



VILLAGE OF CUMBERLAND



LONG RANGE WATER SUPPLY STRATEGY

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Village of Cumberland
Long Range Water Supply Strategy
April 5, 2011
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Executive Summary

Cumberland is facing two significant issues with regards to supply of community water in the Village.

1. The surface water source that has been used for many years now falls under a new Vancouver Island Health Authority treatment policy which effectively mandates that filtration and dual disinfection be added to the treatment system, if the existing supply continues to be used. This is referred to as the VIHA 4,3,2,1 policy. The capital and operating costs of the added treatment will have a significant financial impact on the residences and businesses of Cumberland.
2. Current water demand is close to or at the storage capacity provided by existing dams in the watershed during summer months, stifling any growth potential for the Village.

Options for resolving these issues have been investigated in this study along with their respective concept level estimates of capital and operating costs. The options consider each of the two issues independently and are summarized below:

ISSUE	OPTION
VIHA 4,3,2,1 - Disinfection Policy	<ol style="list-style-type: none"> 1. Existing Surface Water Supply – Upgrade Treatment Construct a filtration and U/V disinfection system 2. Groundwater Supply – Develop sufficient groundwater to enable surface water supply to be shut down during high turbidity events (high runoff due to heavy rain) 3. Regional Water Supply- Participate in a regional system with a deep water intake from Comox Lake (R1)
GROWTH	<ol style="list-style-type: none"> 1. Expand Surface Water Supply – Re-construct Hamilton Lake Dam, add VanWest Lakes, and increase height of Allen Lake Dam. 2. Groundwater Supply – Develop wells in one or more suitable aquifers as demand increases 3. Regional Water Supply - Participate in a regional system with a deep water intake from Comox Lake
VIHA 4,3,2,1 Policy and Growth Combination	<ol style="list-style-type: none"> 1. Groundwater + Surface Water Supply Blend 2. Groundwater Supply + Regional Supply Blend 3. Regional Supply

VIHA 4,3,2,1 Policy

Looking at this issue in isolation, dealing only with existing population of Cumberland and Royston (no growth), the following observations have been made:

- Treatment Improvements to the existing surface water system would result in an estimated capital cost of approximately \$9M, or approximately \$4,457 per existing household, plus increased annual operating and maintenance costs of approximately \$94 per household over current costs.
- To date, groundwater investigations have not proven sufficient quantities to satisfy current demand, and groundwater on its own is therefore not considered to be a viable solution to the VIHA 4,3,2,1 policy at this time.
- Connection to a regional supply such as Option R1 as outlined in the Draft Comox Valley Regional Water Supply Strategy report provides a solution to the VIHA 4,3,2,1 policy. Although the report did not address a no-growth scenario, it is reasonable to expect that the capital and operating costs would be similar to or less than treatment improvements to the existing water system due to economies of scale. Capital costs and annual operating and maintenance costs were estimated to be \$1,767 and \$54 per household for the Regional R1 option.

Growth

Given the VIHA policy requirement, growth cannot be considered in isolation, therefore this study focus is on options that satisfy both VIHA policy and growth. A review of the available options and possible combinations includes the following observations:

- Any application to expand the surface water supply (increase storage) in the water shed will likely trigger additional stream flow for fisheries habitat requirements which will far exceed any increase in capacity for domestic growth. The stream flow requirements which Federal Fisheries and Oceans has stipulated during recent correspondence is roughly equivalent to all the existing storage in the watershed. Therefore, we have eliminated this option for any growth potential.
- The regional option R1 as identified in the Comox Valley Regional Water Supply Strategy draft report, presents the least capital and operating costs for Cumberland growth, but the regional option will likely take several years to implement. A recently proposed regional R5 option, which incorporates a deep intake on the Cumberland side of Comox Lake, (with or without filtration) is anticipated to be more economically attractive, but is currently under further study by the CVRD.
- Groundwater is the most economical supplementary source for Cumberland's existing surface supply, at a maximum of 1% contribution to capital cost by the existing residents. Developer fees (DCC fees) would be used to fund the groundwater connection and related works. It could provide supplementary supply for

growth for up to 10-15 years while the regional source is being developed. The groundwater supply could remain as a supplementary supply to the regional source once the regional system is implemented.

