REGIONAL DISTRICT
RDOS
OKANAGAN-SIMILKAMEEN

Kaleden Lakeshore & Skaha Estates Rotating Biological Contactor & Biological Nutrient Removal Sewage Treatment Plant Options

Options Summary and Cost Estimates

Prepared for:
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1.0 Background

In 1989, a Liquid Waste Management Plan (LWMP) that included Rural Okanagan Falls and Kaleden was completed by T.R. Underwood Engineering. The LWMP indicated that the Kaleden Lakeshore and Skaha Estates areas could potentially have an impact on Skaha Lake as the septic tank systems begin to age. The LWMP suggested addressing phosphorus loading from Skaha Estates and Kaleden Lakeshore through sewering of the communities. The *Okanagan Falls STP - Strategic Review* completed by Earth Tech in 2005 examined the potential for extending the Okanagan Falls sewer system to service these areas.

The Kaleden Lakeshore area has been defined as a 32 hectare area with 142 lots along Skaha Lake between Ponderosa Point and the end of Alder Avenue. Most of these lots are built-out and subdivision of the surrounding larger, agricultural parcels is constrained by the Agricultural Land Reserve (ALR) so a low population growth is assumed for Kaleden Lakeshore.

The Skaha Estates area is a 54 hectare portion of land along Skaha Lake with 183 lots. The current population of Skaha Estates is about 550 people. The community consists of a central area of single family residential lots which are largely built-out, surrounded by larger agricultural or Crown Land holdings. The single family area targeted for sewering has little opportunity for growth so a nominal 1.0% annual growth rate is assumed for the area.

Given that both these areas have aging septic systems and are in close proximity to Skaha Lake, installation of a community sewer has become a priority.

1.1 Cost to Tie-In to Okanagan Falls STP

As part of the *Okanagan Falls Sewage Treatment Plant - Strategic Review*, Earth Tech did not consider in detail expansion of the Okanagan Falls sewer system to include Kaleden Lakeshore and Skaha Estates. The current estimated cost to upgrade the Okanagan Falls treatment plant to accommodate the existing sewerage area is $7,120,000. This upgrade would provide for a future population of 2,070 and service 1,489 parcels.

The Okanagan Falls treatment plant would need to be expanded to accommodate the Kaleden and Skaha Estates sewer systems. As a result, the capital upgrade cost of the plant would increase to approximately $9,000,000. A conceptual design is required to refine and confirm this cost estimate. Under this scenario, the Okanagan Falls plant would need to service an additional 390 parcels in the future. If Kaleden and Skaha Estates were included, the future total sewerage area would service an estimated 1,879 parcels.

Two options exist for financing the additional cost to the Okanagan Falls treatment plant to accommodate Kaleden and Skaha Estates. First, future development and parcels within the expanded sewerage area could equally finance the treatment plant cost expansion. Alternatively, existing and future development

with the Kaleden and Skaha Estates sewerage areas could pay for the premium to upgrade the treatment plant. Table 1.1 provides a summary of the various financing alternatives.

Table 1.1 – Treatment Plant Financing Under Various Scenarios

		Cost Contribution			
		OK Falls Sewerage Area		Kaleden/ Skaha Estates	
Scenario	**Capital Cost ($Million)**	Existing Parcels 1064	Development 425	Existing Parcels 325	Development 65
1.) WWTP to Service Existing Sewerage Area[A]	$7.1	$4,684	$5,026	n/a	n/a
2.) WWTP to Service Kaleden/Skaha Estates[B]	$9.0	$4,652	$4,969	$4,969	$4,969
3.) WWTP to Service Kaleden/Skaha Estates[C]	$9.0	$4,684	$5,026	$4,821	$4,821

Notes: *A.) Assumes future development will contribute 30% of the cost to construct a new WWTP*
B.) Assumes future development and sewerage area expansion will contribute 45% of the WWTP expansion cost
C.) Assumes future development with both OK Falls and Kaleden/Skaha Estates pay for expansion

A shared approach to financing the expansion results in the most equitable approach for financing. Under this scenario, future development and expansion of the sewerage area would finance 45% of the total cost of the plant expansion. As a result of the economies of scale, existing users would pay a slightly lesser cost over the other options.

Therefore, as part of this assessment it is assumed that the estimated capital cost contribution of tying-in to the expanded Okanagan Falls treatment plant by residents of Kaleden and Skaha Estates is $4,969.

1.2 Alternative Servicing Using Satellite Treatment Plants

In this report, separate treatment systems are considered for both Kaleden Lakeshore and Skaha Estates areas. Costs for a Rotating Biological Contactor (RBC) and a Biological Nutrient Removal (BNR) plant will be compared for each area.

The cost of servicing the Kaleden bench area was not considered for this study due to the low density. Given the larger parcel sizes and relatively long distances to the lake, the area is a lower priority for sewering.

