11.0 Analysis of Infrastructure Alternatives for South Irrigation District

11.1 SHORT-LISTED SOURCE ALTERNATIVES

11.1.1 ALTERNATIVES 3: SUPPLY FROM WELLAND CANAL

This alternative will consist of constructing a transmission pipeline from the Welland Canal to the good fruit areas of Pelham and a pipeline distribution system within this area. A pump station near the Welland Canal would be required for this system. The conceptual layout of the system is shown in Figure 11-1. This source alternative requires a pipeline distribution system since the topography of the service area does not allow an open channel distribution system.

The pipeline supplying this area would be constructed within the road right of way and may need to cross some streams. The route may pass close to several sensitive woodlands and ANSIs; however, it may be possible to find a route that would avoid these significant environmental areas.

Theoretically, the irrigation conveyance efficiency of a pipeline system can be 100%. However, in practice, some loss is unavoidable. Losses due to pipe and joint leaks normally occur in pipeline systems and increase as the system ages. An irrigation conveyance efficiency of 95% may be reasonable if a good pipeline maintenance program is put in effect. We will use this conveyance efficiency in our preliminary calculations.

The lateral pipeline system will make water available to most users at the farm gate. Water provided to the growers will generally have “residual pressure”. In lower lands and at points closer to the supply source, this pressure may be sufficient to operate low pressure irrigation systems such as drippers, sprayers, and low to medium range sprinklers. The conceptual design, however, is not based on providing a minimum pressure at the farm gate, and it is assumed that the growers will provide the on-farm pressure requirement of the supplied raw water. The system, however, could be designed to provide a minimum pressure to the users at a later stage with minimal modifications, if the cost of the additional system pressurizing justifies the savings of on-farm pumping.

Significant Issues

The following are some of the main issues regarding the use of this type of water distribution:

- The use of water from this source may impact the water available for hydro power generation. If the use of this source does result in a reduction of water available for hydro power generation, a loss of hydro generation revenue estimated at $1.10 per cfs-hr (1.1 cents per m^3) should be considered.

- The use of this source may be governed by the Niagara Treaty and as such may require approval through the Department of Foreign Affairs. This may cause delays to the implementation of the project.

- The use of this source will require approval by the St. Lawrence Seaway Authority.

- There is substantial general disturbance during construction. The significant construction impacts include erosion, stream disturbance, traffic disturbance, and construction noise. Some of these impacts can be substantially mitigated, however a degree of disturbance will be unavoidable.

- A pipeline irrigation distribution system substantially reduces the amount of on-farm pumping required compared to the other irrigation alternatives. This will reduce capital, operating and maintenance costs and management effort at the farm level. The pressure provided by the system to the farmers can be increased with relatively minor modifications, allowing elimination of on-farm pumping for low-pressure irrigation systems. This would provide additional incentive for the growers to move toward more efficient low-pressure systems such as drippers and spray irrigation.

- The supply of water to the users is secure and the on-going environmental impacts of irrigation water taking can be minimized by improved control over water taking and water distribution.

11.1.2 ALTERNATIVE 10: SUPPLY FROM GROUNDWATER WELLS

This alternative consists of constructing on-farm groundwater wells for the irrigated areas of South District. It will not involve any substantial pipeline construction, other than on-farm piping.

Bedrock wells are expected to be successful in the area. However, the impact of additional groundwater development on the existing users, sensitive woodlots, and headwaters of the streams originating from the Escarpment are uncertain. A major concern is the impact on the headwaters of the Twelve Mile Creek. A general groundwater study of the Niagara Peninsula is being carried out at the present time by the Niagara Peninsula Conservation Authority. A further groundwater study will be needed to assess the specific impact of the proposed irrigation wells.

