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An Assessment of Beaver Creek Water Source Options

Introduction

The water supply system currently servicing the Beaver Creek community is unable to meet the water quality and treatment standards of the Vancouver Island Health Authority (VIHA). Alberni-Clayoquot Regional District (ACRD) has identified the following three broadly-defined strategies as potential water source options for the Beaver Creek service area based on earlier assessment reports.

Source Option #1: The community continues with an independent water supply funding its own water treatment plant, manages and operates the existing water system retaining Stamp River as the source of water;

Source Option #2: The community obtains water through a connection to the City of Port Alberni (CPA) and through a bulk water purchase agreement. The Beaver Creek Service Area (BCSA) forfeits source water acquisition and treatment responsibilities while retaining responsibility for funding and operating distribution infrastructure including a new pumping station and re-chlorination facility; and

Source Option #3: The community obtains water through a connection to the larger regional water system established by the Regional District with the City as the other funding partner. The Region assumes responsibility for water supply while partners maintain independent distribution systems.

As a first step in the selection process, the ACRD commissioned McElhanney Consulting Services Ltd. (McElhanney) to conduct a comparison of the three options using the currently available information. This type of assessment requires consideration of life-cycle costs (combined capital and O&M, operations and maintenance costs), system reliability and shifts in level of reliance that the community would have to place on others.

Existing Relevant Information and Conditions

Appendix A – Background Reports identifies the primary sources of available relevant information and includes contents summaries. Koers and Associates Engineering Ltd (Koers) conducted most of the earlier technical studies on behalf of the Beaver Creek Improvement District (BCID), CPA and ACRD and one of the objectives of this current study is to provide a third party review of this background information. The review and assessment involve making comparisons based on this information and identifying any information gaps significant to the selection of a preferred water source option.



A primary objective of the selection process is to present overall costs of each water supply option in a readily understood format, namely dollars per cubic metre (\$/m³) of billed water. The following list of assumptions and summary of existing conditions represent the starting point of the selection process.

Assumptions

1. Comparisons are for the water supply and treatment elements and exclude the downstream water distribution system;
2. The costing horizon is 25 years;
3. Population growth is considered over the next 25 years at:
 - a. 0.5% per annum for BCSA taking the estimated current population of 2,380 persons to 2,700 persons by year 2038;
 - b. 0.5% per annum for the City of Port Alberni (CPA), taking the estimated current population of 18,240 persons to 20,660 persons by year 2038;
4. Water consumption rates remain constant over the period at 0.55 m³/c/d for BCSA, and 0.67 m³/c/d for CPA;
5. Cost calculations beginning with:
 - a. Capital and O&M estimates developed in the background reports noted above, as applicable and calculated in 2010 \$s to be consistent with these earlier reports.
 - b. Full amortization of capital costs of the 25-year period with the earlier adopted interest rate (5% per annum).
 - c. CPA current bulk water purchase rates, with the City projected cost escalations of 10% per annum for the next five years and 3% per annum for the balance of the 25-year period.

Existing Conditions

Comparisons are made on a \$/m³ supply basis and Table 1 – Billed Water Volumes shows the projected volumes of billed water for the 25-year period used in those comparisons. These volume projections are based on population growths and per capita consumption levels presented in the Appendix A - Background Reports.

Table 1 – Billed-Water Volumes (2013 – 2038)

Community	Accumulated Consumption (m³)	Average Annual Consumption (m³/year)	Current Annual Consumption (m³/year)
BCSA	12,700,000	508,000	480,000
CPA + BCSA	132,970,000	5,319,000	5,000,000

Current water costs (supply and distribution) are calculated to be approximately \$1.55/m³ based on the current annual water consumption levels and the 2013 budget expense figures for Beaver Creek Water System (BC Water System). The budget allocates costs as three components; administration; operating expenses, and capital development. Administration amounts to \$0.26/m³ and the variation in this cost component between supply options would be minimal. Calculated unit rates for the other two cost components are given in Table 2 – Existing Water



Supply Costs. The table values are total costs (supply and distribution) and best available estimates in separating out the water supply portion.