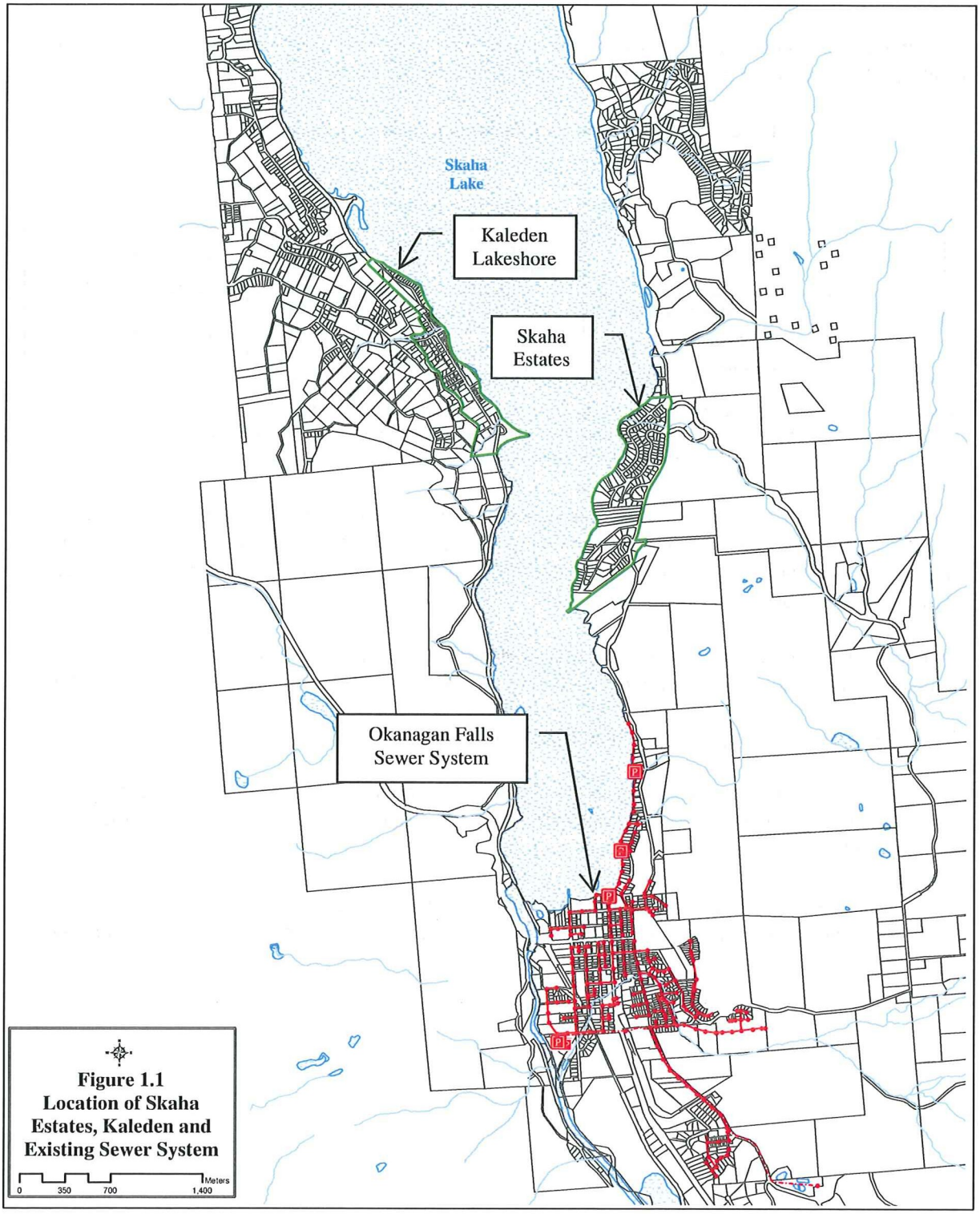

Figure 1.1
Location of Skaha Estates, Kaleden and Existing Sewer System

Estimated capital costs for the treatment plants will be based on a projected population for the year 2030 of 537 for Kaleden (Lakeshore) and 693 for Skaha Estates. Also, for the purposes of sizing treatment components and projecting flows, an average per capita wastewater rate of 470 L/day will be used (Okanagan Falls STP - Strategic Review, August 2005).

2.0 Basics of Sewage Treatment

The wastewater collected from the community flows through the sewers to the sewage treatment plant. Once the sewage gets to the treatment plant, it is typically treated using both physical and biological treatment methods. The different stages of treatment are referred to as primary, secondary, and tertiary treatment.

2.1 Preliminary and Primary Treatment

The first or preliminary stage of treatment involves removing the large debris that can clog or damage pumps, or interfere with subsequent treatment processes. The entering wastewater is passed through bars or screens and periodically the accumulated material is removed manually or by means of automatically operated rakes. Sand and grit is also removed by grit chambers with either gravity settling or centrifugal forces. The solids removed by these units can be disposed of at landfills sites.

The screened wastewater then flows into the primary clarifiers, which slow the wastewater flow down to allow for separation of both settleable and floatable solids. Primary treatment eliminates approximately 60% of total suspended solids and about 35% of organic matter in the wastewater. Primary settlement tanks are usually equipped with mechanically driven scrapers that continually drive the collected sludge towards a hopper in the base of the tank and can then be pumped to further sludge treatment and handling facilities. The primary effluent coming over the weirs of the clarifiers still contains all the dissolved compounds, substantial amounts of suspended organic waste solids, fecal coliforms and other types of bacteria.

2.2 Secondary Treatment

Secondary treatment involves a combination of biological, chemical, and mechanical processes to eliminate dissolved and suspended materials. The secondary stage of treatment can remove up to 90% of the suspended solids and organic materials in the wastewater. The majority of municipal plants using secondary processes treat the sewage using aerobic biological processes which require both oxygen and food. This biological process can be classified as fixed film or suspended growth. In fixed film secondary treatment processes the biomass grows on media and the wastewater is passed over its surface. Examples of fixed film systems are trickling filters and rotating biological contactors (RBCs). In suspended growth systems, such as activated sludge, the microbe rich biomass is constantly mixed with the sewage providing treatment.

Rotating Biological Contactors (RBCs) were chosen as a potential treatment option for the Kaleden and Skaha Lake areas.

