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Regional District of Alberni-Clayoquot

and

City of Port Alberni

ALBERNI VALLEY REGIONAL WATER STUDY

March 1995

KOERS
& ASSOCIATES
ENGINEERING LTD.
Consulting Engineers

PARKSVILLE, B.C.

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March 6, 1995
File: M9330-4

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

Attention: **Mr. R. Harper**
Administrator

City of Port Alberni
4850 Argyle Street
Port Alberni, B.C. V9Y 1V8

Attention: **Mr. K. Watson, P.Eng.**
City Engineer

Dear Sirs:

Re: Alberni Valley Regional Water Study - FINAL REPORT

We are pleased to present 50 copies of our final report on the Alberni Valley Regional Water Study conducted for the Regional District of Alberni-Clayoquot and the City of Port Alberni.

The study considers several alternatives for short term and long term regional supply to the Alberni Valley service area, and provides capital and annual cost estimates, and cost recovery options for comparison.

A total of four alternative supply systems have been investigated, ranging from a new supply system that replaces all existing sources, to a staged implementation of a regional supply system using most of the existing sources, in an effort to spread costs over a longer period.

A first draft of the report was submitted on August 18, 1994, for review by City and Regional District senior staff. A meeting was held on October 3, 1994 to discuss the review comments. A second draft was presented on November 21, 1994 to staff. Comments from staff were incorporated, after which a revised second draft was submitted on December 19, 1994 for discussion and review by City Council and the Regional District Alberni Valley Committee. The report was formally presented to the AV Committee and invited members from all potential user groups on January 18, 1995, followed by a second meeting on February 8, 1995 to receive final input.

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Regional District of Alberni-Clayoquot
City of Port Alberni

The final report incorporates input and feedback received from staff, the AV Committee, the Improvement Districts and other potential users of the system.

We look forward to presenting the final report and discussing the findings with the City and Regional District. We have enjoyed working on this challenging project, and would be pleased to assist further in the implementation of the Alberni Valley Regional Water Supply.

Yours truly,

KOERS & ASSOCIATES ENGINEERING LTD.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D. A. KOERS

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

DAK/sjk

Enclosures

ALBERNI VALLEY REGIONAL WATER SUPPLY STUDY

EXECUTIVE SUMMARY

SCOPE AND OBJECTIVES

Koers & Associates Engineering Ltd. were retained by the Regional District of Alberni-Clayoquot and the City of Port Alberni to determine the most cost effective and secure method of obtaining an adequate long term supply of good quality water for the City of Port Alberni and surrounding Regional areas in the Alberni Valley.

The study builds on data presented in previous regional and municipal studies conducted in 1971 and 1987, and presents an orderly, phased progression from existing supply systems to the ultimate recommended regional supply scheme, comparing viable alternative sources and transmission systems, and considering water quality, quantity, security of supply, as well as capital and operation and maintenance costs.

A financial model is presented to compare, for illustrative purposes, how the total annual costs for the various alternative supply systems could be financed over the full 25 year design period, from a combination of development cost charges, parcel taxes, and user rates.

Throughout the report, it has been assumed that all sources of water used in the various alternative schemes, whether they are existing or new, would be owned and controlled by a single regional water authority, comprising the member water utilities, and that the water from all sources would be shared by the entire system, with costs allocated to the member utilities on a proportional basis. The mechanism by which existing sources are transferred to the regional authority or the administrative and operational structure necessary to run the regional water authority has not been addressed in this report.

BACKGROUND

The Regional District of Alberni-Clayoquot (RDA-C) first looked into regional water supply for the Alberni Valley in 1971. Sources considered at that time were Great Central Lake, Somass and Stamp Rivers, Sproat Lake, and Cameron Lake. The system was expected to serve 60,000 people in the Alberni Valley by the year 2000. Great Central Lake was recommended as the best regional water source.

The current population in the Valley is about 27,000 people, and has been relatively constant over the past 24 years. Additional growth is now predicted to result in a projected year 2020 population of 54,000 in the Alberni Valley.

Existing water supplies are barely able to supply present peak summer demands, and some of the supplies suffer from water quality problems. All existing water systems in the proposed service area are in urgent need to upgrade their individual water supply systems, to ensure adequate and safe domestic drinking water supplies for the immediate, as well as long term needs.

REGIONAL SERVICE AREA

The proposed service area includes the City of Port Alberni, the Beaver Creek and Cherry Creek Improvement Districts, the Sahara Heights and Arrowsmith Heights Water User Communities, and the Sproat Lake/McCoy Lake and Bell/Stuart Road service areas.

The service area includes several First Nations Reserves, which can be included in the proposed regional water supply system without significant system modifications.

EXISTING WATER SYSTEMS

The existing water systems for the City of Port Alberni, the Beaver Creek and Cherry Creek Improvement Districts, and the Sahara Heights Water User Community are supplied from surface water sources, namely China Creek/Bainbridge Lake, Somass River, Stamp River, Lacy Lake, and Rogers Creek. None of the supplies are treated beyond relatively coarse screening and chlorination.

Residents in other parts of the service area generally have individual supplies from Sproat Lake and individual groundwater wells.

It is estimated that over 95% of domestic water in the service area is obtained from surface water supplies.

Based on current moderate growth projections (an average of 2.4% per annum), it is predicted that the total water demand in existing water systems in the service area will surpass the total available capacity of the existing water sources in 1996. This is true for each individual system as well.

POPULATION AND WATER DEMAND PROJECTIONS

The first stage of the proposed regional water supply system is designed to cover a period of 25 years from today, ie. 1995 to 2020. During that time it is projected that the population to be served by the system will roughly double from 30,800 in 1995 to 54,185 in 2020, and the maximum day water demand from 40,615 m^3/day to 66,350 m^3/day.

WATER CONSERVATION

The report discusses potential for water conservation. There is significant potential to reduce water demands by being less wasteful in lawn and garden irrigation practices and by using more efficient plumbing fixtures. Although evidence is mounting that the general public is ready to start addressing this issue seriously, additional measures, such as garden sprinkling restrictions and metering of individual water service connections, combined with increasing block water rates (whereby the price of water increases with increased use), may be necessary to encourage water conservation.

Some allowance has been made in the water use projections for the effect of conservation, but only to the extent that per capita water use is not expected to increase with time, as has been the case in the past. It is also assumed that universal metering will be implemented throughout the service area. There is no demonstrable justification for predicting a decrease in per capita water use at this time, except as a result of metering in the City of Port Alberni. Should a further decrease occur through the success of water conservation programs, the effect will be that the first stage system will last longer than the projected 25 years, and public expenditures to further expand the system can be postponed.

REGIONAL WATER SUPPLY CONCEPT

The general concept of the proposed regional water supply system is that bulk water would be supplied to the various existing community water systems by means of a regional transmission main and a supply system from a new or existing regional surface water source or sources. The existing water systems would continue to operate their distribution systems as they have in the past, buying bulk water from the regional system and selling water to their customers. The cost of buying water from the regional system would be offset by the reduction in operating costs of their traditional sources and would shift the responsibility of meeting increasing demands for adequate quantity and quality of water to the regional supply authority.

By agreement, the regional supply system would provide maximum day water demands at adequate pressures at one or more metered connection points. The individual water systems would continue to be responsible for distributing water to the consumer through their own systems, including the provision of storage for balancing peak hourly demands and fire flows.

New service areas, such as Sproat Lake, McCoy Lake, and Bell/Stuart Road are accommodated in the various supply system alternatives. In the staged system, service to these areas would only be possible when the transmission system is sufficiently developed and reservoir storage added to allow service to extend to those areas. Such areas would be responsible for constructing their own water distribution systems.

REGIONAL WATER SOURCES

General

Existing sources considered suitable for incorporation into a regional water supply system for the Alberni Valley are China Creek/Bainbridge Lake, Somass River and Lacy Lake. Only the Somass River is expected to require treatment beyond chlorination in the short term.

New sources considered suitable for long term regional water supply are Great Central Lake or the Somass River, either on their own, or in conjunction with China Creek.

Sproat Lake has been considered as a regional supply, but has been rejected because of extensive development around Faber and Stirling Arms, and the anticipated difficulty in securing additional water licence, over MacMillan Bloedel's current licence.

Water quality for all sources considered is excellent, and well within the Guidelines for Canadian Drinking Water Quality, with the exception of turbidity and colour during high runoff in China Creek, Cold Creek (Lacy Lake system), and the Somass River, and coliform bacteria in the Somass River.

Water quality in the Somass River has deteriorated over the years from land runoff, which originates from forestry lands and many farms. The Somass source for the City is only used sporadically because of taste and odour complaints.

Short to Medium Term Regional Water Sources

In the short term, regional water can be supplied to the existing water systems in the proposed service area by improving interconnections between the systems and utilizing the existing China Creek, Somass River and Lacy Lake sources. It is important to at all times maximize the use of the China Creek and Lacy Lake gravity sources, to avoid the high annual costs of pumping. This requires the completion of a new water main connection across Rogers Creek from the Cowichan Reservoirs to the Johnston Street reservoir.

Use of the Somass River will require the immediate installation of a filtration water treatment plant.

Long Term Regional Water Sources

The best long term regional water source is Great Central Lake. It is expected that adequate watershed protection can be achieved for the lake, and that the high cost of treatment can be postponed longer than for any other source in the area. The development of an Integrated Watershed Management Plan for the Great Central Lake watershed should be a high priority. The report considers Great Central Lake as the sole source of regional water supply, as well as in combination with the existing China Creek source.

As an alternative to the Great Central Lake source, the report considers the expansion of the Somass River intake and pump station, in conjunction with immediate treatment. The Somass source is also considered on its own, or in combination with the existing China Creek source.

REGIONAL WATER SUPPLY ALTERNATIVES

The report identifies and investigates two main options, based on the long term use of Great Central Lake or the Somass River. These options are further split in four sub-options based on using the new sources on their own, or in combination with the existing China Creek source. Each option is phased in by using the Lacy Lake source in the initial stages, and by postponing treatment for China Creek and Great Central Lake as long as can be justified from a public health point of view.

The following options have been considered:

OPTION 1 Somass Source with Treatment Plant in Phase I	OPTION 2 Great Central Lake Source No Treatment Until Phase III
Phase I - 1995 - Retain China Creek, Bainbridge Lake and Lacy Lake with new source - Construct treatment plant, Phase I - Construct distribution system interconnection across Rogers Creek	**Phase I - 1995** - Retain China Creek, Bainbridge Lake and Lacy Lake with new source - Construct intake, pump station and supply main - Construct distribution system interconnection across Rogers Creek
Phase II - 2005 - Add Sproat Lake expansion - Abandon Lacy Lake supply and construct booster pump station, reservoir, and distribution main connection - Construct treatment plant, Phase II	**Phase II - 2005** - Add Sproat Lake expansion - Abandon Lacy Lake supply and construct booster pump station, reservoir, and distribution main connection
Phase III - 2015 ? **(Mandatory Treatment)** **A.** Install treatment plant on China Creek supply, and replace China Creek supply main **or** **B.** Abandon China Creek and upsize Somass treatment and supply system Construct transmission main from Cherry Creek to Cowichan Reservoirs	**Phase III - 2015 ?** **(Mandatory Treatment)** **A.** Install treatment plants on Great Central supply and China Creek supply, and replace China Creek supply main **or** **B.** Install large treatment plant at Great Central, and abandon China Creek Construct transmission main from Cherry Creek to Cowichan Reservoirs

WATER TREATMENT REQUIREMENTS

The Somass River source will require filtration treatment immediately to remove turbidity as well as taste and odour compounds from the river water.

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 new legislation governing forestry practices, fisheries, and community watersheds, to the extent that water quality can be protected sufficiently to be able to postpone the construction of filtration treatment plants on the China Creek and Great Central Lake supply sources for the foreseeable future.

Should this not be successful, or if legislation is brought in similar to that already introduced in the United States, to force mandatory treatment of all surface water supplies, treatment will have to be added before the date assumed in this report.

TOTAL ESTIMATED COST OF OPTIONS

Capital costs are estimated for all facilities in each of the four options of the proposed regional supply system, based on mid-1994 construction costs.

Nominal estimates have been included for property acquisition for pipeline right-of-ways, where these are not located in public roads, and for reservoir, pump station and treatment plant sites.

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. Although it is not expected that restrictions will be required over and above those already in force through Fisheries/Forestry Guidelines and other environmental legislation, it is possible that future integrated watershed management plan negotiations may result in specific additional demands for water management. Compensation may then be required, as determined by arbitration. An allowance of $1,000,000 has been added to the Great Central Lake options to cover this eventuality.

A summary of the capital costs of the options follows:

Table S-1 **ESTIMATED CAPITAL COST (1994 $)**

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

COMPARISON OF OPTIONS

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. 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.

Annual operation and maintenance costs are a significant consideration in the comparison of alternative systems. These include the cost of labour to operate and maintain the facilities, as well as the cost of power, chemicals, and repairs. Higher capital costs to build longer pipelines to reach Great Central Lake will be offset by lower power costs because of the elimination of major pumping costs at the Somass.

The report presents a comprehensive analysis of the revenues required to finance the projected expenditures. A financial model has been designed to track amortization of capital costs, operation and maintenance costs, including inflation, in the years that they are occurring, balanced against revenues from development cost charges (DCC's), general taxation based on parcel taxes, and user charges based on volume. This is presented for illustrative purposes to arrive at a reasonable estimate of annual per household cost to pay for the system. Specific cost recovery methods and apportionments will likely vary when the system is actually implemented.