Table 2 – Existing Water Supply Costs (2013)

Cost Component	Supply Portion \$ (%)	Distribution Portion \$ (%)	Supply + Distribution
Annual capital works program	\$0.11/m ³ (64%)	\$0.06/m ³ (36%)	\$0.17/m ³
Day-to-day operations	\$0.38/m ³ (35%)	\$0.74/m ³ (65%)	\$1.12/m ³
Totals	\$0.49/m ³	\$0.80/m ³	\$1.29/m ³

Taxes and tolls are revenues sources that cover the costs of owning and operating the BC Water System.

Given present water costs as context, the following discussion addresses the costs of the three water supply options identified in the first paragraph of this report.

Source Option #1 - Beaver Creek Service Area Continues to Use Stamp River for Source Water and Continues to Operate a Stand-alone Water System

The scope of capital works that this option requires includes both upgrades to the Stamp River infiltration gallery system and water treatment facilities. Sub-options are considered based on two different water treatment systems others assessed in earlier studies. These sub-options coincide with the membrane filtration process that Koers used for costing purposes, and the conventional filtration treatment process that Corix Utilities adopted in their proposal.

The status and location of the site proposed for the water treatment plants are factors also relevant to the planning and costing of this option.

1. BC water system does not currently have property to construct the proposed facility.
2. The site assumed in the Koers and Corix proposals is:
 - o Located within the ALR and use would require approval, and
 - o Located within the 200-year floodplain with associated additional construction and mitigation costs. We have used an allowance of \$150,000 as an order-of-magnitude cost for estimating and comparison purposes.
3. The ACRD has identified land values for a 3-acre site to be in the \$352,000 (assessed value) to \$700,000 (previous BCID offer) range. The mid-range value is used for costing purposes.

Table 3 – Source Option #1 Water Supply Unit Costs breaks out the costs for an independent supply based on the above information and assumptions.



Table 3– Source Option #1 Water Supply Unit Costs

Cost Elements	Source Option #1a (Membrane Filtration)		Source Option #1b Conventional Filtration	
	Initial & annual costs	\$/m ³	Initial & annual costs	\$/m ³
Intake Works	\$800,000	0.11	\$800,000	0.11
O&M costs (IW)	\$22,800	0.04	\$22,800	0.04
Treatment Works	\$3,832,000	0.53	\$2,565,800	0.36
O&M costs (T)	\$291,900	0.57	\$175,700	0.35
Land Purchase	\$526,000	0.07	\$526,000	0.07
Flood Protection Allowance	\$150,000	0.02	\$150,000	0.02
Overall costs (\$/m ³)		\$ 1.34		\$ 0.95

Capital expenditures are up-front costs to construct the water supply system. The figures in Table 3 are derived from facility cost estimates presented in the Koers and Corix reports, and unit costs (\$/m³) are calculated by dividing their amortized values by the billed-water volumes in Table 1. O&M unit costs (\$/m³) are calculated as accumulated expenditures over the 25-year period divided by the same Table 1 billed-water volumes.

Capital costs for Source Option 1a are essentially the same values Koers presented in relevant reports to the Improvement district, City and Regional District. Capital costs for Source Option #1b treatment works are adjusted Corix Utilities figures included in their proposal to BCID. Adjustments were made to contingency and engineering allowances to provide greater consistency with the Koers estimates. With this approach, the comparison is between the treatment technologies and not the delivery methods.

O&M costs for Option 1a and Option 1b are derived through a number of methods including:

1. Stats Canada analysis of water supply system data collected during extensive surveys in 2005, 2006 and 2007.
2. Generalized cost curves^{1,2}, and
3. Asset management studies³

Pilot testing is a particularly important element of preliminary engineering design in the case of the membrane filtration option. The testing is required to determine if chemical pre-treatment is necessary. Koers has assumed that pre-treatment would be required, but capital and operating costs could be as much as 20% lower if it was not. In either case, the cost of membrane filtration based on the comparative costs found through this assessment would be higher than conventional filtration.

¹ William T. McGivney et.al. Cost Estimating Manual for Water Treatment Facilities, John Wiley & Sons, 2008

² Kerry J Howe, Mark M Clark; Coagulation Pre-treatment for Membrane Filtration; 2002

³ Ontario Ministry of Public Infrastructure Renewal; Water and Wastewater Asset Cost Study; R.J. Burnside & Associates Limited; May 2005



Source Option #2 – Beaver Creek Enters into a Bulk Water Purchase Agreement with the CPA for Treated Source Waters

Under this option, the CPA has the responsibilities for water acquisition and treatment while BCSA has responsibility for funding and operating the required local infrastructure. Local infrastructure required for this option includes a new pumping station and re-chlorination facility.

