934	$109,593	$0	$71,148	$6,763	$730,000

2% Interest rate

Option 1B - Effluent Pumping to Columbia River

Forcemain

Length = 2700 m (From HK Memo 5) C-factor: 100

Pump

Static head: 8 m Station losses & other friction losses: 2 m

Q: 10,000 m^3/d = 0.12 m^3/s

(Buildout)

Forcemain dia. in	Dia. mm	h_f (m)	Total dynamic head (m)
10	250	90.11	100.11
12	300	37.08	47.08
16	400	9.13	19.13
20	500	3.08	13.08
24	**600**	**1.27**	**11.27**

Velocity (600 mm) 0.41 m/s

Pbrake = Q x H x S / (3960) / n

where Q = flow in (USGPM)
H = TDH in psi
n = 80%
S = Specific Gravity of Fluid (assume 1)

Effluent Pump (Hp) 7

Say 10 hp

City of Revelstoke WWTP
Liquid Waste Management Plan - Stage 2
1.50.200

Life Cycle Cost for Options

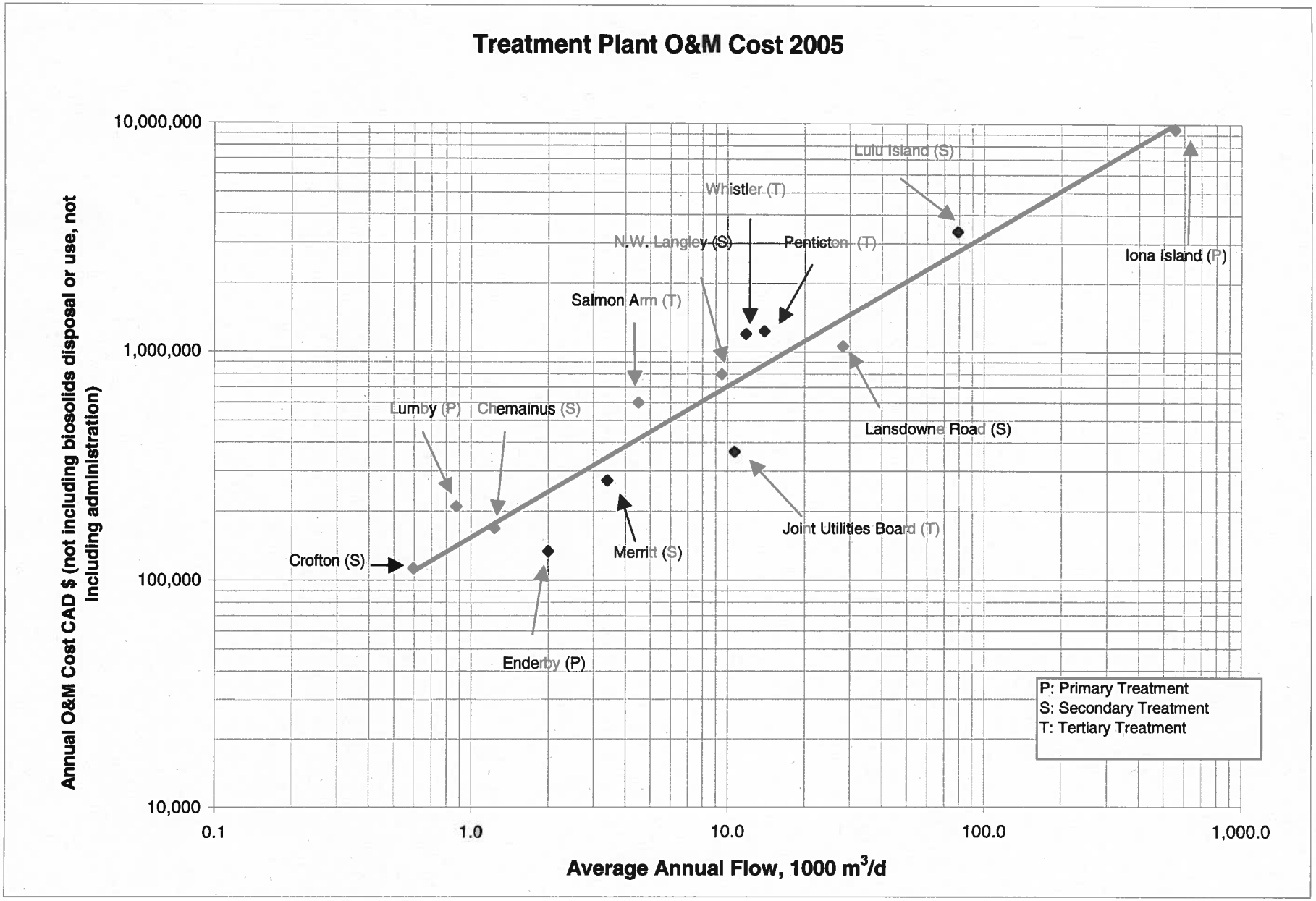
	OPTION 1A	OPTION 1B
CAPITAL COST	$19,350,000	$20,026,000
Discounted O&M COST	$8,298,000	$6,516,000
TOTAL	**$27,648,000**	**$26,542,000**