The following table shows a summary of the estimated DCC's, parcel taxes, and user rates required to pay for the various options, based on the financial model presented.

Table S-2 SUMMARY OF TYPICAL ANNUAL COSTS PER HOUSEHOLD

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

	DCC	Parcel Tax	User Rate	Total Tax
Alt. 1 - Somass & China Creek	**$2,000**	**$113**	**$86**	**$199**
Alt. 2 - Great Central & China Creek	**$2,000**	**$165**	**$53**	**$218**

Table S-2 (Cont'd)

Beyond 2015 - Mandatory Treatment

	DCC	Parcel Tax	User Rate	Total Tax
Alternative 1 - Somass & China Creek				
Option 1 A - Keep China Creek	**$2,000**	**$200**	**$230**	**$430**
Option 1 B - Abandon China Creek	**$2,000**	**$115**	**$265**	**$380**
Alternative 2 - Great Central & China Creek				
Option 2 A - Keep China Creek	**$2,000**	**$247**	**$176**	**$423**
Option 2 B - Abandon China Creek	**$2,000**	**$200**	**$170**	**$370**

It should be noted that the additional annual costs for a new regional supply system will be somewhat offset by the elimination of existing annual costs to operate and maintain existing individual water supply systems. The costs of operating and maintaining the existing supply systems that become part of the regional supply system are included in the regional system cost estimates.

The above comparison represents a typical financial model that will generate the revenues to finance the scheme. Given the different ways that taxes and user rates may be applied, it illustrates as a minimum the order of magnitude of the costs involved. The regional district and its members must decide what they consider to be a fair basis for distributing tax burdens, capital and user charges. They may elect to increase the DCC's (within the limits allowed under the Municipal Act) to lower tax rates to the existing and future consumer, or alternatively change the user rate or parcel tax method of cost allocation.

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 S-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.

CONCLUSIONS AND RECOMMENDATIONS

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, 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, about $8,500,000 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.

Recommendations:

Based on the conclusions reached, the following recommendations are presented:

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.

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SECTION 1

SECTION 1.0
INTRODUCTION

1.1 BACKGROUND

The Regional District of Alberni-Clayoquot (RDA-C) first looked into a regional water supply for the Alberni Valley in 1971 (1). That study considered regional water supply sources from Great Central Lake, Somass-Stamp Rivers, Sproat Lake, and Cameron Lake.

Projected growth at that time called for a regional water system to supply 60,000 people by the year 2000. It was recommended that, based on costs, availability of water, and water quality, Great Central Lake was the best regional water source.

Growth did not occur as predicted in 1971. On the contrary, the Alberni Valley population has been relatively static during the past 23 years, at about 27,000 people. With additional growth in the region becoming apparent, the projected population for the year 2020 is estimated at 54,000.

The existing sources of supply will not be sufficient to supply that level of growth. The main source from China Creek/Bainbridge Lake is limited due to supply main constraints, and beyond that, due to watershed size limitations. Some of the existing sources, such as the Somass River source for the City of Port Alberni, and the Stamp River source for the Beaver Creek Improvement District, suffer from water quality problems.

A report prepared for the City of Port Alberni in 1987 (2) determined that the best short-term (20 years) water supply plan for the City consisted of continued use of China Creek, supplemented by the Somass River source, with filtration treatment provided for the latter, to overcome water quality concerns. This report reiterated the view that Great Central Lake would be the best long term (regional) water supply alternative. It also recommended the development of watershed management guidelines for the China Creek watershed to minimize future water quality impacts from forestry and mining activities in the watershed.

With the existing China Creek/Bainbridge Lake source operating at capacity and the supplemental Somass River source being available only as a last resort, because of water quality problems, the City needs to review its short and long term options for water supply. At the same time, the two water improvement districts are reviewing their options: the Beaver Creek Improvement District needs to upgrade its supply system, to solve water quality problems, and also needs to upgrade its distribution system, to improve water pressure in some parts of the service area; and the Cherry Creek Improvement District needs to increase its supply capacity and improve distribution system pressures in some areas. The

Sahara Heights Water Users Community has had a long standing shortage of fire demand water, and is interested in reviewing options to become part of the adjacent City or Cherry Creek water systems. Arrowsmith Heights, Devil's Den, and the developed areas around Sproat Lake are other areas that could benefit from a regional water supply system.

1.2 SCOPE AND OBJECTIVES

The objective of this study is to determine the most cost effective and secure method of obtaining an adequate long term supply of good quality water for the City of Port Alberni and surrounding Regional areas in the Alberni Valley. The study is prepared jointly for the the City of Port Alberni and the Regional District of Alberni-Clayoquot, under the general direction of the City of Port Alberni Engineering Department.

Having previously identified Great Central Lake and Sproat Lake as the two major alternative regional water supply sources (1,2), this study has set out to move forward from the data presented and conclusions drawn in the previous studies, taking into consideration recent developments and modern domestic water supply criteria. Included in the assessment is a proposed orderly, phased progression from existing supply systems to the ultimate recommended regional supply scheme, comparing viable alternative sources and transmission systems, and considering water quality, quantity, security of supply criteria, as well as capital and operation and maintenance costs. Location, preliminary layout and sizing of the major components of the supply and transmission works are determined for the major alternatives to allow cost estimates for comparison purposes.

Demand side management of water supply systems is becoming increasingly important, particularly in areas such as Port Alberni where per capita water demands are higher than normal because of historically abundant supplies and absence of individual metering. This is addressed in the current study.

Proposed means of financing the major capital expenditures required to build a regional supply system for the next 25 years are discussed to show how the systems may be paid for.

1.3 DATA SOURCES, BIBLIOGRAPHY

Data sources and a bibliography of references used in the preparation of this report are listed in Appendix A.

Records of meetings held with key agencies and individuals to discuss the proposed regional water supply system are contained in Appendix B.

1.4 STUDY TEAM

The Koers & Associates Engineering Ltd. study team for this project was led by Dr. D.A. Koers, P.Eng. He was assisted by Mr. L.S. Dillon, P.Eng. and C. Downey, E.I.T. Assistance in cost estimating was provided by Mr. D. Shillabeer, P.Eng.

1.5 ACKNOWLEDGEMENTS

Koers & Associates Engineering Ltd. is very appreciative of the assistance provided by City of Port Alberni and Regional District of Alberni-Clayoquot staff in the preparation of this study. In particular, we thank Mr. Ken Watson, P.Eng., City Engineer, Mr. Guy Cicon, P.Eng., Deputy City Engineer, regional Administrator, Mr. Bob Harper, and regional Director of Planning, Mr. Jim McManus, for their assistance.

We also thank the staff and Directors of the Beaver Creek and Cherry Creek Improvement Districts, the Sahara Heights Water Users Community, and the staff of MacMillan Bloedel, Alberni Specialties (Pulp Mill) Engineering Department for their assistance in providing records and feedback on system operations.

We wish to also acknowledge the assistance provided by Messrs. Richard Eliason and Brian Tutty of Fisheries and Oceans Canada, and George Bryden, John Baldwin and Bob Cook of Ministry of Environment, Water Management Branch.

SECTION 2

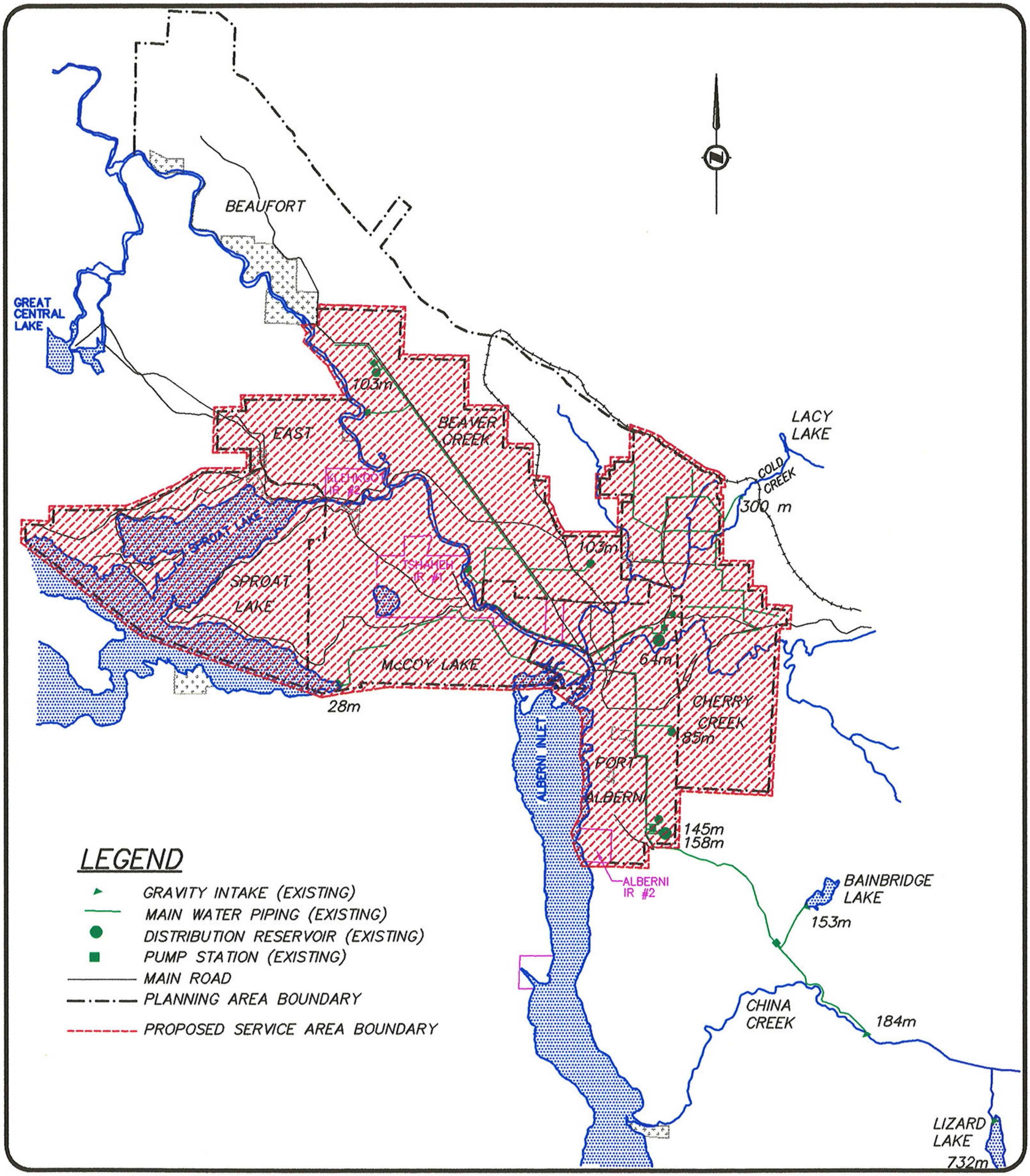
SECTION 2.0
REGIONAL SERVICE AREA

The service area to be considered for the proposed regional water supply is shown on Figure 2.1.

The service area includes the City of Port Alberni, the Beaver Creek and Cherry Creek Improvement Districts, the Sahara Heights and Arrowsmith Heights Water User Communities, the Bell/Stuart Road, McCoy Lake (Devil's Den), and Sproat Lake service areas.

The layout of the proposed regional water supply system alternatives has been selected under the assumption that both the Beaver Creek and Cherry Creek systems will be incorporated into the regional system. If either one of these areas would not participate, the ultimate layout of the system would have to be revisited. The Sproat Lake, McCoy Lake, Bell/Stuart Road, Arrowsmith Heights and Sahara Heights areas can be deleted from the regional service area without affecting the layout of the main system.

The service area includes several First Nations Reserves. Although this report does not address service to First Nations communities in detail, they can be easily serviced from the proposed regional water supply system. The additional demands involved will not significantly affect the size of the initial system.



CLIENT/PROJECT CITY OF PORT ALBERNI / REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

ALBERNI VALLEY REGIONAL WATER STUDY

SUBJECT **PROPOSED SERVICE AREA**

APPROVED		SCALE	1:125,000
DATE	NOVEMBER 1994	DWG No.	FIG. 2.1
JOB No.	M9330		

SECTION 3

SECTION 3.0
EXISTING WATER SUPPLY SYSTEMS

3.1 GENERAL

Table 3.1 contains a listing of all existing community water systems, along with the type of water supply system, reported capacities of the supply system components, and the balancing storage capacities provided in the various distribution systems. The location and extent of all of the existing community water systems, including source location and size of the main distribution piping and reservoirs, are shown in Figure 3.1.

Each existing water system is described in more detail below:

3.2 CITY OF PORT ALBERNI

The City of Port Alberni is generally served by the main source of water from China Creek, supplemented by stored water in Bainbridge Lake. The China Creek supply is from an intake dam across the river bed, approximately 7.5 km upstream from the mouth of the river. At the intake (elev. 184 m) the water passes through a travelling screen, into a 8 km long, 400 mm diameter supply main to the Lower Cowichan Reservoir. The steel supply main was constructed in 1931, and now is over 60 years old, close to its expected useful life span.