2.3 Tertiary Treatment

The wastewater can also be treated to a higher standard than secondary treatment by removing nutrients, a process which is known as tertiary treatment. In many areas, the secondary level of treatment has proved to be insufficient to protect the receiving waters or to provide reusable water. Thus, additional treatment steps are used to provide further organic and solids removals and to provide for the removal of nutrients and/or toxic materials. An example of a tertiary treatment is a biological nutrient removal (BNR) system.

A BNR treatment plant option was also considered for both Kaleden and Skaha Estates for this report.

3.0 RBC Process

Rotating Biological Contactors (RBCs) are fixed-film biological reactors that are typically a cost effective, simple to operate secondary treatment system for domestic wastewater. The following simplified schematic shows the flow of wastewater through a typical RBC treatment plant.

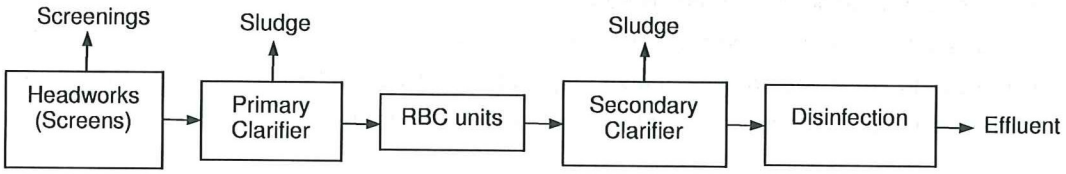

Figure 3.1: Simplified RBC Flow Diagram
(Reference: Metcalf & Eddy, Wastewater Engineering, 2003; pg549)

A biological film (microorganisms) grows on the surface of a series of durable plastic discs mounted on a horizontal rotating shaft placed in a tank. The shaft is aligned along the flow of sewage so that the discs slowly rotate at right angles to the flow. Typically about 40% of the disc area is immersed in the sewage. As the disc rotates, the attached microbes that have formed the film consume the organics in the wastewater while using oxygen picked up from the atmosphere. When excess microbes are produced, they are sloughed off by shearing forces exerted on the film as the discs rotate. These excess microbes are then removed in the secondary clarifier. In secondary clarifiers, similar to the primary clarifiers, sludge is settled to the bottom and the treated effluent is discharged over the weirs. The settled sludge is wasted to the sludge handling facilities where it is thickened and dewatered.

When only secondary treatment is used, a great deal of ammonia and phosphorus from the wastewater remains in the effluent and the secondary treated effluent is not permitted to be discharged directly to river or lake systems in the Okanagan. An infiltration gallery is then a possible method for disposal of the effluent.

Many advantages and disadvantages exist for using only secondary treatment systems. These are listed in the following two sections.

3.1 Advantages for using an RBC sewage treatment plant:

- Simple to operate
- Generally quite reliable, fairly stable process under fluctuating hydraulic and BOD loading
- Minimal land area is required
- Relatively low power consumption
- Low installation and operating costs
- Slow speed of the rotors creates very little noise
- Very little odour if operated properly
- Effluent can be disposed of to tile fields or stored for reuse by reclaimed water irrigation

3.2 Disadvantages for using an RBC sewage treatment plant:

- Process efficiency drops with organic and hydraulic shock loads
- Not inexpensive
- Mechanical plant and some maintenance is required
- May be somewhat odorous if feed is septic
- Sludge must be removed regularly once or twice a year
- Large storage reservoir and chlorination required if reclaimed water irrigation is contemplated
- Effluent contains nutrients and is not suitable for lake discharge

4.0 BNR Process

Biological Nutrient Removal (BNR) is a tertiary treatment process that involves the removal of organics and nutrients in the wastewater. With only secondary treatment, the discharged effluent would still contain high levels of nitrogen and phosphorus. Nitrogen and phosphorus are the main ingredients in fertilizers, and discharge of these nutrients can result in algae blooms and accelerated plant growth which can lead to fish kills and poor aesthetics. Nutrient removal in the BNR plant occurs in the bioreactor with specific micro-organisms using the wastewater as their food source to grow and multiply. The following figure illustrates the BNR process layout through a typical plant.

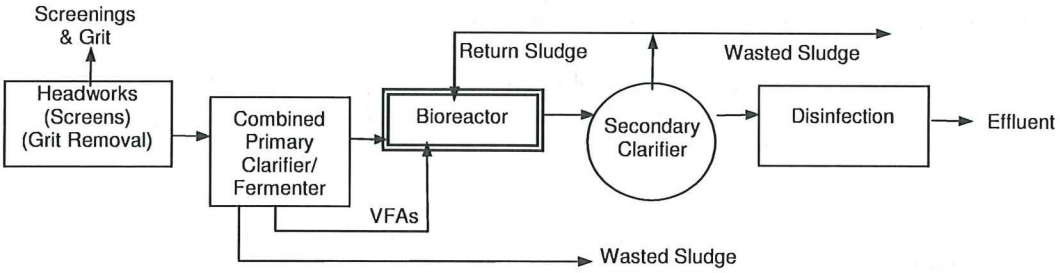

Figure 4.1: Simplified BNR plant layout

The BNR bioreactor is typically separated into three zones; anaerobic, anoxic and aerobic. The zones are classified based on the amount of oxygen that is available to the microbes for various processes. The anaerobic zone in the bioreactor contains no dissolved oxygen or nitrates. The anoxic zone contains no free oxygen but contains bio-available oxygen bound in the nitrate radical. The aerobic zones contain dissolved oxygen forced in by aeration devices at the bottom of the tanks.