Discount Rate	**6%**
Base Year	**2012**

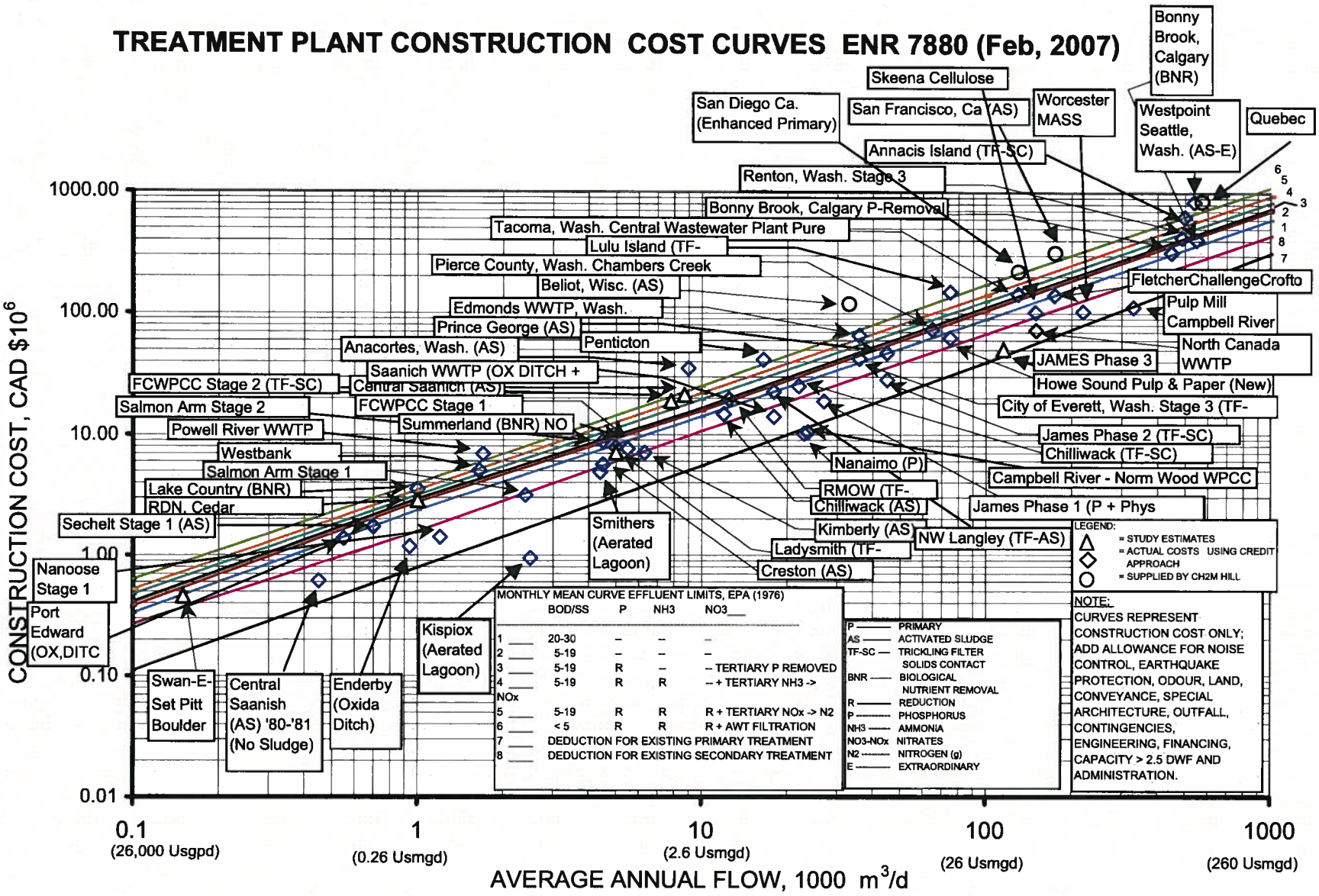
	O&M	CAPITAL	O&M	CAPITAL
NPV	$8,298,000	$19,350,000	$6,516,000	$20,026,000
Year				
1	$372,000		$372,000	
2	$380,000		$380,000	
3	$388,000		$388,000	
4	$395,000		$395,000	
5	$403,000		$403,000	
6	$411,000		$411,000	
7	$781,000		$586,000	
8	$798,000		$596,000	
9	$819,000		$605,000	
10	$840,000		$615,000	
11	$861,000		$625,000	
12	$908,000		$639,000	
13	$930,000		$650,000	
14	$948,000		$660,000	
15	$963,000		$672,000	
16	$978,000		$683,000	
17	$993,000		$694,000	
18	$1,012,000		$706,000	
19	$1,028,000		$718,000	
20	$1,044,000		$730,000	

