Niagara Irrigation Strategic Action Plan

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Acknowledgments

The lead consulting firm, JAYEFF PARTNERS, division of Take It Up Consulting Inc., acknowledges the valuable input and data provided by stakeholders connected to water for agriculture in Niagara (growers, association executives, municipal and regional government officers and engineers, Ontario Ministry of Agriculture, Food and Rural Affairs specialists, representatives of Ontario Power Generation and the St. Lawrence Seaway Management Corporation). The important role of the collaborating consultants is acknowledged on p. 7. Many of the ideas in this report were suggested and contributed by those who provided input. The lead author was the recorder of their ideas – they were not original on his account. The photos used in this report were provided by a Niagara nursery, a Niagara greenhouse, growers' associations, a Niagara Region employee, and one of the collaborating consultants. Their permission to use their photography is appreciated.

Disclaimer

The opinions and views expressed in this report are the sole responsibility of the lead consulting firm, JAYEFF PARTNERS, division of Take It Up Consulting Inc., and are not necessarily held or endorsed by the Niagara Peninsula Fruit and Vegetable Growers' Association; The Regional Municipality of Niagara; The Ontario Ministry of Agriculture, Food and Rural Affairs; Agriculture and Agri-Food Canada; and/or the Agricultural Adaptation Council.

This project was funded in part through *Growing Forward 2 (GF2)*, a federal-provincial-territorial initiative. The Agricultural Adaptation Council assists in the delivery of *GF2* in Ontario.

Growing Forward 2 AAC agricultural adaptation council Ontario Canada

A Message From The Chair

This strategy is a call to action.

The unusually dry conditions in 2016 underscored the urgency of better addressing the water security needs of Niagara growers for irrigation purposes.

There are three reasons why stakeholders in Niagara are able to approach this task from a position of strength.

First, Niagara has an abundance of good quality surface water available. It is a case of getting it to the farms where it is needed for irrigation reliably and cost effectively. This strategy requires that all stakeholders be on the same page. Better targeting of water to farm needs requires the alignment of all the regulatory bodies which have jurisdiction with shared goals and common purpose.

Second, there is a proven public-private partnership model for the management of the Town of Niagara-on-the-Lake's (NOTL's) irrigation system. This model shows what can be accomplished when the growers and the municipality work together. There is opportunity to adapt this proven model so that other growers below the escarpment can work with their municipal councils to provide water security for their farms. There are also opportunities to continuously improve the NOTL system.

Third, the conditions of 2017, in which rainfall was generally plentiful and water levels of Lake Ontario were elevated, in contrast to the drought of 2016, demonstrated the increasing range of extreme conditions that can arise from climate change. Our governments recognize that climate change is an urgent priority. There is opportunity to work with government to implement water security solutions that equip growers to manage the impact of future dry periods on the quality and value of their crops.

This investment in Niagara's future will protect the farmland, as envisaged by the Greenbelt Plan, and enable its stewards – Niagara's farmers – to recover more value from this precious resource and sustain it for future generations.

The key question for all stakeholders in Niagara – growers and government alike – is, "Do we have the will to drive forward and do what is necessary together?" The way forward requires more than words. It requires action – deliberate, goal-oriented action taken together – and investment and commitment from both the public and private sectors.

Together, we can implement this strategy and make a positive difference to the future of agriculture in Niagara.

Bill Schenck, Chair, Strategy Steering Committee
Vice-Chair, Grape Growers of Ontario

1. Executive Summary

1.1 KEY FACTS

- Although there has been expansion of irrigation infrastructure since the 2007 Stantec Phase 2 Assessment was completed ten years ago, primarily from private resources, there is significant farm acreage below the escarpment in Niagara producing grapes, tender fruit and nursery stock that does not have water security with respect to meeting current and future irrigation needs
- There has been no region-wide initiative to address irrigation needs in Niagara and no significant public investment in infrastructure to deliver water for irrigation purposes
- Among fruit growing regions of the world, the Niagara Peninsula has an abundance of surface water sources, surrounded by water on three sides – Lake Erie, Lake Ontario and the Niagara River – and the water naturally flows from higher elevation to the orchards, vineyards and fields making up the primary farmland below the escarpment
- The inadequate access to irrigation water was particularly evident in the recent record-setting dry year, 2016, and it took a toll on yields – on average, tender fruit yields were down 15% and fresh grape yields were down 24% over 2015[1]
- Water security is an important strategy for mitigating the climate change risk of prolonged dry periods in order to optimize growers' yields and corresponding plant health and vigour – even in "normal" years, irrigation is valuable to maintain plant productivity