Bainbridge Lake is situated about halfway between the China Creek intake and the City boundary. Water flows from Bainbridge Lake (elev. 153 m) through a 500 mm diameter main, and is pumped into the China Creek supply main at the Bainbridge pump station. The supply main from Bainbridge Lake was replaced with a PVC main in 1992, as the existing steel main was severely corroded in many locations. Gas chlorination of the water supply takes place at the pump station. The combined capacity of China Creek and Bainbridge Lake is 32,500 m^3/day (16,000 from China Creek and 16,500 from Bainbridge Lake). During periods of high turbidity in China Creek, the China Creek supply is shut off, and Bainbridge Lake supplies the entire City to a maximum capacity of 24,000 m^3/day. The licensed withdrawal from China Creek is limited to 24,450 m^3/day, and the City's water license on Bainbridge Lake allows withdrawals up to 9,760 m^3/day, for a combined licensed amount of 34,210 m^3/day.

The China Creek watershed is 6,500 ha in area. Water withdrawals at the intake are supported by storage at Lizard Lake, with a live storage volume of 545,000 m^3. Live storage at Bainbridge Lake is 1,230,000 m^3.

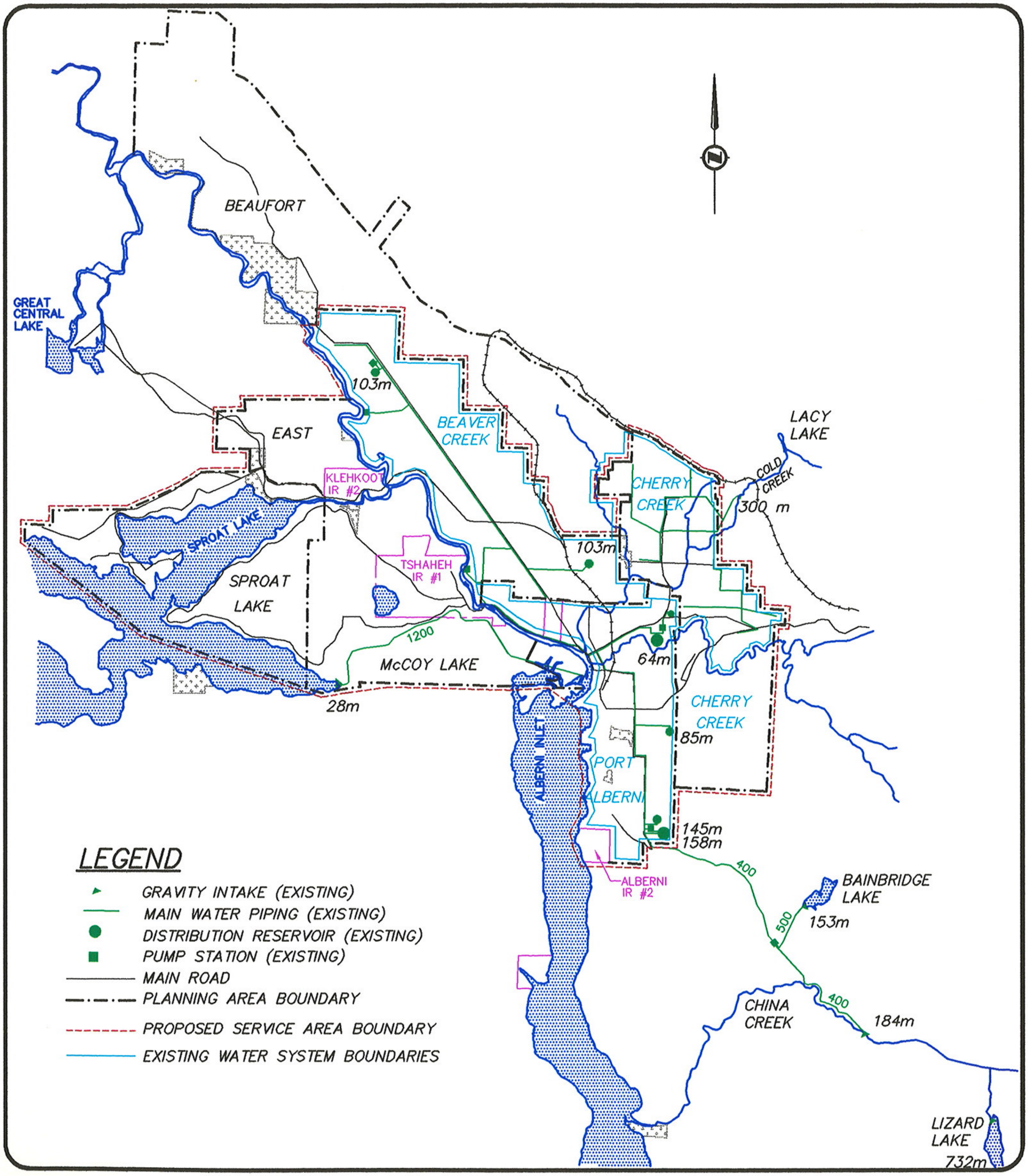
The combined capacity of China Creek and Bainbridge Lake is close to present maximum day demands in the City. When the daily demand is higher than the

TABLE 3.1

EXISTING WATER SYSTEMS (1994)

Capacity

AREA	SUPPLY				BALANCING STORAGE			
	Type	Description	Capacity m3/day	Licence m3/day	Description	Volume m3	TWL m	Depth m
City of Port Alberni	Surface	China Creek	16,000	24,450	Cowichan (1 & 2)	18,000	158/146	5
	Surface	Bainbridge Lake	16,500	9,760	Burde	6,750	86.8	5
	Surface	Somass River	17,000	13,650	Johnston	9,000	66.8	5
		Total	49,500	47,860	Total	33,750		
Beaver Creek Improvement District	Surface	Stamp River	3,430	6,225	Northwest	275	103	3
					Southeast	1,135	103	3
		Total	3,430	6,225	Total	1,410		
Cherry Creek Improvement District	Surface	Cold Creek	3,430	5,145	Cold Creek	6,953	212	2.6
		Total	3,430	5,145	Total	6,953		
Sahara Heights	Surface	Rogers Creek	170	52	Groundlevel/pumped	90	100	2
Arrowsmith Heights	Wells	Individual		n/a	None			
	GRAND TOTAL		56,530	59,282		42,203		



CLIENT/PROJECT CITY OF PORT ALBERNI / REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

ALBERNI VALLEY REGIONAL WATER STUDY

SUBJECT: EXISTING WATER SYSTEMS

APPROVED		SCALE	1:125,000
DATE	NOVEMBER 1994	DWG No.	FIG. 3.1
JOB No.	M9330		

China Creek/Bainbridge Lake capacity, the City has the ability to activate the Somass River pumping station, which essentially supplies the northern portion of the City. The Somass River pump station contains a fixed screen and gas chlorination facilities, and is located approximately 1 km upstream from the crossing of Highway 4. The capacity of the Somass River source is 17,000 m^3/day, but the water license only allows withdrawals up to 13,650 m^3/day. The Somass River source is used only as a last resort, because of the marginal water quality in the summer months from fish runs and agricultural runoff upstream.

The City water distribution system is divided into numerous pressure zones, controlled by the main distribution reservoirs, namely upper and lower Cowichan, Burde Street, and Johnston Street, most of which are interconnected by pressure reducing valves. The Johnston Street pump station supplies a higher pressure zone without a control reservoir. The City meters most commercial, industrial, and multi-family services, but does not meter individual residential services, although new residential service connections are now required to include water meters.

3.3 BEAVER CREEK IMPROVEMENT DISTRICT

The Beaver Creek Improvement District takes its water from a single 450 mm corrugated metal pipe infiltration gallery in the Stamp River, at the foot of McKenzie Road. The intake is at elevation 12 m and discharges into a wet well, from where the water is pumped into the distribution system by means of three parallel pumps, each having a capacity of 15 lps at 110 m total dynamic head (TDH). The three pumps combined have a capacity of 40 lps at 110 m TDH. The intake is subject to siltation, and needs to be backflushed frequently during peak demand periods to maintain its capacity, and to prevent a low wet well level shut down of the pumps. Water is chlorinated at the pump house, using a fixed feed gas chlorinator. The chlorination feed rate does not change when additional pumps are called on stream.

The water licenses issued to the Beaver Creek Improvement District allow a-year-round average withdrawal of 3,114 m^3/day and a maximum daily withdrawal of 6,225 m^3/day.

The distribution system consists of a mixture of 100, 150, 200, 250 and 300 mm diameter piping, with the main 1,135 m^3 reservoir located at the south end of the system on Kitsucksis Street, and a 275 m^3 elevated reservoir at the north end of the system on Beaver Creek Road. The top water level (TWL) of the main reservoir is at elevation 103 m, and the TWL of the smaller reservoir is at 102 m. A small booster pump at the northern reservoir elevates the pressure to the high area north of the reservoir, however, its capacity is not sufficient to meet peak demands.

All water services are metered.

Development has been allowed to occur in areas where static pressure is less than 275 kPa (40 psi), particularly in the southern part of the system, near the main reservoir. There are considerable areas with static pressures in the 20 to 30 psi range, where individual services require booster pumping.

In the lower portions of the service area, pressures in excess of 690 kPa (100 psi) occur.

Water quality has been a concern in the last two years, with the onset of algae growth in the river, causing musty odours in the water. This reportedly is due to higher water temperatures and fertilization of Great Central Lake to increase productivity for fish. The presence of large quantities of dead fish during the spawning season in the river at the intake affects the appearance of water quality.

An emergency connection exists to the City of Port Alberni distribution system at Falls Road and Georgia Street.

3.4 CHERRY CREEK IMPROVEMENT DISTRICT

The Cherry Creek Improvement District takes its water from Lacy Lake and Cold Creek, with licenses totalling 5,145 m^3/day for diversion and 616,750 m^3 (500 acre feet) for storage. The Cold Creek intake impoundment has a volume of 6,953 m^3 and a TWL of 217 m.

The watershed for Lacy Lake and Cold Creek above the intake is rather small and steep, resulting in almost a total absence of runoff during the dry summer months, during which time the water supply has to rely entirely on storage in Lacey Lake.

Water from the intake is pressure reduced into the distribution system, which is divided into two pressure zones. Water is chlorinated at the intake by a hypochlorination system. All water services are metered.

An emergency connection exists to the City of Port Alberni distribution system at the Alberni Highway and Broughton Street.

3.5 SAHARA HEIGHTS WATER USERS COMMUNITY

The Sahara Heights Water Users Community was established in 1963 and comprises a 35-lot subdivision located on the Alberni Highway east of the City boundary, and west of the Cherry Creek boundary. Water is obtained from Rogers Creek through a 300 mm diameter infiltration gallery, leading to a sump, from where two 2.8 lps submersible pumps lift the water to a 90 m^3 groundlevel storage tank within the subdivision. The water license allows withdrawals up to 52 m^3/day. The water is chlorinated at the reservoir by hypochlorinator, and pumped into the distribution system through a hydropneumatic system, fed by two 3.75 lps centrifugal pumps. Distribution system pressures are maintained between 345 and 625 kPa (50 - 90 psi).

Although the system is adequate for distribution of domestic demands, it does not provide an adequate standard for fire protection for the homes in the area, and also does not have adequate provision for standby during power outages. The water supply has a high turbidity during times of high runoff in Rogers Creek.

3.6 ARROWSMITH HEIGHTS COMMUNITY

Arrowsmith Heights is a small rural subdivision located approximately 1.2 km east of the City boundary on the extension of Burde Street. The subdivision has approximately 40 homes, and is serviced from individual wells.

Residents have approved construction of a water distribution system and connection to the City of Port Alberni distribution system. The new water system will be administered under the Regional District as a Local Service Area.

SECTION 4

SECTION 4.0
DESIGN CRITERIA

4.1 DESIGN PERIOD SELECTION

The design period for a water supply facility is usually a combination of considerations involving useful life of the system, ability to pay by the present users, development of new technologies, and reliability of growth projections.

The design period chosen for the first phase of the proposed regional water supply system is 25 years. It is tempting to argue that pipelines for instance, because they last much longer than 25 years, should be designed for a longer period, as the incremental costs of increasing pipe size at the outset is so much less than the cost of twinning a pipeline later. However, apart from the time value of money analysis, this puts increasing burdens on the smaller population base to pay for something that is not going to be required for more than 25 years later. There is also the difficulty of not being able to predict conditions so far into the future, which may call for a totally different approach at that time, or to predict how significant the impact of water conservation measures may be on required capacities beyond the next 25 years. In any case, if duplication is required in 25 years, the population base will be that much larger to pay for the expansion.

Thus it is recommended that a maximum design period of 25 years be used, starting from the anticipated date the system will be in operation, or from 1995 to 2020.

Pipelines will be sized for the projected 25 year demand conditions. Facilities such as dams and intakes will also be designed for the 25 year period. Other facilities with a higher redundancy factor, such as treatment plants and pumping stations, will be designed in modular form, to be added to in phases over the 25 year design period. Distribution reservoirs, where appropriate, will be designed in stages over the design period.

4.2 CONSIDERATIONS FOR EXPANSION

Even though facilities will be designed for a 25 year period, consideration needs to be given to expansion beyond the first phase, as the proposed regional water supply system will obviously be in place for much longer.

Such considerations include, but are not limited to, a review of provisions for future expansion of the benefitting area and provision for future connection points to the system.

4.3 POPULATION PROJECTIONS

City and Regional District data have been used as a basis for estimating present populations and past growth in the area. In addition, data obtained from the various water utilities on numbers of service connections and average number of people per household have been used in determining population levels within the water utility boundaries, which do not follow political boundaries used in the Canada Census.

Table 4.1 shows the population projections for use in sizing facilities over the 25 year design period. This table shows the estimated distribution of the population among the various water systems, as well as the estimated populations not presently served by a water system, but to be included in the proposed regional water supply system. Total population levels in the service area have stayed practically constant over the past 20 years, with a slight decline in the City of Port Alberni and a slight increase in the rural areas over that period.