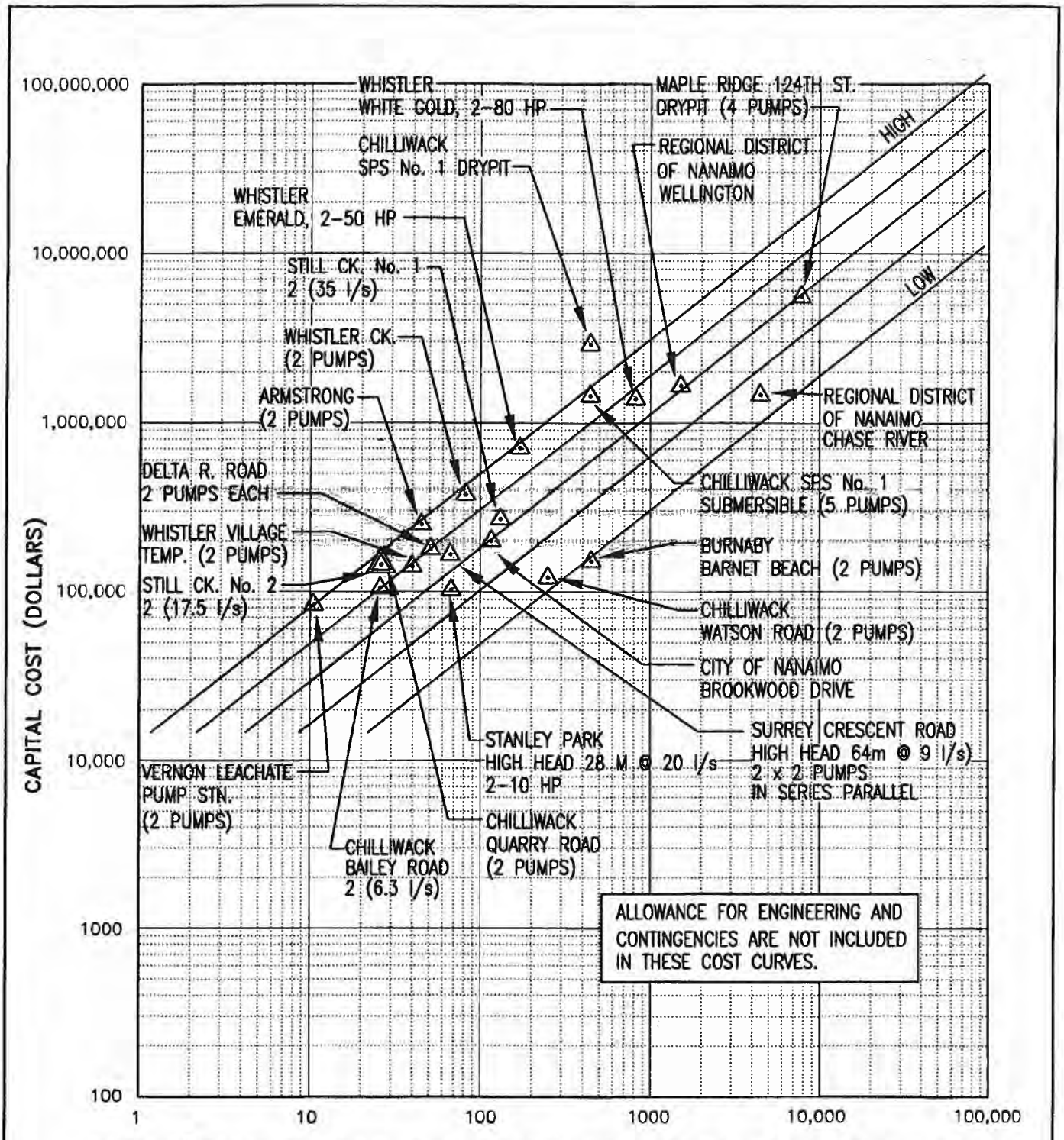
Discounted O&M	$8,298,000		$6,516,000	
Discounted CAPITAL		$19,350,000		$20,026,000
TOTAL	**$27,648,000**		**$26,542,000**	