1.2 KEY MESSAGES

- Major public policy initiatives have been undertaken in Ontario to address global climate change and review the Greenbelt Plan and the Niagara Escarpment Plan
- Irrigation does not factor prominently in these reviews and it is not the focus of any recommendations
- Security around water for irrigation purposes needs to be raised in the public consciousness and brought into the public space for attention and action so that it receives priority in decision-making and investment
- The Green Investment Fund, created by the Government of Ontario to invest the proceeds from cap and trade to address global climate change and support measures to move to a lower carbon economy, could be targeted to provide resources to support catch-up public investment in irrigation infrastructure in Niagara to expand its coverage and security
- The NOTL irrigation system model for irrigation east of the canal is a public-private partnership in which growers invest to maintain the system and cover its annual operating costs and can be used as a template for operating public pipeline irrigation systems for areas west of the canal

1. Sources: Ontario Tender Fruit Growers 2016 Annual Report, Ontario Fresh Grape Growers 2016 Annual Report respectively. To what extent the decline in yield was due to drought stress, as compared to other factors such as winter injury or late spring frosts, was not measured but anecdotally growers report that it was a major contributing factor. The figures reported are for all of Ontario. Niagara accounts for nearly 90% of production of these crops.

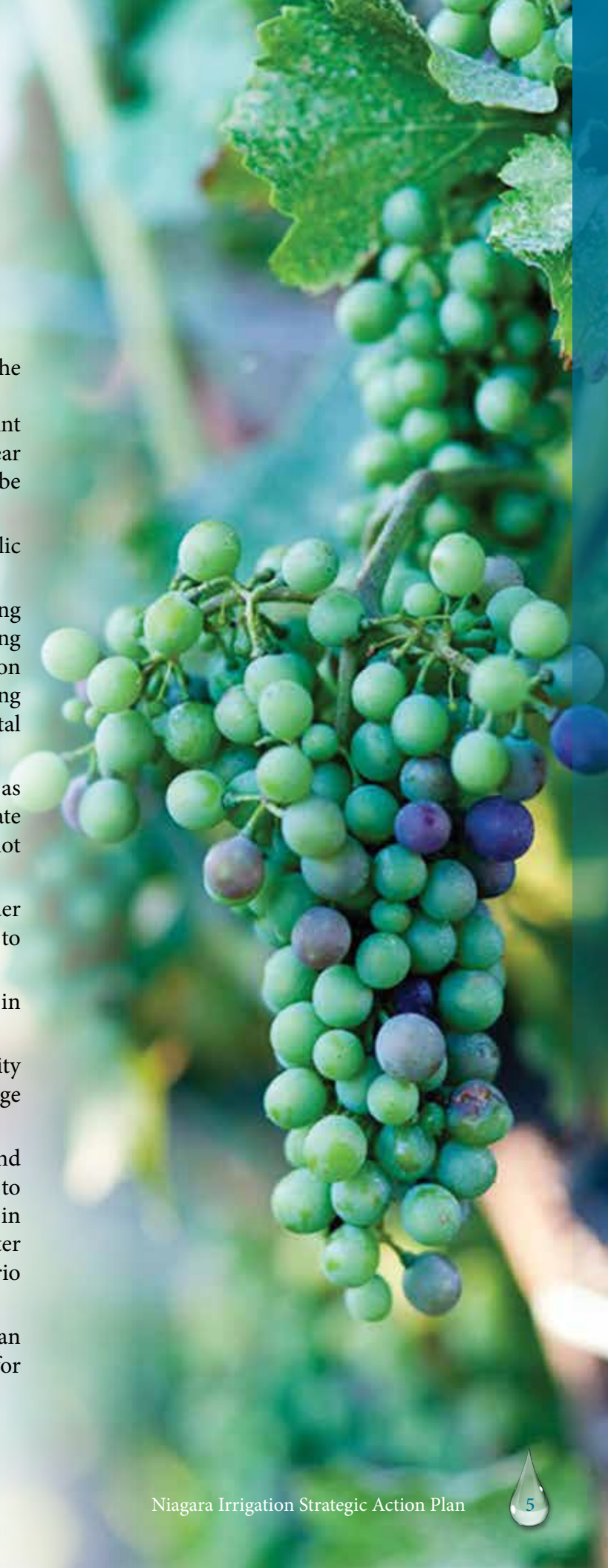
1.3 STRATEGIC "CALL TO ACTION" STEPS

The strategy is based on the following vision.