In consultation with the City and the Regional District, it has been concluded that a realistic growth rate for the next 25 years will be 2.4% per annum for the Alberni Valley as a whole. The regional district planning department feels that under certain development scenarios, the growth rate for the proposed water system service area could be greater, possibly as high as 3.5 - 4.0%. Using such a high growth rate for sizing the first phase of the regional water supply system is difficult to justify from an engineering point of view, given the growth pattern over the past 20 years. Moreover, if such a high growth rate would be relied upon for financing projections, it would result in lower per capita revenue requirements, which in turn may lead to serious financing shortfalls should the growth rate be less. It has therefore been decided to use a growth rate of 2.4% per annum for sizing and financing calculations for the first phase of the system.

Using the 2.4% annual growth rate, it is projected that the serviced population in the benefitting area will grow from a present level of 29,000 people to 54,185 people in the year 2020.

4.4 EXISTING WATER USE

Water use patterns throughout the benefitting area vary considerably. Generally, the City of Port Alberni system has the highest per capita water use, as the City has an adequate distribution systems and source of supply, and total water use figures include commercial and industrial demands, and municipal sprinkling.

The rural systems have the lowest per capita water use, particularly where there have been supply problems, and where the distribution system restricts availability of water.

TABLE 4.1

ALBERNI VALLEY WATER SUPPLY

POPULATION PROJECTIONS Design Annual Growth Rate: 2.4%

	1990	1995	2000	2005	2010	2015	2020
City of Port Alberni	18,400	20,717	23,325	26,261	29,568	33,290	37,481
Beaver Creek Improvement District	3,100	3,490	3,930	4,424	4,982	5,609	6,315
Cherry Creek Improvement District	2,700	3,040	3,423	3,854	4,339	4,885	5,500
TOTAL ON WATER SYSTEMS	**24,200**	**27,247**	**30,677**	**34,539**	**38,888**	**43,784**	**49,296**
Sproat Lake	2,050	2,308	2,599	2,926	3,294	3,709	4,176
McCoy Lake	250	281	317	357	402	452	509
Beaufort	100	113	127	143	161	181	204
NOT ON WATER SYSTEMS	**2,400**	**2,702**	**3,042**	**3,425**	**3,857**	**4,342**	**4,889**
TOTAL ALBERNI VALLEY WATER SYSTEM DESIGN POPULATION	**26,600**	**29,949**	**33,720**	**37,965**	**42,745**	**48,126**	**54,185**

Tables 4.2, 4.3, and 4.4 show an analysis of current water use in the City of Port Alberni, the Beaver Creek, and Cherry Creek Improvement Districts, respectively, based on 1993 water records. Current annual average per capita water use in the benefitting area has been 1,118 litres per capita per day (lpcd) for the City and 460 lpcd for the rural areas. The range among the various water systems in the benefitting area is 489 (Cherry Creek) to 425 lpcd (Beaver Creek). Maximum day water use has averaged 1,780 lpcd in the City and 1,190 lpcd in the rural areas, or 1.6 times and 2.6 times average day, respectively.

4.5 POTENTIAL FOR WATER CONSERVATION

In the past, water demand projections have been made based on an assumed increase in average annual per capita consumption with time, using the rationale that, as more people obtained modern water using equipment, water use would increase. Historically, this has been the case, and average per capita water use has increased over the years.

Generally in North America, this increase appears to have levelled off somewhat. This is probably due to factors such as higher cost of water, increased metering of residential service connections, changes in billing structure based on the user pay principle, summer sprinkling restrictions, more efficient water using equipment, more efficient watering of gardens and lawns by automatic sprinkler systems, and probably increasing awareness on the part of the public that some measure of water conservation is good practice.

North American water use practices have been extremely wasteful when compared against water use in countries where there are water shortages and on continents where water quality is such that expensive treatment systems are required to produce potable water, driving up the cost. The west coast of British Columbia has been no exception. Historically, water has been plentiful and cheap, as it did not require any treatment, and was close at hand. There are still entire communities where it is considered politically unacceptable to restrict the use of water by regulation, let alone meter the residential use of water.

Because of this attitude and the relative cheapness of our water, per capita annual water consumption in some areas can be as high as 800 lpcd, and peak day per capita demands in the heat of summer as high as 2,400 lpcd, three times the average. Water supplies and water supply piping systems have to be sized to be able to supply the peak demands, which may only occur for a two or three week period in the summer. For the rest of the year the facilities are grossly oversized.

High government grants during previous decades (up to 75% of the capital costs) when most water systems in B.C. were being built or upgraded, protected the municipal taxpayer from the true cost. Because of this, the cost of water has been

TABLE 4.2
ALBERNI VALLEY WATER SUPPLY
City of Port Alberni
Water Consumption – 1993

1993	
Estimated Population	19,000
Persons per HU	2.9
Est Single Family Avg Demand (m3/c/d)	0.400

			Water Consumption in Cubic Meters					
			Average Day			Maximum Day		
Category	Number of Services	Number of HU	Total	per Capita	%	Factor	Total	per Capita
Residential								
Unmetered (Single Family) *	5,336	5,336	6,189	0.400				
Metered (Multiple Family)	79	1,216	771	0.219				
Total Residential	5,415	6,552	6,961	0.366	32.78%	2.80	19,490	1.026
Commercial								
Unmetered *	274		2,034	0.107				
Metered	173		1,285	0.068				
Total Commercial	447		3,319	0.175	15.63%	1.00	3,319	0.175
Government (Metered)	32		563	0.030	2.65%	1.00	563	0.030
Industrial (Metered)	18		4,605	0.242	21.68%	1.00	4,605	0.242
Unaccounted For			5,790	0.305	27.26%	1.00	5,790	0.305
TOTAL	5,912	6,552	21,237	1.118	100.00%	1.59	33,766	1.777

* Estimated

TABLE 4.3
ALBERNI VALLEY WATER SUPPLY
Beaver Creek Waterworks District
Water Consumption – Sep 15,1992 – Sep 15,1993

Estimated Population 2,799
Estimated Number of Persons per HU 2.9

Category	Number of Services	Number of HU	Water Consumption in Cubic Meters – Average Day: Total	Average Day: Per Capita	Average Day: %	Maximum Day: Factor	Maximum Day: Total	Maximum Day: Per Capita
Residential								
Housing	815	852	788					
Mobile Homes	5	113	45					
	820	965	833	0.298	70.03%	4.10	3,417	1.221
Other								
Schools	2		21					
Commercial	6		48					
	8		69	0.025	5.80%	1.00	69	0.025
Unaccounted For			288	0.103	24.17%	1.00	288	0.103
TOTAL			1190	0.425	100.00%	3.17	3,774	1.348

Note: Residential and Other consumptions are based on meter readings from mid–Sep, 92 to mid–Sep 93 whereas TOTAL consumption is based on pump station records from Jul 1, 1992 to Jun 30, 1993

TABLE 4.4
ALBERNI VALLEY WATER SUPPLY
Cherry Creek Waterworks District
Water Consumption 1993

Estimated population 2,581
Estimated number of persons per HU 2.90

	Number of Services	Number Of HU	Water Consumption in Cubic Meters: Avg Day: Total	Avg Day: per Capita	Avg Day: %	Max Day: Factor	Max Day: Total	Max Day: Per Capita
Residential								
Metered								
Single Family	734	734						
Multiple Family	24	83						
	758	817	579					
Unmetered*								
Multiple Family	5	73	52					
Total Residential	763	890	630	0.244	49.97%	3.20	2,017	0.781
Commercial/Industrial (Metered)	20		267	0.104	21.18%	1.00	267	0.104
Government (Unmetered)*	2		27	0.010	2.14%	1.00	27	0.010
Unacounted For			337	0.131	26.71%	1.00	337	0.131
TOTAL	785	890	1,261	0.489	100.00%	2.10	2,648	1.026

*Estimated

very stable over the past decades, in sharp contrast to the cost of other essential utilities, such as hydro and telephone. The cost of water has not kept pace with the real costs of planning for and providing a safe water system.

Now that only a maximum of 25% funding is available for water system capital costs from the provincial government, and some systems are beginning to require expensive upgrading to increase capacity and provide more elaborate facilities for water quality protection, the high cost of providing capacity to handle three times the average annual demand for a short period each summer becomes very evident.

Fortunately, the Alberni Valley regional water supply system is being considered at a time when people are becoming more aware of the need to conserve in general terms - the need to conserve is becoming politically acceptable, perhaps even essential. It is this reasoning that will ensure that programs designed to prevent excessive water use will meet with success.

It is the firm opinion of this project team that water conservation measures are essential ingredients in the successful management of water supply systems. Demand side management, such as pricing and appropriate sprinkling restrictions during the summer, designed to provide sufficient water to grow our gardens, without wasting water, are an essential element of any public water system. Public education is required to teach people the reasons and benefits, so that it is not seen as a measure instituted solely because of water shortages.

Metering of individual residential service connections is now essential in any residential water system. However, utilities must go one step further, and that is to charge considerably higher unit rates for excessive amounts of water use. This is done in very few systems at this time, but it is the only way to ensure that peak water use will decrease, and that those who contribute to the higher peak use end up paying for the excess capacity needed.

It is expected that the water industry, in response to the growing public awareness towards responsible conservation, will increasingly provide products which will result in reduced water use, such as lower volume toilets, more efficient dishwashers, automatic laundry machines, water saving shower heads and faucets. This will affect both average water use and peak water use. Building code changes to require these are now under consideration.

4.6 WATER DEMAND PROJECTIONS

In view of the foregoing, it may be tempting to optimistically reduce per capita water conservation figures significantly for design purposes, and thus provide a smaller first phase supply system at a reduced cost.

Although water conservation policies are expected to be an important factor in eventually reducing per capita water consumption, it is not known how soon and to what extent this will impact consumption in this part of the Province. From an engineering point of view, therefore, a relatively conservative approach is needed, based to a large extent on past data.

As a minimum, it has been assumed that within the design period of 25 years universal metering will be instituted in the City, resulting in decreased peak demands on the system. Proposed provincial government policies (3,10) indicate a move to encouraging conservation through universal metering, by making infrastructure grants available only to fully metered systems. Table 4.5 and Figures 4.1 and 4.2 illustrate the effect of universal metering on projected per capita water demands. It is expected that by implementing universal metering, in conjunction with increasing block user rates, approximately ten years can be added to the useful life of the proposed Alberni Valley regional water system. This assumption is still expected to result in relatively conservative 25 year design demand values. If actual demands are lower through changes in population and even lower per capita consumption through additional conservation measures, then future system expansion can be further deferred. For example, Table 4.5 illustrates the effect on design demands for an annual growth rate of 1%. It should be noted also from Figures 4.1 and 4.2 that at the current per capita demands there is only a few years of spare capacity in the existing supply systems, whereas, if demands can be reduced through universal metering, the existing sources are expected to be adequate for another ten years.

The design water demands adopted for this study are shown in the lower section of Table 4.5 (2.4 % growth and full metering) for the various areas, at five year intervals until the year 2020. These are based on an average annual per capita demand of 300 lcpd for the City and a peaking factor from average to maximum day consumption of 2.5, plus a commercial/industrial demand of 700 lpcd with a peaking factor of 1.0, resulting in a design per capita maximum day demand of 1,450 lcpd for the City. An average per capita demand of 500 lpcd with a peaking factor of 2.5, results in a design per capita maximum day demand of 1,250 lpcd for the rural areas. These per capita demands have been kept the same throughout the design period.

Total average annual daily demands are expected to increase from 24,368 to 36,957 m^3/day between 1995 and 2020. Maximum daily demands would increase from 40,615 to 66,351 m^3/day in the same period (see Table 4.5).