Note:
Option 1A - Add Diffuser to Existing Outfall; Future Advanced Treatment
Option 1B - Add Diffuser to Existing Outfall; Future Outfall to Columbia River


Treatment Plant O&M Cost 2005
Annual O&M Cost CAD $ (not including biosolids disposal or use, not including administration)
10,000,000
1,000,000
100,000
10,000
0.1
1.0
10.0
100.0
1,000.0
Average Annual Flow, 1000 m3/d
Lulu Island (S)
Whistler (T)
N.W. Langley (S)
Penticton (T)
Iona Island (P)
Salmon Arm (T)
Lumby (P)
Chemainus (S)
Lansdowne Road (S)
Joint Utilities Board (T)
Merritt (S)
Crofton (S)
Enderby (P)
P: Primary Treatment
S: Secondary Treatment
T: Tertiary Treatment

TREATMENT PLANT CONSTRUCTION COST CURVES ENR 7880 (Feb, 2007)





(USEFUL* CAPACITY, CFS x TOTAL DYNAMIC HEAD, FT.) (m^3/s x TDH, m x 116)

2002, ENR-C 6800

* NOT INCLUDING REDUNDANT
OR STANDBY PUMPS

Capital Cost Curves for Sewage Pump Stations

CAPITAL COST CURVES FOR SPS.DWG 1:1 02-09-05

Dayton & Knight Ltd.
CONSULTING ENGINEERS
DRAWN BY: LW
DWG. No.