Local infrastructure refers to connection to the City water distribution system and includes a combined booster pumping station and re-chlorination facility with associated piping to connect to the CPA water distribution system. Koers investigated connection options for two pressure zones. Costing based on connection to the 65 m pressure zone and new piping routed along Strick Road is presented in Table 4 - Source Option #2 Water Supply Unit Costs.

Table 4–Source Option #2 Water Supply Unit Costs

Cost Elements	Option 2 (Bulk Water)	
	Initial & annual costs	\$/m ³
Pumping/Re-chlorination Station	\$567,000	0.08
O&M costs (Station)	\$20,200	0.04
Bulk-Water Purchase		0.66
	Overall costs (\$/m ³)	\$ 0.78

Costs for bulk-water purchase are from Schedules “A” and “B” attached to Port Alberni’s Waterworks Bylaw No 4494. At BCSA’s current consumption rates and billing rates outlined in the bylaw schedules, water purchases would initially be at \$0.326 /m³. Annual increases are anticipated; 10% per annum for the next five years and 3% per annum thereafter. At these escalation rates water purchase would reach \$0.95/ m³ by the end of the 25-year period, and the average over the period would be \$0.66/ m³.

Estimated cost of water with this option over the 25-year period is approximately 18% less than the Source Option #1 lowest-cost scenario.

Source Option #3 - Beaver Creek Obtains Treated Source Water from Alberni Valley Regional Water System

The scope of capital works for this option includes upgrades to the CPA water supply system as well as connection to the BCSA distribution system. That connection would be as previously described “local infrastructure” under Source Option #2 – Bulk-Water Purchase. The CPA upgrades Koers described as “Regional Option II China Creek/Bainbridge Lake in Combination with Sproat Lake” in the Regional Water Study Report. Table 5 – Regional Water Supply System Upgrades outlines the region’s costs for water acquisition, treatment facilities, and cost allowance applicable to this option.



Table 5– Regional Water Supply System Upgrades

China Creek/Bainbridge Lake/Sproat Lake Regional System Upgrades	Capital Cost Estimate⁴
Pump Station and Water Treatment Plant at Stamp Avenue (20,000 m ³ /d); Initial installation of UV and chlorination	\$2,500,000
Water Treatment Plant at Bainbridge (30,000 m ³ /d); Initial installation of UV and chlorination	\$2,500,000
SCADA & Instrumentation	\$300,000
Construction Subtotal	\$5,300,000
Contingencies, Engineering and Administration (40% of Construction)	\$2,120,000
New Works Total	\$7,420,000
Negotiated charge item for connection to the existing Catalyst Sproat Lake Water Supply System	undefined
City Project Total	\$7,420,000+

The region requires the above infrastructure to meet VIHA current standards and the full serviced area would benefit with implementation. On this basis, allocation of costs to the full serviced population is appropriate. In terms of timing, the CPA Capital Development Program has the Bainbridge works scheduled for 2014 and the Sproat Lake/Stamp Avenue works for 2015.

Two important factors to note with this option are the following.

1. Moving forward requires securing Sproat Lake as a water source through negotiation with Catalyst Paper Corporation (Catalyst), and
2. Costing assumes that any requirement for filtration as part of the treatment process would be deferred beyond the 25-year planning horizon.

While negotiations with Catalyst have not yet begun some costing assumptions have to be made to enable comparison of this approach to the other options. An assumed Catalyst connection cost of \$1 million is used in the following summary table for illustration purposes.

The second item, deferral of filtration, is possible because of the high quality (low turbidity) of Sproat Lake waters. The period of deferral is largely dependent upon maintaining the high quality of the raw water and upon ensuring the new disinfection facilities provide reliable service. Existing data suggests that deferral of filtration beyond 25 years is a reasonable expectation.

