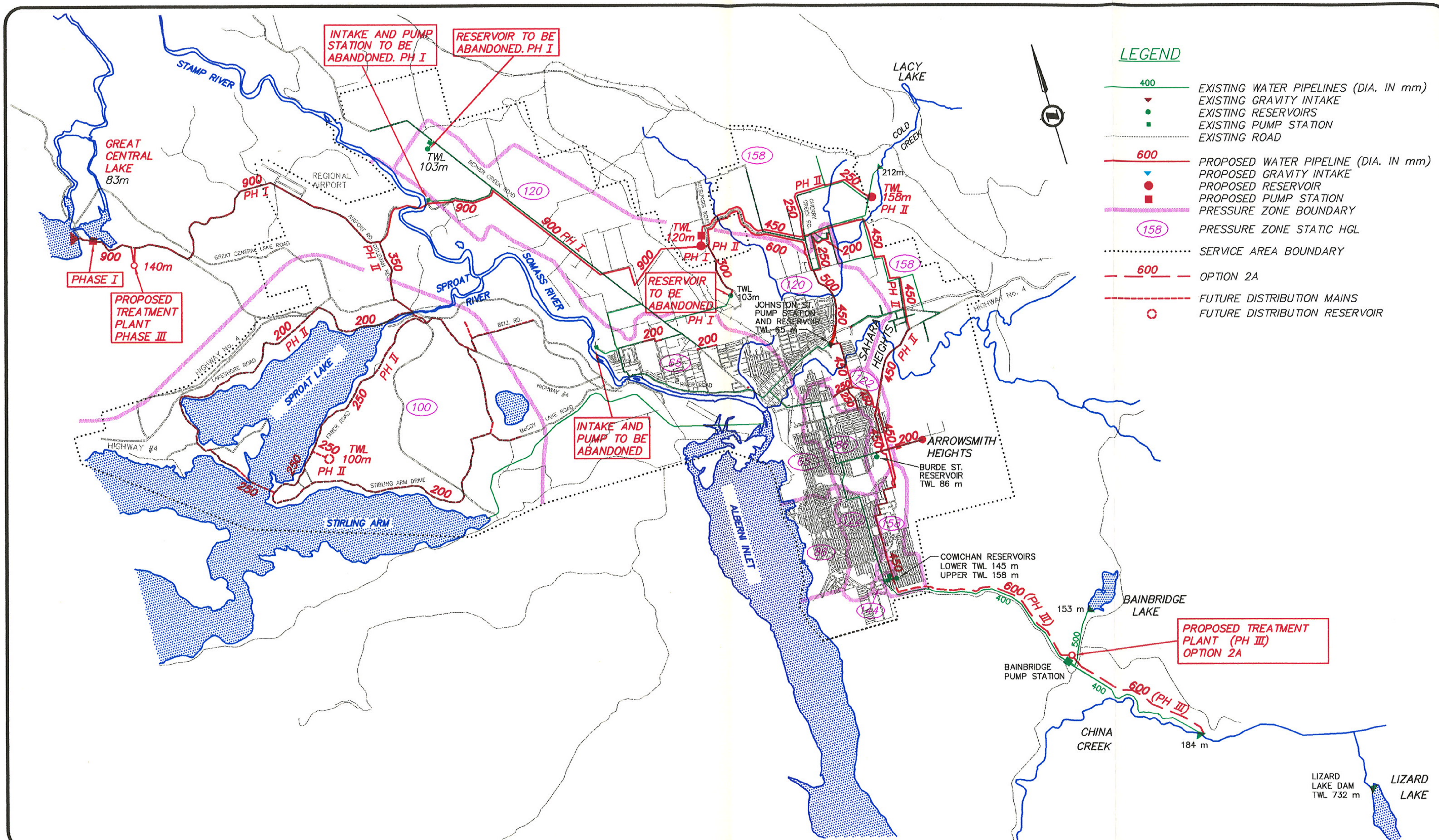

KOERS & ASSOCIATES ENGINEERING LTD. Consulting Engineers	CLIENT: CITY OF PORT ALBERNI / REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT	TITLE: OPTIONS 2A AND 2B GREAT CENTRAL LAKE / CHINA CREEK SUPPLY
	PROJECT: ALBERNI VALLEY REGIONAL WATER STUDY	APPROVED; DATE NOV. 1994; JOB No. M9330; SCALE 1:75,000; DWG No. FIG 6.2

6.3.2 Great Central Lake Supply Only (Option 2B):
Expansion of the Great Central Lake medium lift pump station and the construction of a treatment plant at the 140 m elevation site south of the supply main near Great Central Lake will this source to supply the total system demands to the year 2020.

Phasing out of the Lacy Lake and China Creek supplies will require a new booster pump station at the new TWL 120 reservoir to boost from the 120 m pressure zone to a new TWL 158 reservoir in Cherry Creek, which will supply the 158 pressure zone in Cherry Creek and the 158 m upper Cowichan reservoir zone, via a new transmission main along the eastern City boundary to a point upstream from the Burde Street PRV. This system is shown in Fig. 6.2.

The implications of these various alternatives on total annual cost and system financing requirements will be reviewed in Sections 7.0 and 8.0.

6.4 WATER TREATMENT REQUIREMENTS

As illustrated under Section 5.2, the water quality of all potential regional water sources is well within the Guidelines for Canadian Drinking Water Quality (4). The exception is turbidity and colour for the China Creek and Somass sources, which are higher than acceptable during and after heavy rainfall events, and organic material and taste and odour causing compounds for the Somass source, due to upstream contamination.

All surface water sources are subject to contamination by coliform and other, sometimes pathogenic, bacteria, for which mandatory disinfection is applied. Surface waters are also subject to contamination from protozoan parasites, such as Giardia Lamblia, in a cyst form. The latter are transmitted by animals in the watershed and are the cause of "beaver fever". Disinfection is able to kill these to some extent, but if they are present in sufficient numbers, filtration treatment is required.

All surface water sources in the Alberni Valley are somewhat aggressive, rendering the water corrosive towards metal pipes and asbestos-cement pipes. If this presents major problems in the water distribution system, the aggressiveness can be reduced by adding lime to the water.

Colour in water indicates the likely presence in water of precursers for the formation of tri-halomethane compounds (THM's) and other halogenated organics. These could form upon disinfection with chlorine compounds. This may call for special disinfection methods, if THM formation is significant.

Turbidity and colour can be prevented in the China Creek source by switching to Bainbridge Lake during storm events. Turbidity is monitored at the China Creek intake, and the water supply is switched to Bainbridge when the turbidity exceeds a value of 5 NTU. Temporary shut down of the China Creek supply during high turbidity periods will be even more controllable under a new regional supply system with an alternate source of water.

In some of the larger communities in British Columbia, it has been common practice to protect the surface water sources from human contamination by prohibiting access to the watershed. Treatment has typically been limited to coarse screening and chlorination. In community waterheds of the smaller communities, where land ownership does not rest with the water supply authority, attempts are generally made to cooperate with the (generally forestry) land owner and reach agreements on management of activities in the watershed. The provincial government is currently in the process of revising its community watershed guidelines, by increasing restrictions of activities and regulating activities in comunity watersheds, to protect water quality. We understand these new guidelines will apply to crown lands only. Other legislation under the Forestry Act and Fisheries Act also regulates activities near streams, to protect water quality for fisheries purposes.

It is believed that it will be possible to continue to improve watershed management practices in the China Creek and Great Central Lake watersheds under these new legislative umbrellas, to the extent that water quality can be protected sufficiently to be able to postpone the construction of filtration treatment plants on these supplies for the foreseeable future. The City and the Regional District, however, will need to become leaders in the process of establishing watershed management plans for these watershed, much like the City has been doing at China Creek for some time. Watershed level water quality control would provide the first barrier against bacterial or protozoan contamination, with disinfection providing the second barrier.

Should this not be successful, or if legislation is brought in, as it already has in the USA, to force mandatory treatment of all surface water supplies, treatment on both these sources may have to be added prior to the date assumed in this report.

Because of the size and extent of agricultural activity in the Somass watershed, and the already known problems with taste and odour of that water source, it is not considered possible to reverse the deteriorating water quality in that river through watershed controls. The use of the Somass source for regional or municipal water supply will require the construction of a water treatment plant immediately. Such plant would incorporate stilling ponds, conditioning of the water using alkali to reduce water aggressiveness, stabilization, polymer addition for coagulation, mixing and flocculation of suspended particles, likely followed by sedimentation, then followed by rapid dual media (anthracite and sand) filtration, possibly granular activated carbon filtration for taste and odour removal, and final disinfection. The exact unit processes and sizing of units would be determined by pilot plant studies.

Sedimentation, followed by filtration would separate the coagulated and flocculated particles until the filter is automatically backwashed. This treatment would address turbidity, colour and possibly taste and odour concerns, and would also provide a barrier against pathogens, including Giardia, prior to final disinfection. The backwash water must be disposed of in dewatering ponds. Granular activated carbon treatment may be required to further remove taste and odour compounds.

SECTION 7

SECTION 7.0
CAPITAL COST ESTIMATES

7.1 INTRODUCTION

The purpose of this report is to recommend a regional water supply system which will meet the Regional District and the City's needs for the next 25 years as well as form the initial basis for long range water supply planning for future development of the area. Various source locations, pipeline, pumping and treatment alternatives will be compared to decide on the most appropriate course of action. Cost is a major factor in the decision making process, although not the only consideration.

Construction, operation and maintenance costs are based on preliminary layout of the proposed water supply options. Sufficient attention must be given to alternatives and costs to ensure that the decision making process is conducted realistically. Costs of the various components are based on similar projects in the area or on projects elsewhere and modified to reflect prevailing construction conditions in the project area.

7.1.1 Construction Cost Estimates

These are an estimate of the successful low bidder's costs for a defined project scope of work. It includes labour, material, equipment, subcontractor costs, prime and subcontractor mark up for overhead and profit as well as a contingency allowance.

7.1.2 Contingency

A contingency budget is established within the cost estimates to cover-yet-to-be defined project elements. It is a percentage of the other items in the cost estimate. The level of contingency depends on the level of development of the design at the time the estimate is made. It reflects the level of confidence in the completeness of the work. It is <u>not</u> intended to cover changes in the scope of the project. It is intended to cover detail items that are not currently in the design but will be at the tender time. The amount of the contingency budget should be managed by the owner and the design team through the life of the project and declines as the project approaches the tender day.

7.1.3 Engineering, Legal and Administration

The cost of engineering services for major construction projects may include special investigations, preliminary engineering reports, application for government approvals and permits, surveys, foundation explorations, location of conflicting utilities, preparation of construction drawings and specifications, construction management, inspection, materials testing, plant start up services, operator training and preparation of record drawings. These costs typically range between 10 and 20 percent of project construction costs depending on the magnitude and complexity of the project. Other costs directly associated with water supply and treatment facilities include administrative and legal services. These costs normally range between 2.5 and 7.5 percent of construction costs.

For this project an allowance of 15 percent is included in the total project costs to cover engineering, legal and administrative expenditures. This percentage is considered reasonable for this stage of the project and typical of experience on similar projects elsewhere.

GST applies to all costs associated with the project. After allowing the 4% rebate available to municipal and regional authorities, 3% effective GST is to be added to all estimated costs. This is included in the cost estimates.

7.2 ACCURACY OF ESTIMATES

The precision of a cost estimate is a function of the detail to which the design of a facility has been completed and the techniques used in preparation of the estimates. The American Association of Cost Engineers divides the estimates into three categories:

Order of Magnitude. These estimates are approximate and are made without detailed engineering data. Techniques such as cost-capacity curves, scaling or scale-down factors, and ratio factor are used in developing this type of estimate. An Order-of-Magnitude estimate is expected to be accurate within a scope of plus 50% and minus 30% of the final cost.

Budget Estimate. This estimate is based on preliminary layouts, and predesign of main facilities, process flow sheets, and equipment details. A budget estimate is intended to be accurate within plus 30% and minus 15% of the final project cost.

Definitive Estimate. As the name implies this estimate is based on-well-defined engineering plans and specifications as approved for construction. This estimate is expected to be accurate within plus 15% to minus 5%.

The estimates contained in this report are of an accuracy between order of magnitude and budget level estimates unless otherwise indicated.

7.3 COSTS OVER TIME

This report has been prepared in 1994 whereas the actual construction of the first phase is not anticipated to start before 1996 and would extend into 1997, with successive later phases staged through to 2015. The costs of material, labour and equipment during this period will vary in response to changes in the national and local economy. These variations will affect the actual construction costs increase over the life of the project. The estimates presented in this report have been prepared on the basis of estimated construction costs for work tendered in mid 1994.

7.3.1 Present Value

Capital costs expended in the short term are only one aspect of the total project costs. Future capital expenditures and long term operating and maintenance costs are an integral component of the total project costs and thus play an important role in the economic comparison of alternatives.

Long term expenditures must be taken into account when evaluating alternatives in a manner which reflects their comparative value. Future costs incurred for services/commodities would be higher than the current costs for the same services/commodities because of inflation. However, a capital facility is similar to an investment - it appreciates over time. The rate of return (or interest) on this investment must be factored into an evaluation. The technique normally used for this purpose is to evaluate the comparative worth of options on the basis of their present value, sometimes termed life cycle costing. The present value of any facility is the amount which would have to be invested in the base year to cover all future costs. Thus, the invested amount would accrue interest while being used to pay for costs in inflated dollars.

7.4 PIPELINE COSTS

The location and the size of the watermains depends on the water supply option as discussed in previous sections. The watermains will generally be located within existing road rights-of-way (ROW) or within 20 m ROW yet to be acquired in undeveloped lands.

Table 7.1 sets out base unit prices for installation of pipes which have been used for estimating costs of construction. These prices include 15% contingency and are based on typical construction conditions assuming common excavation with one metre of cover over the pipe, backfill, compaction and restoration of existing roads and boulevards, supply and installation of pipe, line valves, miscellaneous materials and concrete work. To these prices must be added additional cost allowances for specific conditions related to a particular scheme. These would include items such as, difficult ground conditions, rock excavation, high water table, river crossings, augered road crossing and access roads.

TABLE 7.1
PIPELINE BASE COST PRICES

Diameter (mm)	Cost ($/m)
200	120
250	140
300	175
350	205
400	215
450	270
500	305
600	380
700	460
750	510
800	550
900	640

7.5 SCADA SYSTEM & CONNECTION COSTS

The estimated cost of the Supervisory Control and Data Acquisition (SCADA) system, as well as for metering flows and pressure regulating at connection points to existing systems are included in this section. The cost of SCADA facilities for the water treatment plant are included in the WTP cost estimate.

7.6 PUMP STATION COSTS

The size and costs of pump stations for the various water supply options varies with respect to the quantity of water to be pumped and the static lift (ie. the height the water has to be raised) and to a lesser extend the distance to be pumped. The quantity to be pumped varies with water demand, and with the extent the gravity China Creek source is used.

For pumping stations consideration must be given not only to capital costs but also operation and maintenance costs. The running costs over the design period frequently exceed the capital costs on a present worth basis and therefore influence the selection of the least cost solution.

The installation of pumps will be staged over the design period to suit the gradual increase in demand. To select the most economical pump station for a particular scheme, estimates were made for various staging options. In all cases, the pump station would have an installed capacity equal to the maximum day demand plus a standby pump for the largest pump installed. When the pump station is not supported by distribution storage, the installed capacity would be equal to the peak hour demand in the zone, plus a standby pump for the largest pump installed, or equal to the design fire flow for the zone, whichever is the greatest. The basis for these estimates is discussed in Section 8.0.

7.6.1 Low Lift Pump Station Costs

A low lift pump station is required for all Somass River options. The existing Somass pump station would be modified for this use.

7.6.2 High and Medium Lift Pump Station Costs

A high lift pump station is required for all Somass River options.
A medium lift pump station is required for the Great Central Lake option.
New higher lift pumping equipment will be required at the Johnston Street pumping station for the Somass options.

7.6.3 Booster Pump Station Costs

A booster pump station is required at the new TWL 120 reservoir for the Great Central Lake option, once the Lacy Lake supply is abandoned, to pump water to a new TWL 158 reservoir in the higher Cherry Creek zone, and to pump to the Upper Cowichan reservoir, in case the China Creek supply is abandoned.

For the Somass option, this booster pump station would be located at the Johnston Street reservoir.

7.7 WATER TREATMENT COSTS

Water treatment plant capital costs will vary with level of treatment and process selected, the quality and quantity of water to be treated and the staging of the works as discussed in Section 6.0.

