

0  
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99

APPENDIX "C"  
Capital and Operating & Maintenance Cost Calculations

Town of Ladysmith  
 Operating & Maintenance Cost Estimates

Assumptions

Design Flows (ML/d)	Arbutus	South End
Average Day	4.8	1.43
Peak Day	10.1	3.1

No. of Months of Ozone System Operation 4 months per year

Unit Costs

Cost of Labour (burdened)	\$ 60	per hour
Cost of Power	\$ 0.07	per kWh
Cost of LOX	\$ 0.30	per Sm <sup>3</sup>
Cost of Sodium Bisulphite	\$ 0.50	per kg
Cost of Gas Chlorine	\$ 0.15	per kg

Specific Gravity of LOX 1.31 kg/Sm<sup>3</sup>

Ozone Dosages

Average	3	mg/L
Maximum	5	mg/L

Ozone in Oxygen Concentration

At Average Day	10%	ozone-in-oxygen
At Peak Day Production	6%	ozone-in-oxygen

Sodium Bisulphite Dosages

Average	0.25	mg/L
Maximum	0.5	mg/L

Chlorine Dosages

Average	2	mg/L
Maximum	2.5	mg/L

UV Design Fluence

40 mJ/cm<sup>2</sup>

Ozone Generation Power Demands

Ozone Generator, rated		kW each	2	duty	0	standby
Ozone Destructor, rated		kW each	1	duty	1	standby
Specific Energy Consumption	10	kWh/lb ozone produced				

UV Reactor Rated Power Demands

UV Reactor (300 mm), rated [ ] kW each

Arbutus WTP

Ozone System Costs

1. Energy Costs

Average Daily Ozone Production	14.4	kg/d		
	31.7	lb/d		
Estimated Ave. Daily Energy Usage	317	kWh per day		
Estimated Ave. Daily Energy Cost	\$ 22	per day		
Estimated Annual Energy Cost	\$ 2,756	per year, based upon	4	months per year of ozone plant operation

2. LOX Costs

LOX Usage is ZERO, since air feed is assumed				
LOX Usage	0	kg LOX per day, when plant is in service		
Assume	0	kg LOX per day bleeds from the system when ozone not in use		
Estimated Annual LOX Usage	0	kg per year		
Estimated Annual LOX Cost	\$ -	per year		

3. Maintenance Materials

	\$ 1%	of equipment cost per year	Ozone System Cost	0.6 million
	\$ 6,000	per year		

4. Labour Costs

Manhours per day	0.5			
Manhours per year	62	manhours per year, based on	4	months per year of ozone plant operation
Labour Cost	\$ 3,720			

5. Summary of O&M Costs

Energy	\$ 2,756
LOX	\$ -
Maintenance Materials	\$ 6,000
Labour	\$ 3,720
<b>Total (Ozone System O&amp;M Costs)</b>	<b>\$ 12,476</b>

UV System Costs

Estimated at	\$ 40,000	per year, based upon an unfiltered supply
--------------	-----------	---

Chlorination Costs

Average Daily Chlorine Usage	9.6	kg/d
Annual Chlorine Usage	3,504	kg/yr
Annual Chlorine Cost	\$ 526	

Sodium Bisulphite Costs

Average Daily Bisulphite Usage	1.2	kg/d
Annual Chlorine Usage	438	kg/yr
Annual Chlorine Cost	\$ 219	per year

Miscellaneous Labour Costs

	\$ 1	manhour per day, excluding ozone
	\$ 21,900	per year

Miscellaneous Building Energy Costs

Total HVAC and Lighting Load	30	kW
Annual Building Energy Usage	87,600	kWh, with building operation 8 hours per day
Annual Building Energy Cost	\$ 6,132	

O&M Cost Summary (Arbutus WTP)

Energy Costs	\$ 38,900
Chemical Costs	\$ 700
Maintenance Materials Costs	\$ 16,000
Labour Costs	\$ 25,600
<b>GRAND TOTAL</b>	<b>\$ 81,200</b>

South End WTP  
Ozone System Costs

None, there is no ozone at South End WTP

UV System Costs

Estimated at \$ 15,000 per year, based upon an unfiltered supply

Chlorination Costs

Average Daily Chlorine Usage	2.86	kg/d
Annual Chlorine Usage	1,044	kg/yr
Annual Chlorine Cost	\$ 157	