Beaver Creek’s access to this new water source requires use of existing CPA infrastructure and cost sharing of these jointly-used components would be expected. The City and ACRD have identified the shared infrastructure and determined a prorated value based on remaining useful life (Appendix B). The prorated value of the shared-use infrastructure is estimated as \$10,241,000. Beaver Creek’s portion of this shared infrastructure value is \$980,000 based on

⁴ Alberni-Clayoquot Regional District; Alberni Valley Regional Study Update; Koers & Associates September 2010, Table 7



estimated, year 2013 water consumption levels. Consumption estimates are 5,000,000 m³/year for CPA+BCSA combined and 480,000 m³/year for BCSA alone (Table 1).

Table 6 – Source Option #3 Water Supply Unit Costs includes the shared-infrastructure and assumed Catalyst amounts, both amortized over the 25-year planning horizon.

Table 6– Source Option #3 Water Supply Unit Costs

Cost Elements	Option 3 - (Regional Partnership)	
	Initial & annual costs	\$/m ³
Regional System Upgrades	\$7,420,000	0.10
O&M costs (Beaver Creek portion)	\$60,700	0.12
Use of Existing City Infrastructure (Beaver Creek portion)	\$980,000	0.14
Capital Charge from Catalyst (Beaver Creek portion)*	\$115,032	0.01
Pumping/Re-chlorination Station	\$567,000	0.08
O&M costs (Station)	\$20,200	0.04
Overall costs (\$/m ³)		\$ 0.49

**Catalyst connection costs are undefined but assumed to be \$1M for comparison purposes.*

Table 6 refers to the initial cost of the Regional System Upgrades and this estimate is for the full project. Beaver Creek’s portion of this capital cost is \$708,800 and the unit cost of \$0.10/m³ applies to all users to cover amortization of these capital costs.

Continued use of shared-infrastructure suggests a likelihood of BC participation in funding future upgrades as well. This is an undefined, shared, capital cost of relatively minor significance similar in nature to the Catalyst provision. Table 6 shows that a Catalyst allowance funded at a \$1M level would not be a significant factor in differentiating the cost of Beaver Creek’s supply options.

This option by way of comparison has an estimated supply cost over the 25-year period approximately 37% lower than Option 2. Overall costs with Option #3 are estimated to be close to existing water supply costs and O&M at less than half the current \$0.38/m³ figure (Table 2).

Abbreviated Triple Bottom Line Assessment

The triple bottom line (TBL) analysis is a formalized approach to assess the relative merits of different options. The three dimensions that a TBL analysis considers are: (1) environmental, (2) social/community, and (3) economic, and each option is rated with respect to those considerations. The rating process typically is formal and provides a means of quantification. This report, however, adopts a qualitative rather than quantitative approach and ranks each option within each of the three dimensions.



Conclusions

The three water supply options have significantly different environmental, social and economic features which are considered in the ranking process. Source Option #3 (regional partnership) is ranked highest on all three scales, environmental, social and economic.

In relation to the costs, water production costs for Source Option #3 are estimated at 32% less than the next alternative and cost uncertainties do exist for all three options. Initial capital costs and on-going operations costs are major uncertainties in relation Source Option #1. Future bulk water charges are a significant uncertainty in relation to Source Option #2. Catalyst negotiations and future funding requirements to maintain/upgrade shared CPA infrastructure are relatively minor uncertainties in relation Source Option#3.

Factors that impact implementation timing for Source Option #1 are pilot testing and design. Source Option #2 as a water source is readily available but VIHA quality standards will not be met until the CPA implements the Source Option #3 capital works. In relation to Source Option #3, the CPA's Capital Development Plan is a major timing factor with related capital expenditures beginning in 2014.

Recommendations

McElhanney recommends that:

1. The pumping/re-chlorination station be constructed this year.
2. Beaver Creek implement Source Option #3 to obtain treated source waters from the Alberni Valley Regional Water System, and
3. Related agreements are coordinated with CPA.