The selection of the least cost plant is not based on capital costs alone but on life cycle or present value cost analysis.

The capital costs of both slow and conventional rapid sand filtration were estimated for various size plants, for use in comparative present worth analysis of costs for staging of the works and calculations of O & M costs. Comparative costs are shown in Table 7.2.

TABLE 7.2 COMPARATIVE CAPITAL COST OF WATER TREATMENT OPTIONS ($1000)					
	Plant Capacity (m3/day)				
	12,500	37,500	66,500	70,000	75,000
Rapid Sand Filtration	$4,200	$7,400	$10,200	$11,000	$11,900
Slow Sand Filtration	4,600	8,100	11,000	11,900	12,900

7.8 PROPERTY COSTS

While it is anticipated that most of the watermains will be located in road-rights-of-way, or other existing rights-of-way or easements, it will be necessary to acquire additional property for the water treatment plant, reservoir sites, and portions of the supply main. The actual quantity of land required and the value of land varies with the site and the specific option selected. A value of $2,000/ha has been used for purchase of pipeline corridors.

Land value for the treatment plant and reservoir sites would be approximately $10,000 and $15,000 per hectare respectively. The land costs have been included in the summaries of capital cost, Tables 7.3 - 7.7.

7.9 WATERSHED USE IMPACT COSTS

Outright ownership of the watershed, while providing the greatest flexibility to manage a water supply source, is not economically feasible, given the large areas tributary to the various intakes.

The China Creek and Somass watersheds are already the subject of watershed management planning, and municipal water extraction is an established use. The Great Central Lake watershed is not yet subject to watershed management planning. If this watershed is to be seriously considered for municipal water supply use, it must be protected from development pressure which could affect water quality. The predominant use at this time is forestry, and a management plan must be put in place to ensure that this remains the case, as well as to ensure that residential and commercial development around the lake perimeter does not increase and is prevented from affecting water quality in the lake, particularly if this source is to be used without filtration treatment.

Although it is not expected that additional restrictions will be required over and above those already in force through Fisheries/Forestry Guidelines, the Forestry Amendment Act and other environmental, forestry, and watershed protection legislation, it is possible that future integrated watershed management planning may result in specific additional demands for water management. Compensation may then be required, as determined by negotiation or arbitration. A cost allowance is proposed to cover land use impact costs for compensation to the major land owners in the watershed for any potential negative impact on their logging operations on account of specific restrictions for water quality protection.

An allowance of $1,000,000 has been added to the capital cost of the Great Central Lake option, to cover this eventuality. This allowance is arbitrary and should be considered an additional contingency allowance. This does not apply to the other options, as municipal water supply is already a well established use in these watersheds.

7.10 TOTAL CAPITAL COSTS - ALL WATER SUPPLY OPTIONS

For comparison purposes total capital costs of the above components for the options and phases are summarized in Tables 7.3, 7.4, 7.5, and 7.6. The total construction costs include property acquisition, power supply and a contingency allowance of 15%. Added to this is engineering, administration and legal costs, estimated at 15% of total construction costs, as well as the land use impact cost allowance, and the 3% net GST.

On the basis of capital costs, the Somass River Only option (Option 1B - Table 7.4) is the least costly option, at an estimated cost of $36,586,000 for system development to the year 2020. This option and the combined Somass River/China Creek option (Option 1A - Table 7.3) both have the lowest first stage cost, at an estimated $20,000,000. The Great Central Lake Only option (Option 2B - Table 7.6) is 23% more expensive at $45,172,000, with a first stage cost of $26,329,000, 31% higher than the Somass options. However, as stated previously, capital costs alone do not present the complete economic picture.

Annual cost estimates for capital cost amortization and system operation and maintenance, as well as a financial model showing costs against revenue for all four options are presented in Section 8.0. Section 9.0 contains the discussion of comparison of the four regional water supply options.

Table 7.3 — ALBERNI VALLEY REGIONAL WATER SUPPLY — 22-Feb-95

CAPITAL COST ESTIMATES

ALTERNATIVE 1 — SOMASS RIVER, CHINA CREEK, & LACY LAKE SOURCES

OPTION 1 A — ULTIMATE UPGRADING AND TREATMENT OF CHINA CREEK SUPPLY

Assumed Treatment of China Creek Mandatory by Year 2015 – Lacy Lake Abandoned at Year 2005

All Service Areas Included

Description	Phase	Length (m)	Size (mm)	Capacity (m3/day)	Unit Cost	Extended Cost
Universal Metering 5,800	I				241	1,396,350
Modify Exist. Somass to Low Lift	I			12,500		50,000
Somass Low Lift Pump Station	II			25,000		200,000
Supply Piping	I	300	900		640	192,000
Somass Treatment Plant	I			12,500		4,200,000
Somass Treatment Plant	II			12,500		1,600,000
Somass Treatment Plant	III			12,500		1,600,000
High Lift Pump Station	I			12,500		400,000
High Lift Pump Station	II			25,000		200,000
Property Acquisition	I					150,000
Scada System	I					250,000
Power Supply	I					100,000
Somass Treatment Plant to Beaver Cr. Rd.	I	2,055	750		500	1,027,500
Beaver Cr. Rd. to TWL 120 Reservoir	I	2,155	900		640	1,379,200
Holly Rd to TWL 120 Reservoir	I	1,885	300		175	329,875
Reservoir (TWL 120)	I			8,500	265	2,252,500
TWL 120 Reservoir to Cherry Cr. Rd. at Moore	I	3,690	500		305	1,125,450
Cherry Cr.Rd. to P. Alb. Hwy	I	1,530	400		215	328,950
Connect Beaver Cr. @ Grandview Rd.	I	1,035	200		120	124,200
Connect Beaver Cr. @ Beaver Cr. Rd.	I	1,380	200		120	165,600
Connect Beaver Cr. @ Fayette Rd.	I	1,400	200		120	168,000
Connect 300 & 150 Gordon and Strick	I		200		2,000	2,000
PRV's in Beaver Creek System	I		2		26,000	52,000
Cowichan Reservoirs to Johnston St. Reservoir	I	6,350	500		305	1,936,750
Connect Cherry Cr. @ Alberni Hwy.	I		200		2,000	2,000
Arrowsmith Heights, Pump, Main, Reservoir	I		200		L.S.	430,000
Sahara Heights Main	I	2,410	400		215	518,150
Milligan PRV to Rumsby St.	I	1,720	250		140	240,800
Burde St. Area Improvements	II	1,290	250		140	180,600
Internal Cherry Creek Upgrades	II	4,180	250		140	585,200
Cherry Creek Reservoir (TWL 158)	II			2,000	275	550,000
Cherry Creek Booster Pump Station @ Johnston	II			5,000	L.S.	30,000
Supply Main to Johnston Reservoir	II	5,450	600		380	2,071,000
Supply Main to Johnston Reservoir	II	1,675	500		305	510,875
Sproat Lake Supply Main (Beaver Cr. Rd.)	II	3,985	350		205	816,925
Sproat Lake Supply Main	II	4,980	300		175	871,500
Sproat Lake Booster Pump Station	III			5,800	L.S.	100,000
China Creek Supply Main Replacement	III	8,000	600		450	3,600,000
Bainbridge Treatment Plant	III			35,000	L.S.	7,000,000
Sub-Total, incl. 15% contingency						$36,737,425
Engineering, Legal, Administration @ 15%						5,510,614
Effective GST @ 3%						1,267,441
TOTAL ESTIMATED COSTS						**$43,515,480**

PHASE I COSTS (1997)	19,924,859
PHASE II COSTS (2005)	9,021,270
PHASE III COSTS (2015)	14,569,350

Table 7.4 — ALBERNI VALLEY REGIONAL WATER SUPPLY — 22-Feb-95

CAPITAL COST ESTIMATES

ALTERNATIVE 1 — SOMASS RIVER, CHINA CREEK, & LACY LAKE SOURCES

OPTION 1 B — ULTIMATE ABANDONMENT OF CHINA CREEK SUPPLY

Assumed Treatment of China Creek Mandatory by Year 2015 – China Creek Abandoned at Year 2015

All Service Areas Included

Description	Phase	Length (m)	Size (mm)	Capacity (m3/day)	Unit Cost	Extended Cost
Universal Metering 5,800	I				241	1,396,350
Modify Exist. Somass to Low Lift	I			12,500		50,000
Somass Low Lift Pump Station	II			25,000		200,000
Somass Low Lift Pump Station	III			35,000		150,000
Supply Piping	I	300	900		640	192,000
Somass Treatment Plant	I			12,500		4,200,000
Somass Treatment Plant	II			12,500		1,600,000
Somass Treatment Plant	III			47,500		6,000,000
High Lift Pump Station	I			12,500		400,000
High Lift Pump Station	II			25,000		200,000
High Lift Pump Station	III			35,000		200,000
Property Acquisition	I					150,000
Scada System	I					250,000
Power Supply	I					100,000
Somass Treatment Plant to Beaver Cr. Rd.	I	2,055	750		500	1,027,500
Beaver Cr. Rd. to TWL 120 Reservoir	I	2,155	900		640	1,379,200
Holly Rd to TWL 120 Reservoir	I	1,885	300		175	329,875
Reservoir (TWL 120)	I			8,500	265	2,252,500
TWL 120 Reservoir to Cherry Cr. Rd. at Moore	I	3,690	500		305	1,125,450
Cherry Cr.Rd. to P. Alb. Hwy	I	1,530	400		215	328,950
Connect Beaver Cr. @ Grandview Rd.	I	1,035	200		120	124,200
Connect Beaver Cr. @ Beaver Cr. Rd.	I	1,380	200		120	165,600
Connect Beaver Cr. @ Fayette Rd.	I	1,400	200		120	168,000
Connect 300 & 150 Gordon and Strick	I		200		2,000	2,000
PRV's in Beaver Creek System	I		2		26,000	52,000
Cowichan Reservoirs to Johnston St. Reservoir	I	6,350	500		305	1,936,750
Connect Cherry Cr. @ Alberni Hwy.	I		200		2,000	2,000
Arrowsmith Heights, Pump, Main, Reservoir	I		200		L.S.	430,000
Milligan PRV to Rumsby St.	I	1,720	250		140	240,800
Sahara Heights Main	I	2,410	400		215	518,150
Burde St. Area Improvements	II	1,290	250		140	180,600
Internal Cherry Creek Upgrades	II	4,180	250		140	585,200
Cherry Creek Reservoir (TWL 158)	II			2,000	275	550,000
Cherry Creek Booster Pump Station @ Johnston	II			5,000	L.S.	30,000
Supply Main to Johnston Reservoir	II	5,450	600		380	2,071,000
Supply Main to Johnston Reservoir	II	1,675	500		305	510,875
Sproat Lake Supply Main (Beaver Cr. Rd.)	II	3,985	350		205	816,925
Sproat Lake Supply Main	II	4,980	300		175	871,500
Sproat Lake Booster Pump Station	III			5,800	L.S.	100,000
Sub-Total, incl. 15% contingency						$30,887,425
Engineering, Legal, Administration @ 15%						4,633,114
Effective GST @ 3%						1,065,616
TOTAL ESTIMATED COSTS						**$36,586,155**
	PHASE I COSTS (1997)					19,924,859
	PHASE II COSTS (2005)					9,021,270
	PHASE III COSTS (2015)					7,640,025

RECOMMENDED OPTION

Table 7.5 — ALBERNI VALLEY REGIONAL WATER SUPPLY — 22-Feb-95

CAPITAL COST ESTIMATES

ALTERNATIVE 2 — GREAT CENTRAL LAKE, CHINA CREEK, & LACY LAKE SOURCES

OPTION 2 A — ULTIMATE UPGRADING AND TREATMENT OF CHINA CREEK SUPPLY

Assumed Treatment Mandatory by Year 2015 – Lacy Lake Abandoned at Year 2005

All Service Areas Included

Description	Phase	Length (m)	Size (mm)	Capacity (m3/day)	Unit Cost	Extended Cost
Universal Metering (complete) 5,800	I				241	~~1,396,350~~
Intake	I			100,000	250,000	250,000
Medium Lift Pump Station	I			12,500	L.S.	300,000
Medium Lift Pump Station	II			25,000	L.S.	150,000
Chlorination Station	I			37,500	L.S.	80,000
Great Central Lake Treatment Plant	III			37,500	L.S.	7,000,000
Property Acquisition	I					150,000
Scada System	I					250,000
Power Supply	I					50,000
Supply Main to TWL 120 Reservoir	I	17,580	900		640	11,251,200
Future TWL 120 Reservoir to Cherry Creek	I	3,690	600		380	1,402,200
Moore Rd to Cherry Creek	I	755	500		305	230,275
Cherry Creek to Alberni Hwy	I	780	450		270	210,600
Holly Rd to TWL 120 Reservoir	I	1,885	300		175	329,875
Reservoir (TWL 120)	I			8,500	265	2,252,500
Cowichan Reservoirs to Johnston St. Reservoir	I	6,350	450		270	1,714,500
Johnston Res. Alt Valve (complete)	I		450		50,000	~~50,000~~
Connect Beaver Cr. @ Grandview	I	1,035	200		120	124,200
Connect Beaver Cr. @ Beaver Cr. Rd.	I	1,380	200		120	165,600
Connect Beaver Cr. @ Fayette Rd.	I	1,400	200		120	168,000
Beaver Cr. PRV's & Interconnections	I		2		26,000	52,000
Connect Cherry Cr. @ Alberni Hwy.	I		200		2,000	2,000
Arrowsmith Heights, Pump, Main, Reservoir (complete)	I	1,800	200		L.S.	~~430,000~~
Milligan PRV to Rumsby St.	I	1,720	250		140	240,800
Sahara Heights Main (complete)	I	1,200	400		215	~~258,000~~
Burde St. Area Improvements	II	1,290	250		140	180,600
Internal Cherry Creek Improvements	II	4,180	250		140	585,200
Cherry Creek Reservoir (TWL 158)	II			2,000	275	550,000
Cherry Creek Booster Pump Station	II			5,000	L.S.	100,000
Sproat Lake Supply Main	II	1,775	350		205	363,875
Sproat Lake PRV & Interconnections	II		1		26,000	26,000
China Creek Supply Main Replacement	III	8,000	600		450	3,600,000
Bainbridge Treatment Plant	III			35,000		7,000,000
Sub-Total, incl. 15% contingency						$40,913,775
Engineering, Legal, Administration @ 15%						6,137,066
Land Use Impact Cost (Phase I)						1,000,000
Effective GST @ 3%						1,441,525
TOTAL ESTIMATED COSTS						**$49,492,366**
	PHASE I COSTS (1997)					26,328,669
	PHASE II COSTS (2005)					2,316,497
	PHASE III COSTS (2015)					20,847,200

Table 7.6 | ALBERNI VALLEY REGIONAL WATER SUPPLY | 22-Feb-95

CAPITAL COST ESTIMATES

ALTERNATIVE 2 | GREAT CENTRAL LAKE, CHINA CREEK, & LACY LAKE SOURCES

OPTION 2 B | ULTIMATE ABANDONMENT OF CHINA CREEK SUPPLY

Assumed Treatment Mandatory by Year 2015 – China Creek Abandoned at Year 2015

All Service Areas Included

Description	Phase	Length (m)	Size (mm)	Capacity (m3/day)	Unit Cost	Extended Cost
Universal Metering 5,800	I				241	1,396,350
Intake	I			100,000	250,000	250,000
Medium Lift Pump Station	I			12,500	L.S.	300,000
Medium Lift Pump Station	II			25,000	L.S.	150,000
Medium Lift Pump Station	III			35,000	L.S.	100,000
Chlorination Station	I			72,500	L.S.	80,000
Great Central Lake Treatment Plant	III			72,500	L.S.	11,000,000
Property Acquisition	I					150,000
Scada System	I					250,000
Power Supply	I					50,000
Supply Main to TWL 120 Reservoir	I	17,580	900		640	11,251,200
Future TWL 120 Reservoir to Cherry Creek	I	3,690	600		380	1,402,200
Moore Rd to Cherry Creek	I	755	500		305	230,275
Cherry Creek to Alberni Hwy	I	780	450		270	210,600
Holly Rd to TWL 120 Reservoir	I	1,885	300		175	329,875
Reservoir (TWL 120)	I			8,500	265	2,252,500
Cowichan Reservoirs to Johnston St. Reservoir	I	6,350	450		270	1,714,500
Johnston Res. Alt Valve	I		450		50,000	50,000
Connect Beaver Cr. @ Grandview	I	1,035	200		120	124,200
Connect Beaver Cr. @ Beaver Cr. Rd.	I	1,380	200		120	165,600
Connect Beaver Cr. @ Fayette Rd.	I	1,400	200		120	168,000
Beaver Cr. PRV's & Interconnections	I		2		26,000	52,000
Connect Cherry Cr. @ Alberni Hwy.	I		200		2,000	2,000
Arrowsmith Heights, Pump, Main, Reservoir	I	1,800	200		L.S.	430,000
Milligan PRV to Rumsby St.	I	1,720	250		140	240,800
Sahara Heights Main	I	1,200	400		215	258,000
Burde St. Area Improvements	II	1,290	250		140	180,600
Internal Cherry Creek Improvements	II	4,180	250		140	585,200
Cherry Creek Reservoir (TWL 158)	II			2,000	275	550,000
Cherry Creek Booster Pump Station	II			5,000	L.S.	100,000
Sproat Lake Supply Main	II	1,775	350		205	363,875
Sproat Lake PRV & Interconnections	II		1		26,000	26,000
Cherry Creek Booster Pumps to Burde St. PRV	III	10,565	450		270	2,852,550
Sub-Total, incl. 15% contingency						$37,266,325
Engineering, Legal, Administration @ 15%						5,589,949
Land Use Impact Cost (Phase I)						1,000,000
Effective GST @ 3%						1,315,688
TOTAL ESTIMATED COSTS						**$45,171,962**
	PHASE I COSTS (1997)					26,328,669
	PHASE II COSTS (2005)					2,316,497
	PHASE III COSTS (2015)					16,526,795

SECTION 8

SECTION 8.0
ANNUAL COST ESTIMATES

8.1 INTRODUCTION

Annual costs of the various water supply components are derived in this Section and are combined with the capital costs to determine the total life cycle costs for each alternative water supply option as well as to identify the least cost solution. The alternative schemes are compared in both economic and non-economic terms in Section 9.0.