Figure

CITY OF REVELSTOKE
LIQUID WASTE MANAGEMENT PLAN – STAGE 2

APPENDIX C

EXECUTIVE SUMMARY FROM SYLVIS REPORT EXAMINING COMPOST OPTIONS

CITY OF REVELSTOKE
LIQUID WASTE MANAGEMENT PLAN
STEERING COMMITTEE MEETING

Minutes of the Liquid Waste Management Plan Steering Committee meeting held February 18, 2009 in the Council Chambers located at Suite 102-103 Second Street East at 6:45 p.m.

Present:	Phil Welock, Councillor COR
	David Raven, Mayor COR
	Antoinette Halberstadt, Councillor COR
	Chris Stroich, M.O.E. Protection Officer
	Brian Mallett, Director of Engineering & Public Works, COR
	Darren Komonoski, Operations Manager, COR
	Gordon Hall, Engineering Technician, CoR
	Gail Ferguson, Engineering & Public Works Clerk, COR
City Consultants:	Harlan Kelly, Dayton and Knight
	Allan Gibb, Dayton and Knight

The Steering Committee for the Liquid Waste Management Plan Committee met briefly prior to the regular joint meeting to choose a new Chair as City of Revelstoke Councillors on the Committee have changed. It was decided that Councillor Phil Welock will sit as Chair on the Liquid Waste Management Committee.

CITY OF REVELSTOKE
LIQUID WASTE MANAGEMENT PLAN
JOINT LOCAL AND TECHNICAL COMMITTEE MEETING

Minutes of the Liquid Waste Management Plan Joint Local and Technical Committee meeting held February 18, 2009 in the Council Chambers located at Suite 102-103 Second Street East at 7:00 p.m.

Present:	Phil Welock, Councillor COR (Chair)
	David Raven, Mayor COR
	Antoinette Halberstadt, Councillor COR
	Gord Davis, Parks Canada
	Gordon Hall, Engineering Technician, CoR
	Chris Stroich, M.O.E. Protection Officer
	Ico de Zwart, Masse3 & Miller Consulting
	Brian Mallett, Director of Engineering & Public Works, COR
	Darren Komonoski, Operations Manager, COR
	Gordon Hall, Engineering Technician, COR
	Gail Ferguson, Engineering & Public Works Clerk, COR
	Will Hayman, Public Representative
	Brian Gadbois, Public Representative
City Consultants:	Harlan Kelly, Dayton and Knight
	Allan Gibb, Dayton and Knight

Committee Chair, Councillor Welock called the meeting to order at 7:00 pm. Round table introductions were made as there were some new faces.

Moved by Councillor Halberstadt and seconded by Darren Komonoski that the minutes for the September 11, 2008 meeting be adopted as presented.

Moved by Brian Gadbois and seconded by Will Hayman that the Agenda for the February 18, 2009 meeting be adopted.

The meeting was turned over to Allan Gibb of Dayton & Knight Ltd., the consultant for the City of Revelstoke. Allan Gibb presented a review of the Liquid Waste Management Plan to the stage it is currently at. Printout of slideshow is attached.

The Committee also received for review a letter from MoE regarding their decision that a "monitor and see" plan would not be acceptable to them. They indicate the need for an overall plan to be developed, submitted for approval and then carried out. The Committee also reviewed a letter from Masse & Miller that said "Because of the inherent difficulties involved in developing an acceptable monitoring program, a time schedule for the upgrades or the new outfall should be developed as part of the LWMP." Both letters submitted to the Committee are attached.

The existing treatment facility is a two-cell aerated lagoon system with very limited space for expansion. This facility currently discharges to the Illecillewaet River, and requires some upgrades. Based on the projected growth of the community, including Revelstoke Mountain Resort, the current facility with the present upgrades completed should meet demands until approximately 2014. A more space efficient process would then be. In addition to continuing to expand and upgrade treatment facilities at the existing site, changes to the WWTP outfall discharge will also be necessary. Two options being presented:

Option 1A which involves advanced treatment, adding an outlet diffuser and continue discharge into Illecillewaet River.
Option 1B which involves using the existing secondary treatment and extending the discharge outfall to Columbia River.