- Two developer initiated groundwater sources have been investigated and tested to date. Both sources look promising as a community supply, but some additional study is needed to further assess which source to select initially.
- A cost summary of the only two remaining viable options which satisfy both VIHA and growth requirements is shown in the table below:

Option	Est. Capital Cost	Est. Cap Cost per New Lot (DCC)	Est Cap. Cost per exist. Household	Est Annual O&M cost for all households
Groundwater/Regional Blend*	\$16,352,000	\$1,778	\$1,767	\$66
Regional Option R1	\$15,320,000	\$1,767	\$1,767	\$54

* This option assumes development of only one groundwater source (Wacor well as an example)

Conclusions

It is clear that a VIHA policy solution with allowance for growth is needed as a long range water supply strategy for the Village. Among the options considered, it appears that a regional solution is the best option for Cumberland for the following reasons:

1. A regional supply option provides the lowest capital and O&M costs for the existing and future households of Cumberland.
2. A regional water supply would satisfy VIHA 4,3,2,1 policy and also accommodate growth
3. Cumberland's borrowing capacity would be exceeded if attempting to finance the project internally through borrowing.
4. Grant funding is more likely to be available if there is a regional benefit.

The R1 regional option used in this report represents the least cost option to Cumberland in the Draft Comox Valley Regional Water supply Strategy report, but further investigation on a new option (R5) with a deep water intake at the Cumberland side of Comox Lake could prove to be more economically attractive. Either regional option could be suitable as a long range water supply strategy for Cumberland.

It is likely that planning, engineering, preparation of a governance model, and construction of a new regional water supply could take at least 5 years to complete. In the interim, a supplementary supply using groundwater is a viable solution to satisfy growth. This would not resolve the VIHA 4,3,2,1 policy, but combined with a regional commitment, could form a reasonable amendment to the operating permit, deferring VIHA 4,3,2,1 improvements until a regional solution is implemented.

Recommendations

Based on the observations and conclusions noted above, a long range water supply strategy for Cumberland can be adopted for the benefit of existing and future residents and businesses of the community. The long range water supply strategy is recommended as follows:

1. Continue to work with the CVRD towards adoption of a regional strategy which includes Cumberland as a stakeholder.
2. Participate in negotiations with the CVRD to develop a suitable governance model.
3. Encourage the CVRD and benefitting members to expedite the implementation of the strategy within the next 5 years.
4. Include groundwater as a supplementary source to enable growth during the interim period before the regional system is operational.
5. As a future step, select a groundwater source or sources based on hydrogeological investigation and testing, engineering, current policy and operational merit, to provide the most suitable water supply supplement for Cumberland.

1.0 Introduction

A long range water supply strategy for Cumberland will need to consider two key issues:

1. The Vancouver Island Health Authority (VIHA) 4,3,2,1 disinfection policy.

VIHA has jurisdiction over operating permits for public water systems. As of February 16, 2010, Policy 3.3 of the Drinking Water Treatment for Public Water Supplies was revised. A copy of the policy is included in Appendix 1.

The policy states that all water supply systems in VIHA that use surface water sources will be required to maintain the following treatment specifications:

- 4-log removal /inactivation of viruses
- 3-log removal/inactivation of Giardia cysts and Cryptosporidium oocysts
- 2 treatment processes, usually filtration and disinfection
- 1 NTU turbidity (maximum) in finished water

This is referred to as the VIHA 4,3,2,1 policy. The procedure for existing water systems included an amendment to the operating permit to include an implementation strategy from the water supplier, and monitoring of progress leading to compliance with the conditions of the permit. Cumberland submitted the implementation strategy in 2010, which was appended to the operating permit. These are attached in Appendix 1 for reference.

2. Demand Due to Growth

The Village of Cumberland Water Master Plan (WMP) was prepared by Anderson Civil Consultants Inc. and adopted by Council in 2007. The WMP provides useful data, including; historical water consumption records, available storage volume in the existing watershed reservoirs, projected population growth, comments on perceived system deficiencies, and cost estimates for proposed improvements including filtration. Further analysis by the current Village Engineer of design standards for watershed storage, existing consumption rates, and recorded water levels behind #4 dam (Stevens Lake) concluded that Cumberland was effectively close to, or at, the limit of its water supply capacity. This condition was projected to be potentially more critical during the years following 2007 as a result of previously approved development projects which could add up to 20% more population to the Village. The results of this analysis were reported to Council by the Village Engineer in 2007 with a recommendation to withhold approval of new water connections until the issue is resolved. Subsequent recommendations to Council by the Village Engineer included, universal water metering, inclusion of groundwater development in the DCC bylaw, and criteria for consideration of

developer initiated wells for adoption into the Village water system. Based on the above recommendations, Council adopted the initiatives and policies outlined in the following section to address the existing water supply limitations.