8.2 PRESENT VALUE

As discussed, the technique normally used to factor in the future capital expenditures and long term operation and maintenance costs, together with capital costs, for comparison of alternatives is known as present worth or present value costing. The present value of a facility is the equivalent amount which would have to be invested in the base year to cover all future costs (ie. capital and O & M). Thus, this invested amount would accrue interest over time and be used to pay for future costs in inflated dollars.

8.3 FINANCIAL COMPARISONS

Although present value costing has been used to compare the life cycle cost of treatment options, it is considered more useful for this report to present the capital and annual operation and maintenance costs in a financial spreadsheet model covering the design period of the system. All relevant variables, such as construction staging, interest rate, rate of inflation, and government assistance are built in on the cost side of the model. Projected revenues from parcel taxes, user rates and development cost charges to offset these costs are shown annually as a function of population growth, new development, and inflation.

This will allow comparison of the supply options based on actual tax and user rate levies required to pay for the system over the full design period.

8.3.1 Rate of Inflation

An important task in the determination of costs is projecting the rate of cost increases for capital, and operation and maintenance expenditures, both in the short and long term. There are several measures of historic fluctuations in the costs of commodities and/or services, including the Consumer Price Index (CPI), Engineering News Record (ENR) Index, etc. Statistics Canada compiles the CPI and has also developed measures of cost changes for other portions of the Canadian economy - both nationally and regionally based. The index considered most appropriate for this project is the Output Price Index (OPI).

Over the last four years a specific costs of construction OPI has been compiled for the heavy industrial sector of the Lower Mainland. In that period, it rose at an average annual rate of 5.25%. This compares to an annual regional CPI increase of 4.15% over the same period. The 1.1% difference is likely due to the demand for construction services in the Vancouver area between 1987 and 1990. The value of the OPI over the last four years is considered a conservative estimate for future cost fluctuations and would also be applicable to the construction and operation of water treatment facilities in the Nanaimo area. For this report, costs are projected to increase/inflate at an annual rate of 5.0% over the life of the project.

8.3.2 Rate of Interest

Typically, in the last 20 years, the average long term municipal debenture rate is about 10.5% in the Vancouver area. The interest rate has dropped slightly to 10.25% for the last four years. It is recommended that a rate of 10.0% be used to predict future average interest rates.

8.3.3 Discount Rate

The discount rate is the proportional difference between the inflation rate and the interest rate. It is calculated according to the following formula:

$$dr = \frac{(1 + INT)}{(1 + INF)} - 1$$

Where:

	dr	=	Discount rate
	INT	=	Rate of Interest
	INF	=	Rate of Inflation

With an interest rate of 10.0% and an inflation rate of 5.0%, the discount rate is about 4.8%. The interest rate and inflation rate (CPI Basis) for the last 20 years is about 3.5%. The higher discount rate evident in recent years reflects federal monetary policies which are intended to control inflation.

The choice of a reasonable discount rate must be based on predicted economic conditions and monetary policy well into the future. A discount rate of 5.0% has been chosen as the basis for life cycle cost analysis. This rate is similar to that of the recent past and higher than the historic discount rate of the longer term.

8.3.4 Present Value Evaluations

The major influence of the discount rate is in the impact of future costs on an alternative's present value. At higher discount rates, a future cost has less impact, ie. initial capital costs are a greater factor in the total life cycle costs.

When comparing alternatives, it is prudent to assess the sensitivity of life cycle costs to variations in the discount rate. This is done by calculating the present values not only at the selected discount rate, but also at discount rates above and below the base. For this reason, the economic comparisons contained in this report will be conducted using 5% discount rates - from 3% to 7% to provide a measure of the comparison sensitivity to the discount rate.

8.4 OPERATION AND MAINTENANCE COSTS

Operations and maintenance costs are usually expressed as an annual cost and comprise all expenditures in running a water supply system. They include the costs of staff, power, chemicals, maintenance materials, etc. Some of the unit rates used to formulate the operations and maintenance costs are listed below:

Labour	$40.00 - $45.00/hour
Power	$0.07/Kwh
Hydrated Lime	$0.30/kg
Polyaluminum Chloride (PAC)	$1.00/kg
Polymer	$5.00/kg
Chlorine	$0.50/kg

8.4.1 Labour Costs

Labour costs have been based on $44.00 per hour with annual salaries based on 1950 hours per year (7.5 hours per day), and include 52.5% benefits and 35% general overhead. Staffing at the treatment plant is related to the capacity and the staging of plant expansions with full time staff levels increasing from a minimum of 3 to a maximum of 6 persons for the largest plant option. Pump station labour has been based on rule-of-thumb requirements, such as 200 hours per year per pump.

8.4.2 Power Costs

Power will actually be based on a variety of service charges and variable consumption charge rates. An average rate of $0.07/kilowatt hour has been used in this report.

Water treatment plant power costs have been estimated based on rule-of-thumb estimates for the average day flow rates through the plant. The pump stations use the greatest amount of power. Pumping costs have been based on the gradually increasing water demands each year and the head conditions for a particular station, using 0.80 efficiency rating for both the pumps and the motors.

8.4.3 Chemical Costs

The rate of consumption of the chemicals is directly related to the volume of flow and the source. The quantity of chemicals used at the treatment plant will be less for those options retaining the wells.

8.4.4 Maintenance Costs

The cost of maintenance is over and above the operation costs, it is meant to cover routine upkeep, repairs, and maintenance of all plant and equipment. It is common practice to estimate the annual costs based on a percentage of the capital cost of construction. A higher percentage is used for more complex system components that contain mechanical and electrical equipment, and a lower percentage for fixed or non-moving plant. For this report, annual maintenance costs have been estimated using the following percentage of capital costs:

Water Treatment Plants & Pump Stations	2.0%
Civil Works and All Other Facilities (ie. intakes, dams, pipeline, reservoirs)	0.5%

8.5 WATER TREATMENT PLANT PRESENT VALUE

8.5.1 Slow Sand vs. Rapid Sand Filtration

Consideration was given to two types of filtration plants, slow sand filters and rapid dual media filters with pre-coagulation, flocculation, and sedimentation. Capital costs of rapid sand filters are normally lower than for slow sand filters, however, the operating cost is generally lower for slow sand filters. A present worth analysis was carried out to compare the two options for a 75 ML/day plant using 25 ML/day stages, as shown in Table 8.1.

TABLE 8.1
PRESENT VALUE 1994 COMPARISON OF SLOW SAND vs. RAPID FILTRATION PLANTS CAPITAL COST AND 25 YEARS OF O & M COSTS ($1000)

Discount Rate	3%	5%	7%
Slow Sand	23,075	18,225	14,785
Rapid Filters	22,210	17,535	14,255

The above table shows that the rapid filters have a small economic advantage. Other possible scenarios using larger first stage construction or greater flows would make the rapid sand filter option increasingly more attractive. Therefore, the slow sand filter option was removed from further consideration.

8.6 FINANCIAL ANALYSIS

8.6.1 General:

The derivation of capital cost estimates for the four final options is presented in Section 7.0. A comparison of the options, based on financial model cost recovery predictions and other non-economic considerations is presented in Section 9.0.

Funds required to pay for the capital costs of the various stages of the project will be obtained by the regional district by means of a borrowing by-law at the time the funds are required. Operation and maintenance costs will be paid each year from taxation and user rates. The regional district must establish adequate sources of revenue to pay for the annual loan amortization and operation and maintenance expenditures, without incurring a deficit.

This Section presents a financial analysis of the estimated project expenditures and revenues, examining the impact of government funding and cost of borrowing. It proposes a method of paying for the system over its life cycle, through the various cost recovery mechanisms available to the Regional District, such as general taxation, user fees and development cost charges (DCC's).

Financial, administrative, and engineering staff are generally quite comfortable with net present value assessments used to compare the life cycle costs of various alternative systems. To the layman, however, such figures, especially when they include the present value costs of 25 years of operation and maintenance expenditures, are often difficult to understand, and can be easily misinterpreted because of the large magnitude of the total costs relative to initial capital outlay. It is important therefore that these figures are put into proper perspective. The simplest way to do this is to demonstrate what the anticipated annual costs will be to the individual property owners and end users of the water system. These additional costs would be levied to pay for the system in one form or another, on the annual taxes of end-users and beneficiaries of the system.

It is recognized that the detailed process of determining tax rates, DCC's and user rates to generate sufficient revenues to pay for capital and operation and maintenance expenditures is a complex one. It requires input from regional district, municipal, and Ministry of Municipal Affairs administrative and financial experts, and cannot be concluded based on engineering assessments alone. For purposes of this analysis, it is assumed that the means of general taxation will be in the form of a parcel tax. In addition we have used a typical user rate per connection, based on average water use, as the method to recover the cost of using the system.

Other details will need to be studied more by the regional district and the City. For example, charges for the system to users within municipal boundaries will likely occur through recoveries by the regional district from the City, who, in turn, will pass these charges on to the end user and benefitting properties, through the municipal tax system. The regional recoveries will be based on metered bulk water volumes for the amount of water consumed, and on some form of property assessment or general tax, as well as DCC's to assist in paying for the capital cost of the system. The financial model discussed later in this Section does not include municipal recoveries, but rather assumes (*for the purposes of the model only*) that taxes and DCC's will be levied directly by the regional district to the end user. This is a deliberate over-simplification, to derive the approximate order-of-magnitude of the property (parcel) taxes, user rates and DCC's that would be required to offset the total costs of the proposed regional water supply system. It is felt that this is a realistic means of comparing the real cost of options, and much more meaningful than present value estimates.

8.6.2 Senior Government Funding:

Provincial Funding:

Approved regional and municipal water supply and distribution projects generally qualify for capital funding under Section 3 of the provincial Revenue Sharing Act Regulations.

Although the amount of the grant is defined as not less than 25% nor more than 50%, the rule for funding of approved projects is normally 25%, unless extenuating circumstances exist, such as those related to serious public health and environmental concerns, or for service area populations less than 1,000.

It has been assumed that the proposed regional water supply project is an approved project, and will therefore qualify for the 25% provincial capital cost grant. As there are signs that provincial funding may be decreasing, we have also shown the sensitivity of taxation and pricing rates to the possible absence of grant monies.

Federal Funding:

There are no known sources of federal funding for regional or municipal water supply projects, except for the current federal/provincial infrastructure program. Unless the terms of this agreement are extended beyond 1996, it is assumed that this source of funding would not be available for this project.

It is noted that the Great Central Lake option of this project will have considerable value to federal interests through the possible provision of low level cold water release from the lake into the Stamp River to enhance conditions for the important Somass River Sockeye run. This could present an opportunity for federal cost sharing in the intake facility, although it should be recognized that the volume of water required for fisheries enhancement is several orders of magnitude greater than that required for regional water supply.

In the past Fisheries and Oceans Canada have to our knowledge not participated in the cost of joint use intake provisions. However, on the basis of the "user should pay" principle, it is recommended that the federal government, through Fisheries and Oceans Canada, be formally approached for financial participation in proportion to the benefit received. Such assistance, however, because of its lack of precedent, has not been included in the financial analysis of this project.

8.6.3 Development Cost Charges:

Section 983 of the Municipal Act authorizes a municipality or regional district to levy development cost charges (DCC's) against new development in order to assist with the capital cost of providing new services, such as water supply and distribution, to accommodate projected growth. The principle behind the DCC concept is the establishment of an equitable basis for distributing new capital cost burdens for servicing between existing and future development.

DCC's are payable either at the time of subdivision or at the building permit stage. Upon approval of a DCC by-law, the funds raised must be applied to projects identified in the by-law, which must be incorporated in the approved five-year capital works program.

The DCC for regional facilities must be collected within the municipalities by the municipal government. The municipal government in turn can pay over to the region the DCC funds collected for the regional facilities. In unincorporated areas of the region, the regional district can create a specified area to which a DCC is applied and collected by the region.

The actual establishment of a DCC charge involves detailed input from planning, engineering and finance, and will be based on a series of relatively involved calculations, as well as policy decisions with respect to the "assist factor" to be applied, and whether or not all areas within the service area require similar treatment. The general principle of equitable distribution between existing and future development, however, allows the establishment of the general magnitude of DCC's for a particular project, based on the proportion of existing and future development. In the case of the regional water supply proposal, therefore, with an existing population of 26,500 and a design population of 54,185, the equitable total DCC contribution, based on proportion of new to existing development, could be as much as 51% of the net first stage capital cost (after provincial grant).

No attempt has been made in this report to establish the full range of considerations for determining the actual DCC for the regional water supply project. This should be the subject of a separate exercise after the project is approved and all decisions made with respect to the implementation of the project. For the purpose of the financial analysis in this Section, a reasonable level of DCC contribution has been assumed and does not exceed the maximum 51% estimated above. The financial model described in the following sections has been designed to facilitate evaluation of changes in the value of the DCC, and to determine the resulting impact on parcel taxes and user rates for the forecasted population growth.

8.6.4 Financial Model:

A financial model has been prepared on Lotus spreadsheet, as shown in Tables 8.1 through 8.4. The spreadsheets are designed to track total annual costs and revenues throughout the project design period, given a set of variables consisting of interest rate, inflation rate, population growth rate, provincial grant as a percentage of capital costs, DCC rate, parcel tax and user rates. All of the variables can be changed to result in immediate recalculation of the spreadsheet, showing the effect of the changes on the balance of cost and revenues. Other spreadsheet inputs are the estimated phased capital costs, derived in Section 7.0, the annual estimated operation and maintenance costs, derived in Section 8.0, and the population estimates, derived in Section 4.0.

8.6.4.1 Total Annual Costs

The spreadsheets incorporate all phased capital expenditures over the design period of the project (column 2) and the anticipated provincial grants (column 3). These costs include allowances for contingencies, engineering, legal and administration, and are inflated in accordance with the assumed inflation rate shown in the top right hand block of variables. The net capital costs (column 4) are amortized over a 20 year period from the time they are incurred (column 5). The interest rate is assumed to be constant over the 20 year amortization period, as shown in the block of variables.

To the annual costs of debt amortization are added the estimated inflated annual operation and maintenance costs for the system (column 6), resulting in total annual costs for each year of the project to the design year 2020 (column 7).

8.6.4.2 Revenue Units (Population and Parcels)

The rest of the spreadsheet deals with revenues, which are based on the number of existing parcels, the number of new parcels created and the number of users of the system for each year in the project design period. The number of parcels and users are derived from the projected population figures developed in Section 4.0 of this report, and entered in the spreadsheet in column 8. Population growth in the model can be varied by varying the growth rate shown in the block of variables.

Column 10 lists the estimated unserviced population in the benefitting area. Although it is assumed that the unserviced population remains unchanged over the design period from the present estimated figure, an estimated 2% growth rate in this rural population represents expansion of existing water distribution systems into the surrounding rural areas, cumulatively shown in column 9. This growth due to boundary expansion of existing water systems is in addition to normal projected population growth, resulting in the total estimated serviced population shown in column 11 (sum of columns 8 and 9).