> Farms in Niagara have reliable access to irrigation water used efficiently and safely to sustain their productivity

To achieve this vision, the strategy recommends the following actions:

- Recruit, engage and fund an irrigation point person for the Region as a whole for a two year trial period with specific deliverables to be accomplished
- Raise the positive profile of irrigation in the public space
  - across the government so that (i) planning decision-makers have better understanding in order to expedite approval of irrigation projects and (ii) infrastructure funding programs are accessible to support capital costs of irrigation infrastructure
  - build public support and understanding as to why irrigation is a shared public-private responsibility with the full cost burden not falling on the grower
  - coordinate actions and influence policy under the mandates of different regulatory bodies to enable irrigation access
- Work to secure public infrastructure dollars, in the context of global climate change, to:
  - Make improvements to the capacity, reliability and efficiency of the NOTL open drainage ditch system
  - Subject to a satisfactory engineering and economic feasibility study, for systems (a) to deliver irrigation water west of the canal in west St. Catharines and (b) to provide greater security for pumping water from Lake Ontario to service farms in Lincoln
  - Enable growers to access Canadian Agricultural Partnership (C.A.P.) funding for individual irrigation projects on-farm



2. Outline of the Project

2.1 THE IMPETUS FOR THE STRATEGIC PLAN

Partly in response to the challenges to growers arising from the very dry conditions during the late spring and summer of 2016, the Agricultural Policy Action Committee (APAC) of the Regional Municipality of Niagara supported its Irrigation Sub-committee in undertaking the development of a strategic plan for irrigation. Because Niagara growers are the front-line stakeholders that will most directly benefit from the plan, the Niagara Peninsula Fruit and Vegetable Growers' Association, together with Ontario Tender Fruit Growers and Grape Growers of Ontario, provided the industry share of the funding for undertaking this project. Niagara Region also made an important direct contribution to the project budget. The balance of the funding, as noted in the Acknowledgments, came from the *Growing Forward 2* (*GF2*) policy framework a federal-provincial-territorial initiative. The Agricultural Adaptation Council assists in the delivery of *GF2* in Ontario. A Steering Committee for this project was formed consisting of Erik Acs (Niagara Region), Sarah Marshall (General Manager, Ontario Tender Fruit Growers), Kelly Provost (Niagara Region) and Bill Schenck (grape grower and greenhouse farmer serving as Committee Chair).

2.2 TERMS OF REFERENCE FOR THE STRATEGIC PLAN

The agricultural sector in the Niagara Region has a critical need for a strategic plan for irrigation. The plan will determine a strategy that enables the abundant resources from the Great Lakes and Region's river and canal systems to be effectively and efficiently used by farmers. Long term access to water resources for irrigation is integral to the sustainability of the agricultural sector to be able to produce local products for consumers. The strategic planning process will be designed to serve as a "call to action" as well as a methodical systematic approach to taking that action. As expanding water access will require significant financial and human resources, the plan will bring together key stakeholders to identify needs and examine options for solutions. Consensus will need to be reached between municipalities, ministries and growers on the best solutions to maximize efficient use of agricultural water across the region. These solutions will help the region focus on responsible water resource management and be able to provide the provincial/federal government with a cohesive plan of action into the next agricultural framework and beyond.[2]

2.3 THE METHOD FOR DEVELOPING THE PLAN

The lead consulting firm to which responsibility for developing the plan was assigned to Take It Up Consulting Inc. in Grimsby, ON. The principal consultant, James Farrar, is a professional accountant who has worked in the agriculture and food sector of Ontario for thirty-five years in public service (OMAFRA), private industry (apple and other fruit juice processing), and independent consulting. While the resources available for this project did not allow for any original technical research to be undertaken – and such emphasis was not needed at this time in view of extensive work done ten years earlier – the focus of effort was to assess the current situation and formulate the strategy based on those findings. The assessment of the current situation was made through interviews with key stakeholders and by reviewing relevant literature.