Significant Issues

The following are some of the main issues regarding the implementation of this alternative:

- The impact of water taking on the headwaters of the Twelve Mile Creek will need to be studied.
- The impact of water taking on existing users, headwaters of other streams originating from the Escarpment, fisheries in these streams, and Escarpment woodlots will need to be assessed.
- If the availability of sufficient groundwater capacity for irrigation is confirmed, this alternative will be easy to implement and manage, since it is a familiar concept for both construction and operation. The support by the South Irrigation District may be in the form of carrying out groundwater studies, assisting with Permits to Take Water and assisting in tapping into available financing programs.

11.1.3 ALTERNATIVE 11: SUPPLY FROM OFF-STREAM RESERVOIRS

This alternative consists of constructing on-farm reservoirs with sufficient storage capacity to irrigate the farms during the summer months. The constructed ponds will be filled during spring when stream flows are high. Also farm runoff and tile drainage could be diverted to the ponds. The same pumps and pipelines used for operating the sprinklers and drippers during the summer would be used for filling the ponds during the spring; therefore, there is little requirement for additional pumps and pipes.

Based on the evaporation data for Lake Ontario, we have estimated an evaporation loss of 130 mm of water from these ponds during a ten-year return drought. Evaporation from ponds may be somewhat different from evaporation from the lake, and seepage losses may also be significant. These will need to be investigated in a subsequent study if this alternative is selected. For the purpose of this preliminary study, we will assume that the Off Stream Reservoirs have an efficiency of 90%, which is equivalent to a maximum loss of 0.5 m of water column for a 5 m deep reservoir.

Using the estimated ten-year return annual drought demands in Table 3-7, and assuming a gross storage depth of 5 m for on-farm ponds (net 4.5 m of depth available for irrigation), approximately one acre of pond will be required for every 17 acres of irrigated tender fruit lands (pond area will be equal to 6% of tender fruit irrigated area). Similarly one acre of pond will be required for every 23 acres of irrigated grape land (pond area will be equal to 4% of grape irrigated area).

If farm drainage (tile and/or surface drainage) is diverted to these ponds, they can be substantially smaller than those calculated above.

Significant Issues

The following are some of the main issues regarding the use of this source:

- The location of the ponds should be carefully selected balancing the need to retain premium lands and minimize impact to the environmental heritage of the region. Some good land would probably need to be sacrificed for the construction of the ponds.

- Water taking, especially from sensitive streams, will need to be carried out using approved procedures and limits.

11.2 DISCUSSION OF PROBABLE COSTS

Preliminary cost estimates for the alternatives described in the previous sub-section are illustrated in Table 11-1, Table 11-2 and Table 11-3.

Table 11-1 Cost of Alternative 3 - Supply from Welland Canal for South Irrigation District

Estimated Quantities		
Net Peak Demand		28,126 m^3/d
Net Average Annual Demand		910,736 m^3/d
Estimated Efficiency		95%
Gross Peak Demand (1)		29,606 m^3/d
		24 (acre-feet/d)
Gross Average Annual Demand (2)		958,670 m^3/d
		777 (acre-feet/d)
Length of Laterals		14,750 m
Length of Trunk Mains		9,500 m
Probable Initial Costs		
Laterals	$	2.7 million
Trunk Mains (including increase in cost of Zone A pipes)	$	3.8 million
Pump House	$	1.6 million
Subtotal of Major Components	$	8.0 million
Contingencies (30%)	$	2.4 million
Engineering & Studies (15%)	$	1.2 million
Probable Infrastructure Cost	**$**	**11.7 million**
Probable Annual O&M Costs		
Energy Costs	$	0.033 million
OPA Lost Revenue	$	0.011
Other O & M (1% of Capital)	$	0.117 million
Probable O & M Costs	**$**	**0.150 million**
Probable Annual Costs		
Amortization Period		20 yrs
Interest Rate		5%
Annual Capital & Interest Payments	$	0.9 million
Probable Total Annual Cost and Payments	**$**	**1.1 million**

Notes

(1) Gross Peak Demand is the demand at farm gate plus distribution system losses.

(2) Gross Average Annual Demand is the average quantity of water expected to be withdrawn from the water source.