From columns 8 - 11, the number of existing parcels, new parcels and total number of connections are calculated. The number of existing parcels (column 12) is calculated as the sum of the unserviced and serviced population, divided by the average number of people per household of 3. Column 13 calculates the number of new parcels created each year as the increment in the value of column 12. The total number of connections to the regional water system is calculated in column 14, being the total serviced population (column 11) divided by the average number of people per household of 3.

8.6.4.3 Total Annual Revenues

It is assumed for this analysis that revenues to pay for the total cost of the proposed regional water supply system will be derived from three sources:

Parcel Tax:

All properties within the benefitting area (vacant and occupied) would contribute a parcel tax, to help pay for the capital costs relative to capacity reserved in the system to provide future service to these parcels within the project design period.

It is considered important that some form of general tax be levied to all property owners in the benefitting area, as the system is sized to ultimately benefit all parcels.

Development Cost Charges:

All newly created parcels within the benefitting area would pay a DCC upon subdivision to contribute to the capital cost relative to capacity reserved in the system to service these parcels within the project design period.

For the purposes of this simplified analysis, DCC contributions from commercial and industrial development have been ignored, even though these forms of development would be included in a DCC by-law. DCC revenues derived from these sources would be relatively small, as commercial and industrial water use in this area represents no more than about 15% of the total water use. For this financial analysis, exclusion of this source of DCC revenue would keep residential DCC's and individual taxes on the conservative side. It would also compensate for the rather optimistic assumption that 100% of the annual growth in population would result in DCC revenue. Whereas, some growth will occur as a result of building on existing subdivided lots for which a DCC would not apply.

User Rates:

All parcels connected to the regional water system would pay an annual user fee, likely based on the amount of water consumed. The spreadsheets use a cost per connection, based on average annual water consumption per connection. The actual amounts would vary between consumers, depending on the amount of water used by each, and depending on the detailed rate structure adopted.

Revenues from user fees are usually designed to cover operation and maintenance expenditures for the system, although they may also contribute to capital costs.

Parcel tax revenue is calculated in column 15 of the financial model spreadsheet, as the product of the number of parcels in the benefitting area (column 12) and the parcel tax rate entered in the extreme column to the right. No allowance has been made for inflation. The parcel tax rate is recalculated every five years to achieve a reasonable balance of revenues against costs. In the right hand column, for each pair of values that appear every five years, the top value is the parcel tax and the second value is the user rate. As costs have a built-in inflation factor, and parcel tax revenues do not, the rates calculated in the right-most column generate sufficient revenues to balance inflation in the cost figures.

DCC revenues are calculated in column 16 of the spreadsheet, as the product of the number of newly created parcels each year (column 13), the DCC rate entered in the block of variables, and the inflation rate. Again, the DCC amount entered at the top of the spreadsheet is the rate set for the first year. The DCC amount for subsequent years has been assumed to increase in accordance with the listed inflation rate. In reality this increase would probably not occur every year, but may be adjusted periodically every few years, based on the actual rates of inflation, actual rate of development, and project expenditures.

User rate revenues are calculated in column 17 of the spreadsheet, as the product of the number of connected parcels (column 14) and the user rate entered in the extreme column to the right. No allowance has been made for inflation. As for the parcel tax, the user rate is recalculated every five years.

8.6.4.4 Balancing Costs and Revenues

The entire spreadsheet has been set up using inflated costs and revenues in the years they occur. The object of setting revenue rates is to balance annual costs and revenues, and to establish sufficient funds for future unexpected costs and, in the case of DCC's, for future expansion of the system.

Parcel tax, DCC and user rates can be varied in the model by adjusting the values in the block of variables and in the right-most column, to achieve such a balance. For the purposes of this analysis, it has been assumed that for the most part, the sum of parcel tax and DCC revenue will be applied to offset the annual cost of amortization of the debt, whereas the user rate revenue will be used to offset the annual operation and maintenance costs. The DCC rate has been set at a value which is considered in line with similar charges levied elsewhere. Furthermore, the total amount generated by the DCC's should probably not exceed 51% of the first stage capital costs, as discussed previously. Final DCC calculations should be carried out as a separate assignment when all other factors are known. Columns 18 and 19 show the annual balances of these respective revenues less costs. Column 20 shows the cumulative total balance of total revenues less total costs. By manipulating the parcel tax and user rates, the cumulative balance has been kept at a positive value.

By using a new tax rate every five years a reasonable balance has been achieved over the design period. In practice, actual rates established when the project is implemented will vary from those calculated here, and will vary from year to year, depending on actual budgetary requirements. It is, however, expected that the tax rates calculated in these spreadsheets will be within 10 to 15% of the actual rates required to pay for the estimated cost of the system.

8.6.5 Summary of Typical User Rates

Preliminary typical parcel taxes and user rates to finance the various options have been calculated in Tables 8.2, 8.3, 8.4, and 8.5, based on a DCC of $2,000, and provincial grant of 25%. A discussion of the comparative rates is presented in Section 9.0.

It should be noted that the financial analysis is presented for illustrative purposes only, to provide a means to assess total system costs in terms of annual costs per typical household. Specific cost recovery methods and apportionments will likely vary when the system is actually implemented. The order of magnitude of annual per household costs, and the relative comparisons provided should be useful, if considered in the context of the preliminary nature of the financial analysis.

REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT
ALBERNI VALLEY REGIONAL WATER SUPPLY STUDY
FINANCIAL MODEL

SOMASS RIVER & CHINA CREEK SUPPLY – YEAR 2020
PHASED DEVELOPMENT
ALL SERVICE AREAS INCLUDED

Variables:				
Interest Rate	10.0%		Inflation Rate	5.0%
DCC	$2,000		Parcel Tax	As Shown
Growth Rate	2.4%		User Rate	As Shown
Prov. Grant	25%			

TABLE 8.2 OPTION 1 A – ULTIMATE UPGRADING AND TREATMENT OF CHINA CREEK

	Capital Costs			Annual Costs			Population				Parcels			Revenues			Balance		Total	
Year	Gross	Prov. Grant	Net	Amortization	O & M	Total	Serviced	New Serviced	Unserviced	Total Serviced	Exist. Parcels	New Parcels	Connections	Parcel Tax	DCC's	User Rates	Capital	O & M	Cum. Balance	Parcel Tax
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	User Rate
	data*infl	(2 * %)	(2 – 3)	@PMT(4,int,20)	data * infl.	(5 + 6)	data*growth	(10 * 1.2% / yr)	data	(8 + 9)	(10 + 11) / 3	(incr 12)	(11 / 3)	(12+13)*tax	(13*DCC*infl)	(14*rate)	(15 + 16 – 5)	(17 – 6)	(18 + 19)	
1995							29,949	37	3,000	29,986	10,995	247	9,995				0		0	
1996							30,668	74	3,000	30,742	11,247	252	10,247				0		0	
1997	23,065,515	5,766,379	17,299,136	2,031,950	791,209	2,823,159	31,404	112	3,000	31,516	11,505	258	10,505	1,329,239	597,175	903,451	(105,536)	112,242	6,706	113
1998	0			2,031,950	839,200	2,871,150	32,157	150	3,000	32,308	11,769	264	10,769	1,359,751	641,724	926,153	(30,476)	86,953	63,183	86
1999	0			2,031,950	890,174	2,922,124	32,929	189	3,000	33,118	12,039	270	11,039	1,390,978	689,600	949,387	48,628	59,213	171,023	
2000	0			2,031,950	944,321	2,976,271	33,720	228	3,000	33,948	12,316	276	11,316	1,422,937	741,053	973,165	132,040	28,844	331,908	
2001	0			2,031,950	1,001,842	3,033,792	34,529	268	3,000	34,797	12,599	283	11,599	1,455,646	796,350	997,501	220,046	(4,341)	547,613	
2002	0			2,031,950	1,062,952	3,094,902	35,358	308	3,000	35,665	12,888	290	11,888	1,713,149	855,778	1,307,730	536,977	244,778	1,329,369	130
2003	0			2,031,950	1,127,881	3,159,831	36,206	348	3,000	36,555	13,185	296	12,185	1,752,565	919,646	1,340,335	640,261	212,454	2,182,084	110
2004	0			2,031,950	1,196,872	3,228,822	37,075	390	3,000	37,465	13,488	303	12,488	1,792,906	988,286	1,373,705	749,243	176,833	3,108,160	
2005	15,429,433	3,857,358	11,572,075	3,391,202	1,362,761	4,753,963	37,965	431	3,000	38,396	13,799	310	12,799	1,834,194	1,062,056	1,407,858	(494,951)	45,097	2,658,305	
2006	0			3,391,202	1,445,301	4,836,503	38,876	473	3,000	39,349	14,116	318	13,116	1,876,452	1,141,339	1,442,812	(373,411)	(2,489)	2,282,406	
2007	0			3,391,202	1,532,965	4,924,167	39,809	516	3,000	40,325	14,442	325	13,442	1,476,694	1,226,547	1,774,306	(687,961)	241,340	1,835,785	100
2008	0			3,391,202	1,626,080	5,017,281	40,764	559	3,000	41,324	14,775	333	13,775	1,510,745	1,318,123	1,818,244	(562,333)	192,165	1,465,617	132
2009	0			3,391,202	1,724,990	5,116,192	41,743	603	3,000	42,346	15,115	341	14,115	1,545,596	1,416,545	1,863,216	(429,061)	138,226	1,174,781	
2010	0			3,391,202	1,830,066	5,221,267	42,745	647	3,000	43,392	15,464	349	14,464	1,581,266	1,522,323	1,909,244	(287,612)	79,178	966,348	
2011	0			3,391,202	1,941,699	5,332,901	43,771	692	3,000	44,463	15,821	357	14,821	1,617,775	1,636,010	1,956,354	(137,417)	14,654	843,585	
2012	0			3,391,202	2,060,309	5,451,511	44,821	737	3,000	45,558	16,186	365	15,186	1,655,143	1,758,195	2,232,363	22,137	172,054	1,037,775	100
2013	0			3,391,202	2,193,060	5,584,261	45,897	783	3,000	46,680	16,560	374	15,560	1,693,389	1,889,517	2,287,322	191,704	94,263	1,323,742	147
2014	0			3,391,202	2,343,701	5,734,902	46,998	830	3,000	47,828	16,943	383	15,943	1,732,535	2,030,657	2,343,574	371,990	(126)	1,695,606	
2015	40,589,664	10,147,416	30,442,248	6,966,937	3,091,062	10,057,998	48,126	877	3,000	49,003	17,334	392	16,334	3,545,204	2,182,351	3,756,901	(1,239,381)	665,839	1,122,064	200
2016	0			6,966,937	3,293,695	10,260,632	49,281	924	3,000	50,206	17,735	401	16,735	3,627,225	2,345,389	3,849,105	(994,323)	555,409	683,150	230
2017	0			6,966,937	3,509,775	10,476,711	50,464	973	3,000	51,437	18,146	410	17,146	3,711,176	2,520,620	3,943,478	(735,141)	433,704	381,712	
2018	0			6,966,937	3,740,201	10,707,138	51,675	1,022	3,000	52,697	18,566	420	17,566	3,797,104	2,708,956	4,040,074	(460,877)	299,873	220,708	
2019	0			6,966,937	3,985,936	10,952,873	52,915	1,071	3,000	53,986	18,995	430	17,995	3,885,055	2,911,378	4,138,944	(170,503)	153,008	203,213	
2020	0			6,966,937	4,248,007	11,214,944	54,185	1,121	3,000	55,306	19,435	440	18,435	3,975,079	3,128,942	4,240,142	137,084	(7,865)	332,432	

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REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT
ALBERNI VALLEY REGIONAL WATER SUPPLY STUDY
FINANCIAL MODEL

SOMASS RIVER & CHINA CREEK SUPPLY – YEAR 2020
PHASED DEVELOPMENT
ALL SERVICE AREAS INCLUDED

Variables:				
	Interest Rate	10.0%	Inflation Rate	5.0%
	DCC	$2,000	Parcel Tax	As Shown
	Growth Rate	2.4%	User Rate	As Shown
	Prov. Grant	25%		

TABLE 8.3 OPTION 1 B – ULTIMATE ABANDONMENT OF CHINA CREEK

	Capital Costs			Annual Costs			Population				Parcels			Revenues			Balance		Total	
Year	Gross	Prov. Grant	Net	Amortization	O & M	Total	Serviced	New Serviced	Unserviced	Total Serviced	Exist. Parcels	New Parcels	Connections	Parcel Tax	DCC's	User Rates	Capital	O & M	Cum. Balance	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Parcel Tax
	data*infl	(2 * %)	(2 – 3)	@PMT(4,int,20)	data * infl.	(5 + 6)	data*growth	(10 * 1.2% / yr)	data	(8 + 9)	(10 + 11) / 3	(incr 12)	(11 / 3)	(12+13)*tax	(13*DCC*infl)	(14*rate)	(15 + 16 – 5)	(17 – 6)	(18 + 19)	User Rate
1995							29,949	37	3,000	29,986	10,995	247	9,995				0		0	
1996							30,668	74	3,000	30,742	11,247	252	10,247				0		0	
1997	23,065,515	5,766,379	17,299,136	2,031,950	791,209	2,823,159	31,404	112	3,000	31,516	11,505	258	10,505	1,329,239	597,175	903,451	(105,536)	112,242	6,706	113
1998	0			2,031,950	839,200	2,871,150	32,157	150	3,000	32,308	11,769	264	10,769	1,359,751	641,724	926,153	(30,476)	86,953	63,183	86
1999	0			2,031,950	890,174	2,922,124	32,929	189	3,000	33,118	12,039	270	11,039	1,390,978	689,600	949,387	48,628	59,213	171,023	
2000	0			2,031,950	944,321	2,976,271	33,720	228	3,000	33,948	12,316	276	11,316	1,422,937	741,053	973,165	132,040	28,844	331,908	
2001	0			2,031,950	1,001,842	3,033,792	34,529	268	3,000	34,797	12,599	283	11,599	1,455,646	796,350	997,501	220,046	(4,341)	547,613	
2002	0			2,031,950	1,062,952	3,094,902	35,358	308	3,000	35,665	12,888	290	11,888	1,713,149	855,778	1,307,730	536,977	244,778	1,329,369	130
2003	0			2,031,950	1,127,881	3,159,831	36,206	348	3,000	36,555	13,185	296	12,185	1,752,565	919,646	1,340,335	640,261	212,454	2,182,084	110
2004	0			2,031,950	1,196,872	3,228,822	37,075	390	3,000	37,465	13,488	303	12,488	1,792,906	988,286	1,373,705	749,243	176,833	3,108,160	
2005	15,429,433	3,857,358	11,572,075	3,391,202	1,362,761	4,753,963	37,965	431	3,000	38,396	13,799	310	12,799	1,834,194	1,062,056	1,407,858	(494,951)	45,097	2,658,305	
2006	0			3,391,202	1,445,301	4,836,503	38,876	473	3,000	39,349	14,116	318	13,116	1,876,452	1,141,339	1,442,812	(373,411)	(2,489)	2,282,406	
2007	0			3,391,202	1,532,965	4,924,167	39,809	516	3,000	40,325	14,442	325	13,442	1,476,694	1,226,547	1,774,306	(687,961)	241,340	1,835,785	100
2008	0			3,391,202	1,626,080	5,017,281	40,764	559	3,000	41,324	14,775	333	13,775	1,510,745	1,318,123	1,818,244	(562,333)	192,165	1,465,617	132
2009	0			3,391,202	1,724,990	5,116,192	41,743	603	3,000	42,346	15,115	341	14,115	1,545,596	1,416,545	1,863,216	(429,061)	138,226	1,174,781	
2010	0			3,391,202	1,830,066	5,221,267	42,745	647	3,000	43,392	15,464	349	14,464	1,581,266	1,522,323	1,909,244	(287,612)	79,178	966,348	
2011	0			3,391,202	1,941,699	5,332,901	43,771	692	3,000	44,463	15,821	357	14,821	1,617,775	1,636,010	1,956,354	(137,417)	14,654	843,585	
2012	0			3,391,202	2,060,309	5,451,511	44,821	737	3,000	45,558	16,186	365	15,186	1,655,143	1,758,195	2,232,363	22,137	172,054	1,037,775	100
2013	0			3,391,202	2,193,060	5,584,261	45,897	783	3,000	46,680	16,560	374	15,560	1,693,389	1,889,517	2,287,322	191,704	94,263	1,323,742	147
2014	0			3,391,202	2,343,701	5,734,902	46,998	830	3,000	47,828	16,943	383	15,943	1,732,535	2,030,657	2,343,574	371,990	(126)	1,695,606	
2015	21,284,824	5,321,206	15,963,618	5,266,282	3,706,726	8,973,008	48,126	877	3,000	49,003	17,334	392	16,334	2,038,492	2,182,351	4,328,603	(1,045,439)	621,878	1,272,045	115
2016	0			5,266,282	3,932,053	9,198,335	49,281	924	3,000	50,206	17,735	401	16,735	2,085,654	2,345,389	4,434,838	(835,239)	502,785	939,591	265
2017	0			5,266,282	4,171,377	9,437,659	50,464	973	3,000	51,437	18,146	410	17,146	2,133,926	2,520,620	4,543,573	(611,737)	372,196	700,050	
2018	0			5,266,282	4,425,585	9,691,867	51,675	1,022	3,000	52,697	18,566	420	17,566	2,183,335	2,708,956	4,654,868	(373,992)	229,283	555,341	
2019	0			5,266,282	4,695,621	9,961,903	52,915	1,071	3,000	53,986	18,995	430	17,995	2,233,907	2,911,378	4,768,783	(120,997)	73,162	507,507	
2020	0			5,266,282	4,982,488	10,248,770	54,185	1,121	3,000	55,306	19,435	440	18,435	2,285,670	3,128,942	4,885,381	148,330	(97,107)	558,730	