2. Project Summary, Part I, Schedule "A" from the contract for funding this project between the Agricultural Adaptation Council and Niagara Peninsula Fruit and Vegetable Growers' Association

As part of the original strategy development plan, two additional resources were contracted to support the work of the lead consultant and bring relevant expertise to the project:

- Erik Lockhart, Associate Director of the Queen's University Executive Decision Centre, facilitated a grower session on the evening of October 30 at the Niagara Region offices in Thorold. Forty growers, joined by government staff, provided input as a kind of Strengths/Weaknesses/Opportunities/Threats analysis and needs identification for irrigation in Niagara Region. The valuable input received from growers is incorporated in s. 4 of this document.
- The team of Charles Lalonde and Tiffany Svensson, who have extensive experience in working with agricultural water-related issues in Ontario, provided context for the regulatory environment in which irrigation in Niagara occurs. Their work is reflected in the Regulatory Framework (s. 3.4) and in Strategic action steps. Charles Lalonde has worked extensively with the Ontario Federation of Agriculture and Christian Farmers Federation of Ontario on analyzing water issues. Tiffany Svensson is a professional geoscientist with BluMetric Environmental Inc. in Kitchener. Both Charles and Tiffany have extensive experience working on agricultural water-related issues in the Holland Marsh, the Innisfil Creek watershed and the Norfolk sandplain.

The primary responsibility of the lead consultant was to listen closely to the needs of growers and those who provide irrigation solutions and develop the strategy from their input and with the support of the subject matter experts described above. The final responsibility for the content of this report rests with the lead consulting firm, Take It Up Consulting Inc.

It is therefore important to emphasize that without the willingness of growers, provincial and municipal government staff, and other stakeholders to engage with the lead consultant, the strategy could not have been developed.

2.4 DEFINITIONS

- In this report, "irrigation" is defined as water that is applied to crops to supplement naturally occurring rainfall.
- What is the best way to characterize water that is pumped directly from a surface source, like Lake Ontario or the Niagara River, without municipal treatment to render it potable (i.e. safe for drinking)? Water that is used for irrigation does not need to be potable. In the Stantec study, untreated water pumped directly from a surface water source was referred to as "raw water." In this report, it is referred to as "irrigation water." *Irrigation water has not been treated and is not potable. Irrigation water generally comes from flowing, as opposed to, stagnant sources.* The degree of screening and filtration the water receives are engineering specifications to be determined.
- The term "water security" is used in this report to encompass both the concepts of (a) access to a quality supply of sufficient water and (b) the *reliability* of the supply source and delivery system.

2.5 ACRONYMS

The first use of any acronym is spelled out in full. The following table summarizes the acronyms used in this report.

ACRONYM	IN REFERENCE TO
AAFC	Agriculture and Agri-Food Canada
BMP	Best Management Practice
C.A.P.	Canadian Agricultural Partnership, the program name for the next five year cycle of federal-provincial-territorial funding to follow *Growing Forward 2* which ends in March 2018
FPT	Federal-Provincial-Territorial, used in the context of Ministers with responsibility for agriculture in their Cabinet portfolio
LADII	Leamington Area Drip Irrigation Inc., a private commercial business owned by growers that operates a raw water pipeline to service farms in south Essex County
MMA	Ministry of Municipal Affairs (now distinct from the Ministry of Housing)
MNR	Ministry of Natural Resources
MoECC	Ministry of Environment and Climate Change
NEC	Niagara Escarpment Commission
NOTL	Town of Niagara-on-the-Lake
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
OPG	Ontario Power Generation
PTTW	Permit to Take Water, required from MoECC for daily draws in excess of 50,000 liters from the environment. Requirements are posted at: https://www.ontario.ca/page/permits-take-water
SLSMC	St. Lawrence Seaway Management Corporation, a not-for-profit corporation that operates the Seaway, including the Welland Canal, under contract from Transport Canada

3 Assessment of the Current Situation

3.1 THE RELEVANCE TODAY OF THE EXTENSIVE WORK DONE TEN YEARS AGO

Extensive and comprehensive work on the same subject – irrigation for agriculture in Niagara – was undertaken ten years previously. As the lead consulting firm for this work was Stantec Consulting Ltd., their reports are often referred to as "the Stantec Report." The Stantec Report was undertaken in two phases and includes extensive supplementary reports that were published as appendices and technical memoranda. Stantec's extensive reports can be downloaded from the Region of Niagara website.[3] In this document, they are collectively called "the Stantec Report." Footnotes indicate the specific components of the collective document to which reference is made.