2.0 Village of Cumberland Policy Initiatives

The Village of Cumberland Council has adopted initiatives and policies which were directed towards water conservation, potential groundwater development, and control of water demand within the Village. These are itemized as follows:

- 1. Universal Water Meter Program.** The universal water meter program was adopted by Council in 2008 in compliance with Provincial requirements attached to the water abstraction license, and as a significant demand management tool when combined with inclined user rates. Reduced water consumption of up to 50% has been recorded in other similar communities as a result of universal water metering. Installation of water meters in Cumberland should be complete by July 2011.
- 2. Water Connection Restrictions.** A resolution to apply restrictions on new water connections within the Village was adopted by Council in 2007. The restrictions essentially stopped all new subdivisions or developments which would increase the demand on the water supply, but excluded new construction on existing property and lots approved before the date of the resolution.
- 3. Policy on Private Wells.** A resolution which permitted the use of private wells for development on private property, and consideration of adoption of groundwater into the Village water system was adopted by Council in 2007. The policy included specific criteria for consideration of groundwater, including well capacity, source approval from VIHA, and additional review and acceptance by the Village.
- 4. DCC Bylaw Update.** Council approved the DCC bylaw update in 2009 which included groundwater development in the DCC project list. This was initiated in order to provide a mechanism for the Village to undertake the exploration and development of a groundwater source as a DCC project or take ownership of an approved well which is constructed by a developer and connected to the Village water system.
- 5. Developer Initiated Wells for Public Use.** A resolution was adopted by Council on October 12, 2010 which detailed a policy for review of developer initiated groundwater sources proposed for inclusion into the Village water system and application for DCC credits. The policy set out the application process, exploration, development, and acceptance criteria, and eligible expenditures for DCC credits. The policy was adopted to provide potential developers with some guidance in the process, and advising that the risks of such a venture are solely borne by the developer.

3.0 Objectives

This report is intended to provide a high level (concept) review of long range water supply options for Cumberland over the next 20 – 25 years, based on the Village of Cumberland Water Master Plan, recent condition report for the existing dams, developer initiated well investigation reports, and a draft Comox Valley Regional Water Supply Strategy. The purpose of this report is to consolidate information from the various sources into a format that can be used by Village of Cumberland Council to make informed decisions regarding a long range water supply for the Village.

4.0 Scope of Work

The scope of work for this study is limited to a review of options for which previous studies and information is available, including internal reports, Village of Cumberland Water Master Plan, Draft Comox Valley Regional Water Supply Strategy report, and developer initiated well reports. The work plan includes a review of the available reports, analysis of options, including concept level cost estimates, and preparation of conclusions and recommendations for the Village of Cumberland Council considerations.

5.0 Developer Initiated Wells

The following section is a general overview of the reports prepared by consultants on behalf of Coal Valley Estates, and Trilogy Properties VI relating to well exploration and testing programs for groundwater to date. A more detailed comparative analysis of these wells and their respective reports are found in Appendix 2.

Coal Valley Estates (WACOR Well)

Initial exploration was started in 2008, and continued in 2010 at a location east of Bevan Road on property owned by Wacor Construction as illustrated in Fig.1. The results of well pump testing and water sampling indicated that the well should be capable of approx. 200 US gpm. Water quality results indicate that it is suitable as a potable supply. Field observations indicate that the well is under the direct influence of surface water (GUDI) and therefore should be treated as surface water. Filtration is not considered necessary, but dual disinfection will be needed as well as pH buffering prior to distribution. Although the hydrogeologist indicated there is no apparent connection of the aquifer to the Pidgeon Lake landfill, the report did not rule out some potential contamination from it. Further clarification on this issue is needed. The hydrogeologist also warned that high pump rates could possibly dewater the aquifer. VIHA source approval is pending on this well.