REGIONAL DISTRICT OF ALBERNI–CLAYOQUOT
ALBERNI VALLEY REGIONAL WATER SUPPLY STUDY
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Variables:	Interest Rate	10.0%	Inflation Rate	5.0%
	DCC	$2,000	Parcel Tax	As Shown
	Growth Rate	2.4%	User Rate	As Shown
	Prov. Grant	25%		

GREAT CENTRAL LAKE & CHINA CREEK SUPPLY – YEAR 2020
PHASED DEVELOPMENT
ALL SERVICE AREAS INCLUDED

TABLE 8.4 OPTION 2 A – ULTIMATE UPGRADING AND TREATMENT FOR CHINA CREEK

	Capital Costs			Annual Costs			Population				Parcels			Revenues			Balance		Total	
Year	Gross	Prov. Grant	Net	Amortization	O & M	Total	Serviced	New Serviced	Unserviced	Total Serviced	Exist. Parcels	New Parcels	Connections	Parcel Tax	DCC's	User Rates	Capital	O & M	Cum. Balance	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Parcel Tax
	data*infl	(2 * %)	(2 – 3)	@PMT(4,int,20)	data * infl.	(5 + 6)	data*growth	(10 * 1.2% / yr)	data	(8 + 9)	(10 + 11) / 3	(incr 12)	(11 / 3)	(12+13)*tax	(13*DCC*infl)	(14*rate)	(15 + 16 – 5)	(17 – 6)	(18 + 19)	User Rate
1995							29,949	37	3,000	29,986	10,995	247	9,995				0		0	
1996							30,668	74	3,000	30,742	11,247	252	10,247				0		0	
1997	30,478,725	7,619,681	22,859,044	2,685,015	478,389	3,163,404	31,404	112	3,000	31,516	11,505	258	10,505	1,940,924	597,175	556,778	(146,916)	78,389	(68,527)	165
1998	0			2,685,015	508,256	3,193,270	32,157	150	3,000	32,308	11,769	264	10,769	1,985,477	641,724	570,769	(57,814)	62,513	(63,828)	53
1999	0			2,685,015	540,023	3,225,037	32,929	189	3,000	33,118	12,039	270	11,039	2,031,074	689,600	585,087	35,659	45,064	16,896	
2000	0			2,685,015	573,813	3,258,827	33,720	228	3,000	33,948	12,316	276	11,316	2,077,740	741,053	599,741	133,779	25,929	176,603	
2001	0			2,685,015	609,757	3,294,771	34,529	268	3,000	34,797	12,599	283	11,599	2,125,501	796,350	614,739	236,836	4,982	418,421	
2002	0			2,685,015	647,994	3,333,009	35,358	308	3,000	35,665	12,888	290	11,888	1,844,930	855,778	772,750	15,693	124,755	558,869	140
2003	0			2,685,015	688,674	3,373,689	36,206	348	3,000	36,555	13,185	296	12,185	1,887,378	919,646	792,016	122,009	103,342	784,221	65
2004	0			2,685,015	731,955	3,416,969	37,075	390	3,000	37,465	13,488	303	12,488	1,930,822	988,286	811,735	234,094	79,780	1,098,094	
2005	3,961,996	990,499	2,971,497	3,034,046	801,777	3,835,822	37,965	431	3,000	38,396	13,799	310	12,799	1,975,286	1,062,056	831,916	3,297	30,139	1,131,530	
2006	0			3,034,046	851,965	3,886,010	38,876	473	3,000	39,349	14,116	318	13,116	2,020,795	1,141,339	852,571	128,088	606	1,260,224	
2007	0			3,034,046	905,353	3,939,399	39,809	516	3,000	40,325	14,442	325	13,442	1,476,694	1,226,547	1,075,337	(330,805)	169,983	1,099,402	100
2008	0			3,034,046	962,150	3,996,196	40,764	559	3,000	41,324	14,775	333	13,775	1,510,745	1,318,123	1,101,966	(205,178)	139,816	1,034,041	80
2009	0			3,034,046	1,022,576	4,056,621	41,743	603	3,000	42,346	15,115	341	14,115	1,545,596	1,416,545	1,129,222	(71,905)	106,646	1,068,782	
2010	0			3,034,046	1,086,866	4,120,911	42,745	647	3,000	43,392	15,464	349	14,464	1,581,266	1,522,323	1,157,117	69,544	70,252	1,208,578	
2011	0			3,034,046	1,155,271	4,189,317	43,771	692	3,000	44,463	15,821	357	14,821	1,617,775	1,636,010	1,185,669	219,739	30,398	1,458,716	
2012	0			3,034,046	1,228,059	4,262,105	44,821	737	3,000	45,558	16,186	365	15,186	1,820,657	1,758,195	1,336,381	544,807	108,322	2,111,844	110
2013	0			3,034,046	1,308,919	4,342,965	45,897	783	3,000	46,680	16,560	374	15,560	1,862,728	1,889,517	1,369,281	718,199	60,362	2,890,405	88
2014	0			3,034,046	1,399,814	4,433,860	46,998	830	3,000	47,828	16,943	383	15,943	1,905,788	2,030,657	1,402,956	902,400	3,142	3,795,946	
2015	58,079,519	14,519,880	43,559,639	8,150,545	2,384,736	10,535,280	48,126	877	3,000	49,003	17,334	392	16,334	4,378,327	2,182,351	2,874,846	(1.589,866)	490,110	2,696,190	247
2016	0			8,150,545	2,533,526	10,684,070	49,281	924	3,000	50,206	17,735	401	16,735	4,479,622	2,345,389	2,945,402	(1.325,533)	411,876	1,782,533	176
2017	0			8,150,545	2,691,789	10,842,333	50,464	973	3,000	51,437	18,146	410	17,146	4,583,302	2,520,620	3,017,618	(1.046,623)	325,829	1,061,740	
2018	0			8,150,545	2,860,139	11,010,683	51,675	1,022	3,000	52,697	18,566	420	17,566	4,689,423	2,708,956	3,091,535	(752,166)	231,396	540,970	
2019	0			8,150,545	3,039,229	11,189,774	52,915	1,071	3,000	53,986	18,995	430	17,995	4,798,043	2,911,378	3,167,192	(441,123)	127,962	227,810	
2020	0			8,150,545	3,229,758	11,380,303	54,185	1,121	3,000	55,306	19,435	440	18,435	4,909,222	3,128,942	3,244,631	(112,380)	14,872	130,302	

REGIONAL DISTRICT OF ALBERNI–CLAYOQUOT
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GREAT CENTRAL LAKE & CHINA CREEK SUPPLY – YEAR 2020
PHASED DEVELOPMENT
ALL SERVICE AREAS INCLUDED

Variables:				
	Interest Rate	10.0%	Inflation Rate	5.0%
	DCC	$2,000	Parcel Tax	As Shown
	Growth Rate	2.4%	User Rate	As Shown
	Prov. Grant	25%		

TABLE 8.5 OPTION 2 B – ULTIMATE ABANDONMENT OF CHINA CREEK

	Capital Costs			Annual Costs			Population				Parcels			Revenues			Balance		Total	
Year	Gross	Prov. Grant	Net	Amortization	O & M	Total	Serviced	New Serviced	Unserviced	Total Serviced	Exist. Parcels	New Parcels	Connections	Parcel Tax	DCC's	User Rates	Capital	O & M	Cum. Balance	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Parcel Tax
	data*infl	(2 * %)	(2 – 3)	@PMT(4,int,20)	data * infl.	(5 + 6)	data*growth	(10 * 1.2% / yr)	data	(8 + 9)	(10 + 11) / 3	(incr 12)	(11 / 3)	(12+13)*tax	(13*DCC*infl)	(14*rate)	(15 + 16 – 5)	(17 – 6)	(18 + 19)	User Rate
1995							29,949	37	3,000	29,986	10,995	247	9,995				0		0	
1996							30,668	74	3,000	30,742	11,247	252	10,247				0		0	
1997	30,478,725	7,619,681	22,859,044	2,685,015	478,389	3,163,404	31,404	112	3,000	31,516	11,505	258	10,505	1,940,924	597,175	556,778	(146,916)	78,389	(68,527)	165
1998	0			2,685,015	508,256	3,193,270	32,157	150	3,000	32,308	11,769	264	10,769	1,985,477	641,724	570,769	(57,814)	62,513	(63,828)	53
1999	0			2,685,015	540,023	3,225,037	32,929	189	3,000	33,118	12,039	270	11,039	2,031,074	689,600	585,087	35,659	45,064	16,896	
2000	0			2,685,015	573,813	3,258,827	33,720	228	3,000	33,948	12,316	276	11,316	2,077,740	741,053	599,741	133,779	25,929	176,603	
2001	0			2,685,015	609,757	3,294,771	34,529	268	3,000	34,797	12,599	283	11,599	2,125,501	796,350	614,739	236,836	4,982	418,421	
2002	0			2,685,015	647,994	3,333,009	35,358	308	3,000	35,665	12,888	290	11,888	1,844,930	855,778	772,750	15,693	124,755	558,869	140
2003	0			2,685,015	688,674	3,373,689	36,206	348	3,000	36,555	13,185	296	12,185	1,887,378	919,646	792,016	122,009	103,342	784,221	65
2004	0			2,685,015	731,955	3,416,969	37,075	390	3,000	37,465	13,488	303	12,488	1,930,822	988,286	811,735	234,094	79,780	1,098,094	
2005	3,961,996	990,499	2,971,497	3,034,046	801,777	3,835,822	37,965	431	3,000	38,396	13,799	310	12,799	1,975,286	1,062,056	831,916	3,297	30,139	1,131,530	
2006	0			3,034,046	851,965	3,886,010	38,876	473	3,000	39,349	14,116	318	13,116	2,020,795	1,141,339	852,571	128,088	606	1,260,224	
2007	0			3,034,046	905,353	3,939,399	39,809	516	3,000	40,325	14,442	325	13,442	1,476,694	1,226,547	1,075,337	(330,805)	169,983	1,099,402	100
2008	0			3,034,046	962,150	3,996,196	40,764	559	3,000	41,324	14,775	333	13,775	1,510,745	1,318,123	1,101,966	(205,178)	139,816	1,034,041	80
2009	0			3,034,046	1,022,576	4,056,621	41,743	603	3,000	42,346	15,115	341	14,115	1,545,596	1,416,545	1,129,222	(71,905)	106,646	1,068,782	
2010	0			3,034,046	1,086,866	4,120,911	42,745	647	3,000	43,392	15,464	349	14,464	1,581,266	1,522,323	1,157,117	69,544	70,252	1,208,578	
2011	0			3,034,046	1,155,271	4,189,317	43,771	692	3,000	44,463	15,821	357	14,821	1,617,775	1,636,010	1,185,669	219,739	30,398	1,458,716	
2012	0			3,034,046	1,228,059	4,262,105	44,821	737	3,000	45,558	16,186	365	15,186	1,820,657	1,758,195	1,336,381	544,807	108,322	2,111,844	110
2013	0			3,034,046	1,308,919	4,342,965	45,897	783	3,000	46,680	16,560	374	15,560	1,862,728	1,889,517	1,369,281	718,199	60,362	2,890,405	88
2014	0			3,034,046	1,399,814	4,433,860	46,998	830	3,000	47,828	16,943	383	15,943	1,905,788	2,030,657	1,402,956	902,400	3,142	3,795,946	
2015	46,043,033	11,510,758	34,532,274	7,090,194	2,350,679	9,440,873	48,126	877	3,000	49,003	17,334	392	16,334	3,545,204	2,182,351	2,776,840	(1,362,638)	426,161	2,859,469	200
2016	0			7,090,194	2,492,861	9,583,054	49,281	924	3,000	50,206	17,735	401	16,735	3,627,225	2,345,389	2,844,990	(1,117,580)	352,130	2,094,018	170
2017	0			7,090,194	2,643,843	9,734,036	50,464	973	3,000	51,437	18,146	410	17,146	3,711,176	2,520,620	2,914,745	(858,398)	270,902	1,506,522	
2018	0			7,090,194	2,804,181	9,894,375	51,675	1,022	3,000	52,697	18,566	420	17,566	3,797,104	2,708,956	2,986,142	(584,134)	181,961	1,104,349	
2019	0			7,090,194	2,974,468	10,064,661	52,915	1,071	3,000	53,986	18,995	430	17,995	3,885,055	2,911,378	3,059,219	(293,760)	84,752	895,340	
2020	0			7,090,194	3,155,333	10,245,527	54,185	1,121	3,000	55,306	19,435	440	18,435	3,975,079	3,128,942	3,134,018	13,827	(21,315)	887,853	

SECTION 9

SECTION 9.0
COMPARISON OF ALTERNATIVE SYSTEMS

9.1 DESCRIPTION OF OPTIONS

A total of four possible regional water supply options have been investigated. These options consist of the two most suitable ultimate water sources, Great Central Lake and the Somass River, each of which have the potential of supplying the Alberni Valley with water well beyond the initial 25 year design period. Each of these two main options include the continued use or abandonment of the existing China Creek supply source. All four options assume that universal metering will be instituted during the initial years. The options are summarized below:

1. SOMASS RIVER

1A. <u>Retain China Creek:</u>

The existing Somass pump station would be refitted to low lift pump station. A conventional filtration treatment plant would be constructed immediately, to treat all water taken from the Somass River.

The treatment plant would include two high lift pump stations, built in the same structure, to pump from the plant to the Johnston Street reservoir and to a new TWL 120 reservoir in the Beaver Creek area. The pump stations would be constructed in two phases, and the treatment plant in three phases to match demand over the design period.

Under Phase I of this option, the higher Cherry Creek areas remain connected to the existing Lacy Lake gravity source, but the service area would be reduced by connecting the lower areas to the Beaver Creek and North Port Alberni distribution systems. Use of the existing China Creek gravity supply would be maximized. The following new facilities would need to be built:

- stage 1 of the Somass treatment plant, low lift and high lift pumping stations
- a new transmission main from the Somass treatment plant to the new TWL 120 reservoir
- a new TWL 120 reservoir at Beaver Creek
- a new piping connection across Rogers Creek to supply water from the China Creek system to North Port Alberni and the Beaver Creek and Cherry Creek areas. This will include upgrading of the distribution main between the Cowichan Reservoirs and the Burde Street reservoir

- various distribution system interconnections and reinforcements
- expansion of the SCADA system to include all new mechanical facilities
- piping connection to service Sahara Heights (this could also be done in later phases)
- piping, pumping and reservoir facility to service Arrowsmith Heights (this could also be done in later phases)

Under Phase II of this option, it is assumed that the Lacy Lake source would be put on standby, but the China Creek source would remain in service. This would require the following new facilities:

- stage 2 of the Somass treatment plant, and low lift and high lift pump stations
- distribution system upgrades in the Burde Street reservoir area
- distribution system upgrades in the Cherry Creek area
- a booster pump station to be incorporated in the Johnston Street pump station, to pump from the 120 zone to a new TWL 158 reservoir to serve the higher Cherry Creek area
- upgrading of the supply main from the Somass treatment plant to the Johnston Street reservoir
- a new TWL 158 reservoir at Cherry Creek
- piping connection from Somass treatment plant to Sproat Lake and McCoy Lake service area

Under Phase III of this option, it is assumed that treatment of all surface water is mandatory. A treatment plant will be required on the China Creek supply, located at the Bainbridge pump station site. The treatment plant will incorporate low lift pumping facilities to pump water to the Cowichan reservoirs. It is also assumed that the China Creek supply main will require upgrading at that time, the capacity of which would be increased to the maximum water license available. The Somass treatment plant will need to be expanded during this phase. A booster pump station will be required for the Sproat Lake service area, to allow filling of the reservoir under maximum day demands.