The task for the Committee at this meeting is to decide which of the two options 1A or 1B should be recommended to Council.

The Committee had a number of questions as outlined:

- Mayor Raven asked if there had been alternate sites looked at for the route for the outfall pipe that would be installed as part of Option 1B. D & K advised that no alternative routes had yet to be looked at, but would be thoroughly investigated in a future stage depending on what the Committee decides.

- Councillor Halberstadt expressed that it was her understanding that heat/energy recovery systems are expensive and somewhat not feasible. If this is the case, does this particular item need to be included in the LWMP? D&K replied that adding a heat pump and using heat from the sewage could could be done and should be looked at.

- Brian Gadbois asked how long it would take to design, plan and construct a mechanical plant as the date of 2014 seems close. D & K explained that it would take approximately 2 - 4 years, but that it needs to be stated that the date of 2014 is a rough date that is contingent on many factors.

- When Brian Gadbois asked if there have been any signs of stress on the Illecillewaet River yet, D& K answered that yes there has been signs. This shows the need to move on with an overall, long range plan. There is always the possibility that the City could choose to design the new mechanical plant and have it ready to go on the shelf as a "shovel ready" project.

- Councillor Welock asked what the approximate cost to do a design to the "shovel ready" stage would be. D & K answered that engineering costs are usually between 8 to 14% of the total construction cost. D & K also indicated that the project would likely be completed in stages with the various pieces being constructed as they were needed.

- Will Hayman asked if the phosphorus content is expected to be lower with a mechanical plant. D&K indicated that there would likely be no change as removing phosphorus from the lagoon requires the use of chemicals while in a mechanical plant bacteria is used.

- Brian Gadbois asked about the possibility of storing the effluent and discharging it during higher flow times in the river. D&K responded that this would require a large storage facility and there is not enough space at the site to accommodate such a facility. It was also noted that even during periods of high flow there would still be insufficient dilution.. This brought forward the concern about the fluctuations in the flow of the Columbia River that happen due to the dam. It was explained that even when the Columbia River is flowing at a low level, it is still flowing at a higher level than the Illecillewaet River.

- Mayor Raven asked if the proposed site for the discharge into the Columbia was downstream of the Illecillewaet River and Jordan River. D&K noted that the discharge would not necessarily be downstream of the Illecillewaet, however that will depend upon the site that is chosen after the planning stage of the project.

- Councillor Halberstadt stated that the Committee is looking at construction cost comparisons for the two options and wondered if maintenance costs should also be looked at? It was confirmed that Option 1A would have higher maintenance costs than 1B. Option 1A would mean about a 30% increase in sludge generated, creating the need to desludge the lagoon every 5 years or less and the cost to remove the increased sludge from the site would not only increase this cost, but the sludge would also be put into the landfill site. Harlan Kelly from D & K assured the Committee that Option 1A is only stop gap measure and that eventually Option 1B would have to be undertaken.

- At 7:40 pm Mayor Raven excused himself to attend another meeting but indicated prior to his leaving that in his opinion, 1B is the choice to go with, however he would encourage all options to be explored with regard to the placement and route of the outfall.

- Brian Mallett, when asked his opinion, stated that Option 1B is an eventuality, and the Committee is being given the opportunity to choose an option that has the longest vision and is the most environmentally responsible solution to the issue. The right thing to do as a community is to relieve stress on the Illecillewaet River.

- Councillor Halberstadt asked if the choosing of which Option is best should not be put off until the site is chosen for the mechanical plant so that the outfall does not need to be moved when it comes on line. It was explained that the future site of the mechanical plant is the current lagoon site and that the outfall would not have to be relocated.

- It was explained to the Committee that once the completed Liquid Waste Management Plan is signed off by the Minister, future legislation would not affect us locally as an approved LWMP overrides future legislation.