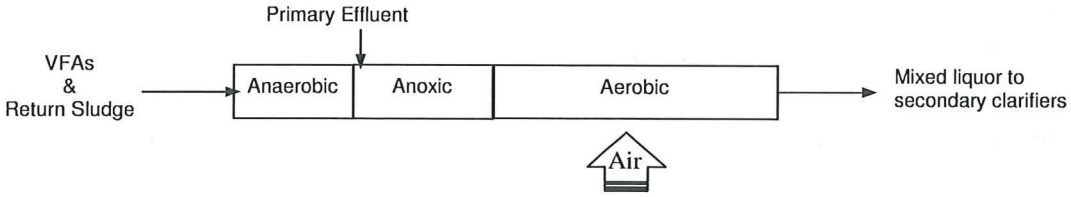

Figure 4.2: Typical BNR bioreactor setup – *simplified*

In the bioreactor, nitrogen removal takes place with two sequential reactions - nitrification and denitrification. Nitrification is the biological oxidation of ammonia to nitrate/nitrite by specialized microbes in the aerobic zones. Denitrification is the biological reduction of nitrate/nitrite to nitrogen gas that occurs in anoxic conditions. The biological phosphorus removal results from other specific organisms passing sequentially through the anaerobic zone then the aerobic zone. By passing through these zones, phosphorus can be taken up by the microbes in excess of that which they require for growth and multiplication. These phosphorus filled microbes can then be harvested from the system and potentially made into a phosphorus rich compost which can be sold.

Several advantages and disadvantages exist for the BNR systems. These are listed in the following two sections.

4.1 Advantages for using a BNR sewage treatment plant:

- Excellent effluent quality with very low nitrogen and phosphorus levels
- More options for effluent disposal including:
  - Stream-flow augmentation
  - Lake discharge
  - Irrigation – possible directly from the plant
- Lake discharge will not cause eutrophication of receiving waters
- Low public impacts
- No foul odours from eutrophication and fish kills
- Large chemical quantities are not required as the process is biological
- Less sludge is produced than in chemical treatment processes
- The sludge can be composted and sold to enhance soils in the community
- Pool of trained operators exists reasonably locally
- Technology continues to improve

4.2 Disadvantages for using a BNR sewage treatment plant:

- Relatively high capital and operating costs compared to a secondary treatment plant
- Skilled operators are required for process monitoring and adjusting
- Extensive laboratory work is typically required to ensure plant is meeting the discharge limits
- Reclaimed water used for irrigation must be chlorinated
- As with any plant, expansion room must be considered to accommodate future population growth

5.0 Cost Estimates

Satellite wastewater treatment plants were considered for Kaleden (Lakeshore) and Skaha Estates. For the purposes of this assessment, a rotating biological contactors and biological nutrient removal process were used as a basis for costing. In addition, a third option which involves provision of a RBC treatment plant in Kaleden to service both communities was considered.

5.1 Satellite Treatment Plants for Kaleden and Skaha Estates

For Kaleden, the estimated cost for a RBC plant is about $2.9 million and for a BNR plant is about $4.6 million. The treatment plant cost on a per parcel basis is estimated at $20,300 for the RBC plant and $32,200 for the BNR plant.

Since the treatment plant site has not been selected, the cost of sewering per parcel cannot be accurately defined. However, based on the work carried out in the *Strategic Plan* and assuming a treatment plant near the south end of the Kaleden Lakeshore area, the servicing cost component is estimated to be $17,000. This cost would include a common liftstation to conveying wastewater to the new plant.

Therefore, total estimated costs per parcel for provision of sewer services and a satellite treatment plant is $37,500 for the RBC plant and $49,400 for the BNR plant.

Table 5.1: Summary of Kaleden Lakeshore Satellite Treatment Plant Options

Kaleden Treatment Plant Options		**RBC**	**BNR**
1.0	General Requirements	$ 290,000	$ 460,000
2.0	Civil	$ 150,000	$ 400,000
3.0	Structural	$ 274,334	$ 432,312
4.0	Process Mechanical	$ 1,046,478	$ 1,411,000
5.0	Building Mechanical	$ 50,000	$ 90,000
6.0	Electrical, Instrumentation & Control	$ 325,000	$ 600,000
	Subtotal	$ 2,135,812	$ 3,393,312
	Contingency 25%	$ 533,953	$ 848,328
	Engineering 10%	$ 213,581	$ 339,331
Total		**$ 2,883,000**	**$ 4,581,000**
Total Cost per parcel for sewers and STP:		**$ 37,483**	**$ 49,441**

For Skaha Estates, the estimated cost for a RBC plant is about $2.9 million and $4.7 million for a BNR plant. With 183 parcels in Skaha Estates, the cost for the treatment plant per parcel at $16,100 for the RBC plant and $25,600 for the BNR plant. Skaha Estates is not yet sewered so the cost of providing trunk sewers and pump facilities for this option was estimated to be $16,800 per parcel. The total estimated cost per parcel for the sewer system and treatment plants is $33,000 for the RBC plant and $42,500 for the BNR plant.

The unit parcel costs for the Kaleden lakeshore area are higher than Skaha Estates due to the lower density.

Table 5.2: Summary of Skaha Estates Satellite Treatment Plant Options

Skaha Estates Treatment Plant Options		RBC	BNR
1.0	General Requirements	$ 300,000	$ 470,000
2.0	Civil	$ 150,000	$ 400,000
3.0	Structural	$ 297,052	$ 499,142
4.0	Process Mechanical	$ 1,061,142	$ 1,411,000
5.0	Building Mechanical	$ 50,000	$ 90,000
6.0	Electrical, Instrumentation & Control	$ 325,000	$ 600,000
	Subtotal	$ 2,183,194	$ 3,470,142
	Contingency 25%	$ 545,798	$ 867,535
	Engineering 10%	$ 218,319	$ 347,014
Total		**$ 2,947,000**	**$ 4,685,000**
Total Cost per parcel for sewers and STP:		**$ 33,044**	**$ 42,541**

5.2 Combined Treatment Plant

The cost associated with constructing a single treatment plant to service both Kaleden and Skaha Estates was also considered. Wastewater could be pumped from Skaha Estates to Kaleden using a submerged forcemain.