TABLE 4.5
ALBERNI VALLEY WATER SUPPLY
Water Demand

	Average Day l/c/d	Max Day Peak Factor	1990			1995			2000			2005			2010			2015			2020		
			Population	Demand m3/d Avg Day	Demand m3/d Max Day	Population	Demand m3/d Avg Day	Demand m3/d Max Day	Population	Demand m3/d Avg Day	Demand m3/d Max Day	Population	Demand m3/d Avg Day	Demand m3/d Max Day	Population	Demand m3/d Avg Day	Demand m3/d Max Day	Population	Demand m3/d Avg Day	Demand m3/d Max Day	Population	Demand m3/d Avg Day	Demand m3/d Max Day
POPULATION GROWTH PROJECTION 1.00% PARTIAL METERING																							
City of Port Alberni – Residential	366	2.80	18,400	6,734	18,856	19,339	7,078	19,818	20,325	7,439	20,829	21,362	7,818	21,892	22,451	8,217	23,008	23,597	8,636	24,182	24,800	9,077	25,415
Commercial/Industrial/Unaccounted For	752	1.00		13,837	13,837		14,543	14,543		15,284	15,284		16,064	16,064		16,884	16,884		17,745	17,745		18,650	18,650
Beaver Creek	500	2.50	3,100	1,550	3,875	3,258	1,629	4,073	3,424	1,712	4,280	3,599	1,800	4,499	3,783	1,891	4,728	3,976	1,988	4,969	4,178	2,089	5,223
Cherry Creek	500	2.50	2,700	1,350	3,375	2,838	1,419	3,547	2,982	1,491	3,728	3,135	1,567	3,918	3,295	1,647	4,118	3,463	1,731	4,328	3,639	1,820	4,549
Sproat Lake	500	2.50	2,050	1,025	2,563	2,155	1,077	2,693	2,264	1,132	2,831	2,380	1,190	2,975	2,501	1,251	3,127	2,629	1,314	3,286	2,763	1,382	3,454
McCoy Lake	500	2.50	250	125	313	263	131	328	276	138	345	290	145	363	305	153	381	321	160	401	337	168	421
Beaufort	500	2.50	100	50	125	105	53	131	110	55	138	116	58	145	122	61	153	128	64	160	135	67	168
			26,600	24,671	42,943	27,957	25,930	45,134	29,383	27,252	47,436	30,882	28,642	49,856	32,457	30,104	52,399	34,113	31,639	55,072	35,853	33,253	57,881
FULL METERING																							
City of Port Alberni – Residential	300	2.50	18,400	5,520	13,800	19,339	5,802	14,504	20,325	6,098	15,244	21,362	6,409	16,021	22,451	6,735	16,839	23,597	7,079	17,698	24,800	7,440	18,600
Commercial/Industrial/Unaccounted For	700	1.00		12,880	12,880		13,537	13,537		14,228	14,228		14,953	14,953		15,716	15,716		16,518	16,518		17,360	17,360
Beaver Creek	500	2.50	3,100	1,550	3,875	3,258	1,629	4,073	3,424	1,712	4,280	3,599	1,800	4,499	3,783	1,891	4,728	3,976	1,988	4,969	4,178	2,089	5,223
Cherry Creek	500	2.50	2,700	1,350	3,375	2,838	1,419	3,547	2,982	1,491	3,728	3,135	1,567	3,918	3,295	1,647	4,118	3,463	1,731	4,328	3,639	1,820	4,549
Sproat Lake	500	2.50	2,050	1,025	2,563	2,155	1,077	2,693	2,264	1,132	2,831	2,380	1,190	2,975	2,501	1,251	3,127	2,629	1,314	3,286	2,763	1,382	3,454
McCoy Lake	500	2.50	250	125	313	263	131	328	276	138	345	290	145	363	305	153	381	321	160	401	337	168	421
Beaufort	500	2.50	100	50	125	105	53	131	110	55	138	116	58	145	122	61	153	128	64	160	135	67	168
			26,600	22,500	36,930	27,957	23,648	38,814	29,383	24,854	40,794	30,882	26,122	42,875	32,457	27,454	45,062	34,113	28,855	47,360	35,853	30,327	49,776
POPULATION GROWTH PROJECTION 2.40% PARTIAL METERING																							
City of Port Alberni – Residential 2.40%	366	2.80	18,400	6,734	18,856	20,717	7,582	21,230	23,325	8,537	23,903	26,261	9,612	26,913	29,568	10,822	30,301	33,290	12,184	34,116	37,481	13,718	38,411
Commercial/Industrial/Unaccounted For 1.00%	752	1.00		13,837	13,837		14,543	14,543		15,284	15,284		16,064	16,064		16,884	16,884		17,745	17,745		18,650	18,650
Beaver Creek	500	2.50	3,100	1,550	3,875	3,490	1,745	4,363	3,930	1,965	4,912	4,424	2,212	5,531	4,982	2,491	6,227	5,609	2,804	7,011	6,315	3,157	7,894
Cherry Creek	600	2.50	2,700	1,620	4,050	3,040	1,824	4,560	3,423	2,054	5,134	3,854	2,312	5,780	4,339	2,603	6,508	4,885	2,931	7,327	5,500	3,300	8,250
Sproat Lake	500	2.50	2,050	1,025	2,563	2,308	1,154	2,885	2,599	1,299	3,248	2,926	1,463	3,657	3,294	1,647	4,118	3,709	1,854	4,636	4,176	2,088	5,220
McCoy Lake	500	2.50	250	125	313	281	141	352	317	158	396	357	178	446	402	201	502	452	226	565	509	255	637
Beaufort	500	2.50	100	50	125	113	56	141	127	63	158	143	71	178	161	80	201	181	90	226	204	102	255
			26,600	24,941	43,618	29,949	27,045	48,073	33,720	29,361	53,037	37,965	31,913	58,569	42,745	34,728	64,740	48,126	37,835	71,627	54,185	41,270	79,316
FULL METERING																							
City of Port Alberni – Residential 2.40%	300	2.50	18,400	5,520	13,800	20,717	6,215	15,537	23,325	6,997	17,494	26,261	7,878	19,696	29,568	8,870	22,176	33,290	9,987	24,968	37,481	11,244	28,111
Commercial/Industrial/Unaccounted For 1.00%	700	1.00		12,880	12,880		13,537	13,537		14,228	14,228		14,953	14,953		15,716	15,716		16,518	16,518		17,360	17,360
Beaver Creek	500	2.50	3,100	1,550	3,875	3,490	1,745	4,363	3,930	1,965	4,912	4,424	2,212	5,531	4,982	2,491	6,227	5,609	2,804	7,011	6,315	3,157	7,894
Cherry Creek	500	2.50	2,700	1,350	3,375	3,040	1,520	3,800	3,423	1,711	4,278	3,854	1,927	4,817	4,339	2,169	5,423	4,885	2,442	6,106	5,500	2,750	6,875
Sproat Lake	500	2.50	2,050	1,025	2,563	2,308	1,154	2,885	2,599	1,299	3,248	2,926	1,463	3,657	3,294	1,647	4,118	3,709	1,854	4,636	4,176	2,088	5,220
McCoy Lake	500	2.50	250	125	313	281	141	352	317	158	396	357	178	446	402	201	502	452	226	565	509	255	637
Beaufort	500	2.50	100	50	125	113	56	141	127	63	158	143	71	178	161	80	201	181	90	226	204	102	255
			26,600	22,500	36,930	29,949	24,368	40,615	33,720	26,422	44,715	37,965	28,683	49,279	42,745	31,175	54,363	48,126	33,923	60,030	54,185	36,957	66,351

FIG. 4.1 – WATER DEMAND PROJECTIONS
FULL METERING – 2.4% GROWTH

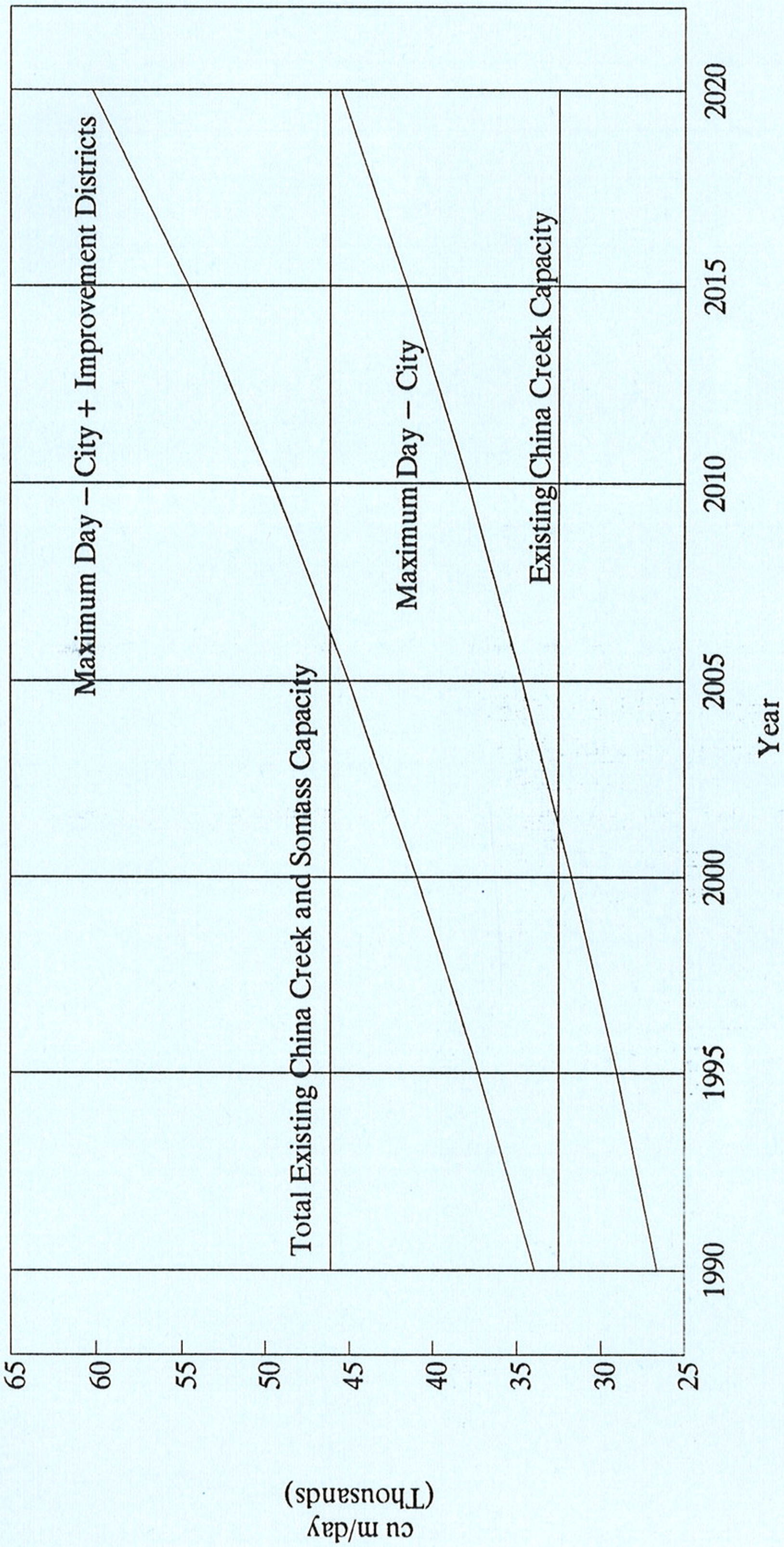
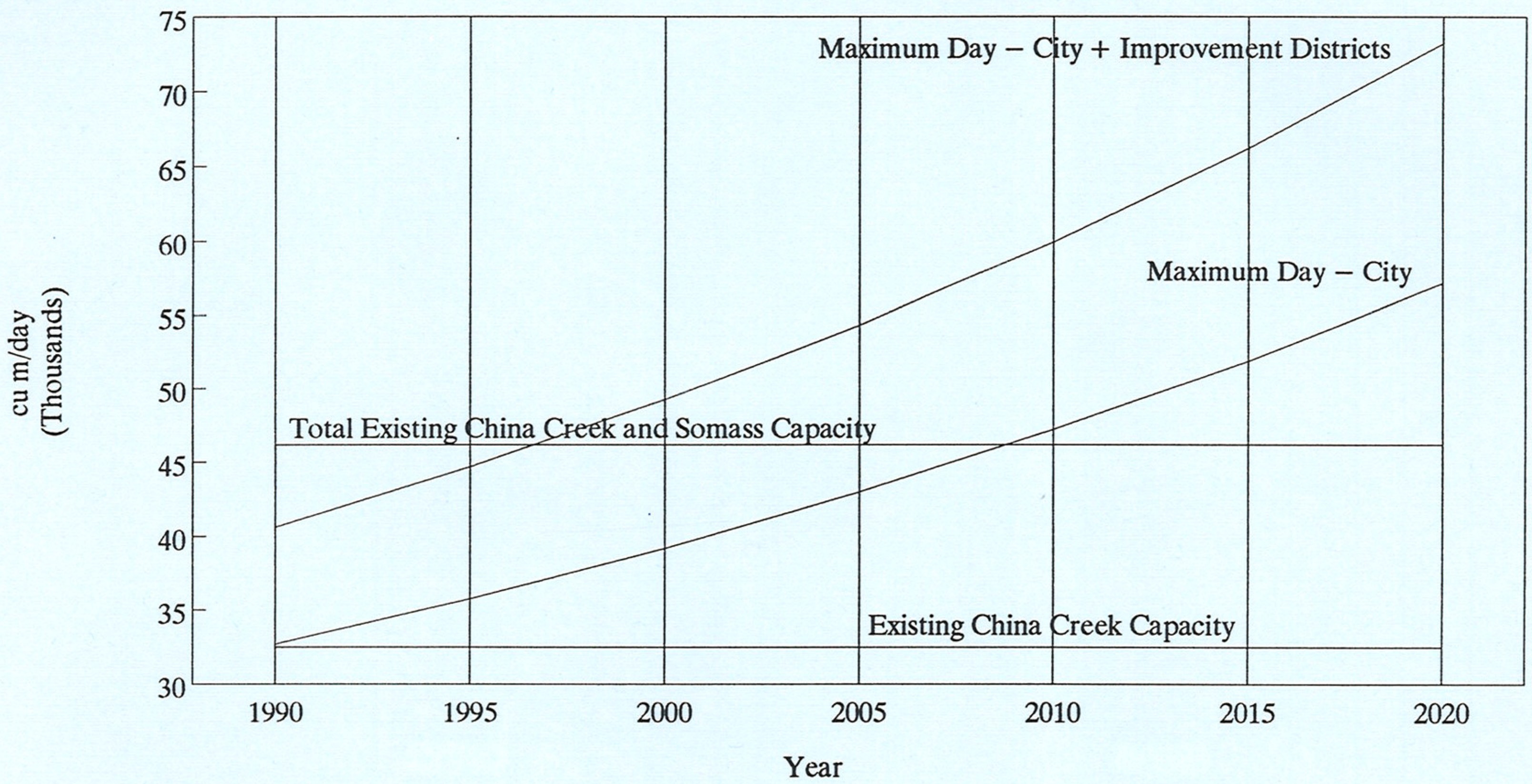


FIG. 4.2 – WATER DEMAND PROJECTIONS
PARTIAL METERING – 2.4% GROWTH



4.7 SYSTEM CONCEPT

The general concept of the proposed regional water supply system is to interconnect all existing community water systems within the benefitting area by means of a regional transmission system, as shown in Figure 4.3.

