7.0 Screening Long List of Source Alternatives

7.1 ALTERNATIVE 1 - MUNICIPAL TREATED WATER

An extensive municipal potable water supply and distribution system already exists in the Niagara Region. DeCew Falls WTP supplies the drinking water distribution system of St. Catharines, NOTL and some parts of Lincoln, while Grimsby WTP supplies the drinking water distribution system of Grimsby and the western areas of Lincoln. Welland WTP supplies urban areas of Pelham.

A limited amount of municipal treated water is currently being used for irrigation. Many greenhouses have municipal water supplies in addition to roof top runoff reservoirs. Some use by other growers has been permitted in the past by allowing them to obtain irrigation water via fire hydrants. However, the existing municipal treated water systems neither have the supply nor the transmission capacity to provide the peak irrigation demand for the proposed Irrigation Districts in addition to their existing and future municipal demands.

The possibility of utilizing the unused capacity of the existing water systems during off-peak demand periods may provide a viable solution for the irrigation demand. The systems are designed to satisfy the peak daily and hourly municipal demands, which invariably occur during the summer months due to lawn watering. During spring, the municipal water demands are substantially below the peak demands. Water may be drawn from the existing water systems during these off peak periods and stored for subsequent irrigation use during the summer months. The irrigation reservoirs to be used in conjunction with this supply alternative will need to have sufficient capacity to store the full seasonal irrigation demand of the growers. New reservoirs will be required at considerable expense.

The alternative of off-peak supply from the municipal systems has a number of major implications:

- The DeCew Falls WTP is currently supplied from the reservoir system owned by Ontario Power Generation (OPG). The addition of the supply to the irrigation reservoirs during spring will require renegotiating the existing agreement between the Region and the OPG for the operation of the DeCew Falls WTP.

- Early discussions indicate that the water provided for irrigation is likely to be billed at the flat rate that all other municipal consumers are paying, currently 44 cents per m^3. This rate may be doubled within the next 10 years.

- The chlorinated water supplied by the treated water systems will need to be de-chlorinated before it is applied to the irrigated lands. This further increases the cost of this alternative (however the long storage period of the irrigation water may make de-chlorination unnecessary due to the relatively short persistence of free chlorine in water).

The main capital cost of this alternative is similar to Alternative 11 (Supply from Off-Stream Reservoirs), while it has substantial additional operating costs and negotiation requirements. This alternative is therefore discounted due to its high annual cost and negotiation requirements with no apparent advantages compared to another alternative.

7.2 ALTERNATIVE 2 - MUNICIPAL TREATED WASTEWATER

Treated wastewater is being used for irrigation in many parts of the world. It has the advantage of reducing water competition between municipal use and agricultural use, as well as providing additional nutrients to the irrigated lands at no cost. There are a number of Water Pollution Control Plants (WPCPs) in or close to the proposed Irrigation Districts. The flows of these plants are generally sufficient for the initial phases of the proposed irrigation development, but will not fulfill the ultimate peak demands of the proposed Districts. The peak irrigation demands, however, can be satisfied using effluent flows if some storage is constructed to supplement the WPCP flows during the peak irrigation demand periods.

Comparing this alternative with Alternative 9 (Lake Ontario) for East and West Districts, the following main advantages are noted:

- the need for a lake intake is eliminated,
- water will have some beneficial nutrients such as nitrogen and phosphorus;

while the following disadvantages should be considered:

- use of treated wastewater is likely to require a higher treatment level that is currently being used, for example, in the US Southwest effluent has to be treated to a “food consumed raw” standard before it can be used to irrigate edible crops,
- the consumers may perceive the agricultural produce to be of lower or questionable quality or desirability by associating it with wastewater,
- supplying the raw water distribution system from the points imposed by the WPCPs will not be the optimum hydraulic arrangement (increasing the capital and operating costs),
- the wastewater production is not sufficient for the ultimate peak demand of the Districts and will required the addition of reservoirs to supply the future peak demands.

Given the above comparative disadvantages and only some limited advantages, this alternative is discounted.

7.3 ALTERNATIVE 3 - WELLAND CANAL

The Welland Canal passes along the eastern border of St. Catharines, providing a natural source of water for the East District. The NOTL Municipal Irrigation System is currently using the Welland Canal as one of its sources of raw water. For the West District, water will have to be transmitted through St. Catharines. CN railway provides a convenient corridor to convey water taken from upstream of Lock 6 to the lowlands of the West District. There is sufficient elevation difference between this point on the Canal and the lowlands of West District (Zone A) to allow water to flow by gravity. However, the areas of the West District above the escarpment (Zone B) will require pumping. The Canal is also a potential supply source for the South District, although considerable transmission piping system is required to supply this district from the Canal.