In August 2005, Stantec Consulting Ltd., under contract from Niagara Region, prepared the first of two feasibility study reports entitled "Raw Water for Agricultural Irrigation Purposes." The general conclusions of this study were:

- There is significant room for growth of high value crops in the Region. Difficulties in access to irrigation water may be preventing the expansion of high value agricultural production into the remaining suitable areas of the region.
- The ideal regional irrigation infrastructure will have an initial cost of approximately of 100 million dollars. The cost, however, can be reduced to approximately 40 million dollars using open channel distribution (i.e. using the existing municipal drainage ditches).
- Any regional irrigation project is likely to require substantial financial support from the government.[4]

In November, 2007, Stantec Consulting Ltd., under contract from Niagara Region, completed a second study, Niagara Feasibility Phase 2 Engineering Report, in which a more detailed technical assessment was made of options outlined in Phase 1 two years earlier. The Phase 2 Report was supported by:

- An Engineering Report
- Hydrogeological Assessment Report
- Natural and Social Environment Report
- An Economic Benefits Report, examining the expected increase in returns to growers and the multiplier effect on the regional and provincial economies
- A detailed Land Use Report for agricultural land in zones under consideration
- A technical memorandum on channel conveyance efficiency
- A technical memorandum on water consumption by different crops
- A technical memorandum on regulatory requirements and related considerations
- A technical memorandum on a pilot off-stream reservoir
- A technical memorandum on a public information centre

Each of the more detailed appendices listed above was summarized in the master report. The analysis included a consideration of possible organizational models for undertaking irrigation infrastructure expansion and an estimate of both the capital and operating costs of various alternatives.

3. https://www.niagararegion.ca/living/ap/irrigation.aspx
4. Stantec Feasibility Study Project Report, Raw Water for Agricultural Irrigation Purposes, p. E.3

A key question: Why was the Stantec recommended plan from ten years ago not acted on?

Before considering the question highlighted above, it is important to summarize key recommendations from Phase 2 of the Stantec report.

Stantec divided the areas requiring irrigation for agriculture into different districts and considered the needs of each district individually.

- The preferred alternative among three considered for the east district, east of the canal servicing farms in Niagara-on-the-Lake, was "an open channel alternative (proposing) to use the existing open channels within the area with major and minor upgrades, and also proposes some new channels. For this alternative, it is also proposed to utilize three existing major intakes, and propose one new intake."[5]

While the full scale of this recommendation was not implemented, upgrades to the NOTL irrigation system have been undertaken over the past ten years, particularly in 2017 at the Queenston Pumping Station, in order to increase pumping capacity in response to the very dry summer of 2016. The cost for these upgrades has been financed by the capital portion of the per acre assessment levied on growers who participate in the NOTL system.

- The preferred alternative among six considered for the west district, was "an all-piped alternative with a single intake…(at) Lake Ontario at Sann Rd."[6]

While this recommendation was not implemented at the scale proposed, and no public infrastructure was put in place to pump water from this intake point in Lake Ontario and distribute in through a buried pipeline to farmland to the west and south, on a small scale privately owned grower consortia in Lincoln have obtained Permits To Take Water (PTTW) from Lake Ontario and pump it through seasonally laid surface pipelines to their farm ponds. This source of irrigation water was extremely valuable to participating growers in the very dry summer of 2016. As these irrigation initiatives by growers are private commercial undertakings, there is no data on the number of acres that are benefitting from these systems. However, it represents an improvement in the situation as it was at the time that the Stantec Report was released. The growers deserve commendation for their initiative.

The Stantec Report also considered irrigation needs in the south district, where groundwater (i.e. from wells) was proposed as the major source.

It is important to have this context, as it requires modifying the key question as follows: Why was the Stantec recommended plan for the west district not acted on?

Among factors that came into play are:

- The system proposal came with a very high capital cost estimated at $75 million for the west district and $19 million for the east district[7] for which funding was not identified and not secured – building parallel infrastructure to deliver raw water (parallel to the municipal water distribution of treated water) for seasonal use through areas with extensive roads and development is costly among other spending priorities
- Because the need for irrigation fluctuates from year to year and is not a constant and necessary requirement every year as in arid growing regions like the Okanagan Valley in BC, it is possible to de-prioritize irrigation in years when the lack of irrigation has not been of crisis proportions

5. *Raw Water for Agricultural Irrigation Study*, Phase 2 Project Report, p. 3.3, recommendation p. 5.3, "As a result, Alternative E3 is the recommended alternative for the East District"
6. *Ibid*, p. 3.2, recommendation p. 5.3 "Therefore W1 is recommended as the preferred alternative for the West District"
7. *Niagara Feasibility Phase 2 Implementation Tech Memo*, s. 3.4 Funding Requirements, p. 3.2

- While the proposed project – the option of choice among those examined – may not have been unduly complex from an engineering standpoint, it could have been daunting from an approvals standpoint, as many regulatory jurisdictions needed to be engaged for the project to proceed. To summarize it by a single word, there could have been a regulatory *juggernaut*.