Trilogy Lot 11 Well

Exploration, pumping, and testing were completed in 2009, with VIHA conditional source approval provided in early 2010. The location of this well is on Trilogy's Lot 11 shown in Fig. 2. This well was given an interim rating of 200 US gpm., similar to the Wacor well. The hydrogeologist indicated that the aquifer could possibly provide a higher yield, but more testing would be needed to verify it. The well water sampling test results indicate that elevated levels of iron and manganese exceed the Guidelines for Canadian Drinking water Quality, and will need to be removed by treatment. The treatment process will add significant capital and operating costs for this well, if it is used as a community water supply.

6.0 Options for Consideration

Over the next few years, Cumberland faces the challenge of making significant decisions regarding the supply of water, involving large capital expenditures, and an increase in operating and maintenance expenses. It is generally understood that water conservation measures such as universal metering and consumption based billing can significantly defer the cost of infrastructure for growth, but conservation measures alone will not satisfy water demand due to growth over the long term. The two issues; VIHA disinfection policy, and increased demand from growth, as noted above, can have different impacts on what options are applicable, but some options could resolve both of the above issues. A general summary of options discussed in this report are listed in Table 1 below and categorized as to which issues are addressed.

Table 1

ISSUE	OPTION
<p>VIHA 4,3,2,1 - Disinfection Policy</p>	<ol style="list-style-type: none"> 1. Existing Surface Water Supply – Upgrade Treatment - Construct a filtration and U/V disinfection system 2. Groundwater Supply – Develop sufficient groundwater to enable surface water supply to be shut down during high turbidity events (high runoff due to heavy rain) 3. Regional Water Supply- Participate in a regional system with a deep water intake from Comox Lake (Option R1)
<p>GROWTH</p>	<ol style="list-style-type: none"> 1. Expand Surface Water Supply – Re-construct Hamilton Lake Dam, add VanWest Lakes, and increase Allen Lake dam height. 2. Groundwater Supply – Develop wells in one or more suitable aquifers as demand increases 3. Regional Water Supply - Participate in a regional system with a deep water intake from Comox Lake
<p>VIHA 4,3,2,1 Policy and Growth Combination</p>	<ol style="list-style-type: none"> 1. Groundwater + Surface Water Supply Blend 2. Groundwater Supply + Regional Supply Blend 3. Regional Supply

A more detailed description of these options is found in the following sections.

6.1 Options for VIHA Disinfection Policy

A brief discussion of options which will address the VIHA 4,3,2,1 disinfection policy follows:

1. Existing Surface Water Supply – Upgrade Treatment

If Cumberland wishes to continue with the existing surface supply, the VIHA 4,3,2,1 disinfection policy will require additional treatment, specifically filtration, followed by dual disinfection (typically ultraviolet sterilization and chlorination) prior to distribution. Existing treatment is limited to chlorination. The Village of Cumberland Water Master Plan prepared in 2007 by Anderson Civil Consultants Inc., included a preliminary cost estimate for a filtration plant and clear well reservoir with a capacity for approx. 10,000 people. The capital cost of this facility was estimated to be approximately \$10.1 M. Estimated annual operating and maintenance (O&M) costs for this plant were in the order of \$250,000 or \$63/household per year. If the filtration plant were to be downscaled to handle only the existing population for Cumberland and Royston (approx. 5048 people) , it is reasonable to suggest that the cost per household could increase by 30-50% due to economies of scale. Retention of the surface water supply system will also require seismic upgrades as identified in the dam condition report prepared by Levelton Consultants Inc. and adopted in 2010. The cost of seismic upgrades is estimated to be approximately \$1M. Table 2 illustrates the estimated capital costs and resulting shared costs to the existing property owners.