Each existing water system would be supplied from the transmission main through a master meter and control facility which would ensure that the existing distribution system can continue to operate as before, under the same or better pressure conditions.

It is recognized that some existing water systems, because of their location, will not have a direct connection to the regional transmission main. Examples of this situation are Sahara Heights, which would be serviced from the Cherry Creek distribution system, and Arrowsmith Heights, which would be serviced from the City distribution system. Connecting mains required to provide such connections are included in the cost of the regional water system.

Generally, no upgrading of the internal distribution systems has been included in the regional supply system development, except where required to upgrade existing problem areas to a normal standard.

New service areas, such as Sproat Lake, McCoy Lake, and Bell/Stuart Road, are accommodated in the various supply system alternatives. In the staged system, this is only possible when the transmission system is sufficiently developed and reservoir storage added to allow service to extend to that area.

4.8 SYSTEM PRESSURES

Generally the supply system will feed existing reservoirs, controlling existing established pressure zones. Where pressures significantly exceed 690 kPa or are significantly below 275 kPa, pressure zone boundaries will be adjusted or new reservoirs created to ensure distribution pressures between these limits during peak hour demands. Fire demands will be supplied generally at pressures higher than 140 kPa under maximum day demand conditions.

4.9 DISTRIBUTION STORAGE REQUIREMENTS

Transmission piping in the proposed regional water system is designed for maximum day demands, which assumes that peak hour balancing and fire flow demand is provided from storage facilities within the member distribution systems. Some of the smaller areas do not have sufficient distribution storage, and some have groundlevel storage, and would want to take advantage of the gravity flow provisions from the regional transmission system.

In the long term, the regional district should require that all member systems have sufficient local storage facilities for peak hour balancing and fire flows, otherwise the transmission system would reach its capacity ahead of schedule. In the initial years of the system, however, when demands are still well below the available capacity, the regional district could consider letting the smaller systems phase in the storage requirement, as the spare capacity in the regional system can supply peak hour demands.

A new storage reservoir is required in the Beaver Creek/Cherry Creek area to improve distribution pressures in Beaver Creek, and to serve as a feed to the Sproat Lake area for the staged options. The Sproat Lake system extension will require a distribution storage reservoir to save on long oversized lines and to provide adequate fire flows.

Connection points would have a flow limiting device to control the maximum rate of flow into each service area. The regional supply system would be contractually responsible to supply not less than the maximum day demand.

SECTION 5

SECTION 5.0
REGIONAL WATER SOURCES

5.1 SOURCES CONSIDERED

In keeping with earlier reports, two regional water supply scenarios have been contemplated, namely a system incorporating existing sources, which can likely serve the Alberni Valley for the short to medium term, and a long term system using a new regional water supply source.

Existing sources considered suitable for incorporation into a regional supply system are China Creek/Bainbridge Lake, Somass River, and Cold Creek, of which only the Somass River source is expected to require treatment beyond chlorination in the short term.

The existing MacMillan Bloedel pulp mill supply main from Sproat Lake was also considered as a potential short term source, in combination with the China Creek source.

New sources considered suitable for a long term regional water supply system are Great Central Lake and the Somass River, either on their own, or in conjunction with China Creek.

The location of the various water sources is shown on Figure 4.3.

5.2 WATER QUALITY

Water quality for all sources mentioned above is excellent, and well within the Guidelines for Canadian Drinking Water Quality, issued by Health and Welfare Canada (4), with the exception of turbidity and colour during high runoff in China Creek, Cold Creek, and the Somass River, and coliform bacteria in Sproat Lake near the MacMillan Bloedel intake and the Somass River near the City intake. A summary of typical water quality parameters reported for the various sources is shown in Table 5.1.

The occasional localized high coliform counts in Sproat Lake and general coliform presence in the Somass River are caused by unsewered residential development along the eastern shores of the lake, and agricultural runoff along the lower reaches of the Somass River.

Turbidity and colour appear in the rivers only during and after high runoff, particularly in China Creek. The China Creek watershed is logged extensively and contains many logging roads, which contribute to siltation of the riverbed.

Nevertheless, China Creek has provided the City with many decades of excellent quality water supply. During periods of high turbidity, which normally occur only

TABLE 5.1 COMPARISON OF WATER QUALITY

Parameter	China Creek	Bainbridge Lake	Somass River	Gr. Central Lake	Sproat Lake	Stamp River	Cold Creek	Remarks
pH	7.9	7.3	7.05	7.2	7.3	7.4	8	6.5 – 8.5 AO
Hardness (as $CaCO_3$)	22.9	33	17.7	15	25.1	15.4	79.6	0 – 50 soft 50 – 100 mod. soft
Alkalinity (as $CaCO_3$)	22.7	26.6	20	20	26.5	16.4	65.3	
Total Iron	< 0.01	0.053	0.06	0.03	0.01	< 0.1	< 0.01	0.3 AO
Total Manganese	< 0.01	< 0.005	0.008		< 0.01	< 0.02	< 0.01	0.05 AO
Chloride	0.7	1.25	0.97			1.1	2.1	250 MAC
Specific Conductivity (umhos/cm)	56	71.1	43.2	32.2	62	37	144	

Parameters in mg/l unless otherwise noted
Reference: (1), (2), MOE Lab. Results 1979 – 1992
IMAC – Interim Maximum Acceptable Concentration (4)
AO – Aesthtic Objective (4)

during the fall, winter and spring, when water demands are at their lowest, the creek source is shut down and water is taken only from Bainbridge Lake, which stays relatively clear during storms.

Water quality in the Somass River has deteriorated over the years from land runoff, which originates from forestry lands and many farms. The Somass source is only used when China Creek and Bainbridge Lake cannot supply peak summer demands. Over the last six years the Somass has been used sporadically, only during the summers of 1988 and 1990, and briefly during the summer of 1993. Water quality complaints occur in the area served by the Somass when the river source is in use, generally related to colour, turbidity, particulates and odour, although the water, after disinfection, has always tested within the stipulated health parameters.

5.3 CHINA CREEK AND BAINBRIDGE LAKE

5.3.1 Description:

The China Creek watershed is located approximately 15 km southeast of the City of Port Alberni. The watershed drains an area of 56 km^2 above the intake dam, which is at elevation 184 m. Lizard Lake is located within the watershed above the intake. The lake drains an area of 2.7 km^2 and has a top water level of 732 m. The level is controlled by a dam and control gate and provides the only regulated storage within the China Creek watershed above the intake.

Bainbridge Lake drains to McFarland Creek, which in turn drains to China Creek below the City intake. This lake provides the second source of water within the China Creek watershed with the lake level controlled by a small dam at elevation 153 m. The catchment area of the lake is 13 km^2. An intake pipe in the lake directs water to the Bainbridge pumping station via a 1,200 m supply main, from where it is pumped into the supply main from China Creek.

5.3.2 Resources:

The lower 11 km of China Creek is an important fisheries resource with a substantial run of steelhead and coho salmon. Fish run upstream primarily in the summer and thus the maintenance of flow in the lower reaches of the creek is essential. A minimum flow of 5 cfs is specified at the mouth of China Creek. The Water Management Branch is concerned about the accuracy of the level gauge at the City's China Creek intake dam. It would also like to see a better method of controlling the discharge out of Lizard Lake over the present manual method.

Active logging operations are being carried out in the watershed in recent years. Many previously logged areas are now covered in second growth timber. The main leaseholder within the watershed is MacMillan Bloedel

Ltd. (MB). Proper forest management can prevent the occurance of undue erosion, allowing water quality impacts to be reduced to a minimum and enabling water supply and forest harvesting to proceed within the same watershed. A five year harvesting plan for TFL 44 is under preparation by MB. The company is in consultation with the Water Management Branch and the City of Port Alberni in the preparation of a forestry development plan for China Creek. A preliminary plan has been submitted showing stream corridors to be protected, and identifying areas for biological habitat protection. The newly proclaimed forest practices code is expected to have further positive impact on the China Creek forestry development plan, and resulting water quality protection.

Mining exploration in the watershed has taken place, and the potential exists for further mining activity that could impact on water quality, particularly in the case of surface mining. Within a small watershed such as China Creek, an extensive mining operation would have a significant potential negative impact on water quality and the two uses will likely be incompatible.

The China Creek watershed is accessible to recreational pursuits via the many logging roads. This increases the risk of water supply contamination from pathogenic organisms.

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

5.3.3 Water Quantity:

The City holds water licenses on China Creek and Bainbridge Lake to allow diversion of 24,450 and 9,760 m^3/day respectively, for a total of 34,210 m^3/day. It has been estimated (2) that the maximum flow that can theoretically be supplied from the watershed (with existing storage) during the extreme dry weather season is 43,500 m^3/day. The existing capacity of the supply main system is about 75% of the maximum volume available, or 32,500 m^3/day, slightly less than the currently licensed volume. The potential for additional storage in the China Creek watershed is limited to the raising of Lizard Lake by 7.3 m to provide an additional yield of 14,600 m^3/day (2).

5.3.4 Water Treatment:

At present the only treatment practiced for the China Creek and Bainbridge Lake water sources is screening and disinfection. Gaseous chlorine is added to the water at the Bainbridge pumping station, proportional to the flow. There is sufficient contact time in the remaining supply main before the first service. During power failures the chlorination system is operated on backup power from a generator, while gravity flow from China Creek only continues. There is no backup power provision for the Bainbridge pump station.

During periods of high turbidity, chlorine demand increases, while the particulate matter can shield bacteria from the disinfection process.

Normal chlorination is not effective against Giardia cysts, which may be present in any surface water source, and which cause Giardiasis, an intestinal disease causing severe vomiting and diarreah. To provide disinfection protection against Giardia requires higher free chlorine residual and longer contact time. The higher residual usually means that dechlorination is required before the water can be delivered to consumers.

Recent US EPA guidelines (9) require all public water systems with surface water sources to provide filtration, including disinfection, unless approved for exception. The US EPA guidelines prefer conventional filtration (coagulation, rapid mix, flocculation, sedimentation, followed by filtration), although under certain conditions direct filtration (coagulation and rapid mix, followed by filtration) or slow sand filtration, with disinfection may be used.

At the present time it is not known whether British Columbia will follow the US EPA's example for mandatory filtration for surface water supply, and if so, when. It should be assumed, however, that it is only a matter of time before more stringent regulations will be applied in B.C. In our opinion, this is likely to occur sometime within the 25 year design period of the proposed regional water supply system. Barring a giardiasis outbreak, implementation of the new forestry code and efficient disinfection of the water supply are expected to defer the need for filtration treatment on China Creek for at least the next ten years.

Based on current water quality, the China Creek source is expected to lend itself to direct filtration. Slow sand filtration is not practical due to the large filter area (75 m by 75 m) required for the maximum flow available from China Creek.

The most suitable location for a direct filtration plant on the China Creek system would be just upstream from the Bainbridge pumping station, where both gravity mains could flow into the treatment plant, or near the Cowichan reservoirs. For treatment at Bainbridge, all treated water will need to be pumped, to recover the lost pressure head.

It is premature at this time to draw definitive conclusions regarding process design and costs, as base watershed data are incomplete. Data collection for treatment process design requires baseline water quality data over a full year, followed by pilot plant studies using water from the source.

5.4 SOMASS RIVER

5.4.1 Description:

The Somass River, which flows into the Alberni Canal at Port Alberni, originates from the confluence of the Stamp River, which discharges from Great Central Lake and the Sproat River, which discharges from Sproat Lake. The total watershed area is 1,280 km^2, with extreme maximum and minimum flows of 1,130 m^3/s and 21.6 m^3/s near the mouth.

The existing City water intake consists of a screened bank-type intake sump and pumping station containing three vertical turbine pumps.

5.4.2 Resources:

The Somass River is an extremely important river for steelhead and many salmon species, especially sockeye and spring.

Historically, MacMillan Bloedel has operated storage on Great Central Lake and Sproat Lake to maintain a flow of at least 26 m^3/s (940 cfs) in the Somass River at the gauging station, in order to achieve adequate dilution of its mill outfall discharge and maintenance of water quality in the Somass River and Alberni Inlet. Now that the pulp mill has installed secondary treatment facilities, this same quantity may not be required for water quality maintenance purposes.

Prompted by a significant sockeye salmon kill during the summer of 1990, which was believed to have been the result of a combination of low flows, high water temperature, and low dissolved oxygen levels in the Somass River, terms of reference were prepared in 1992 for the preparation of a Somass River Water Management Plan. The purpose of the plan was to provide a comprehensive assessment of available water supplies in the Somass River watershed for both extractive and non-extractive uses, and in-stream flow requirements, hopefully leading to a new flow regulation plan, possibly through modification of the existing scheme or by identifying the need for additional storage capacity. It is believed that no significant progress has been made on this plan to-date.

During the summer of 1993 Fisheries and Oceans Canada were successful in lowering water temperatures in the Somass about 2°C by withdrawing colder water from Great Central Lake at greater depth into the Stamp River by means of a deep water curtain.

The water resources in the Somass River watershed also support community, domestic, industrial, and irrigation water requirements, provide recreational opportunities, and supply hydroelectric power generation.