The layout of the Canal and the different water levels available throughout its length provide a range of desirable alternatives for irrigating the target lands. We will, therefore, evaluate this alternative for all three Irrigation Districts.

7.4 ALTERNATIVE 4 - LAKE GIBSON/LAKE MOODIE

Lake Gibson and Lake Moodie are OPG reservoirs used for the storage of water for hydropower generation. Lake Moodie is close to the south-east corner of the West Irrigation District. Both Zone A and Zone B can be supplied from Lake Moodie. The supply of Zone A (below the Escarpment) can be achieved by gravity flow, while the supply of Zone B (above the escarpment) is likely to require pumping.

The water quality of Lake Moodie is essentially the same as the water of the Welland Canal. However, Lake Moodie has the advantage of being immediately adjacent to the south-east corner of the West District Zone A. This alternative, therefore, is not applicable to the East or South Districts, since Welland Canal provides more advantageous supply points for these Districts.

This alternative has the major advantage of having water with a high head available near the West District. However, the use of this source poses the following implications:

- It will require negotiation with OPG to install an intake in their property in Lake Moodie.
- Any water taken for irrigation purposes will reduce water available for hydropower generation. Therefore, any water used by irrigation will represent a potential loss of revenue to OPG. (This disadvantage may also applicable to Alternative 3 - Welland Canal depending on the location of water taking.)
- The lands around Lake Moodie are part of the Escarpment Protection Area, and there is a band of Escarpment Natural Area that will need to be crossed by the pipeline transmitting water from Lake Moodie to the West Irrigation District.

Even though the above challenges will need to be met, the hydraulic advantage of this alternative cannot be disregarded. We will, therefore, include this alternative in the short-listed alternatives to be considered in more detail.

7.5 ALTERNATIVE 5 - TWELVE MILE CREEK

Twelve Mile Creek passes along the eastern border of the West Irrigation District. It is a potential source of raw water for the West District, but its distance to the other two Districts, together with the availability of obviously superior sources for the South and East Districts, makes this alternative only applicable to the West District. We will not consider this alternative for the South and East Districts.

Water used by OPG for hydropower generation is discharged to the Twelve Mile Creek. The peak demand of the West Irrigation District constitutes a small faction of this diverted water (in the order of 1%). Therefore, a supply point downstream of the OPG discharge point would be feasible.

This alternative has none of the challenges of Alternative 4 (Lake Gibson/Lake Moodie), but will also forego the water elevation advantage of Alternative 4. We will include this alternative in the short-listed alternatives to be considered in more detail for the West Irrigation District.

7.6 ALTERNATIVE 6 - QUEENSTON RESERVOIR

The Alternative of supply from the Queenston Reservoir is not applicable to the West and South Irrigation Districts due to the length of the required pipeline and the availability of other closer viable alternatives such as supply from the Welland Canal. The existing NOTL Municipal Irrigation System uses the Queenston Reservoir as one of its sources of raw water.

This alternative has the major advantage of having water with a high elevation available near the East District. However, the use of this source poses the following implications:

- It will require negotiation with OPG to install an intake in their property.
- Any water taken for irrigation purposes will reduce the water available for hydropower generation. Therefore, any water used by irrigation will represent a potential loss of revenue to OPG.
- The lands to the North of the Queenston Reservoir are part of the Escarpment Protection Area, and there is a band of Escarpment Natural Area that will need to be crossed by the pipeline transmitting water from this source to the East District.
- The level of this reservoir fluctuates based on power generation requirements of OPG, and it is therefore not a reliable irrigation source (water may not be there when it is needed).

Due to the last problem, this alternative will not be short-listed for further consideration.

7.7 ALTERNATIVE 7 - OUTLET OF OPG TUNNELS

The Alternative of supply from the Outlet of the OPG Tunnels (south of the Queenston Reservoir) is not applicable to the West and South Irrigation Districts due to the length of the required pipeline and the availability of other closer viable alternatives such as supply from the Welland Canal. The existing NOTL Municipal Irrigation System uses the Outlet of OPG Tunnels as one of its sources of raw water.

This alternative has some similar general advantages and disadvantages as Alternative 6 (Queenston Reservoir). Comparing Alternative 7 (Outlet of OPG Tunnel) with Alternative 6 (Queenston Reservoir), Alternative 7 has the following advantages:

- unlike the Queenston Reservoir water, water at this point has not been pumped; therefore, OPG will not have to be compensated for the additional pumping cost of the Queenston Reservoir water, and
- the system does not have to operate under the fluctuating water level of the Queenston Reservoir;

while, it has the following disadvantage:

- a transmission pipeline is required to transmit water to the East District.