For this option, it was assumed that the treatment plant would be constructed in Kaleden. In addition, given the limited data on treatment plant sites and the fact that both communities would be combined into a single sewerage, the capital costs were distributed equally between all the parcels.

Capital costs for construction of a community sewer and treatment plant were distributed over the 325 parcels in Kaleden and Skaha Estates. On this basis, the total capital cost per parcel was estimated to be $35,500 per parcel.

Table 5.3: Summary Costs for a Single Treatment Plant to Service Kaleden and Skaha Estates

Kaleden/Skaha Estates RBC Treatment Plant		RBC
1.0	General Requirements	$ 380,000
2.0	Civil	$ 150,000
3.0	Structural	$ 375,253
4.0	Process Mechanical	$ 1,566,620
5.0	Building Mechanical	$ 50,000
6.0	Electrical, Instrumentation & Control	$ 325,000
	Subtotal	$ 2,846,873
	Contingency 25%	$ 711,718
	Engineering 10%	$ 284,687
Total		**$ 3,843,000**
Total Cost per parcel for sewers and STP:		**$ 35,486**

5.3 Summary of Cost Estimates

Table 5.1 provides a summary of capital costs for the servicing options considered in this report. The option with the least capital cost is to pump wastewater from Skaha Estates and Kaleden to the Okanagan Falls wastewater treatment plant.

The cost of Option 2 and Option 4 appear to be marginally higher. However, the treatment plant costs do not consider land acquisition or operational costs. Consideration of these additional costs would tend to increase the cost gap between Option 1 and other options.

Table 5.4 – Comparison of Capital Costs

Option	Capital Cost per Parcel	
	Kaleden Lakeshore	Skaha Estates
1.) Tie-in to the Okanagan Falls sewer system	$33,400	$29,000
2.) Satellite RBC Sewage Treatment Plant	$37,500	$33,000
3.) Satellite BNR Sewage Treatment Plant	$49,400	$42,500
4.) Common RBC Sewage Treatment Plant	$35,500	$35,500

6.0 Recommendations & Conclusions

Based on a Class 'D' cost comparison, the option of pumping to the Okanagan Falls sewer system is the least cost option. The cost estimates provided do not consider land acquisition or operational costs. Further analyses and selection of treatment plant sites are required to develop a life-cycle cost estimate for each option. Based on a specific treatment plant site, life-cycle costs could be calculated which consider the operational costs, including electricity, equipment replacement, labour, insurance and overhead costs.

Although the current assessment does not take into account property acquisition and operational costs, the smaller service populations associated with Option 2, 3 and 4 would likely have the same or higher annualized costs than Option 1.

APPENDIX A

DETAILED COST ESTIMATES

April 9, 2007

Kaleden and Skaha Estates
RBC Sewage Treatment Plants

Class 'D' Construction Cost Estimate

		Kaleden				Skaha Estates			
Item	Description	Quantity	Unit	Unit Price ($)	Total Price ($)	Quantity	Unit	Unit Price ($)	Total Price ($)
1.0	**GENERAL REQUIREMENTS**								
1.1	Mobilization / Demobilization				$ 290,000				$ 300,000
	Overhead - Indirect Costs								
	Site soft costs								
	Total 1 - General Requirements				**$ 290,000**				**$ 300,000**
2.0	**CIVIL**								
2.1	General Excavation				$ 150,000				$ 150,000
	Site Servicing								
	Landscaping / clearing and grubbing allowance								
	Interconnecting Piping								
	Total 2 - Civil				**$ 150,000**				**$ 150,000**
3.0	**STRUCTURAL**								
3.1	Primary Clarifier Tank Walls	25	m^3	1200	$ 30,273	30	m^3	1200	$ 36,432
3.2	Primary Clarifier Tank Base Slab	8.5	m^3	900	$ 7,665	10.7	m^3	900	$ 9,670
3.3	RBC Tank Walls	55	m^3	1200	$ 65,789	55	m^3	1200	$ 65,789
3.4	RBC Tank Base Slab	24	m^3	900	$ 21,331	24	m^3	900	$ 21,331
3.5	Secondary Clarifier Walls	43	m^3	1200	$ 51,091	52	m^3	1200	$ 62,639
3.6	Secondary Clarifier Base Slab	12	m^3	900	$ 11,115	16	m^3	900	$ 14,122
3.7	Sludge Storage Tank Walls	11	m^3	1200	$ 13,524	11	m^3	1200	$ 13,524
3.8	Sludge Storage Tank Slab	4	m^3	900	$ 3,546	4	m^3	900	$ 3,546
3.9	Admin building	1	LS	70000	$ 70,000	1	LS	70000	$ 70,000
	Total 3 - Concrete				**$ 274,334**				**$ 297,052**
4.0	**PROCESS MECHANICAL**								
4.1	**Headworks**								
4.1.1	Coarse Screening - 6mm screen	1	LS	70000	$ 70,000	1	LS	70000	$ 70,000
4.1.2	Miscellaneous (Gates, Gas Detection, Bar Screen)	1	LS	30,000	$ 30,000	1	LS	30,000	$ 30,000
4.1.3	Mech. Installation	1	LS	40,000	$ 40,000	1	LS	40,000	$ 40,000
4.2	**Primary Clarification**								
4.2.1	Primary Tank Scrapper Mechanism	1	LS	30000	$ 30,000	1	LS	30000	$ 30,000
4.2.2	Mech. Installation	1	LS	24,000	$ 24,000	1	LS	24,000	$ 24,000
4.3	**Secondary Treatment**								
4.3.1	RBC Equipment	1	LS	420000	$ 420,000	1	LS	420000	$ 420,000
4.3.2	Secondary Clarifier Mechanisms	1	pair	40000	$ 40,000	1	pair	40000	$ 40,000
4.3.3	Secondary Sludge Pumps	1	pair	40000	$ 40,000	1	pair	40000	$ 40,000
4.3.4	Mech. Installation	1	LS	130,000	$ 130,000	1	LS	130,000	$ 130,000
4.3.5	Channel aeration	1	LS	15,000	$ 15,000	1	LS	15,000	$ 15,000
4.6	**Miscellaneous**				$ -				$ -
4.6.1	Gates / Weirs	1	LS	100,000	$ 100,000	1	LS	100,000	$ 100,000
4.6.2	Flow Measurement	1	LS	20,000	$ 20,000	1	LS	20,000	$ 20,000
4.6.3	Metal Fabrication	1	LS	30,000	$ 30,000	1	LS	30,000	$ 30,000
4.6.4	Composite Sampler	1	LS	7,000	$ 7,000	1	LS	7,000	$ 7,000
4.7 4.6.5	Infiltration gallery	252	m^3	200	$ 50,478	326	m^3	200	$ 65,142
	Total 4 - Process Mechanical Equipment				**$ 1,046,478**				**$ 1,061,142**
5.0	**BUILDING MECHANICAL**								
	Heating and Ventilation				**$ 50,000**				**$ 50,000**
	Plumbing								
6.0	**ELECTRICAL, INSTRUMENTATION & CONTROL**				**$ 325,000**				**$ 325,000**
	SUB-TOTAL				**$ 2,135,812**				**$ 2,183,194**
	Construction Contingency		25%		$ 534,000				$ 546,000
	Engineering		10%		$ 214,000				$ 218,000
	TOTAL ESTIMATE OF CAPITAL COST (2007)				**$ 2,884,000**				**$ 2,947,000**