Table 2

Improvement	Estimated Capital Cost	Estimated Annual O&M Costs	Estimated Capital Cost per Household**	Estimated Annual O&M cost per Household
Improved Water Treatment	\$8M*	\$190,000*	3,962	\$94
Seismic Upgrades	\$1M	-	\$495	-
Total	\$9M	\$190,000	\$4,457	\$94

* Assuming a smaller plant for existing population (5048)

** Assumes 2.5 people per household

2. Groundwater Supply

This option requires that sufficient ground water be developed in order to satisfy the total demand for Cumberland and Royston during periods of high turbidity in the watershed. If there is sufficient groundwater available, the surface water system could be bypassed and only groundwater used during the high turbidity event. The combined summer demand for Cumberland and Royston is anticipated to be approximately 3,000 cu.m/day (34.7 l/sec) assuming Cumberland's universal meter billing system is in place. To date, the two wells that have been drilled and tested by Coal Valley and Trilogy have been rated at 12.6 l/sec each, although the Trilogy hydrogeologist has indicated that additional capacity may be proven as

result of more pump testing and analysis. A minimum of 3, and preferably 4 wells producing 12.6 l/sec each would be required to satisfy the current maximum day demand. The wells would preferably be in one location to capitalize on economies of scale for common pumphouse, treatment facilities, electrical, controls, and plumbing components. The Wacor well aquifer would not be suitable for this quantity according to the well report. Without additional pump testing and related work at the Trilogy well, the total capacity potential is unknown, therefore until additional groundwater is proven, this option does not satisfy the VIHA policy.

3. Regional Water Supply

The Draft Comox Valley Regional Water Supply Strategy report presented to Village of Cumberland Council on February 14, 2011 included a comparative analysis of options using Net Present Value (NPV) of capital and operating costs over a 50 year horizon. This is a very effective way of comparing alternatives where varying operating costs could have a significant impact on the preferred option over time. There was no analysis available in the draft report for a no-growth scenario. All financial analysis was undertaken over 50 years, assuming an annual growth rate of 3.11% (as per the RGS). As a reference point, however, it is useful to look at Cumberland's share of the CVRD's recommended Regional Supply with a deep intake at Comox Lake (Option R1) to compare with other options which do not include a growth component. Cumberland's share of the capital cost for the R1 option was estimated to be approximately \$15.32M with a future contributing population of 21,672 people, resulting in a capital cost per person of approximately \$707 or roughly \$1,767 per household. O&M costs were estimated to be approx. \$54.30 per household.

Due to overall economies of scale it is reasonable to expect that Cumberland's share of regional capital and O&M costs would be less than undertaking the treatment improvements independently. Further detailed study would be required to assess the actual costs, which is outside the scope of this study.

6.2 Options For Growth

Options that are presented to satisfy growth objectives follow:

1. Expanded Surface Water Supply

Restoration of Hamilton Lake Dam and/or expanding the storage capacity of Allen Lake have been considered internally and in previous regional reports as options for increasing supply capacity to satisfy future growth in Cumberland (and the region). Preliminary discussions have been held with the Ministry of Environment (MOE) and Cumberland regarding fisheries issues on this matter, and correspondence dated June 13, 2007 has been received from DFO regarding

requirements under the Fisheries Act. A copy of this correspondence is included in Appendix 1. This correspondence and the discussions have suggested that any restoration work to the existing dams, or construction of additional storage in the watersheds will trigger improvements to fish habitat. Reference is made to Section 22(3) of the Fisheries Act stating that there is a requirement of an owner of an obstruction to provide sufficient flow to satisfy fisheries needs. DFO has indicated that 2.4 cfs would likely be needed downstream from the log bridge in Perseverance Creek in order to maintain a minimum base flow of 1.2 cfs in the lower reaches of the creek for minimum habitat needs. Based on a design drought period of 150 days (ie. 2006 event) this flow is equivalent to approximately 880,000 cu.m. of storage. The existing total constructed storage in the watershed is 891,000 cu.m., so it is apparent that any increased storage in Allen Lake or Hamilton Lake for domestic use would be claimed for Fisheries habitat by the release of water into Perseverance Creek during summer drought. Based on the above, it is reasonable to expect that future expansion of storage in the watershed to satisfy demands imposed by growth will involve a significant cost with limited return in order to satisfy fisheries requirements. Based on the information to date, this option does not appear to have much potential for added capacity.

2. Groundwater Supply

Groundwater as a supply source in response to the VIHA 4,3,2,1 policy has been discussed in the previous section. Although the two wells tested to date do not satisfy the volume required to avoid filtration of the existing surface supply, there is potential to supplement the existing surface supply to accommodate growth with funding from Development Cost Charges (DCC's). As an added benefit, if there is a decision to continue with the existing surface water supply, a portion of it (Stevens Lake dam for example) could be decommissioned temporarily for seismic upgrading and maintenance during the summer construction period if there is sufficient supplementary ground water available.