1B. <u>Abandon China Creek:</u>

Phases I and II of this option are the same as for Option 1A above, as the gravity China Creek source would be retained as long as the existing supply main remains serviceable, and treatment of the China Creek source would not yet be required.

Under Phase III of this option it is assumed that treatment of China Creek water will be mandatory, and the cost of supplying the entire service area from the Somass River supply is examined. Under this option, the China Creek source is abandoned at that time, requiring the following new facilities:

- large expansions of the Somass treatment plant and low and high lift pumping facilities
- expansion of the Johnston Street reservoir booster pump station to pump water from the 120 zone north of Rogers Creek, to the Cowichan reservoirs.

2. GREAT CENTRAL LAKE

2A. <u>Retain China Creek:</u>

A new intake and medium lift pump station would be constructed at Great Central Lake to pump to a site at elevation 140 m, the ultimate treatment plant site, located approximately as shown on Fig. 6.2. Chlorination facilities would be built at that site. A supply main would supply water from there by gravity to a new TWL 120 reservoir in the Beaver Creek area. The pump station would be constructed in two stages, to match demand over the design period.

Under Phase I of this option, the higher Cherry Creek areas remain connected to the existing Lacy Lake gravity source, but the service area would be reduced by connecting the lower areas to the Beaver Creek and North Port Alberni distribution systems. Use of the existing China Creek gravity supply would be maximized. The following new facilities would need to be built:

- an intake and stage 1 of a medium lift pumping station at Great Central Lake
- a chlorination facility
- a new supply main from the Great Central Lake intake to to the new TWL 120 reservoir
- a new TWL 120 reservoir at Beaver Creek
- a new piping connection across Rogers Creek to supply water from the China Creek system to North Port Alberni and the Beaver Creek and Cherry Creek areas. This will include upgrading of the distribution main between the Cowichan Reservoirs and the Burde Street reservoir
- various distribution system interconnections and reinforcements
- expansion of the SCADA system to include all new mechanical facilities

- piping connection to service Sahara Heights (this could also be done in later phases)
- piping, pumping and reservoir facility to service Arrowsmith Heights (this could also be done in later phases)

Under Phase II of this option, it is assumed that the Lacy Lake source would be put on standby, but the China Creek source would remain in service. This would require the following new facilities:

- stage 2 of the medium lift pump station
- distribution system upgrades in the Burde Street reservoir area
- distribution system upgrades in the Cherry Creek area
- a booster pump station at the TWL 120 reservoir and new supply main, to pump from the 120 zone to a new TWL 158 reservoir to serve the higher Cherry Creek area
- a new TWL 158 reservoir at Cherry Creek
- piping connection from the Great Central Lake supply main to Sproat Lake and McCoy Lake service area

Under Phase III of this option, it is assumed that treatment of all surface water is mandatory. A treatment plant will be required on the China Creek supply, located at the Bainbridge pump station site. The treatment plant will incorporate low lift pumping facilities to pump water to the Cowichan reservoirs. It is also assumed that the China Creek supply main will require upgrading at that time, the capacity of which would be increased to the maximum water license available.

A treatment plant will then also be required on the Great Central Lake supply, to be located at the 140 m elevation site, where the chlorination facilities are already located.

2B. <u>Abandon China Creek:</u>

Phases I and II of this option are the same as for Option 1A above, as the gravity China Creek source would be retained as long as the existing supply main remains serviceable, and treatment of the China Creek source would not yet be required.

Under Phase III of this option it is assumed that treatment of China Creek water will be mandatory, and the cost of supplying the entire service area from the Great Central Lake supply is examined. Under this option, the China Creek source is abandoned at that time, requiring the following new facilities:

- a larger Great Central Lake treatment plant and expansion of the medium lift pumping facilities
- expansion of the TWL 120 reservoir booster pump station to pump water from the 120 zone north of Rogers Creek, to the Cowichan reservoirs.
- a supply main from the 120 reservoir booster pump station to the Burde Street reservoir PRV station.

9.2 CAPITAL COST COMPARISON OF OPTIONS

Capital cost estimates are discussed in Section 7.0 and are itemized for the four options in Tables 7.3, 7.4, 7.5 and 7.6 on pages 7-8 to 7-11. A summary of the capital costs follows in Table 9.1.

Table 9.1 Estimated Capital Costs of Options

		ESTIMATED CAPITAL COST (1994 $)	
	OPTION	PHASE I (1997-2005)	TOTAL (1997-2020)
1A	**Somass/China Cr.**	**$19,924,900**	**$43,515,500**
1B	**Somass Only**	**$19,924,900**	**$36,586,200**
2A	**Gr. Central/China Cr.**	**$26,328,700**	**$49,492,400**
2B	**Gr. Central Only**	**$26,328,700**	**$45,172,000**

The total capital cost of the Great Central Lake options is estimated to be approximately $6,000,000 to $8,500,000 higher than for the Somass River options, including full treatment on all water sources. This is almost totally due to the cost of the long supply main from Great Central Lake. Total water supply system development would be sufficient to support growth to the year 2020.

For Phase I water supply development, sufficient to provide regional water until the year 2005, the initial capital costs of the Great Central Lake schemes are an estimated $6,500,000 higher than for the Somass River schemes, with treatment provided initially only on the Somass source.

The higher capital cost of both supply schemes that ultimately retain the China Creek source (Options 1A and 2A) is due to the replacement of the old China Creek supply main with a new larger supply main in the year 2015 (or earlier if the existing main deteriorates).

This favours the combined Great Central Lake/China Creek scheme (Option 2B), as the costs for that option already include the full supply main from Great Central Lake, giving the combined system a 50% higher capacity than the other 3 options. For the combined Somass/China Creek scheme (Option 1B), the supply costs only include sufficient pumping at Somass to provide the year 2020 demands.

An analysis based on total annual costs, including cost of amortization and system operation and maintenance, is presented in the next section, as well as the impact of annual costs on required sources of revenue.

9.3 TOTAL ANNUAL COST COMPARISON OF OPTIONS

Annual costs estimates are discussed in Section 8.0 and are included in the financial models presented in Tables 8.2, 8.3, 8.4 and 8.5 on pages 8-14 to 8-17.

A summary of typical parcel taxes and user rates required to finance the various options is presented in Table 9.2, based on a DCC of $2,000 and a provincial grant of 25%.

Table 9.2 Summary of Typical Annual Costs per Household

Initial Years - No Treatment at China Creek or Great Central Lake

	Parcel Tax	User Rate	Total
Alt. 1 - Somass & China Creek	**$113**	**$86**	**$199**
Alt. 2 - Great Central & China Creek	**$165**	**$53**	**$218**

Beyond 2015 - Mandatory Treatment

	Parcel Tax	User Rate	Total
Alternative 1 - Somass & China Creek			
Option 1 A - Keep China Creek	**$200**	**$230**	**$430**
Option 1 B - Abandon China Creek	**$115**	**$265**	**$380**
Alternative 2 - Great Central & China Creek			
Option 2 A - Keep China Creek	**$247**	**$176**	**$423**
Option 2 B - Abandon China Creek	**$200**	**$170**	**$370**

It should be noted that the latter four rate groupings are rates expressed in 1994 dollars, required to meet inflated capital and operation and maintenance costs in 2015, 20 years hence.

As discussed previously, the combined Great Central Lake/China Creek option (Option 2A) has the built in capacity to supply the full 2020 design demand of 66,000 m^3/day from Great Central Lake, as well as 35,000 m^3/day from China Creek, resulting in 50% excess capacity compared to the other options. This excess capacity can be put to use with relatively low incremental operation and maintenance costs, as there will be considerably less pumping for Option 2A.

The options retaining China Creek also provide the considerable benefit of increased security of supply from two sources, on opposite sides of the system. Also, long term upgrading costs of the internal distribution systems will be much less with two sources entering the system from opposite ends.

The annual costs listed in Table 9.2 are calculated on the basis of 25% government funding and a DCC contribution of $2,000 per newly created lot or housing unit. This DCC value has been set arbitrarily for the purpose of initial financial analysis. It can be varied considerably within the provisions of the Municipal Act. Government funding for infrastructure projects is not guaranteed, and there is every possibility that funding may not be available at all at the time this system would proceed. Municipalities and regional districts are increasingly looking towards DCC's to help finance projects that are necessary because of increased development.

DCC's incorporated in the present financial models represent considerably less than 51% of the total capital repayment, which is the estimated maximum level of DCC's that can be charged. Therefore, there is the possibility of raising the DCC's to reduce parcel taxes, or to offset a possible reduction in available grant funding. It would be easy to run additional financing scenarios with the financial model set up for the project.

SECTION 10

SECTION 10.0
CONCLUSIONS AND RECOMMENDATIONS

10.1 CONCLUSIONS

The following conclusions may be drawn from the work presented in this report:

1. The proposed Alberni Valley Regional Water Supply System would service the City of Port Alberni, the Beaver Creek and Cherry Creek Improvement Districts, the Sahara Heights and Arrowsmith Heights Water User Communities, and the McCoy Lake (Devil's Den), Sproat Lake, and Bell/Stuart Road service areas.

2. The present (1995) population in the service area is estimated at 30,000 people. The best estimate of projected population growth over the next 25 years is an average annual growth rate of 2.4%, resulting in a design population of 54,000 people in the service area for the year 2020.

3. The existing peak day water demand for the regional service area is estimated at 48,000 m^3/day. With universal metering in all communities, it is projected that the year 2020 peak day demand will be 66,500 m^3/day. Without universal metering, the projected year 2020 peak day demand will be 79,500 m^3/day. At a given capacity, this represents an additional 10 years of useful system life for a fully metered system at the projected rate of growth.

4. The existing China Creek/Bainbridge Lake and Lacy Lake sources can be used for regional water supply with no additional treatment for the foreseeable future. The present combined capacity of these sources is 36,000 m^3/day. Additional existing source capacity exists at the Somass River (City) and at the Stamp River (Beaver Creek), to a total of 20,500 m^3/day, however, water quality for these sources has been below aesthetic acceptability during the summer, and continued use without consumer complaints will require filtration treatment.

5. The existing China Creek supply consists of 8 km of more than 60 year old steel supply main which is close to its expected useful life span. It is not known whether this main can last through the next 25 year design period without major repairs or full replacement.

6. Suitable future regional water sources capable of supplying the entire Alberni Valley service area are Great Central Lake and the Somass River. Great Central Lake water is suitable for drinking water without treatment in the foreseeable future, other than disinfection, whereas Somass River

water will require filtration treatment immediately, as well as disinfection. Each source is able to supply the design water demands for the regional service area on its own, or in combination with the existing China Creek source.

7. It is expected that surface water sources, including Great Central Lake and China Creek will require mandatory filtration treatment sometime within the next 10 to 20 years, unless water quality concerns require earlier treatment.

8. The Somass River supply options present the lowest capital cost opportunities for regional water supply, approximately $8,000,000 lower than the Great Central Lake options.

9. The options retaining China Creek, including the provision of treatment and replacement of the China Creek supply main, provide the best opportunity for expansion beyond the next 25 year design period.

10. When considering the annual costs of operation and maintenance in addition to the capital costs, the Great Central Lake options become marginally cheaper after mandatory treatment has been implemented.

11. Assuming the implementation of development cost charges (DCC's) for water supply to the extent of $2,000 per new development unit, and 25% provincial financing, initial total annual costs to pay for the regional water supply system are estimated at around $200 per household for the Somass option and $220 for the Great Central Lake option, until the implementation of treatment. Annual per household costs would roughly double after the implementation of treatment at Great Central Lake and China Creek, expected around the year 2015. The DCC may be increased to reduce taxes, or to offset reduced government funding.

10.2 RECOMMENDATIONS

Based on the conclusions reached, we make the following recommendations:

1. That universal metering be instituted, in conjunction with increasing block water rates, and a public education program to encourage water conservation. The objective is to reduce per capita water demands to more reasonable values, and postpone required water supply system expansion.

2. That a regional water supply system be implemented, supplying bulk water to the various member distribution systems, and that Option 2A - Great Central Lake, in conjunction with China Creek be selected as the best long term source.

3. That the universal metering program and associated water conservation efforts be operated for at least two years before sizing the regional water supply system, to prove design per capita water demands. This will allow a firmer basis to be established for design of the ultimate water supply system capacity, and required timing.

4. That, in the interim, short term upgrading and interconnection options be investigated that will allow the existing sources to supply the existing water systems, working progressively towards the ultimate scheme. This will require the setting up of a mechanism to review individual system upgrading plans in the context of the future regional water supply system.

5. That the appropriate government agencies having jurisdiction be given copies of this report and that they be advised about the regional district's long term interest in Great Central Lake and China Creek as sources for regional water supply.

6. That discussions take place with the major stakeholders about use of the affected watersheds for water supply purposes, with the objectives of protecting the watersheds for public drinking water supply.

7. That a Development Cost Charge Bylaw be implemented at the earliest opportunity to collect funds to assist in the financing of the proposed regional water supply system.

APPENDIX A

APPENDIX A

REFERENCES

APPENDIX A
REFERENCES

1. Water Supply and Sewerage Study for the Alberni Valley, Regional District of Alberni-Clayoquot, by Associated Engineering Services Ltd. March 1971.

2. China Creek/Somass River Water Supply, City of Port Alberni, by Associated Engineering (B.C.) Ltd., November, 1987.

3. Stewardship of the Water of British Columbia, A Review of British Columbia's Water Management Policy and Legislation, by the Ministry of Environment, Lands and Parks. 1993.

4. Guidelines for Canadian Drinking Water Quality, 4th Edition, by Health and Welfare Canada, 1989.

5. Water Treatment Principles and Applications, a Manual for the Production of Drinking Water, by Health and Welfare Canada, 1989.

6. Planning and Implementing Water Conservation. Proceedings of a Technology Transfer Seminar sponsored by the B.C. Water and Waste Association, Victoria, B.C. May 11, 1994.

7. Water Quality and Treatment, A Handbook of Community Water Supplies, 4th Edition. Edited by the American Water Works Association. 1990.

8. Water Treatment Plant Design, 2nd Edition. Edited by the American Society of Civil Engineers and the American Water Works Association. 1990.

9. Surface Water Treatment: The New Rules. Published by the American Water Works Association. 1992.

10. Canadian Water Management - Visions for Sustainability. Bruce Mitchell and Dan Shrubsole, Canadian Water Resources Association, October 1994.

APPENDIX B

APPENDIX B

RECORDS OF MEETINGS

January 11, 1994	MacMillan Bloedel Limited Re: Sproat Lake Supply Main
January 26, 1994	MacMillan Bloedel Limited Re: China Creek Watershed
February 4, 1994	Ministry of Environment, Water Management Branch Re: Regional Water Sources
February 14, 1994	Fisheries and Oceans Canada Re: Somass River - Great Central Lake
February 8, 1994	Letter from Ministry of Environment Re: River Flows and Lake Levels
March 3, 1995	Letter to Regional District Re: Sproat Lake Water Distribution System Costs

File: M9330

Alberni Valley Water Supply
Report on Meeting

Subject- Water from the Mill Supply Pipeline for Domestic Use
Date- January 11, 1994
Time- 11:00 AM
Location- MacMillan Bloedel Ltd, Alberni Pulp & Paper Division
Present- City Of Port Alberni:
K. Watson
G. Cicon
MacMillan Bloedel Ltd.
G. Dillon
W. Konkin
H. Grist
Koers & Associates Engineering Ltd.
L. Dillon

The City gave a brief description of the study presently underway. M&B had approached the City and suggested that rather than building a new pipe line to Great Central Lake that consideration should be given to taking water from the pipeline supplying the mill from Sproat Lake. Such a proposal is now possible because M&B have reduced their water requirements at the mill.

M&B advised that their understanding is that the requirement is for a topping up and emergency supply only with the principal supply still being provided from China Creek. They advised that supply from their pipeline would be interrupted in case of a power failure at the intake. In the case of a mill shutdown the pipeline is normally shut down. During line maintenance the pipeline is routinely shut down for a 12 hour period.