Sodium Bisulphite Costs

Average Daily Bisulphite Usage	0	kg/d	Bisulphite Not Used at South End
Annual Chlorine Usage	0	kg/yr	
Annual Chlorine Cost	\$ -	per year	

Miscellaneous Labour Costs

	0.5	manhour per day, excluding ozone
	\$ 10,950	per year

Miscellaneous Building Energy Costs

Total HVAC and Lighting Load	15	kW
Annual Building Energy Usage	43,800	kWh, with building operation 8 hours per day
Annual Building Energy Cost	\$ 3,066	

O&M Cost Summary (South End WTP)

Energy Costs	\$ 14,300
Chemical Costs	\$ 200
Maintenance Materials Costs	\$ 3,800
Labour Costs	\$ 11,000
<b>GRAND TOTAL</b>	<b>\$ 29,300</b>



Project Number: 55059 (2) Date: November 20, 2002  
 Project Name: Ladysmith Water Study Prepared: Jeff Howard & Simon Breese  
 Description: Treatment Alternatives and Upgrade Requirements

**Alternative A- Consolidated Treatment at Arbutus Reservoir**

Upgrade Requirements	Amount	Unit	Unit Cost	Total Cost
<b>Water Treatment Plants</b>				
New 13.2 ML/d Arbutus WTP	\$			2,700,000
<b>Treated Water Reservoirs</b>				
New 6 ML Arbutus Reservoir at elevation 140 m	6,000	m <sup>3</sup>	240	1,440,000
New 3.9 ML South End Reservoir at elevation 158 m	3,900	m <sup>3</sup>	240	936,000
<b>Conveyance Systems</b>				
New 2700 m of 200 mm pipe from Arbutus Reservoir to Contact Tank	2,700	m	230	621,000
Arbutus Treated Water Pump Station	-	Lump Sum	-	150,000
NPV of next 50 years of pumping	-	Lump Sum	-	25,000
NPV of 200 AC replacement in 15 years from valve house to Arbutus	-	Lump Sum	-	332,000
New 2,400m of 300 mm Main for South Ladysmith & Saltair	2,400	m	300	720,000
New PRV Station into Saltair	-	Lump Sum	-	50,000
Valves and Controls at Arbutus Reservoir	-	Lump Sum	-	100,000
Valves and Controls at Contact Tank	-	Lump Sum	-	50,000
<b>Miscellaneous</b>				
SCADA Upgrades		Lump Sum		250,000
Decommissioning of Contact Tank	-	Lump Sum	-	20,000
Decommissioning of Arbutus Reservoir	-	Lump Sum	-	20,000
<b>Sub-Total</b>				<b>7,414,000</b>
Engineering at 10%				741,400
Contingencies at 20%				1,482,800
<b>Total</b>				<b>9,638,200</b>



Project Number: 55059 (2)  
 Project Name: Ladysmith Water Study  
 Description: Treatment Alternatives and Upgrade Requirements

Date: November 20, 2002  
 Prepared: Jeff Howard & Simon Breese

**Alternative B - Separate Treatment**

Upgrade Requirements	Amount	Unit	Unit Cost	Total Cost
<b>Water Treatment Plants</b>				
Ozone-UV Facility at Arbutus (10.1 ML/d)				\$ 2,200,000
New 3.1 ML/d South End WTP				\$ 600,000
<b>Treated Water Reservoirs</b>				
New 5.7 ML reservoir at Arbutus at elevation 140 m	5,700	m <sup>3</sup>	240	\$ 1,368,000
New 3.9 ML South End Reservoir at elevation 158 m	3,900	m <sup>3</sup>	240	\$ 936,000
<b>Conveyance Systems</b>				
NPV of 200 AC replacement in 15 years from valve house to Arbutus	-	Lump Sum	-	\$ 332,000
New 2,400m of 300 mm Main for South Ladysmith & Saltair	2,400	m	300	\$ 720,000
New PRV Station into Saltair				\$ 50,000
Valves and Controls at Arbutus Reservoir	-	Lump Sum	-	\$ 100,000
Valves and Controls at Contact Tank	-	Lump Sum	-	\$ 50,000
<b>Miscellaneous</b>				
SCADA Upgrades		Lump Sum		\$ 250,000
Decommissioning of Arbutus Reservoir	-	Lump Sum	-	\$ 20,000
Decommissioning of Contact Tank	-	Lump Sum	-	\$ 20,000
<b>Sub-Total</b>				<b>\$ 6,646,000</b>
Engineering at 10%				\$ 664,600
Contingencies at 20%				\$ 1,329,200
<b>Total</b>				<b>\$ 8,639,800</b>