- Brian Gadbois asked how much the new mechanical plant would cost and D & K responded that the total cost for a new plant would be approximately $15 million, while the pump station and outfall cost would be approximately an additional $5 million.

- Councillor Welock asked if the City has allowed for this project in the 2009 Budget, or if not, how soon can we expect the outfall to be extended. Brian Mallet explained that optimistically, the project could potentially be completed between 2014 and 2016. There would be 6 months engineering and front end preparation, then a review by DFO and MoE which realistically would take up to 6 months. Then there is the possibility that it would have to be approved by Navigable Waters, depending on location of the outfall, and then the time involved to get funding. As this project will require Senior Level Government funding, the time frame on that is unpredictable. The time frame for the construction of the outfall depends entirely on how long it takes to get approval and funding.

- Councillor Halberstadt asked if the present upgrades that have been done will carry us up until the time that the Option chosen can be put in place. The answer to that was yes.

Councillor Welock then called for a vote asking the Committee to vote on either Option 1A or Option 1B as presented in the report.

- When asked to vote by a show of hands who was in favour of the choice of Option 1A the Committee was unanimously opposed.
- When asked to vote by a show of hands who was in favour of the choice of Option 1B the Committee was unanimously in favour. After distributing the information to the public and allowing time for public feedback, the Committee will recommend to Council that the City proceed with steps outlined in the recommendation for Option 1B.

A discussion was held to try to plan how the information would be distributed to the public as the Committee at a previous meeting felt that it was unnecessary to hold another public meeting. After deciding that information to include would be a synopsis of Stage 2 and information on why Option 1B was chosen by the Committee, it was decided that the Engineering Department would put together the flyer with information provided by D&K and would put together a plan for distribution and receiving public feedback and forward that to the Committee.

Brian Gadbois explained to the Committee that there are residents now in Big Eddy or Arrow Heights whose septic systems are failing. Regulations require that a resident replace a failing system with a new Type 2 system which averages a $25,000 - $30,000 cost. Also some of the properties are not large enough on which to place the newer system. He asked why the LWMP plan could not state that due to the eventual hookup of residences to sewer, that systems needing replacement could be replaced with the same older type of system for the interim which is cheaper. Information provided explained that this regulation for onsite systems is a MoH regulation and not one placed by the City. This topic is not one that is covered by the LWMP, therefore Councillor Halberstadt suggested that this is a subject best addressed to Council.

Recommendation: That Council develop a plan with Ministry of Health to consider a transition plan for existing residential properties on septic systems, allowing owners to revitalize a failing system to the existing level and not have to install a Type 2 System due to the eventuality of sewer services to residences in Revelstoke.

The Committee agreed that there is no need for another Stage 2 Meeting and that another meeting of the LWMP Committee would be called as and when required.

The meeting was adjourned at 8:45 pm.

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Councillor Phil Welock, Chair

CITY OF REVELSTOKE
LIQUID WASTE MANAGEMENT PLAN – STAGE 2

APPENDIX D

JAC MEETING MINUTES AND PUBLIC INFORMATION BROCHURE

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City of Revelstoke
Liquid Waste Management Plan Update

The City has completed the draft of the Stage 2 portion of the Liquid Waste Management Plan (LWMP). Prior to finalizing the plan and submitting it to the Province for approval, the City would like residents to comment on the Stage 2 plan. Details on how to make a comment are provided below. Please note that the period to make comment on the draft plan will only be open until January 28th, 2010.

Background

In December 2006 the City of Revelstoke initiated preparation of a Liquid Waste Management Plan. In keeping with provincial guidelines, the City has formed the three committees to guide development of the Plan, a Steering Committee, a Technical Committee and a Local Advisory Committee. The Steering Committee includes City Councilors, staff, and a representative of the B.C. Ministry of Environment. The Technical Committee includes City technical staff and representatives of various government agencies. The Local Advisory Committee is designed to represent the interests of the community with representation from ratepayers associations, businesses, environmental groups, First Nations, City Councilors and staff, and interested private citizens. The City engaged Dayton & Knight Ltd. Consulting Engineers to act as technical consultant to the committees.