April 9, 2007

Kaleden and Skaha Estates
BNR Sewage Treatment Plants

Class 'D' Construction Cost Estimate

		Kaleden				Skaha Estates			
Item	Description	Quantity	Unit	Unit Price ($)	Total Price ($)	Quantity	Unit	Unit Price ($)	Total Price ($)
1.0	**GENERAL REQUIREMENTS**								
1.1	Mobilization / Demobilization				$ 460,000				$ 470,000
	Overhead - Indirect Costs								
	Site soft costs								
	Total 1 - General Requirements				**$ 460,000**				**$ 470,000**
2.0	**CIVIL**								
2.1	General Excavation				$ 150,000				$ 150,000
	Site Servicing								
	Landscaping / clearing and grubbing allowance								
	Interconnecting Piping								
2.2	Deep Lake Outfall				$ 250,000				$ 250,000
	Total 2 - Civil				**$ 400,000**				**$ 400,000**
3.0	**STRUCTURAL**								
3.1	Primary Clarifier/VFA Tank Walls	19	m^3	1200	$ 23,003	22	m^3	1200	$ 25,881
3.2	Primary Clarifier/VFA Tank Base Slab	8	m^3	900	$ 7,052	10	m^3	900	$ 8,779
3.3	Bioreactor Tank Walls (2 trains)	168	m^3	1200	$ 201,264	191	m^3	1200	$ 229,264
3.4	Bioreactor Tank Base Slab (2 trains)	47	m^3	900	$ 42,095	54	m^3	900	$ 48,695
3.5	Secondary Clarifier Walls	44	m^3	1200	$ 52,262	56	m^3	1200	$ 66,774
3.6	Secondary Clarifier Base Slab	24	m^3	900	$ 21,764	39	m^3	900	$ 34,878
3.7	Sludge Storage Tank Walls	11	m^3	900	$ 10,143	11	m^3	900	$ 10,143
3.8	Sludge Storage Tank Base Slab	4	m^3	1200	$ 4,729	4	m^3	1200	$ 4,729
3.9	Admin building	1	LS	70000	$ 70,000	1	LS	70000	$ 70,000
	Total 3 - Concrete				**$ 432,312**				**$ 499,142**
4.0	**PROCESS MECHANICAL**								
4.1	**Headworks**								
4.1.1	Coarse Screening - 6mm screen	1	LS	70000	$ 70,000	1	LS	70000	$ 70,000
4.1.2	Grit Removal, Classifier, Compactor & Conveyor	1	LS	125000	$ 125,000	1	LS	125000	$ 125,000
4.1.3	VFA Fermenter Scraper and Cover	1	LS	60000	$ 60,000	1	LS	60000	$ 60,000
4.1.4	Miscellaneous (Gates, Gas Detection, Bar Screen)	1	LS	30,000	$ 30,000	1	LS	30,000	$ 30,000
4.1.5	Mech. Installation	1	LS	40,000	$ 40,000	1	LS	40,000	$ 40,000
4.2	**Primary Clarification**								
4.2.1	Primary Tank Scrapper Mechanism	1	LS	30000	$ 30,000	1	LS	30000	$ 30,000
4.2.2	Mech. Installation	1	LS	24,000	$ 24,000	1	LS	24,000	$ 24,000
4.3	**BNR**								
4.3.1	Bioreactor Aerators	1	LS		$ -	1	LS		$ -
4.3.2	Bioreactor Mixers	1	LS		$ -	1	LS		$ -
4.3.3	Secondary Clarifier Mechanisms	1	LS	80000	$ 80,000	1	LS	80000	$ 80,000
4.3.4	Secondary Sludge Pumps	1	pair	40000	$ 40,000	1	pair	40000	$ 40,000
4.3.5	Mech. Installation	1	LS	130,000	$ 130,000	1	LS	130,000	$ 130,000
4.4	**Disinfection / Filtration**								
4.4.1	UV Disinfection	1	LS	60,000	$ 60,000	1	LS	60,000	$ 60,000
4.4.2	Disk Filter	1	LS	120,000	$ 120,000	1	LS	120,000	$ 120,000
4.4.3	Mech. Installation	1	LS	45,000	$ 45,000	1	LS	45,000	$ 45,000
4.5	**Sludge Handling**								
4.5.1	Sludge Thickener/DAF and all associated equipment	1	LS	400,000	$ 400,000	1	LS	400,000	$ 400,000
4.6	**Miscellaneous**								
4.6.1	Gates / Weirs	1	LS	100,000	$ 100,000	1	LS	100,000	$ 100,000
4.6.2	Flow Measurement	1	LS	20,000	$ 20,000	1	LS	20,000	$ 20,000
4.6.3	Metal Fabrication	1	LS	30,000	$ 30,000	1	LS	30,000	$ 30,000
4.6.4	Composite Sampler	1	LS	7,000	$ 7,000	1	LS	7,000	$ 7,000
	Total 4 - Process Mechanical Equipment				**$ 1,411,000**				**$ 1,411,000**
5.0	**BUILDING MECHANICAL**								
	Heating and Ventilation				**$ 90,000**				**$ 90,000**
	Plumbing								
6.0	**ELECTRICAL, INSTRUMENTATION & CONTROL**				**$ 600,000**				**$ 600,000**
	SUB-TOTAL				**$ 3,393,312**				**$ 3,470,142**
	Construction Contingency		25%		$ 848,000				$ 868,000
	Engineering		10%		$ 339,000				$ 347,000
TOTAL ESTIMATE OF CAPITAL COST (2007)					**$ 4,580,000**				**$ 4,685,000**