Table 11-2 Costs of Alternative 10 - Supply from Groundwater Wells for South Irrigation District

Estimated Quantities	
Average Well Service Area	27 Acres
Size of Potential Irrigated Area	1,320 Acres
Estimated Number of Wells	49
Probable Initial Costs	
Unit Well Construction Cost Estimate	$ 35,000
Estimated Construction Cost of All Wells	$ 1.7 million
Contingencies (30%)	$ 0.5 million
Engineering & Studies (15%)	$ 0.3 million
Probable Infrastructure Cost	**$ 2.5 million**
Probable Annual O&M Costs	
Energy Costs	$ 0.010 million
Other O & M (1% of Capital)	$ 0.025 million
Probable O & M Costs	**$ 0.035 million**
Probable Annual Costs	
Amortization Period (yrs)	20
Interest Rate	5%
Annual Capital & Interest Payments	$ 0.2 million
Probable Total Annual Cost and Payments	**$ 0.23 million**

Table 11-3 Cost of Alternative 11 Supply from Off-Stream Reservoirs for South Irrigation District

Estimated Quantities	
Net Annual Irrigation Requirement for Ten-Year Return Drought	1,494,318 m^3
Estimated Storage Efficiency	90%
Gross Storage Volume	1,660,353 m^3 1,347 acre-ft
Initial Costs	
Unit Construction Cost	$ 250 /acre-in
Construction Cost (million dollars)	$ 4.0 million
Contingencies (30%)	$ 1.2 million
Engineering & Studies (15%)	$ 0.6 million
Probable Infrastructure Cost	**$ 5.9 million**
Probable Annual O&M Costs	
Energy Costs	$ 0.018 million
Other O & M (1% of Capital)	$ 0.059 million
Probable O & M Costs	**$ 0.077 million**
Probable Annual Costs	
Amortization Period (yrs)	20
Interest Rate	5%
Annual Capital & Interest Payments	$ 0.470 million
Probable Total Annual Cost and Payments	**$ 0.547 million**
Land Requirements	
Total Surface Area of Ponds	332,071 m^2 82 acres
Additional land required (e.g. Berms)	10%
Total land for Pond Facilities	90 acres

The costs of Alternatives 3, 10 and 11 are summarized in Table 11-4. There is a substantial difference between the costs of the different alternatives. The pipeline distribution alternative will require long transmission and distribution pipelines, due to long distance to the source. The cost per acre for this alternative is excessive due to the relatively limited acreage of the probable irrigated area. The two on-farm water supply solutions appear to be more feasible. The cost of drilling wells is substantially less than the cost of the construction of ponds large enough to store the full season irrigation demand. However, the groundwater well solution is subject to the availability of excess supply capacity in the aquifers of Pelham. This alternative may have to be abandoned if the water taking cannot be done without significant impact to the existing users and the environment. There may, however, be some municipal and other wells currently not in use due to the extension of the Welland water distribution system to Fonthill, which can be used by some farmers for irrigation.

Even the least expensive alternative is likely to cost substantially above the current payments by the NOTL users.

Table 11-4 Alternative Infrastructure Solutions for South Irrigation District[31]

Alternative Infrastructure Solution	Initial Cost (Million Dollars)	Initial Cost Per Acre (1)	Total Annual Cost and Payments per Acre (2)
Alternative 3: Supply from Welland Canal	12	$9,200	$850
Alternative 10 Supply from Groundwater Wells	2.5	$1,900	$180
Alternative 11 Supply from Off-Stream Reservoirs	5.9 + land	$4,500 + land	$450 + land

Notes:

(1) Based on service area of 1,300 acres

(2) Based on service area of 1,300 acres. For details of annual payments refer to Table 11-1, Table 11-2 and Table 11-3.

[31] It should be emphasized that the figures shown in this table are preliminary estimates based on the available data. Significant data gaps will need to be addressed before these figures can be relied on for budgeting purposes.