Project Number: 55059 (2) Date: November 20, 2002  
 Project Name: Ladysmith Water Study Prepared: Jeff Howard & Simon Breese  
 Description: Treatment Alternatives and Upgrade Requirements

**Alternative C - Divert Holland Creek to Stocking Lake**

Upgrade Requirements	Amount	Unit	Unit Cost	Total Cost
<b>Water Treatment Plants</b>				\$ 2,700,000
<b>Treated Water Reservoirs</b>				
New 7.4 ML Arbutus at Elevation 140 m	7,400	m <sup>3</sup>	240	\$ 1,776,000
New 3.9 ML South End Reservoir at elevation 158 m	3,900	m <sup>3</sup>	240	\$ 936,000
<b>Conveyance Systems</b>				
New 4000 m of 300 mm pipe from Holland Creek to Stocking Lake	4,000	m	300	\$ 1,200,000
New 2200 m of 250 mm pipe from south valve house to Arbutus	2,200	m	260	\$ 572,000
	-	Lump Sum	-	\$ 5,000
New 2,400m of 300 mm Main for South Ladysmith & Saltair	2,400	m	300	\$ 720,000
New PRV Station into Saltair				\$ 50,000
Valves and Controls at Arbutus Reservoir	-	Lump Sum	-	\$ 100,000
PRV at Valve House	-	Lump Sum	-	\$ 50,000
	-	Lump Sum	-	\$ 50,000
<b>Miscellaneous</b>				
SCADA Upgrades				\$ 250,000
	-	Lump Sum	-	\$ 20,000
Decommissioning of Contact Tank	-	Lump Sum	-	\$ 20,000
Decommissioning of Arbutus Reservoir	-	Lump Sum	-	\$ 20,000
<b>Sub-Total</b>				<b>\$ 8,469,000</b>
Engineering at				\$ 846,900
Contingency				\$ 1,693,800
<b>Total</b>				<b>\$ 11,009,700</b>

Project Number: 55059 (2) Date: November 20, 2002  
 Project Name: Ladysmith Water Study Prepared: Jeff Howard & Simon Breese  
 Description: Treatment Alternatives and Upgrade Requirements

**Alternative D - Divert Stocking Lake to Holland Creek**

Upgrade Requirements	Amount	Unit	Unit Cost	Total Cost
<b>Water Treatment Plants</b>				
New 13.2 ML/d Consolidated WTP at Arbutus				\$ 2,700,000
<b>Treated Water Reservoirs</b>				
New 7.8 ML Arbutus Reservoir at elevation 140 m	7,800	m <sup>3</sup>	240	\$ 1,872,000
New 3.9 ML South End Reservoir	3,900	m <sup>3</sup>	240	\$ 936,000
<b>Conveyance Systems</b>				
New 2700 m of 200 mm pipe from Arbutus Reservoir to Contact Tank	2,700	m	230	\$ 621,000
New 400 m of 250 mm pipe from Heart Lake creek to Arbutus Reservoir	400	m	260	\$ 104,000
Pump House from Arbutus Reservoir to Contact Tank Reservoir	-	Lump Sum	-	\$ 150,000
NPV of next 50 years of pumping	-	Lump Sum	-	\$ 25,000
New 2,400m of 300 mm Main for South Ladysmith & Saltair	2,400	m	300	\$ 720,000
New PRV Station into Saltair				\$ 50,000
Valves and Controls at Arbutus Reservoir	-	Lump Sum	-	\$ 100,000
Valves and Controls at Contact Tank	-	Lump Sum	-	\$ 50,000
<b>Miscellaneous</b>				
SCADA Upgrades				\$ 250,000
Raise dam on Stocking Lake	-	Lump Sum	-	\$ 400,000
Decommissioning of Contact Tank	-	Lump Sum	-	\$ 20,000
Decommissioning of Arbutus Reservoir	-	Lump Sum	-	\$ 20,000
<b>Sub-Total</b>				<b>\$ 8,018,000</b>
Engineering at 10%				\$ 801,800
Contingencies at 20%				\$ 1,603,600
<b>Total</b>				<b>\$ 10,423,400</b>