The liquid waste management planning process is designed to allow B.C. communities to develop their own solutions for managing liquid wastes, while meeting regulatory requirements and objectives for protecting public health and the environment as well as financial constraints. The primary objective of the LWMP is to examine long-term options and associated costs for wastewater collection, treatment, and disposal or reuse, and to select the best option(s) for the short-term and long-term future. Other components of the LWMP include stormwater management, reduction of wastewater volumes, source control of contaminants, and management of solid residuals produced by wastewater treatment.

The Liquid Waste Management Plan is designed to provide the City of Revelstoke with a sustainable, cost effective, and environmentally friendly strategy for managing liquid wastes. Support and participation from the community is important in developing a successful Plan. Options for liquid waste management were developed in consultation with the Advisory Committees, and the options were shared with the community at a Public Open House held on December 5, 2007 at the Revelstoke Community Centre. Public input from the Open House was then incorporated into the Liquid Waste Management Plan solutions in consultation with the Advisory Committees.

Findings

A number of alternative sites for the location of future wastewater treatment facilities were considered. Following extensive discussion by the Advisory Committees and at the Public Open House, it was determined that the best option would be to continue to upgrade and expand the existing wastewater treatment facilities at the current site adjacent to the Industrial Park. The alternative sites were dropped from consideration because of environmental and habitat concerns, poor ground conditions, potential conflicts with local recreational activities, and odour concerns.

The existing wastewater treatment facility meets the current minimum regulatory requirements for discharge to rivers and lakes (referred to as "secondary treatment"). However, the treated wastewater is currently discharged to the Illecillewaet River, which is a sensitive receiving environment. The Illecillewaet River is a relatively small river with low flows occurring in the winter. The minimum dilution provided by the river at low flow to the treated wastewater discharge flow does not currently meet B.C. regulatory standards. During periods of low flow in the river, the discharge of treated wastewater can be expected to have a greater impact on the river environment than during periods of high river flow. As the City's population grows, the impacts of the discharge on the river can be expected to increase.

Environmental impact studies conducted in the Illecillewaet River upstream and downstream of the treated wastewater discharge show minor impacts at present, which have been attributed mainly to nutrient (phosphorus) inputs in the discharge. Phosphorus inputs to sensitive receiving environments can accelerate the growth of algae and aquatic plants, and in extreme cases can affect species diversity. Two options were considered for protection of the Illecillewaet River; one option would be to implement advanced ("tertiary") treatment at the wastewater treatment facilities to remove phosphorus from the discharge, and the other would be to pipe the discharge to the Columbia River, where the dilution ratio more than meets regulatory standards and the impact of the discharge would be greatly reduced. Both options would have similar costs. The Local Advisory Committee has voted unanimously for the option of relocating the discharge to the Columbia River. The Ministry of Environment also prefers this approach, and this is the solution that the City intends to adopt in the Liquid Waste Management Plan.

The Liquid Waste Management Plan also contains commitments for the City to address control of contaminants at the source, reduction of wastewater volume through water conservation, management of storm runoff to minimize its entry into the sewer system and to protect life, property and the environment; use of solids residuals produced by wastewater treatment to produce compost; and energy conservation and recovery.

Further Information and to Comment

Detailed information regarding the Liquid Waste Management Plan is available on the City of Revelstoke website, and bound or digital copies of the Stage 1 and Stage 2 LWMP reports can be viewed at the City Engineering Department (for more information please contact Mr. Brian Mallett, P.Eng., Director of Engineering and Public Works, City of Revelstoke, 250-837-2922. Comment forms are available on the City's web site or from the City Engineering Department located at City Hall.