We will include this alternative in the short-listed alternatives for the East District to be considered in more detail.

7.8 ALTERNATIVE 8 - NIAGARA RIVER

The Alternative of supply from the Niagara River is not applicable to the West and South Irrigation Districts due to the length of the required pipeline and the availability of other closer viable alternatives such as supply from the Welland Canal. The existing NOTL Municipal Irrigation System uses the Niagara River as one of its sources of raw water.

The main disadvantage of this alternative for the East District is the relatively low water elevation. Water will have to be pumped at substantial pumping capital and operating costs. However, this source has little other limitations. We will, therefore, include this alternative in the short-listed alternatives for the East District to be considered in more detail.

7.9 ALTERNATIVE 9 - LAKE ONTARIO

Lake Ontario constitutes the northern border of the East and West Irrigation Districts. It is not applicable to the South Irrigation District due to the length of the required pipeline and the availability of other closer viable alternatives such as supply from the Welland Canal.

The optimum locations of intakes for the West and East Districts in Lake Ontario are likely to be near the mid point of their shorelines in order to minimize distribution pipeline sizes. The intakes will have to be some distance away from the shore to reach deep enough points to provide stable water supplies. Water will need to be pumped up gradient into the irrigation Districts. Booster pumping will be needed to supply the areas above the escarpment (Zone B).

We will include this alternative in the short-listed alternatives for the West and East Irrigation Districts.

7.10 ALTERNATIVE 10 - GROUNDWATER

This alternative consists of providing groundwater wells for the irrigated areas. It is envisaged that a relatively large number of wells would be drilled, each well providing water to some 30 acres of land (average size of farms in the target areas). The wells would be managed by individual farmers or a few individuals with small operations. This would depend on the availability of reliable groundwater throughout the Irrigation Districts.

The use of groundwater for irrigation below Escarpment in the past has been problematic due to quality problems. A discussion with the Niagara Peninsula Conservation Authority indicated that although there may be pockets of reliable overburden aquifers with potential for providing acceptable groundwater below the escarpment, it may not be able to fully satisfy the requirements of the East District and West District Zone A. Therefore, this alternative is not considered for these areas.

Bedrock wells have often been successful south of the escarpment, although their development at the scales required for the South District and the West District Zone B will require further studies. We will include this alternative in the short-listed alternatives for the South District and West District Zone B.

7.11 ALTERNATIVE 11 - SUPPLY FROM OFF-STREAM RESERVOIRS

This alternative consists of constructing sufficient storage capacity to irrigate the target lands in the Irrigation Districts during the summer months. The constructed ponds will be located on-farm and will be filled during spring when there is excess flow in the streams and drains. The on-farm drainage can also be used to contribute to the storage. 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. Water sources for this alternative will be the permanent and temporary streams and drains in close proximity to the storage ponds.

Some farmers in the region are currently using this type of irrigation approach.

A major drawback of this type of irrigation is the need to allocate a portion of the farm acreage to water storage.

The NOTL Irrigation System has already invested in the construction of a system that is able to provide the requirement of the serviced areas without necessarily needing to dedicate land for on-farm ponds. We will, therefore, not consider this alternative for the East Irrigation District.

We will include the alternative of Supply from Off-Stream Reservoirs in the short-listed alternatives for the West and South Districts.

7.12 ALTERNATIVE 12 - OTHER SURFACE STREAMS

The following other rivers and surface streams were considered:

- **Welland River:** The Welland River could be a source for the South and West Districts. The use of the Welland River for the South will require a transmission pipe of about the same length as a transmission pipeline from the Welland Canal, but the pumping head would be higher due to the lower elevation of the Welland River. Also, water quality of the Welland Canal is more stable than the water quality of the Welland River. We will therefore not short-list this alternative for the South since it has no apparent advantage over a short-listed alternative.

  Welland River could be used as a source of irrigation water in the West District by pumping water from the Welland River to the Twenty Mile Creek and allowing it to flow by gravity through the middle of the West District. Both Zones A and B can be irrigated by drawing Welland River water from the Twenty Mile Creek. However, the conveyance of water via the Twenty Mile Creek may incur substantial losses due to evaporation, seepage, bedrock fractures and karst features (NPCA, 2005). Furthermore, the Niagara Peninsula Conservation Authority has expressed concern over the further utilization of watercourses to transmit irrigation water[24]. Finally, the pumping and piping costs for diverting the irrigation water from the Welland River to the Twenty Mile Creek will be a substantial cost which is likely to absorb any saving from the natural advantage of use of this watercourse.