Combined Kaleden and Skaha Estates Sewerage Areas
RBC Sewage Treatment Plant

Class 'D' Construction Cost Estimate

		Kaleden/Skaha Estates STP			
Item	Description	Quantity	Unit	Unit Price ($)	Total Price ($)
1.0	**GENERAL REQUIREMENTS**				
1.1	Mobilization / Demobilization				$ 380,000
	Overhead - Indirect Costs				
	Site soft costs				
	Total 1 - General Requirements				**$ 380,000**
2.0	**CIVIL**				
2.1	General Excavation				$ 150,000
	Site Servicing				
	Landscaping / clearing and grubbing allowance				
	Interconnecting Piping				
	Total 2 - Civil				**$ 150,000**
3.0	**STRUCTURAL**				
3.1	Primary Clarifier Tank Walls	48	m^3	1200	$ 57,632
3.2	Primary Clarifier Tank Base Slab	18.4	m^3	900	$ 16,569
3.3	RBC Tank Walls	55	m^3	1200	$ 65,789
3.4	RBC Tank Base Slab	24	m^3	900	$ 21,331
3.5	Secondary Clarifier Walls	85	m^3	1200	$ 102,391
3.6	Secondary Clarifier Base Slab	27	m^3	900	$ 24,471
3.7	Sludge Storage Tank Walls	11	m^3	1200	$ 13,524
3.8	Sludge Storage Tank Slab	4	m^3	900	$ 3,546
3.9	Admin building	1	LS	70000	$ 70,000
	Total 3 - Concrete				**$ 375,253**
4.0	**PROCESS MECHANICAL**				
4.1	**Headworks**				
4.1.1	Coarse Screening - 6mm screen	1	LS	70000	$ 70,000
4.1.2	Miscellaneous (Gates, Gas Detection, Bar Screen)	1	LS	30,000	$ 30,000
4.1.3	Mech. Installation	1	LS	40,000	$ 40,000
4.2	**Primary Clarification**				
4.2.1	Primary Tank Scrapper Mechanism	1	LS	30000	$ 30,000
4.2.2	Mech. Installation	1	LS	24,000	$ 24,000
4.3	**Secondary Treatment**				
4.3.1	RBC Equipment	1	LS	780000	$ 780,000
4.3.2	Secondary Clarifier Mechanisms	1	pair	60000	$ 60,000
4.3.3	Secondary Sludge Pumps	1	pair	40000	$ 40,000
4.3.4	Mech. Installation	1	LS	160,000	$ 160,000
4.3.5	Channel aeration	1	LS	15,000	$ 15,000
4.6	**Miscellaneous**				$ -
4.6.1	Gates / Weirs	1	LS	120,000	$ 120,000
4.6.2	Flow Measurement	1	LS	25,000	$ 25,000
4.6.3	Metal Fabrication	1	LS	50,000	$ 50,000
4.6.4	Composite Sampler	1	LS	7,000	$ 7,000
4.7 4.6.5	Infiltration gallery	578	m^3	200	$ 115,620
	Total 4 - Process Mechanical Equipment				**$ 1,566,620**
5.0	**BUILDING MECHANICAL**				
	Heating and Ventilation				**$ 50,000**
	Plumbing				
6.0	**ELECTRICAL, INSTRUMENTATION & CONTROL**				**$ 325,000**
	SUB-TOTAL				**$ 2,846,873**
	Construction Contingency		25%		$ 712,000
	Engineering		10%		$ 285,000
TOTAL ESTIMATE OF CAPITAL COST (2007)					**$ 3,844,000**