The pipeline is a 48 " dia. wood stave pipe mounted above ground on wooden sleepers. This line was replaced in 1963. The portion within the company grounds, including the buried river crossing, is steel pipe. The pump station is located at the lake intake. The intake is equipped with travelling screens. There are 12 pumps with a maximum capacity of 65,000,000 gpd (300,000 m^3/day). There is a standpipe on the height of land above the pump station. A pressure of 45 psi is maintained at the mill.

In order to avoid draining the pipeline and possibly causing a collapse, the main must be shut down immediately in the case of a power failure at the pump station. This shutdown is done by means of a valve located where the pipeline enters the mill. Any connection for domestic water supply would have to be after this valve.

Water for drinking in the mill is provided from a separate connection from the City water system. The water from the Sproat Lake pipeline is not treated. There have been some algae problems although not serious enough to affect mill operations.

M&B maintain a small weir in Sproat River where it leaves the lake. They also maintain two dams on Great Central Lake. A small wooden crib dam on Robertson Creek controls flow to a fish hatchery. The main dam on the Stamp River at the outlet from the lake is a concrete structure with stop log weirs and one mechanical gate. It was originally installed to provide dry weather flow for dilution of the pulp mill effluent. The operation is now controlled entirely by the requirements of Fisheries and Oceans Canada.

M&B need to know the quantity of water required before negotiations can proceed further. It is likely that the existing water licences would have to be amended if M&B were to supply domestic water.

The 1971 Regional study projected a water supply requirement for the Alberni Valley at 115,000 m^3/day by the year 2000. These projections are now known to be high and are under review by Koers. It was agreed that M&B would be informed as soon as the projections have been revised.

Alberni Valley Water Supply
Report on Meeting

Subject-	Timber Harvesting, China Creek Watershed
Date-	January 26, 1994
Time-	1:00 PM
Location-	City Engineering Department, City Hall, Port Alberni
Present-	City Of Port Alberni:
	K. Watson
	G. Cicon
	N. Meunier
	J. Forsyth
	MacMillan Bloedel Ltd.
	G. Eason
	R. Askin
	Koers & Associates Engineering Ltd.
	A. Koers
	L. Dillon

M&B advised that their five-year harvesting plan for TFL 44 in the China Creek watershed is under preparation and should be ready for presentation by mid-February.

Consideration is being given that this is an important community water supply. The City was asked to provide M&B with turbity and stream flow records.

M&B's Land use Planning Advisory Team have been in consultation with the Ministry of Environment, Water Management Branch in the preparation of the Forest Development Plan for China Creek.

Experimental thinning has been carried out in similar watersheds to increase the runoff by increasing the snowpack under the forest canopy. Consideration is being given to basing the allowable cut on zoning within the watershed. This zoning could consist of three areas, the lowest which receives precipitation predominately in the form of rain, the second which receives rain or snow and the highest which receives mostly snow. Allowable cutting would be from 20% to 30%. Areas which have been clearcut would be considered to be completely reforested when the new trees have reached a height of 9-10 meters.

A preliminary forestry development plan was presented which showed stream corridors to be protected. Also a large block of land at the head of the watershed was indicated as being steep and unstable, and could therefore not be logged. Other areas for wildlife habitat protection were indicated.

M&B advised that they are also preparing a 20 year plan but it is a long way from completion. Such plans are very unreliable, however. Even 5-year plans are subject to frequent changes.

M&B were requested to provide a plan showing the present harvested areas in TFL 44 within the watershed. They agreed to this.

Alberni Valley Water Supply
Report on Meeting

Subject-	Community Water Supply- Alberni Valley
Date-	February 4, 1994
Time-	10:00 AM
Location-	Environment, Lands & Parks, Water Management Branch, Nanaimo
Present-	Water Management: G. Bryden J. Baldwin B. Cook Koers & Associates Engineering Ltd. A. Koers L. Dillon

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Water Management saw no particular difficulty in obtaining a community water supply from the M&B pipeline from Sproat Lake. It would be much easier to transfer part of a licence from M&B to the Regional District than to issue a new licence.

With reference to a supply from Great Central Lake the biggest objection would come from DFO, as they are routinely opposing applications as low as 500 gpd. Three feet of Great Central Lake is presently unlicensed. The bottom of the lake is privately owned. The inlet elevation of pumps supplying the hatchery on Robertson Creek has reduced the capacity of the dam. If the water is drawn down too far the pumps cavitate.

Summer temperatures in the Stamp/Somass River system are often too high for optimum salmon habitat. Previously it was believed that the migration of the salmon upstream in the Somass/Stamp rivers depended on the quantity of flow. It is now believed that the fish respond to water temperature. One or two degrees can make the difference. Before the hydro development on Elsie Lake, cold water from Elsie Lake would flow directly into the Stamp system. Now water is diverted from Elsie into Great Central Lake, where the cold water sinks to the bottom, displacing warmer surface waters into the Stamp River. DOF have tried to lower the water temperature by installing a curtain at the lake outlet to force water up from the bottom. The success of this venture is not known.

The Branch is concerned about the water supply to both the Beaver Creek and Cherry Creek Waterworks Districts. They would like to see a more reliable source for these areas. There is a shortage of water in Cherry Creek now for fish habitat. The golf course in the Cherry Creek district is asking for more water from the creek. There is a question of water quality in the water supply from the Stamp river for the Beaver Creek area.

China Creek is an essential community water supply which has been adversely affected by timber harvesting. The "Guidelines for Watershed Management of Crown Lands used as Community Water Supplies" is now being revised. It is believed that the revised guidelines along with the new Forest Practices code will be much more effective in protecting community water sheds.

A minimum flow of 5 cfs is required at the outlet of China Creek. The present gauge at the Port Alberni water intake is very inaccurate. Also the Branch would like to see a better method of controlling the discharge out of Lizard Lake. At the present time it can only be done manually.

The Branch advised that Integrated Watershed Management Plans (IWMP) have proven to be unwieldy in the past. They are hopeful that the new regulations will be effective in protecting community watersheds. If this does not prove to be the case then consideration should be given to setting up a IWMP for the China Creek watershed.

Alberni Valley Water Supply
Report on Meeting

Subject-	DOF Requirements- Somass River System
Date-	February 14, 1994
Time-	9:30 AM
Location-	Fisheries & Oceans, South Coast Division, Nanaimo
Present-	Fisheries & Oceans (DFO): Richard Eliason Brian Tutty Koers & Associates Engineering Ltd. A. Koers L. Dillon

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The sockeye salmon run in the Somass river system is the largest and most important on Vancouver Island. Approximately half of the run goes to Sproat Lake and the other half to great Central Lake. The system also supports steelhead, coho and pinks.

The summer flows in the Sproat river are 70 cfs. Summer discharges from Great Central Lake into the Stamp River are 900 cfs. Control on Sproat Lake is minimal with only a small weir which can hold a foot or so of stop logs. There is a major dam structure controlling storage in Great Central Lake. At the present time approximately ten feet of water can be stored. There is another small wooden crib dam which controls flow from Great Central Lake into Robertson Creek which in turn discharges into the Stamp River.

A further three feet of storage at the dam on Great Central Lake is unavailable because of the level of the wet well for the pumps serving the Robertson Creek hatchery. The pump station is located on the bank of the lake. The wet well is supplied by a pipeline with an intake at about 50 feet deep. The pump station discharges into Robertson Creek just below the dam for the purpose of controlling the water temperature for the hatchery. It is estimated that it would cost $70,000 to lower the pumps in this pump station so and additional 3 feet of storage capacity capacity of the lake could be utilized. Beyond that, the entire wet well has to be lowered, which would cost a lot more.

A large fish kill was experienced in 1990 when the spawning salmon refused to proceed past the estuary. It was determined that the water temperature in the river system was too warm. Surface temperatures in the lakes are as high as 25°C in the summer season. In 1993 DFO installed a polyethylene curtain at the mouth of Great Central Lake to force cold water up from a depth of about 50 feet. They managed to lower the river temperature 2°C. Planning is now under way for the installation of pipelines at the outlet of both Sproat Lake and Great Central Lake to pull cold water from below the thermocline. It is proposed that these pipelines would have a capacity equal to approximately one half the summer flow. For Sproat Lake this would be around 25 cfs and for Great Central Lake about 500 cfs. Outlet elevations would be below minimum water elevations. Control would be by means of valves at the outlets of the pipelines. The intakes would require careful design to prevent danger to small fry in the lake. Intake depths would be in the order of 50 feet. Water tested at that depth was 100% oxygenated.

According to DFO, BC Hydro operate their generating plant at excess capacity until all the storage in Elsie Lake is used and then shut the plant down for an extended maintenance period. DFO would prefer that they operate the plant at a rate that could be sustained for the full year. The water from Elsie Lake is very cold but when discharged into Great Central Lake from the generating plant sinks to the thermocline without affecting the surface temperature. Prior to the construction of generating plant the water from Elsie Lake flowed directly into the Stamp river thus providing cooling. Apparently, Hydro's operation is presently under review.

DFO have undertaken a fertilizing program in both lakes to increase plankton feed for the fish. Much of the spawning occurs along the shores of the lakes so water levels are critical during the hatching period.

For further information on fish migration and spawning reference was made to the following staff at DFO in the Nanaimo office:

Kimm Hyatt - sockeye biologist
Wilf Liedke - fish stock officer

Province of
British Columbia
Ministry of
Environment,
Lands and Parks

BC Environment

Vancouver Island Region 1
Regional Headquarters
2569 Kenworth Road
Nanaimo
British Columbia
V9T 4P7
Telephone: (604) 751-3100

February 8, 1994

File: 76800-20-31-20-01
76800-20-31-30-01
76800-20-31-40-01
76800-20-31-50-01

RECEIVED FEB 15 1994

Koers & Associates Engineering Ltd.
PO Box 1289
Parksville BC V9P 2H3

ATTENTION: Larry Dillon

Dear Larry Dillon:

Re: Alberni Water Supply Study

Further to our meeting on February 4, 1994, with George Bryden (Water), Tony Koers and Bob Cook (Water) regarding the Water Supply Study you are undertaking for the Regional District and City, please note the attached requested information for 1993 on water levels and flows for lakes and creeks in the study area. If you require more details regarding this information, you can contact Bob Harrigan at the City (720-2840) for the China Creek system and Joe Kozson at M & B (723-2161) for details on Great Central Lake, Sproat Lake and Somass River.

I look forward to obtaining a copy of your final report this May.