  We will therefore not consider supply from Welland River any further for any of the districts.

- **Fifteen Mile Creek:** This creek has low flow upstream of the CN bridge during the peak irrigation demand period, therefore it cannot be used as a direct source of irrigation water.

[24] Letter from Niagara Peninsula Conservation Authority (T. D'Amario) to Stantec (S. Soltani), dated June 29, 2005.

- **Sixteen Mile Creek:** This creek has low flow upstream of the CN bridge during the peak irrigation demand period, therefore it cannot be used as a direct source of irrigation water.

- **Twenty Mile Creek:** This creek has low flow upstream of the CN bridge during the peak irrigation demand period, therefore it cannot be used as a direct source of irrigation water. However, downstream from the CN bridge (Jordan Harbour) provides a reliable source of water due to reverse flow from Lake Ontario. This possibility will be considered in more detail as a special case of Alternative 9 – Supply from Lake Ontario. Other alternatives related to supply from Twenty Mile Creek upstream of the CN Bridge will not be considered.

7.13 SPECIAL CONSIDERATION OF ZONE B ALTERNATIVES

The main irrigated area of the West Irrigation District is Zone A. This area is much larger than Zone B and has a considerable area dedicated to the production of peaches. It is expected that the majority of peach growers would be interested in participating in the irrigation project. Zone B is much smaller than Zone A. It is assessed as good grape land; therefore it is likely that a considerable number of growers would not participate in the project. The preliminary estimate for the demand of Zone B is approximately 20% of the demand of the West Irrigation District.

A dedicated supply line from one of the major surface water supply alternatives of the West District – such as Lake Ontario, Welland Canal, Lake Moodie, or Twelve Mile Creek – will not be feasible due to the long distances and the high elevations of Zone B. However, it may be feasible to supply Zone B by connecting to the trunk main distribution line of Zone A near Vineland Station. A booster pump would provide the required head of a Zone B pipeline distribution system.

The applicability of some alternatives to Zone B, namely alternatives 3, 4, 5, and 9, will, therefore, depend on whether or not they are chosen as the Preferred Source Alternative for Zone A.

We will, therefore, initially carry out our evaluation of the alternatives for Zone A disregarding the demand of Zone B. If the Preferred Alternative for Zone A is among Alternatives 3, 4, 5, and 9, we will consider supply from Zone A as one of the alternatives of Zone B. The Preferred Alternative for Zone A is, therefore, carried forward to as one of the alternatives of Zone B. All the implications of the selection of this alternative for Zone B, including increasing the capacities of the Zone A transmission system, will be taken into account in the evaluation of Zone B Alternatives.

Therefore, Alternatives 3, 4, 5, and 9 are tentative alternatives for the West District Zone B.

7.14 SHORT-LISTED SOURCE ALTERNATIVES

The short-listed source alternatives are summarized in Table 7-1:

Table 7-1 Screening of Long-Listed Source Alternatives

No	Alternative	West District		East District	South District
		Zone A	Zone B		
1	Municipal treated water	FAIL	FAIL	FAIL	FAIL
2	Municipal treated wastewater	FAIL	FAIL	FAIL	FAIL
3	Welland Canal	SHORTLIST	TENTATIVE(1)	SHORTLIST	SHORTLIST
4	Lake Gibson/Lake Moodie	SHORTLIST	TENTATIVE(1)	FAIL	FAIL
5	Twelve Mile Creek	SHORTLIST	TENTATIVE(1)	FAIL	FAIL
6	Queenston Reservoir	FAIL	FAIL	FAIL	FAIL
7	Outlet of OPG Tunnels	FAIL	FAIL	SHORTLIST	FAIL
8	Niagara River	FAIL	FAIL	SHORTLIST	FAIL
9	Lake Ontario	SHORTLIST	TENTATIVE(1)	SHORTLIST	FAIL
10	Groundwater (2)	FAIL	SHORTLIST	FAIL	SHORTLIST
11	Supply from Off-Stream Reservoirs (2)	SHORTLIST	SHORTLIST	FAIL	SHORTLIST
12	Other surface streams	FAIL	FAIL	FAIL	FAIL

Notes:

(1) One of the "TENTATIVE" alternatives may be considered for Zone B, only if it has been selected as the Preferred Alternative for Zone A.

(2) Alternatives 10 and 11 are self-supply options, to be implemented by individual growers probably with technical and financial support from a district irrigation project.