These benefits are contingent upon the adoption of a well (or wells) of suitable quality and capacity to satisfy the above criteria. Well exploration, drilling and testing activities include some risk. Although preliminary surficial geology review of potential well sites and related activities can improve the odds of success, actual drilling and testing are costly, sometimes yielding wells with poor quality water or limited flow capacity. These issues have been considered during the preparation of Cumberland's Developer Initiated Well policy, to ensure that Cumberland has an opportunity to approve or reject any groundwater source proposed by the development community, to suit the public interest.

The two developer initiated well applications submitted to date could be used to supplement growth for 10 – 15 years, and possibly more, depending on additional long term pump testing results. The two developer initiated wells are noted as :

1. Wacor Well – Located at the end of Hope Street as shown in Fig. 1, this well was initiated by Coal Valley Estates.
2. Lot 11 Well – Located east of Maple Lake as shown in Fig. 2, this well was initiated by Trilogy Properties.

It should be noted that although the well applications were initiated by the two developers, there is no commitment by Cumberland to accept either or both of them. Further, if one or both are accepted, development rights are not included. If a well is accepted and adopted by the Village, applications for development are dealt with on a first come/first served basis. If a developer constructs the works required to connect the well to the existing system, Water DCC credits will offset DCC fees related to the development.

A comparative analysis of the two well applications is attached in Appendix 2. The Lot 11 well has a potentially higher capacity and lower risk of contamination than the Wacor well, but has higher capital and operating costs due to the additional treatment required for removal of iron and manganese. The estimated development costs of these wells are noted in Table 3 below for comparison.

Table 3

Well Application	Estimated Capital Cost	Estimated Annual O&M Costs	Estimated Capital Cost per new Residential Unit	Estimated Annual O&M cost per Household
Wacor Well (Coal Valley)	\$1,032,000	\$20,000	\$1,950	\$11
Lot 11 Well (Trilogy)	\$1,372,000	\$40,000	\$2,594	\$22

3. Regional Water Supply

As noted in the previous section, the Draft Comox Valley Regional Water Supply Strategy report included a comparative analysis of options using Net Present Value (NPV) of capital and operating costs over a 50 year period, assuming an annual growth rate of 3.11% .

Cumberland's share of the CVRD's recommended Regional Supply Option (R1) can be compared to the other options considered for growth. The regional option has a significant benefit in that it also satisfies the VIHA 4,3,2,1 policy. Cumberland's share of the capital cost for this option was estimated to be approximately \$15.32M with a contributing population of 21,672 people, resulting in a capital cost per person of approximately \$707 or roughly \$1,767 per household. O&M costs were estimated to be approx. \$54.30 per household.

6.3 Options That Satisfy Both VIHA Policy & Growth

Three options may be implemented to accommodate VIHA 4,3,2,1 policy and growth. The following examples are used to indicate what options or combinations of options could be considered.

1. Groundwater/Existing Surface Water Supply Blend –Growth to 7692 people

If a regional solution is not considered appropriate or suitable for Cumberland, an option to combine improvements to the existing surface water supply with groundwater options could be used to satisfy both the VIHA policy and increased water consumption resulting from growth. In order to evaluate this option as a long term water strategy, both Wacor and Lot 11 wells are assumed to be implemented (but not necessarily at the same time). Each well is assumed to accommodate 592 residential lots in accordance with the rated capacity of each well as per the developer's reports submitted to date. Table 4 illustrates the estimated costs of this option.

Table 4 - Groundwater/Existing Surface Water Supply Blend

Option	Est. Capital Cost	Est. Cap Cost/ New Lot (DCC)	Est Cap. Cost/ exist. Household	Est Annual O&M per Household
Groundwater (WACOR)* (1322) people)	\$1,032,000	\$1,950	\$17**	\$11
Groundwater (Lot 11) (1322) people)	\$1,372,000	\$2,595	\$23**	\$22
Exist. Surface Water Supply (5048 people)	\$9M		\$4,457	\$94
Blended (7692 people)	\$11,404,000	\$2,273	\$4,457	\$127

* VIHA Source Approval Pending ** assuming 1% community contribution to DCC projects