5.4.3 Water Quantity:

The City holds a water licence on the Somass River allowing the diversion of 13,650 m^3/day, about 0.73% of the minimum recorded flow. Subject to the findings of the Somass River Water Management Plan, it is believed that additional licences to divert water for regional water supply purposes can be obtained, because of the virtually unlimited ability to increase storage on Great Central Lake.

The existing installed capacity of the Somass River pumping station is 17,000 m^3/day, about 25% more than the licenced volume.

5.4.4 Water Treatment:

As mentioned before, the Somass River supply is only used sporadically by the City, and as little as possible, because of water quality complaints. The present source does not provide treatment beyond proportional gas chlorination.

Somass River water is considerably softer than China Creek water and more agressive. The river suffers from occasional high turbidity levels as a result of runoff and organic debris from salmon spawning in the fall. Feacal coliform levels are significant, reflecting agricultural development upstream. All measured parameters are well within the Guidelines for Canadian Drinking Water Quality, and the data indicate that the water supply is generally of good quality.

Due to the size and multiple land uses within the Somass River watershed, the implementation of watershed protection guidelines to protect water quality is not considered feasible. If this source is to be used for year-round domestic consumption, further water treatment to produce a suitable and consistent finished water quality is the only option available.

Treatment of this source should be by conventional filtration with disinfection, consisting of coagulation-flocculation followed by sedimentation, filtration and finally disinfection. The exact process to be defined after study of more complete water quality data and pilot plant runs.

The most suitable location for a filtration plant near the Somass intake would be across the road on City owned land in the old gravel pit. The original pumping station would be converted to a low lift station to pump the water into the treatment plant. The treatment plant would incorporate high lift pump stations to pump the treated water into the distribution system.

5.5 SPROAT LAKE

5.5.1 Description:

Sproat Lake is the second largest lake in the Somass River watershed with a surface area of 4,300 ha, and a drainage area of 350 km^2. The mean water level elevation of the lake is 28 m, with normal level fluctuations within 1 m above and 1 m below full storage level (FSL), and extreme high level of 3 m above FSL.

The outlet into Sproat River is controlled by a small stoplog weir maintained by MacMillan Bloedel. The weir height is adjustable only within a 300 mm range. The MacMillan Bloedel pulp mill supply main has its intake at Stirling Arm, from where the water is pumped into a 1200 mm diameter wood stave supply main. Pressure at the mill is maintained at 45 psi.

5.5.2 Resources:

Sproat Lake serves as the water supply for MB's pulp mill as well as many individual residences along the eastern shores. Because of the residential development along the lake shore, water levels cannot be allowed to fluctuate greatly.

The lake is important for the rearing of sockeye salmon and many other fish species, and has a high recreational value.

5.5.3 Water Quantity

MacMillan Bloedel holds a licence to divert 260,000 m^3/day of water from Sproat Lake for industrial purposes and to store 25,000,000 m^3.
The pulp mill has adopted a rigorous process of water conservation because of the expense of secondary treatment of its process effluent. The reported target is to come down to a flow of 100,000 m^3/day.

Although this indicates that there may be substantial spare capacity under the MB licence and in the supply main, for use by the proposed regional water system, we have not been able to obtain a firm confirmation of quantity available and conditions under which the water would be made available.

Given the residential development on Sproat Lake in the area of the MB intake, this source would require similar treatment as the Somass River source. We are also concerned about the reliability of supply from this main, as it would be controlled by private interests, and would be shut down and not available for municipal water supply under power failure conditions at the Sproat Lake pump station, to safeguard against negative pressures in the wood stave supply main.

There would also be a concern about responsibility for pipeline maintenance and remaining useful life of the supply main. We have concluded that there would be no significant financial advantage of using the Sproat Lake main over the Somass River source, whereas there is a high potential for serviceability problems related to power failures and possible private interests over which the regional district would have no control.

For these reasons, use of the Sproat Lake supply main has not been considered as a viable alternative for regional supply. Consideration may be given to the use of the lake as a separate community supply for the Sproat Lake community, if the costs of connecting to the regional supply system prove prohibitive. Such supply would require a separate intake, pump station and chlorination.

5.6 GREAT CENTRAL LAKE

5.6.1 Description:

Great Central Lake is the largest lake within the Somass River watershed with a surface area of about 5,000 ha, and a drainage area of approximately 930 km^2. The top storage level elevation of the lake is 83 m.

The level is controlled by a dam fitted with mechanically operated slide gates, which discharge into the Stamp River. The dam is maintained by MacMillan Bloedel Limited. The zero storage level elevation is 80 m. The minimum lake level in practice cannot be drawn down below 81 m, otherwise water would not reach the wet well of the pump station which supplies the Robertson Creek fish hatchery. This pump station has an intake at 30 m depth to draw cold water from the lake, but the wet well containing the pumps is above the zero storage level of the lake. The lake has an additional wooden crib dam controlled outlet into Robertson Creek via Boot Lagoon, which in turn discharges into the Stamp River. The cost of lowering the pump station to 80 m has been estimated by Fisheries and Oceans Canada at $100,000.

5.6.2 Resources:

The lake was historically regulated by MB to maintain minimum downstream flows in the Somass River to provide dilution at the point of discharge of wastewater effluent from the pulp mill. Now that full secondary treatment at the mill has been in place since 1993, it is understood that regulation of Great Central Lake is totally governed by Fisheries and Oceans Canada to support the requirements for flow quantities and water temperatures of the Stamp and Somass River sockeye salmon runs, as well as other salmon species.

A B.C. Hydro generating station on the shore of Great Central Lake discharges water into Great Central Lake, which is diverted from Elsie Lake on the Ash River system. The plant discharges 14.2 m^3/s (500 cfs) when in operation. As pointed out before, this diversion apparently has contributed to a general raising of water temperatures in the Stamp and Somass Rivers, and the B.C. Hydro operation is currently under review.

B.C. Hydro has prepared plans to increase the generating capacity of the Ash River plant from 27 megawatts to possibly 39 megawatts, which would divert more water from Elsie Lake into Great Central Lake. Apart from the effects on temperature in the Somass River system, the effects of the additional diversion would support a proposed regional water supply scheme, assuming that containment provisions are provided for possible contaminated spills from the generating plant.

Apart from MB logging operations and the B.C. Hydro plant, the watershed is generally undeveloped, except for some very limited recreational development along the shore, such as a wilderness lodge and boating operation to ferry hikers to the west end of the lake for access to Della Falls, and several houseboats at the east end of the lake, presumably with limited sewage disposal facilities.

The lake is important for the rearing of sockeye salmon and many other fish species, and has recreational value. There have been proposals for the establishment of fish farms for rearing of Atlantic Salmon on Great Central Lake, which we understand have so far been rejected. Such operations are not considered compatible with domestic water supply, as they would likely be located close to the proposed intake site, because of access, and because antibiotics are often used to counteract fish disease.

5.6.3 Water Quantity:

Besides the fisheries interest, the only major water licence holder on Great Central Lake is MacMillan Bloedel for storage and release of 98,680,000 m^3 (80,000 acre feet). It is expected that with the major improvement to mill effluent discharge quality, this amount of dilution water can be substantially reduced, and fisheries low flow requirements will govern the issuance of additional licences for domestic water supply.

It is expected that no additional storage will be required to support a water licence for a regional water system, at least up to year 2020 demands, as this would require less than 0.5 m of storage. Fisheries and Oceans Canada are known to be interested in a scheme that would provide for withdrawal of 14.2 m^3/s (500 cfs) of water from Great Central Lake at depth (say 15 m) for discharge into the Stamp River to achieve lower water temperatures during salmon runs. This compares to a projected year 2020 maximum day domestic water consumption of 0.75 m^3/s. Whether or not the fisheries diversion can economically be provided as part of a regional water system intake needs to be investigated.

The Water Management Branch does not appear to have any objections to additional water withdrawal from Great Central Lake for regional water supply purposes.

5.6.4 Water Treatment:

It is expected that any surface water source will be required to include treatment at some time before the end of the design period. However, because of the limited development in the Great Central Lake watershed, and the ability to implement a watershed management program, it provides the best opportunity to maximize delay of the implementation of treatment beyond disinfection. Implementation of an Integrated Watershed Management Plan (IWMP) for the Great Central Lake watershed is therefore extremely important, should this source be selected as a regional water supply.

Water quality testing conducted in the past (1,2) has indicated very good quality water, with all parameters within the Guidelines for Canadian Drinking Water Quality.

5.7 SHORT TO MEDIUM TERM REGIONAL WATER SOURCES

Reference is made to Figure 4.1, which shows the projected City and regional water demands (with full metering) compared to the available capacities of the existing main City water sources, ie. China Creek and Somass River. It is apparent that the combined capacity of these two sources can supply the projected regional water demands for at least the next 10 years, assuming implementation of universal metering. Figure 4.2 shows that if universal metering is not adopted, the capacity of existing sources runs out in about 2 years.

An earlier report (2) concluded that the best short term supply scenario for the City would be to use these combined sources, with filtration treatment added to the Somass source, for the initial phase of expansion, as the basic infrastructure is in place to distribute the water from these sources to the entire City.

It is important from an operations and maintenance cost point of view that the water supplied by gravity from China Creek be maximized at all times, so as to minimize the amount of water to be pumped and treated from the Somass source. This will require the completion of a new connection from the Cowichan reservoirs across Rogers Creek to the Johnston Street reservoir. This main is included in the 1995/96 capital works budget for the City of Port Alberni.

The Lacy Lake source in Cherry Creek provides good quality water and is located high enough to allow gravity supply to the high pressure zone in Cherry Creek. As such it will be an excellent interim source to supply the higher Cherry Creek area and Sahara Heights. Fisheries concerns about over use of the source during low creek flow periods will likely be alleviated when this source is isolated from the lower pressure zones, thus reducing the demand considerably.

5.8 LONG TERM REGIONAL WATER SOURCES

The best long term regional water source is Great Central Lake, as identified in previous studies (1,2). The supply capacity is relatively unlimited, and water quality is excellent because of relatively low development pressure. It is expected that adequate watershed protection can be achieved for the lake, and that treatment can be postponed longer than any other source in the area. If this water source is implemented, some immediate measures, such as elimination of sewage discharges from relatively few houseboats along the shore and other limited shore based operations, must be taken. The development of an IWMP for the watershed should be a high priority. It is expected that forestry operations in accordance with current forest practice codes will not impact negatively on water quality of the lake.

It is not expected that fisheries interests in the lake will be adverse to municipal water supply taking. However, it is known that the Department of Fisheries and Oceans (DFO) is interested in developing a large capacity deep water outlet from the lake into the Stamp River to reduce high summer water temperatures in the Somass River system, which are reported to adversely affect the important Sockeye salmon runs. This apparently is partially caused by the B.C. Hydro diversion into Great Central Lake from Elsie Lake, which is causing warmer surface waters from Great Central to flow into the Stamp River, instead of the cold water release from glacier fed Elsie Lake before the diversion. DFO are interested in developing a joint outlet/intake with any proposed municipal water taking. However, the quantities of water DFO need to release from depth are several orders of magnitude larger than the regional water supply from the lake, and would require a much more expensive structure than a municipal water intake.

As an alternative to the Great Central Lake source this report considers the expansion of the Somass River intake and pump station, in conjunction with immediate treatment, as a single or combined regional water supply source, which would require a much shorter supply main. The quantity of water available from the Somass River for regional water supply is also virtually unlimited.

SECTION 6

SECTION 6.0
REGIONAL WATER SUPPLY ALTERNATIVES

6.1 GENERAL

As was shown in Figure 4.1, the sum of the capacities of the existing water supply systems in the proposed service area for the Alberni Valley regional water supply system is sufficient to supply projected demands in existing serviced areas for the next 10 years, assuming the introduction of universal metering. As shown in Figure 3.1, the China Creek/Bainbridge and Somass supply and distribution systems are interconnected to service the City of Port Alberni. The City provides emergency connections to the Beaver Creek and Cherry Creek Improvement District systems, however, these are not sufficient to provide peak demands into these service areas.

Thus, a logical first option for developing a regional water supply system would be to maximize use of the existing infrastructure, water sources and water licenses, by simple interconnection, in such a way that peak demands can be satisfied throughout the existing service areas. Such a system could be developed in stages to an ultimate system using the China Creek and Somass supply sources.

This would require the construction of a water treatment facility on the Somass River source immediately, with its concurrent high capital costs, and operation and maintenance costs for treatment and pumping. Even though this option involves an immediate treatment plant, it may be attractive, as it will likely present the lowest initial capital outlay, since the treatment plant can be constructed in stages, and the initial connecting pipeline requirements are minimal. Ultimately, the Somass supply can serve the entire regional service area on its own, or in combination with China Creek. However, once this option is chosen, it would likely not be acceptable to later consider switching to a supply from Great Central Lake, as this would mean abandoning the new Somass treatment plant and pumping facilities.

On the other hand, the second option of developing the Great Central Lake supply immediately needs to be considered, as it represents the best long term regional source of supply. It would require a higher initial capital outlay, as the supply main from Great Central Lake cannot be staged. Other considerations, related to the supply main routing away from existing large distribution mains, requiring the initial supply main to extend all the way into Cherry Creek, also increase first stage costs. However, this option has the advantage of being able to postpone construction of a full scale water treatment plant for an estimated fifteen to twenty years. In the long term, a supply from Great Central Lake can serve the entire regional service area on its own, or in combination with China Creek.