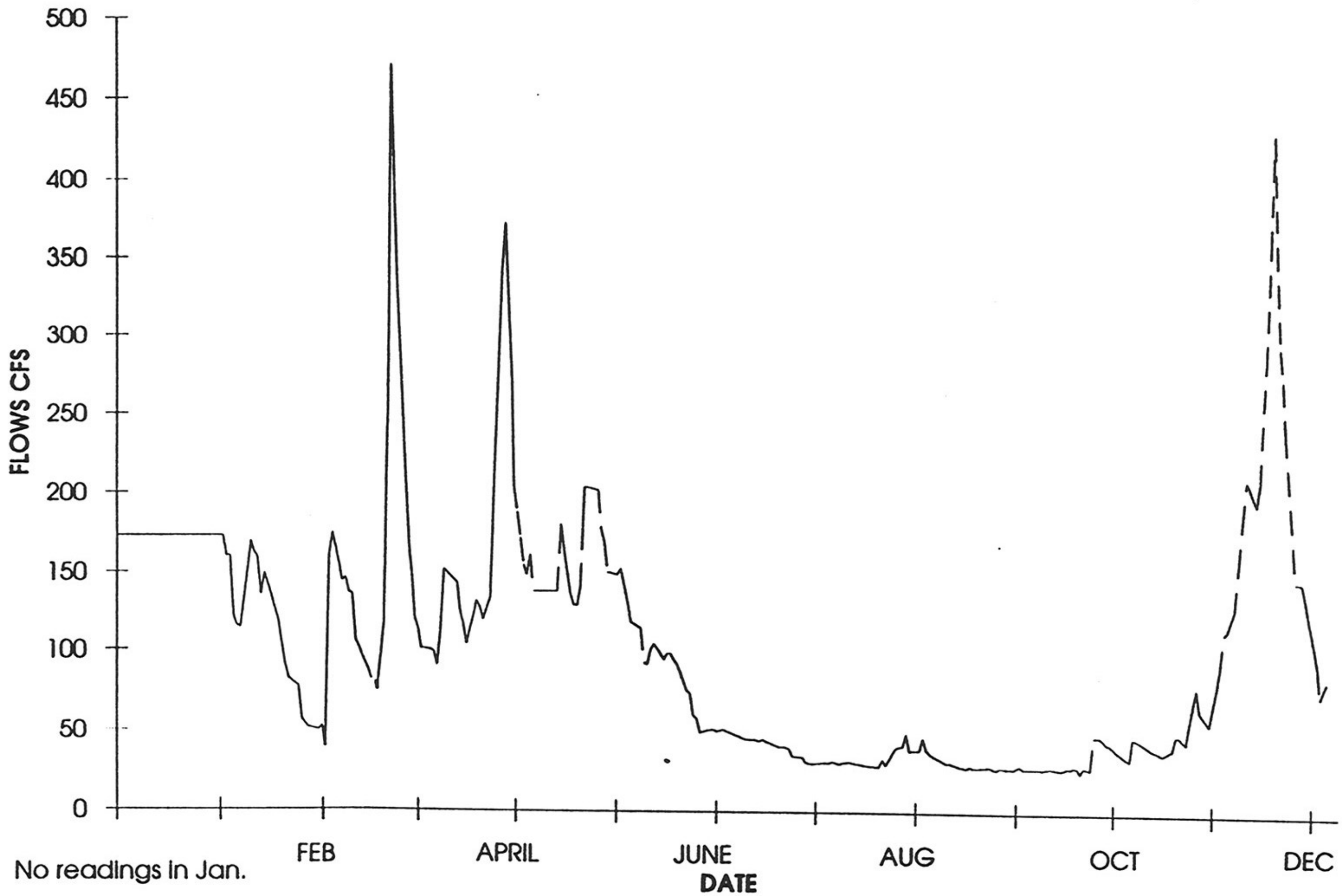
Yours truly,

John Baldwin

M. John Baldwin
Water Allocation Technician

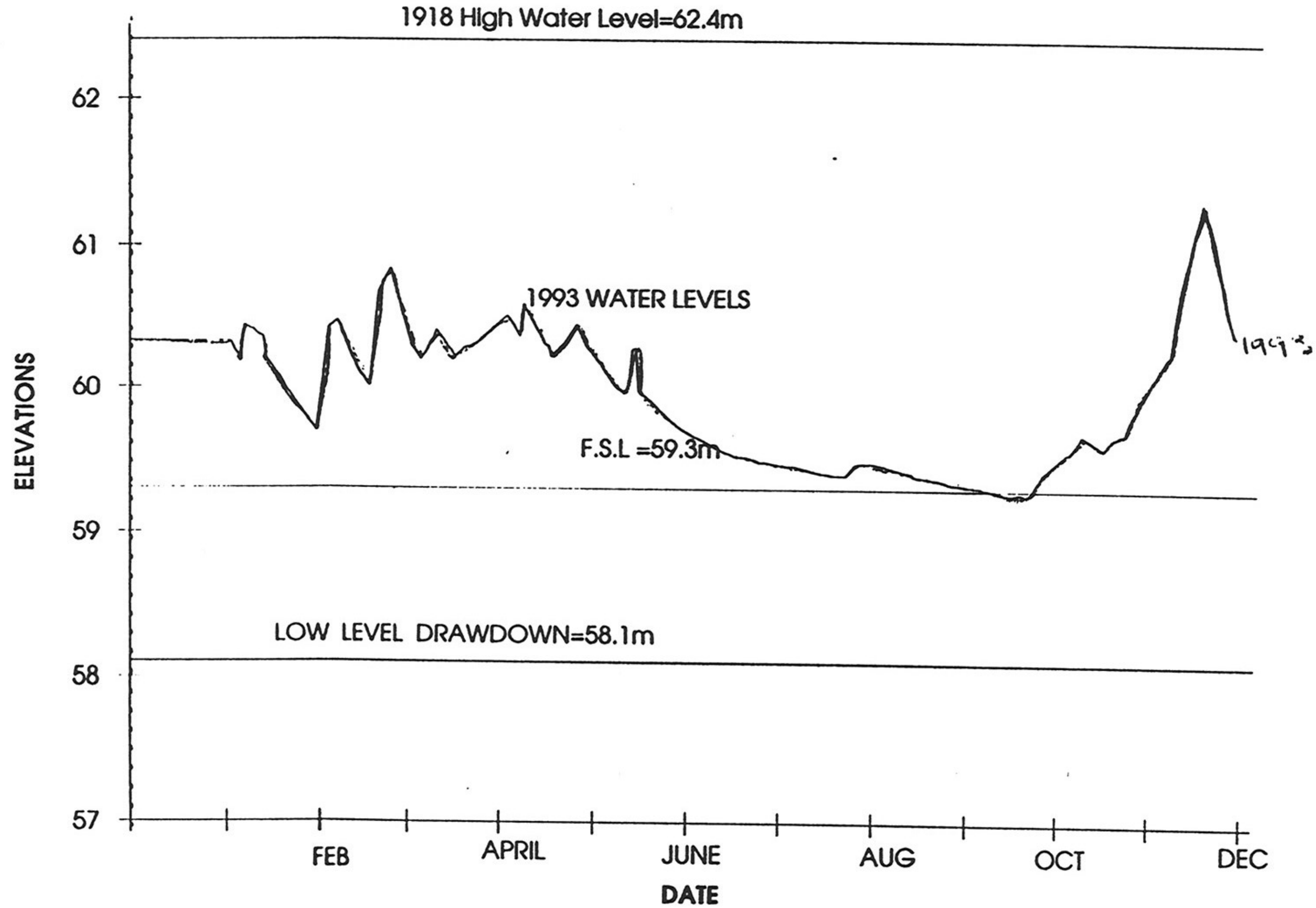
Attachments

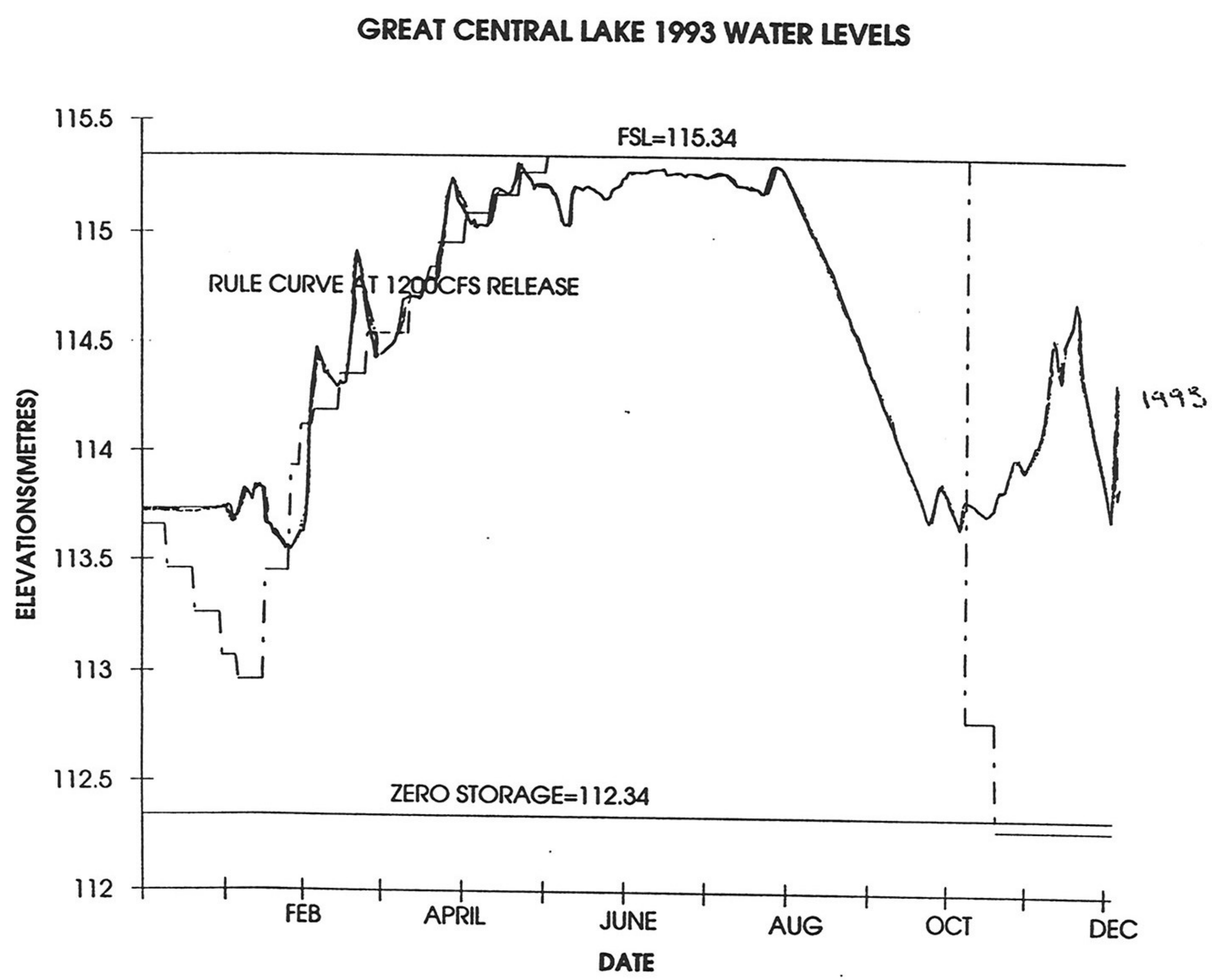
SOMASS RIVER FLOWS FOR 1993



No readings in Jan.

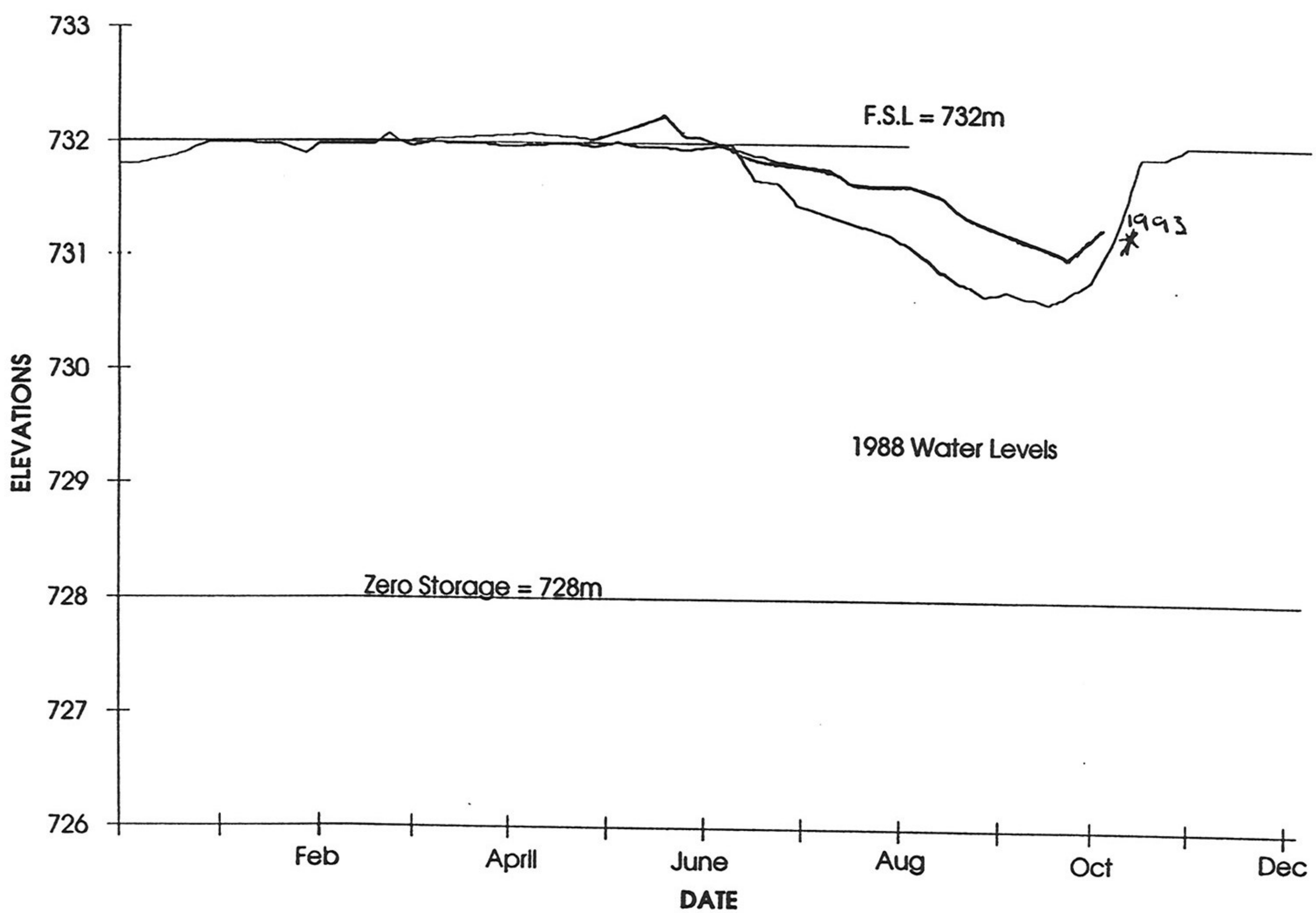
SPROAT LAKE 1993 WATER LEVELS





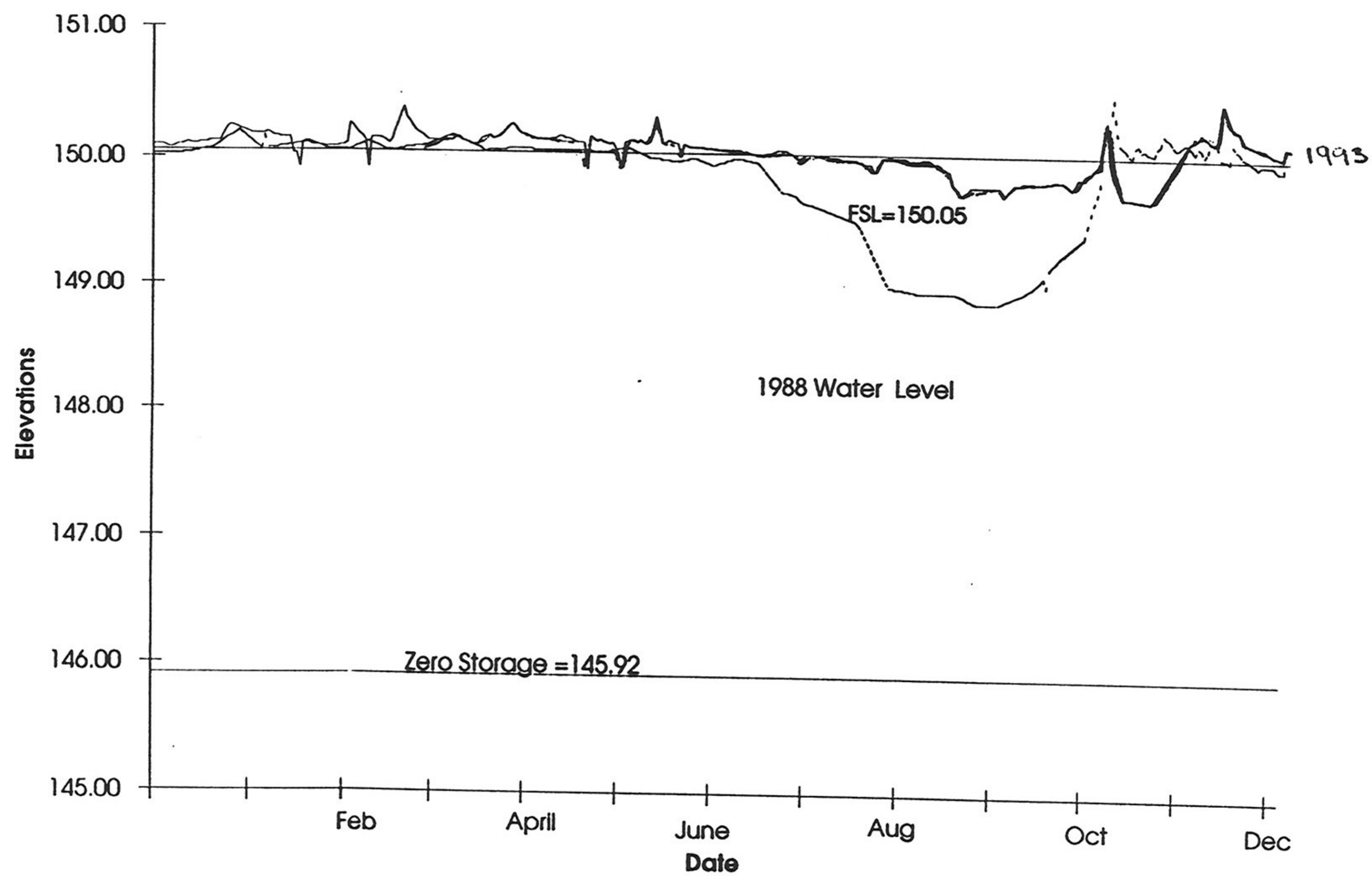
GREAT CENTRAL LAKE 1993 WATER LEVELS
115.5
115
114.5
114
113.5
113
112.5
112
ELEVATIONS(METRES)
FSL=115.34
RULE CURVE AT 1200CFS RELEASE
ZERO STORAGE=112.34
1993
FEB
APRIL
JUNE
AUG
OCT
DEC
DATE

LIZARD LAKE 1993 WATER LEVELS



* NO MEASUREMENTS IN NOV & DEC

Bainbridge Lake 1993 Water Levels



KOERS
& ASSOCIATES
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182 MEMORIAL AVENUE
PARKSVILLE, B.C. V9P 2H3
(604) 248-3151
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March 03, 1995
File: M9330-5

FAXED Mar 3/95

Regional District of Alberni-Clayoquot
3008 - 5th Avenue
Port Alberni, B.C. V9Y 2E3

<u>Attention:</u> **Mr. R. Harper**
Administrator

Dear Sirs:

Re: Alberni Valley Regional Water Study - Sproat Lake Distribution Costs

Further to our discussions of February 20 and 24, 1995, we have now completed the revisions to the regional water system capital cost estimates and financial model spreadsheets, to account for the deletion from the regional system costs of the water distribution main loop around Sproat Lake and to McCoy Lake. You have asked us to supply the estimated capital cost of the Sproat/McCoy Lake water distribution system.

It has been agreed that this part of the system, including the distribution reservoir, would have to be borne entirely by the Sproat Lake user group, should they decide to become part of the regional system. This would provide equity with the other established water systems, whose users have already paid for their water distribution systems.

The regional water supply system has built in capacity to supply water to the Sproat Lake and McCoy Lake community, including projected growth for the next 20 years. The regional system also includes the feeder main from the nearest regional supply main to the start of the future Sproat Lake distribution system.

The capital cost estimates have been adjusted from the previous draft report, as shown on the attached Tables 7.3 through 7.6, and as summarized on the attached page 9-5 of the report. The financial model has been recalculated, based on the revised capital costs, and the resulting estimates of typical annual costs per household are summarized on the attached page 9-6 of the report.

To be able to obtain a regional water supply, the Sproat Lake and McCoy Lake community would have to pay the estimated annual per household cost of the regional supply system, in addition to financing the cost of a water distribution system, which is estimated as follows:

.../2

March 03, 1995
File: M9330-5

Regional District of Alberni-Clayoquot
Mr. R. Harper

Estimated costs of Sproat Lake/McCoy Lake Water Distribution System

8,610 m of 250 mm dia. water main, @ $140/m	$1,205,400
13,665 m of 200 mm dia. water main, @ $120/m	1,639,800
Sproat Lake distribution reservoir, 2,400 cu m	660,000
Total Estimated Construction Costs	$3,505,200
Engineering, legal, Administration @ 15%	525,800
Effective GST @ 3%	120,930
Total Estimated Capital Costs	$4,151,930

Please note that these costs do not include the cost of individual water meters.

We trust this is the information you require. We are in the final stages of completing the final issue of the regional water study report, which we hope to deliver to you by the end of next week. We will be available to present the report to the Alberni Valley Committee at its April meeting.

We appreciate the assistance provided by the regional district in plotting all coloured figures. I particular, we thank Jodi for her tremendous effort in plotting and trimming the many sheets in a very short period.

Please call if you have any questions.

Yours truly,

KOERS & ASSOCIATES ENGINEERING LTD.

D.A. Koers, P.Eng.
Project Manager

DAK/sjk

Enclosures

cc. City of Port Alberni, Ken Watson, P.Eng.