Respectfully submitted
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Economics:

The ranking from highest to lowest is:

Option #3 – Regional Partnership	<p>Ranking is based on the costing described above.</p> <p>Economic advantages of Option #3 arise from:</p> <ol style="list-style-type: none"> 1. A source with higher/more consistent water quality, 2. Economies of scale, and 3. The highest potential for receiving senior government funding. <p>Economic advantages of Option #2 are :</p> <ol style="list-style-type: none"> 1. Lowest capital cost, and 2. Suitable as a short-term solution <p>Option #1 has the highest capital and operating costs.</p>
Option #2 – Bulk water	
Option #1 – Stand-alone system	

Environmental:

The ranking from highest to lowest is:

Option #3 – Regional Partnership	<p>Ranking is based on the quantities of chemical used, waste solids/residuals produced, and plant siting issues.</p> <ol style="list-style-type: none"> 1. Option #2 and Option #3 have the highest and identical rankings. 2. Option #1 ranks lowest in relation to all three factors (chemicals, residuals and plant siting)
Option #2 – Bulk water	
Option #1 – Stand-alone system	

Social/Community:

The ranking from highest to lowest is:

Option #3 – Regional Partnership	<p>Ranking is based on system reliability levels, levels of uncertainty, and BCSA involvement in decision making.</p> <ol style="list-style-type: none"> 1. Option #3 has the greatest level of system redundancy and operating assurance. This option has the lowest level of cost uncertainty; 2. Option #1 is BC directed. Cost uncertainties are significant given plant location issues, outstanding treatability studies and available economies of scale are very limited. 3. Option #2 is dependent on City policy in which BCSA would have limited input. For those reasons this option has the highest level of uncertainty.
Option #1 – Stand-alone system	
Option #2 – Bulk water	



APPENDIX A - SUMMARY OF BACKGROUND REPORTS

Document	Relevant Information
<p>BCID <u>Water Service Delivery Options</u>; August 2011 Sussex Consultants Inc. (Sussex)</p> <p><i>Conversion analysis prepared for BCID to consider governance options for the service.</i></p>	<p>Summary:</p> <p>Role of the report:</p> <ol style="list-style-type: none"> 1. Identifies two go-it alone options and two regional options; 2. Go-it-alone options are based on different treatment processes and delivery models (Koers membrane filtration option with traditional project delivery, and Corix’s conventional filtration treatment process with a design-build-operate service contract); 3. Estimates O&M costs based on the current BCID operating budgets and combines these with capital and O&M costs the earlier reports provided. 4. Cost analysis for all aspects including administration
<p>BCID <u>Water Infrastructure Assessment</u>, May 2011 (Koers)</p> <p><i>Prepared for the consideration of BCID being changed to a local service area of the ACRD. A comprehensive review of the state of the water system and required upgrades to compare governance options.</i></p>	<p>Salient conclusions:</p> <p>Capital costs of two water supply options:</p> <ol style="list-style-type: none"> 1. BCID continuing on its own = \$4,800,000. 2. BCID as Part of Alberni Valley Regional System = \$3,310,000. (BCID portion of the regional system at \$2,500,000 and connection at \$810,000)
<p><u>Feasibility Assessment Report for BCID Water Treatment & Distribution Solutions</u>; December 15, 2010; Corix Utilities (Corix);</p> <p><i>Commissioned by BCID to consider a water supply and distribution agreement for operation, maintenance and implementation of required upgrades to BCID water system.</i></p>	<p>Summary:</p> <ol style="list-style-type: none"> 1. Description of a conventional filtration treatment system at a conceptual level; 2. Design-build-operate proposal based on amortization over a 21-year period (term of contract) for the combined water supply, treatment and distribution systems.
<p>ACRD <u>Alberni Valley Regional Water Study Update</u> – Final Report ; September 2010; (Koers)</p> <p><i>ACRD, BCID, CCID and CPA review of regional water supply options</i></p>	<p>Summary:</p> <ol style="list-style-type: none"> 1. Beaver Creek was considered in two options; one as a separate stand-alone system and the other as a participant of an Alberni Valley Regional Water System. 2. Estimated capital costs were \$4,600,000 for the stand-alone option and \$10,643,500 for the recommended Regional Option II. Primarily features of Region Option II are Sproat Lake as a new supplemental water source



	and dual level disinfection facilities for both Bainbridge and Sproat Lake sources. Report identifies the BCID portion of this regional system as \$2,652,649 with an additional \$500,000 capital cost contribution for use of CPA's existing infrastructure.
<p><u>BCID Water Source Options & Treatment Study; April 2010 (Koers)</u></p> <p><i>Commissioned by the BCID to evaluate supply options for developing the appropriate 4-3-2-1 plan</i></p>	<p>Summary:</p> <ol style="list-style-type: none">1. BCID stand-alone systems<ol style="list-style-type: none">a. Four surface water systems and one groundwater systemb. All surface water systems draw from the current source (Stamp River).c. Capital costs of the surface water systems ranged from \$3.69 to \$6.09M.d. Capital costs of the membrane filtration plant and intake upgrades total \$4,600,000.
	<ol style="list-style-type: none">2. Connection to Port Alberni system<ol style="list-style-type: none">a. Two pressure zone options and different locations within them were considered;b. The lower cost options are to connect to the City's 65m pressure zone. The Strick Road sub-option has an estimated project capital cost of \$890,000.