Conveyance Estimates for Pumping Wastewater to Okanagan Falls WWTP (Option 1)

Kaleden Lakeshore

Item	Unit	Quantity	Cost/Unit	Cost Estimate ($)
1.) Gravity sewer (incl. manholes, services, road/ROW restoration, dewatering)	m	3,170	360	1,141,200
2.) Alder Ave. Pump Station	LS	1	255,000	255,000
3.) Alder Ave. Forcemain	m	585	270	157,950
4.) Pioneer Park Pump Station	LS	1	255,000	255,000
5.) Skaha Lake Forcemain (common trench)	m	980	200	196,000
6.) Skaha Lake Forcemain (submerged)	m	960	245	235,200
7.) Capital Contribution	parcel	142	4,969	705,598
			Sub-Total	2,945,948
			Engineering & Contingency (35%)	1,031,082
			TOTAL (Rounded)	***3,980,000***

Skaha Estates

Item	Unit	Quantity	Cost/Unit	Cost Estimate ($)
1.) Gravity sewer (incl. manholes, services, road/ROW restoration, dewatering)	m	4,390	360	1,580,400
2.) Devon Drive Pump Station	LS	1	255,000	255,000
3.) Devon Drive Forcemain (common trench)	m	250	270	67,500
4.) Laguna Lane Pump Station	LS	1	255,000	255,000
5.) Camberly Cove Forcemain (common trench)	m	695	200	139,000
5.) Capital Contribution	parcel	183	4,969	909,327
			Sub-Total	*3,206,227*
			Engineering & Contingency (35%)	1,122,179
			TOTAL (Rounded)	***4,330,000***

Common Conveyance Upgrades

Item	Unit	Quantity	Cost/Unit	Cost Estimate ($)
1.) Gravity by-pass sewer (incl. manholes, services, road/ROW restoration, dewatering)	m	624	390	243,360
2.) Echo Bay Road Pump Station (c/w odour control)	LS	1	330,000	330,000
3.) Eastside Road Forcemain (road restoration)	m	2,615	270	706,050
			Sub-Total	*1,279,410*
			Engineering & Contingency (35%)	447,794
			TOTAL (Rounded)	***1,730,000***

Conveyance Estimates for Servicing Satellite Plants in Each Community (Option 2, 3)

Kaleden Lakeshore

Item	Unit	Quantity	Cost/Unit	Cost Estimate ($)
1.) Gravity sewer (incl. manholes, services, road/ROW restoration, dewatering)	m	3,170	360	1,141,200
2.) Alder Ave. Pump Station	LS	1	255,000	255,000
3.) Alder Ave. Forcemain	m	585	270	157,950
4.) Pioneer Park Pump Station	LS	1	255,000	255,000
			Sub-Total	1,809,150
			Engineering & Contingency (35%)	633,203
			TOTAL (Rounded)	***2,440,000***

Skaha Estates

Item	Unit	Quantity	Cost/Unit	Cost Estimate ($)
1.) Gravity sewer (incl. manholes, services, road/ROW restoration, dewatering)	m	4,390	360	1,580,400
2.) Devon Drive Pump Station	LS	1	255,000	255,000
3.) Devon Drive Forcemain (common trench)	m	250	270	67,500
4.) Laguna Lane Pump Station	LS	1	255,000	255,000
5.) Camberly Cove Forcemain (common trench)	m	700	200	140,000
			Sub-Total	*2,297,900*
			Engineering & Contingency (35%)	804,265
			TOTAL (Rounded)	***3,100,000***

Conveyance Estimate for Pumping Wastewater to a Common STP in Kaleden (Option 4)

Kaleden Lakeshore

Item	Unit	Quantity	Cost/Unit	Cost Estimate ($)
1.) Gravity sewer (incl. manholes, services, road/ROW restoration, dewatering)	m	3,170	360	1,141,200
2.) Alder Ave. Pump Station	LS	1	255,000	255,000
3.) Alder Ave. Forcemain	m	585	270	157,950
4.) Pioneer Park Pump Station	LS	1	255,000	255,000
			Sub-Total	1,809,150
			Engineering & Contingency (35%)	633,203
			TOTAL (Rounded)	***2,440,000***

Skaha Estates

Item	Unit	Quantity	Cost/Unit	Cost Estimate ($)
1.) Gravity sewer (incl. manholes, services, road/ROW restoration, dewatering)	m	4,390	360	1,580,400
2.) Devon Drive Pump Station	LS	1	255,000	255,000
3.) Devon Drive Forcemain (common trench)	m	250	270	67,500
4.) Laguna Lane Pump Station	LS	1	255,000	255,000
5.) Camberly Cove Forcemain (common trench)	m	695	200	139,000
			Sub-Total	*2,296,900*
			Engineering & Contingency (35%)	803,915
			TOTAL (Rounded)	***3,100,000***

Common Conveyance Upgrades

Item	Unit	Quantity	Cost/Unit	Cost Estimate ($)
1.) Gravity by-pass sewer (incl. manholes, services, road/ROW restoration, dewatering)	m	624	390	243,360
2.) Echo Bay Road Pump Station (c/w odour control)	LS	1	330,000	330,000
3.) Eastside Road Forcemain (road restoration)	m	2,615	225	588,375
4.) Skaha Lake Forcemain (common trench)	m	980	200	196,000
5.) Skaha Lake Forcemain (submerged)	m	960	245	235,200
			Sub-Total	*1,592,935*
			Engineering & Contingency (35%)	557,527
			TOTAL (Rounded)	***2,150,000***