In the development of this strategy, the need to overcome the inertia that prevented widescale action ten years ago was taken into consideration.

In our view, much of the work done ten years previously in the Stantec reports remains highly relevant and valuable. For example, the Stantec report included an economic benefits report undertaken by Dr. Wayne Pfeiffer, Professor of Agricultural Economics at the University of Guelph. The Stantec Report provides the following summary of that component of their larger work:

- The tender fruit and grape growers in the Niagara Region have consistently identified the provision of an irrigation infrastructure as one of the strategies for supporting the agricultural industry in the area. The direct benefit of irrigation to this sector is, therefore, widely recognized. Furthermore, irrigation is indispensable for greenhouses and nurseries. Growth of these high value industries is highly dependent on ease of access to irrigation water.
- Although the direct benefits of irrigation to certain sectors of the regional agricultural economy are clear, the direct benefits to the current growers are not sufficient to justify the large capital expenditure required for the development of a regional irrigation infrastructure. *Feasibility Study – Raw Water for Agricultural Irrigation* concluded that the cost of the project is above the capacity of the existing growers to pay and that there is need for substantial public support for this project. This public support can only be justified by demonstrating that the benefits of the project to the regional, provincial and national economies are greater than the public contribution required for the capital investment.

The development of a regional irrigation infrastructure has several types of benefits:

- Increasing the gross revenues of crops that respond well to irrigation.
- Reducing the risk associated with growing crops that respond well to irrigation.
- Inducing a move toward higher value agriculture by opening up areas that currently have no access or restricted access to irrigation water
- Ripple economic effects: a highly productive agricultural sector fuels the local, regional, provincial and national economies, producing economic impacts that are several times greater than direct farm revenues.[8]

Ten years ago it was clearly recognized that a project on the scale of that proposed could not proceed with grower-financed and grower-led initiatives alone. Therefore the Stantec Report sets forward the case why public sector investment is needed and justified. The arguments made in 2007 remain valid in 2017.

One of the other realities that was recognized ten years ago is that one way to address a price tag for a project that is out of reach is to break the project into smaller components: "it is proposed to break down the overall project into smaller phases."[9] That perspective is reflected in the recommendations of this strategy, in prioritizing providing irrigation water to the district with the greatest need and therefore greatest immediate return on investment.

8. *Raw Water for Agricultural Irrigation Study*, Phase 2 Project Report, s. 6.0 Economic Benefits Report, p. 6.1
9. *Niagara Feasibility Phase 2 Implementation Tech Memo*, s. 3.4 Funding Requirements, p. 3.2

LESSONS FROM LEAMINGTON

At the same time that the Stantec Report was being written and using some of the same public funding resources, a group of thirteen vegetable growers on the east side of Leamington undertook their own feasibility analysis of building an irrigation pipeline, taking water from Lake Erie and running north, to service a range of processing tomato, potato, sweet corn and green pea growers and greenhouses. The growers formed a corporation called Leamington Area Drip Irrigation Inc. (LADII). Among the obstacles which the LADII project had to overcome were:

- obtaining approvals from regulatory bodies – often one regulatory body would condition its approval on approval from another regulatory body, setting up a string of dominoes in which it was very difficult to get the first domino to fall
- obtaining easements across 120 different parcels of land belonging to private owners, government, and utilities – any one of the landowners could have blocked the pipeline if the easement was not granted
- obtaining financing in the range of $7 MM in order to cover capital costs with long term debt

The pipeline delivered its first water to growers in the 2009 growing season and has been operating successfully since. As did Niagara, Essex County had abundant natural rainfall throughout the summer of 2017, and therefore water-taking needs were less during this growing season but all growers applied water to their crops at least once. Most growers use fertigation in which they deliver nutrients as well as water. The following table compares the LADII project with the situation in Niagara.