APPENDIX B
SHARED-USE INFRASTRUCTURE

**WATER SUPPLY INFRASTRUCTURE ASSETS
UTILIZED IN SERVING BEAVER CREEK -
VALUATION**

Prorated Value
based on
remaining useful
life

Replacement
cost as of 2012

Year in
Service

Useful
Life

Remaining
Useful Life

LINEAR INFRASTRUCTURE (SUPPLY MAINS)

SIZE (mm)	PIPE TYPE	TOTAL LENGTH (m)					
150	CI	0	\$ -	1948	75	10	\$ -
150	AC	191	\$ 66,127	1973	75	35	\$ 30,859
200	AC	1178	\$ 428,174	1973	75	35	\$ 199,815
200	PVC	523	\$ 190,098	1994	75	56	\$ 141,940
200	CI	0	\$ -	1948	75	10	\$ -
250	AC	123	\$ 47,259	1973	75	35	\$ 22,054
250	CI	710	\$ 272,795	1948	75	10	\$ 36,373
300	CI	474	\$ 189,509	1948	75	10	\$ 25,268
300	DU	1432	\$ 572,526	1960	75	22	\$ 167,941
300	AC	470	\$ 187,910	1973	75	35	\$ 87,691
300	PVC	511	\$ 345,256	1994	75	56	\$ 257,791
300	STEEL	365	\$ 145,930	1930	75	0	\$ -
350	AC	3202	\$ 1,397,566	1973	75	35	\$ 652,197
350	PVC	0	\$ -	1994	75	56	\$ -
350	DU	243	\$ 106,061	1960	75	22	\$ 31,111
400	AC	0	\$ -	1973	75	35	\$ -
400	PVC	702	\$ 287,695	1994	75	56	\$ 214,812
400	DU	194	\$ 79,505	1960	75	22	\$ 23,322
425	DU	1368	\$ 614,783	1960	75	22	\$ 180,336
425	CI	112	\$ 50,333	1948	75	10	\$ 6,711
450	AC	231	\$ 122,634	1973	75	35	\$ 57,229
450	DU	0	\$ -	1960	75	22	\$ -
450	PVC	0	\$ -	1994	75	56	\$ -
450	STEEL	213	\$ 113,078	1930	75	0	\$ -
500	DI	354	\$ 327,851	2003	75	65	\$ 284,138
500	HDPE	3244	\$ 1,450,324	2007	75	69	\$ 1,334,298
500	PVC	1509	\$ 1,379,939	2007	75	69	\$ 1,269,544
600	STEEL	5063	\$ 5,139,149	1968	75	30	\$ 2,055,660

SUPPLY MAIN TOTAL	22412	\$ 13,514,504	\$ 7,079,091
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OTHER SUPPLY INFRASTRUCTURE (RESERVOIRS, DAMS, PUMPS)

CHINA CREEK INTAKE	\$ 2,721,616	1932	200	119	\$ 1,619,361
BAINBRIDGE LAKE INTAKE(earth dam)	\$ 280,002	1950	200	137	\$ 191,801
LIZARD LAKE DAM	\$ 980,006	1984	200	171	\$ 837,905
BAINBRIDGE PUMPHOUSE-EQUIPMENT	\$ 265,918	2007	45	39	\$ 230,462
BAINBRIDGE PUMPHOUSE-BUILDING	\$ 309,341	1963	40	0	\$ 282,542
RESERVOIR/DAM/PUMPS TOTAL	\$ 4,556,882				\$ 3,162,071

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TOTAL SUPPLY INFRASTRUCTURE VALUATION	\$ 18,071,386		\$ 10,241,162
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** Building values taken from Insurance Statement of Values for 2012