2. Regional Supply + Groundwater – growth to 22,994 people

In Recognition that one of the options may not be sufficient to satisfy long term growth, but could be implemented quickly and comparatively economically with some certainty until another source is available, a combination of two or more options may be applicable. In this example, if a regional water supply is adopted as a long range supply strategy, but the implementation of this option is up to 10 years away, an interim groundwater option could be considered. This does not mean that the groundwater source would be abandoned once the other source is

available, but could be used to supplement the other source, thus reducing the size and cost of some components. This option is based on the notion that by making a commitment to a regional plan (or other plan) that ultimately resolves the VIHA 4,3,2,1 issue, then Cumberland’s operating certificate could be amended to delay the VIHA compliance beyond 2017 until the regional facility is completed. Estimated costs of this example are presented in the following table to show a blended combination of ground water and Regional Supply (R1).

Table 5 - Groundwater/Regional Blend

Option	Est. Capital Cost	Est. Cap Cost per New Lot	Est Cap. Cost/ exist. Household	Est Annual O&M cost/ Household
Groundwater (WACOR) * (1322) people)	\$1,032,000	\$1,950	\$17**	\$11
R1 Regional (21, 672 people)	\$15,320,000	\$1,767	\$1,767	\$54
Blended (22,994 people)	\$16,352,000	\$1,778	\$1,767	\$65

* Wacor well used in this example (the lowest cost groundwater option (subject to VIHA Source Approval)).

** assuming 1% community contribution to DCC projects

3. Regional Supply - growth to 21,672 people

This option is described earlier in the report as the Regional Option R1 from the Comox Valley Regional Water Supply Strategy. This option has been used for this review since it was concluded in the study to be the lowest cost option to the Village of Cumberland of all the options studied by the CVRD. Subsequent to submission of the draft report to the Village of Cumberland on February 14, 2011, the CVRD advised that another option, (R5) will be included for further analysis. Option R5 proposes a deep water intake on the Cumberland side of Comox Lake as the main regional supply source as opposed to a deep intake on the north side of Comox Lake as per Option R1. Option R5 could offer some overall savings to all stakeholders according to preliminary discussions with the project manager of the regional study, however, until this option is given further study, it has not been considered in this review, except to comment on what impact a lower cost regional option will have on Cumberland’s options. Estimated costs of Option R1 are identified earlier and are summarized in Table 6.

7.0 Cost Summary

When comparing the three options which will satisfy both VIHA 4,3,2,1 and growth the Regional Option (R1) shows a significant cost advantage as illustrated in the following table. It would be reasonable to suggest that if R5 proves to be less cost, then the regional option becomes even more favoured. It is interesting to note that there is no difference in Option 2 and Option 3 with respect to capital cost to existing households, but annual O&M costs for Option 2 are slightly higher.

Table 6

Option	Est. Capital Cost	Est. Cap Cost per New Lot (DCC)	Est Cap. Cost per exist. Household	Est Annual O&M cost/ Household
Option 1 (7692 pop) Groundwater/Existing Surface Supply Blend	\$11,404,000	\$2,273	\$4,457	\$127
Option 2 (22,994 pop) Groundwater/Regional Blend	\$16,352,000	\$1,778	\$1,767	\$65
Option 3 (21,672 pop) Regional Option R1	\$15,320,000	\$1,767	\$1,767	\$54

8.0 Discussion of Options

There are only two of the three options reviewed which appear to be feasible for satisfying the VIHA 4,3,2,1 policy, assuming no provision for growth. There has been insufficient groundwater capacity proven to date by the developer initiated groundwater investigations to prove this option as being viable. The Regional R1 option appears to have the least cost per household, chiefly due to economies of scale. Direct comparison of these options is not available, since the Draft Comox Valley Regional Water Strategy report did not include a no-growth option, and a straight line interpolation would not likely result in an accurate estimate. For purposes of this review we have assumed that the capital and operating costs of a reduced Regional R1 option would be similar to or less than the capital and operating costs of "going it alone" with upgrading of existing surface supply treatment with filtration and dual disinfection.