LADII PROJECT	COMPARISON	NIAGARA WEST DISTRICT
Lake Erie was available as a source of surface water	Access to surface water	Surface water sources are less accessible due to development
Annual crops in a rotation cycle meaning that different fields need irrigation each year	Crop mobility	Perennial crops (vines, fruit trees, and nursery stock) that are in a static location each year
While the annual crops to which irrigation is applied, like processing tomatoes, are high value, the gross returns per acre are less than for grapes and tender fruit. Loss would be limited to year of occurrence.	Crop value and risk	High crop value which is impacted by insufficient water in terms of yield and quality. Greater risk from drought as an entire orchard or vineyard could be damaged affecting future years' yields.
The Municipality is a co-owner of the Union Water plant which supplies potable water to homes and businesses in Leamington, Kingsville and Essex.	Other major water users	In addition to the Region's treatment of water for residential and commercial use, Niagara has two other major water users – OPG and the SLSMC.

The growers who were instrumental in setting up LADII and which remain active in its management today identified several factors that led to their success[10]:

- the growers worked hard to develop a shareholders' agreement that defined their working relationship, commitment and obligations right at the outset – for example, growers pay an estimate for their annual access at the beginning of the year in April so that the temptation to resist paying is removed in a year when less irrigation water is needed (as in 2017)
- support from Agriculture and Agri-Food Canada's engineering staff, incentive program, and Farm Credit Canada
- an excellent engineering project manager who facilitated key design decisions and oversaw the project
- perseverance and persistence were needed to see the project through as it took between two and three years to get through the environment assessment process and approvals
- strict rules on the uses of water – for example, for food safety reasons, growers are not allowed to apply water to ground crops like lettuce that consumers eat without cooking first

10. The lead consultant met with Kevin Hamm (President LADII), Mark Lehn (Shareholder, LADII) and Paul Tiessen (Shareholder, LADII) on October 24, 2017.

The key lesson from the LADII project for this strategy is that when growers are organized and driven and willing to have significant "skin in the game", they can accomplish desirable, long term outcomes that would otherwise not occur.

3.2 WHY THE PENINSULA HAS AN IRRIGATION WATER DEFICIT

Figure 3.2.1 The Niagara Peninsula from space[11]

An overhead observer of the Niagara Peninsula would be envious of the abundance of surface water available. The "peninsula" is so named because it has water on three sides – Lake Erie to the south, Lake Ontario to the north, and the Niagara River to the east. The Welland Canal is a manmade channel that joins the two great lakes, flowing through the heart of the Region from south to north. In addition, the major surface water sources are at higher elevation than the farmland below the escarpment and so the flow is in the optimal direction.

A key question: With so much water "in the picture," why is there insufficient irrigation water for farms below the escarpment?

Barriers to accessing surface water in Niagara for agriculture stem from two factors in Niagara's history.

- The irrigation needs of growers in Niagara west of the canal were met with natural rainfall and surface water from streams during the growing season and therefore these farms did not have the need to develop any large scale means for accessing irrigation water from surface water sources.[12]
- Historically, the surface water in Niagara was recognized as having value for two other priority uses:
  - In the late 1820s – nearly two hundred years ago -- the first Welland canal was constructed, using water channeled from Lake Erie to create a water transportation route for moving boats between Lake Ontario and Lake Erie. The canal, now in its fourth version dated from the middle of the 20th century, draws water from Lake Erie under the management of the St. Lawrence Seaway Management Corporation (SLSMC), a not-for-profit corporation that has been contracted by Transport Canada, the owner of the Welland canal, to oversee its operation.
  - In 1898, the first hydro-electric generating station in Niagara was built at Decew Falls, to channel water from man-made reservoirs built alongside the canal (known as Lakes Moodie and Gibson), over the escarpment for discharge into the Twelve Mile Creek. This hydro-electric generating station remains in use today and is owned and operated by Ontario Power Generation (OPG).

11. https://www.google.ca/search?safe=active&hl=en&tbm=isch&q=google+earth+niagara+on+the+lake&chips=q:google+earth+niagara+on+the+lake,online_chips:maps&sa=X&ved=0ahUKEwiD4ve9kY_XAhWr44MKHRdG-BesQ4lYIMCgK&biw=1920&bih=964&dpr=1#imgrc=0_jWlsawqAWC2M:
12. The needs of growers east of the canal, in Niagara-on-the-Lake, were met by a long-standing series of drainage ditches to convey excess water from their farmland to the Lake. The drainage ditches came over time to serve a dual purpose. They could also be used to bring water from higher elevations to flow through the ditches and allow adjacent farms to take water for their irrigation requirements. At the present time, there are four sources of water to supply the ditches. NOTL operates pumping stations on the Niagara River at Queenston and on the Welland Canal above Lock 2. There is also a siphon feed on the Canal below Lock 2. There are two OPG sources that also supply water, one to the Four Mile Creek at St. David's and one further to the east. This water originates in pumped reservoirs and/or tunnels above the escarpment from Niagara River diversion.