Thus, the following main options have been considered:

OPTION 1 **Somass River Source with Treatment Plant in Phase I**	**OPTION 2** **Great Central Lake Source No Treatment Until Phase III**
Phase I - 1995 - Retain China Creek, Bainbridge Lake and Lacy Lake with Somass River source - Construct treatment plant, Phase I - Construct distribution system interconnection across Rogers Creek	**Phase I - 1995** - Retain China Creek, Bainbridge Lake and Lacy Lake with Great Central source - Construct intake, pump station and supply main - Construct distribution system interconnection across Rogers Creek
Phase II - 2005 - Add Sproat Lake expansion - Abandon Lacy Lake supply and construct booster pump station, reservoir, and distribution main connection - Construct treatment plant, Phase II	**Phase II - 2005** - Add Sproat Lake expansion - Abandon Lacy Lake supply and construct booster pump station, reservoir, and distribution main connection
Phase III - 2015 ? **(Mandatory Treatment)** **A.** Install treatment plant on China Creek supply, and replace China Creek supply main **or** **B.** Abandon China Creek and upsize Somass treatment and supply system Construct transmission main from Cherry Creek to Cowichan Reservoirs	**Phase III - 2015 ?** **(Mandatory Treatment)** **A.** Install treatment plants on Great Central supply and China Creek supply, and replace China Creek supply main **or** **B.** Install large treatment plant at Great Central, and abandon China Creek Construct transmission main from Cherry Creek to Cowichan Reservoirs

6.2 OPTION 1 - SOMASS RIVER SOURCE

The Somass River source has the advantage of lower first stage cost, because of the proximity of this source to large supply mains, even with the construction of a first stage 12,500 m^3/day water treatment plant.

Such a system would maximize the use of the gravity China Creek/Bainbridge source to supply all of the City south of Rogers Creek, and as much as possible north of Rogers Creek, the gravity Cherry Creek source from Lacy Lake to supply the 158 m pressure zone in the Cherry Creek service area, and the pumped Somass source to supply the balance of the City north of Rogers Creek, and the balance of the 120 m pressure zone in the Beaver Creek and Cherry Creek service areas. The Beaver Creek source on the Stamp River would be abandoned, as it experiences intake problems and water quality problems, and the demand on the Cherry Creek source would be reduced considerably.

The Somass source would require conventional filtration treatment immediately, and an additional connection would be required from the China Creek service area to the Somass service area, across Rogers Creek to the Johnston Street reservoir, to maximize use of the gravity China Creek/Bainbridge Lake source, thus minimizing pumping and treatment costs. This main is required from the Cowichan reservoirs to the Johnston Street reservoir, and should be sized at 500 mm diameter to suit the ultimate reverse flow requirement for transmission of water from the Somass River source to the Cowichan reservoirs.

The Somass pump station would be refitted to serve as a low lift pump station from the river to the new treatment plant. The treatment plant would be fitted with two high lift pumping facilities to pump treated water into the 120 m pressure zone to a new reservoir near Kitsuksis Road, and the 67 m Johnston Street reservoir. This requires new transmission mains from Beaver Creek to Cherry Creek and from Cherry Creek to the Johnston Street reservoir, which will be sized to suit the ultimate requirement for transmission of water from the Somass River to South Port Alberni.

The rest of the infrastructure north of Rogers Creek can be readily modified to connect the two Improvement Districts to the City's distribution system and the two water sources. This would allow the abandonment of the Beaver Creek source on the Stamp River, which has capacity and quality problems. In order to improve extensive areas of low pressure in the southern portion of Beaver Creek, it will be necessary to phase out the 103 m TWL southern reservoir, and supply the area from the 120 m pressure zone. The higher areas in Cherry Creek would, in the short term, still be supplied from the Lacy Lake source, which provides good quality water and will be adequate in size for the smaller service area.

New service areas in Sahara Heights and Arrowsmith Heights can be accessed by extending the distribution systems from Cherry Creek and the City, respectively. The new service area at Sproat Lake, the developing industrial area south of McCoy Lake (Devil's Den), and the Bell/Stuart Road area should not be serviced until the new 120 m TWL distribution reservoir for the Beaver Creek and northern City areas has been installed. The connection should then be made from the Beaver Creek system at McKenzie Road, across the Stamp River, after upgrading of the Beaver Creek main to McKenzie Road. The regional connection would supply water to a distribution system to be built by the local service area, which should include a distribution reservoir with TWL of 100 m, to optimize pipe sizing of the long loops, and to provide fire flows.

This system is shown in Fig. 6.1. It will be able to serve the Alberni Valley until the year 2005 at presently projected water demands.

Once the improvements recommended under Section 6.2 are in place, the system can be readily expanded to provide service to the year 2020, as follows:

6.2.1 Combined China Creek/Somass River Supply (Option 1A):

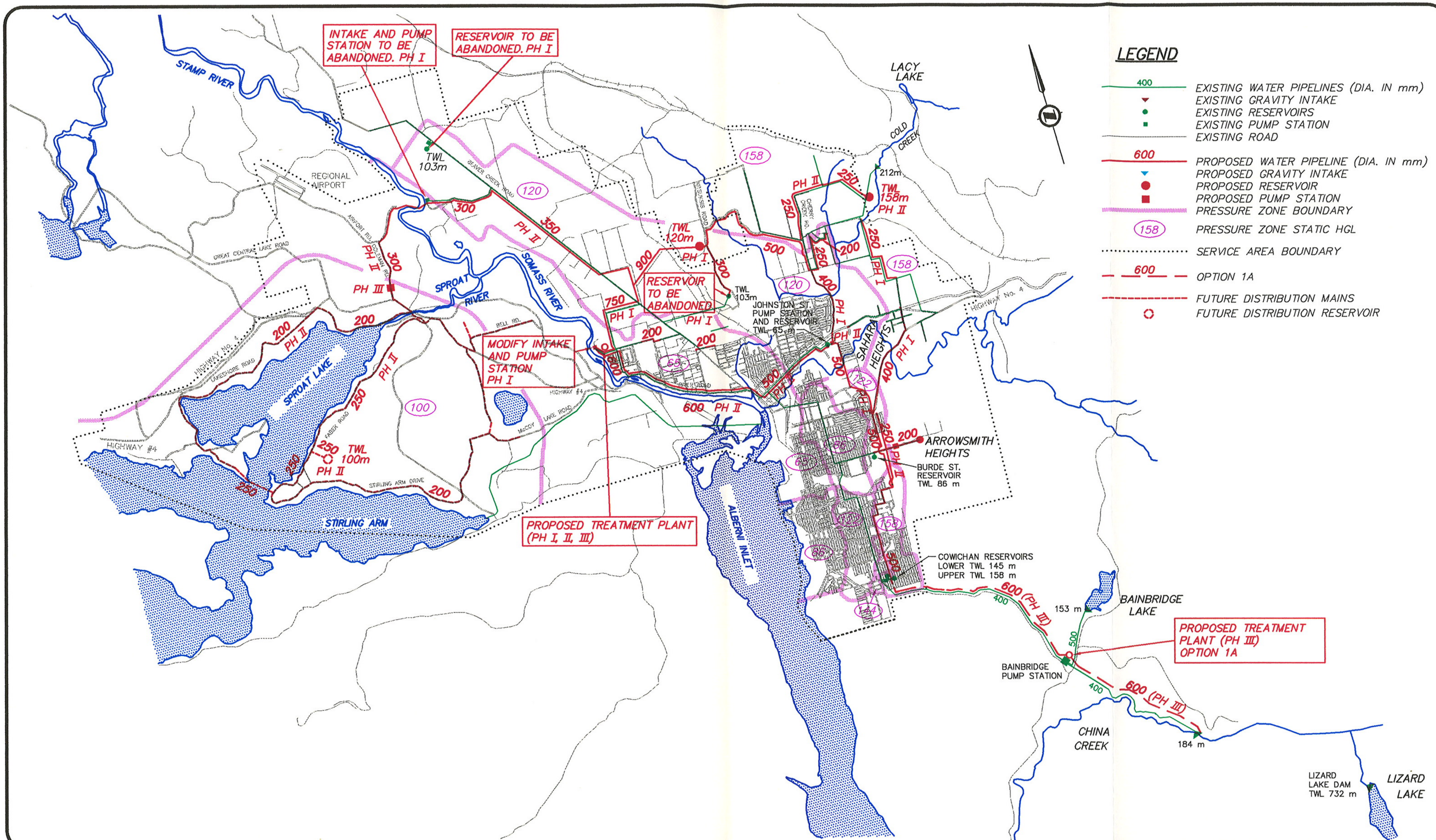
If the China Creek supply main is still serviceable beyond the year 2005, and treatment on the China Creek supply is not yet a requirement, further expansion of the initial system described under 6.2 would be possible.

The Somass pumping and treatment facilities would have to be expanded to a lesser degree than under 6.2.2, and operation and maintenance costs would be reduced because a substantial portion of the water supply would still occur by gravity.

It is assumed that treatment of the China Creek source will become mandatory by the year 2015. Replacement of the China Creek supply main and the addition of treatment to the China Creek source will enable system expansion beyond the year 2015. This system is shown in Fig. 6.1.

6.2.2 Somass River Supply Only (Option 1B):

Expansion of the Somass low lift pump station, treatment plant, and high lift pump station will allow the Somass source to supply the total system demands to the year 2020. The China Creek source would be abandoned, because of the requirement for treatment, and/or the age of the supply main.



KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

CLIENT	CITY OF PORT ALBERNI / REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT
PROJECT	ALBERNI VALLEY REGIONAL WATER STUDY
TITLE	OPTIONS 1A AND 1B SOMASS RIVER / CHINA CREEK SUPPLY
APPROVED	
DATE	NOV. 1994
JOB No.	M9330
SCALE	1:75,000
DWG No.	FIG 6.1

New higher lift pumping facilities will be required at the Johnston Street pump station to supply water from the 65 m TWL reservoir into the 158 m zone in south Port Alberni and Cherry Creek. This system is shown in Fig. 6.1.

6.3 OPTION 2 - GREAT CENTRAL LAKE SOURCE

The Great Central Lake source has the disadvantage of highest first stage cost, but presents the best long term regional water source, and has the advantage of lower pumping heads, ability to postpone treatment, and therefore the lowest operation and maintenance costs.

Facilities required will be the Great Central Lake intake and chlorination facility, medium lift pumping to a site at elevation 140 m located south of the existing logging road, and a gravity supply main from there to the new transmission main system and 120 m TWL reservoir in the Beaver Creek/Cherry Creek area.

Initially, this source should be developed in conjunction with the China Creek supply, to maximize gravity supply. China Creek would supply all of the City south of Rogers Creek, and as much as possible north of Rogers Creek. This requires the connection from the Cowichan reservoirs across Rogers Creek to the Johnston Street reservoir, which should be sized at 450 mm dia. to allow future supply to the 86 pressure zone from Great Central Lake.

Routing of the supply main from Great Central Lake has been selected to follow the logging road for approximately 2.2 km, then crossing Great Central Lake Road, following logging roads in an easterly direction towards the new airport, then along the airport road to Coleman Road, from where it follows a trail to the Stamp River, where it crosses at the location of the Beaver Creek intake. From there it follows MacKenzie Road, Beaver Creek Road, towards the location of the proposed 120 TWL reservoir near Kitsuksis Road. This alignment is considered to be the most economical, and provides a transmission system that can best serve the overall service area, minimizing pumping, and having the ablity to ultimately supply all of South Port Alberni as well.

The rest of the infrastructure north of Rogers Creek can be readily modified to connect the two Improvement Districts to the new transmission system and the two water sources. This would allow the abandonment of the Beaver Creek source on the Stamp River, which has capacity and quality problems. In order to improve extensive areas of low pressure in the southern portion of Beaver Creek, it will be necessary to phase out the 103 m TWL southern reservoir, and supply the area from the 120 m pressure zone. The higher areas in Cherry Creek would, in the short term, still be supplied from the Lacy Lake source, which provides good quality water and is adequate for the smaller service area.

New service areas in Sahara Heights and Arrowsmith Heights can be accessed by extending the distribution systems from Cherry Creek and the City, respectively. The new service area around Sproat Lake, the developing industrial area south of McCoy Lake (Devil's Den), and the Bell/Stuart Road area can be serviced by a connection from the Great Central Lake supply main at Coleman Road and Airport Road. The regional connection would supply water to a distribution system to be built by the local service area, which should include a distribution reservoir with TWL of 100 m, to optimize pipe sizing of the long loops, and to provide fire flows.

The new supply main and transmission system were modelled by computer, using the program WATERWORKS, and incorporating the City's data from its computer network.

It is assumed that water treatment will not be required for this source until very late in the design period, probably not before the year 2015.

This system is shown in Figure 6.2. It will be able to serve the Alberni Valley until the year 2005 at presently projected water demands.

Once the improvements recommended in Section 6.3 are in place, the system can be readily expanded to provide service to the year 2020, as follows:

6.3.1 Combined China Creek/Great Central Lake Supply (Option 2A):

If the China Creek supply main is still serviceable beyond the year 2005, and treatment on the China Creek supply is not yet a requirement, further expansion of the initial system described under 6.3 would be possible.

The Great Central Lake medium lift pumping station would have to be expanded to a lesser degree than under 6.3.2, and operation and maintenance costs would be reduced because a substantial portion of the water supply would still occur by gravity.

Phasing out of the Lacy Lake supply 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.

It is assumed that treatment of the Great Central Lake and China Creek sources will become mandatory by the year 2015. Replacement of the China Creek supply main and the addition of treatment to the Great Central Lake and China Creek sources will enable system expansion beyond the year 2015. This system is shown in Fig. 6.2.