It is quite clear that the Regional R1 option is the most economical choice for a long range water supply strategy for Cumberland with respect to growth as well as the VIHA 4,3,2,1 policy. However, if it is unlikely that a regional water supply will be available within a reasonable period (say 5 years), Cumberland may wish to proceed with a supplementary water supply to sustain growth until the regional supply is available, and groundwater development appears to be the most feasible solution. The resulting impact on the DCC capital cost per new lot is negligible and there is maximum of 1% contribution from Cumberland on the DCC projects. There will be some additional O&M costs associated with the well pump and related facilities.

Water quality from the Wacor well samples meets the Canadian Drinking Water Quality Guidelines except for pH which can be corrected by adding a buffering agent. Although this well is considered as groundwater under the influence of surface water (GUDI), turbidity did not appear to be an issue, therefore, U/V and chlorination are assumed to be suitable disinfection for this well. The Wacor well is considered susceptible to surface contamination, and although the hydrogeologist report indicated that there was no connection between the Pidgeon L. landfill and the Wacor well aquifer, the potential for contamination from the Pidgeon Lake Landfill was not completely ruled out. This would need to be clarified if this well is used to supplement the Cumberland supply. The well and aquifer yield at this site is limited to 200 US gpm (12.62 l/sec). This well would be capable of supplying summer demand to approximately 529 new residential lots. Capital and annual O&M costs per household for this well are estimated to be \$1.032M and \$11 respectively. Further comments and details of the Wacor well report can be found in Appendix 2 for reference. VIHA source approval is pending on this well.

The Lot 11 well could also be used to supplement Cumberland's water supply. This well is deemed to have little risk of contamination, but the water will need to be treated to remove iron and manganese prior disinfection and distribution. U/V and chlorination are assumed to be suitable disinfection for this well. Although this well yield was rated similar to the Wacor well (12.62 l/sec) the report suggested that additional yield may be achieved, based on observations of well recovery and specific capacity. Additional investigation was recommended by the hydrogeologist in order to evaluate the additional yield potential. Capital and annual O&M costs for this well are estimated to be \$1.372M and \$22 respectively. Further comments and details of the Lot 11 well reports can be found in Appendix 2 for reference.

9.0 Conclusions

It is clear that a VIHA policy solution with allowance for growth is needed as a long range water supply strategy for the Village. Among the options considered, a regional solution is the best option for Cumberland for the following reasons:

1. A regional supply option provides the lowest capital and O&M costs for the existing and future households of Cumberland.
2. A regional water supply would satisfy VIHA 4,3,2,1 policy and also accommodate growth
3. Cumberland's borrowing capacity would be exceeded if attempting to finance the project internally through borrowing.
4. Grant funding is more likely to be available if there is a regional benefit.

The Regional R1 option used in this report represents the least cost option to Cumberland in the Draft Comox Valley Regional Water supply Strategy report, but further investigation on a new option (R5) with a deep water intake at the Cumberland side of Comox Lake could prove to be more economically attractive. Either regional option could be suitable as a long range water supply strategy for Cumberland.

It is likely that planning, engineering, preparation of a governance model, and construction could take at least 5 years to complete. In the interim, a supplementary supply using groundwater is a viable solution to satisfy growth. This would not resolve the VIHA 4,3,2,1 policy, but combined with a regional commitment, could form a reasonable amendment to the operating permit, deferring VIHA 4,3,2,1 improvements until a regional solution is implemented.

10.0 Recommendations

Based on the observations and conclusions noted above, a long range water supply strategy for Cumberland can be adopted for the benefit of existing and future residents and businesses of the community. The long range water supply strategy is recommended as follows:

1. Continue to work with the CVRD towards adoption of a regional strategy which includes Cumberland as a stakeholder.
2. Participate in negotiations with the CVRD to develop a suitable governance model.
3. Encourage the CVRD and benefitting members to expedite the implementation of the strategy within the next 5 years.
4. Include groundwater as a supplementary source to enable growth during the interim period before the regional system is operational.
5. Select a groundwater source or sources based on hydrogeological investigation and testing, engineering, current policy and operational merit, to provide the most suitable water supply supplement.

11.0 Closure

This report has been prepared by McElhanney Consulting Services Ltd. exclusively for the Village of Cumberland. It has been prepared in accordance with normally accepted practices and in accordance with the terms of reference for this engagement.

Much of the information presented in this report has been obtained from other background reports and as a result of interviews with Village of Cumberland staff. We would like to thank those who assisted with the this effort, and appreciate the opportunity to be of service.

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