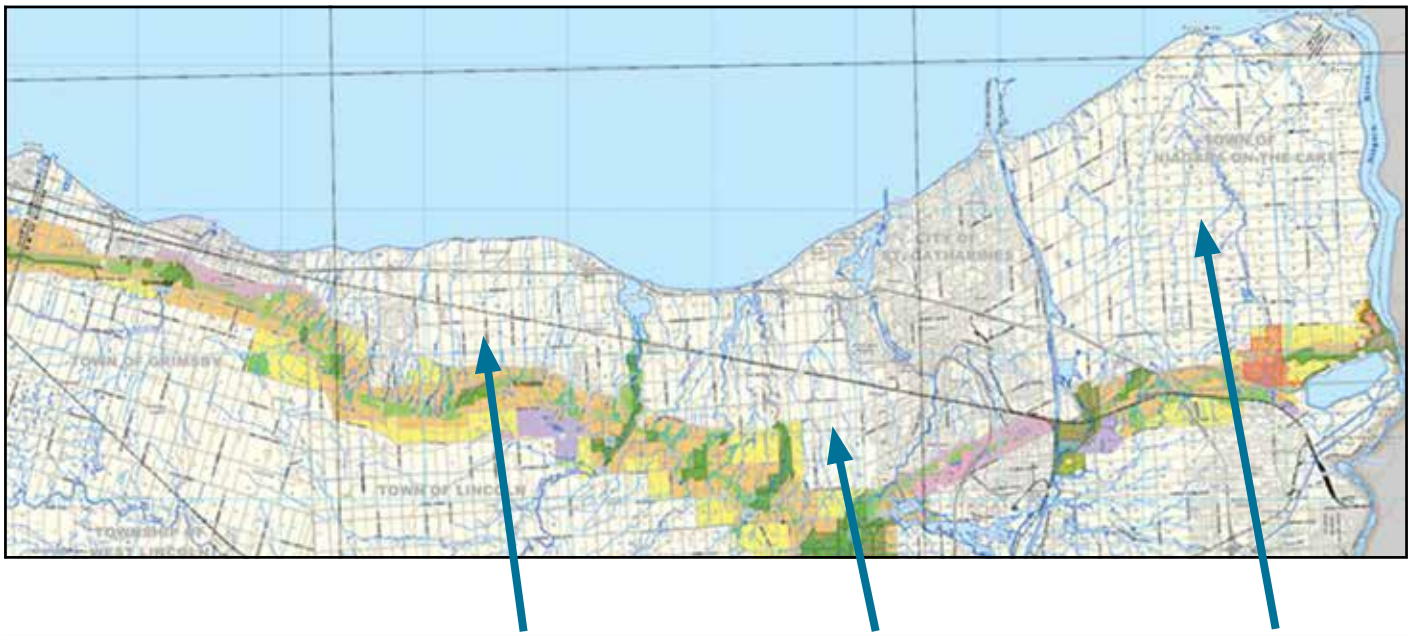
While neither of these major users has "ownership" of the water, both have significant jurisdiction over access to the water on account of their land ownership. The total amount of water that can be diverted from Lake Erie through the Welland Canal was established in the 1909 Boundary Waters Treaty between the United States and Canada and is now monitored by the International Joint Commission. Both SLSMC and OPG co-operate with the Municipality of Niagara-on-the-Lake to provide water to the Municipality for distribution through its network of drainage ditches for irrigation purposes. Increasing the volume of water which either of these major long-standing users of surface water in Niagara can make available for irrigation is not easily done as they have priority needs to meet first within the total allocation available. SLSMC must make sure that there is sufficient water in the canal system to enable it to operate as a water transportation corridor. OPG must make sure that it is generating sufficient electricity for the grid to ensure adequate power for Ontario's requirements.

In addition to these two uses, water from the Welland Canal is treated by the Region at its Decew Water Treatment plant and supplied to St. Catharines and Niagara-on-the-Lake to provide potable water for domestic and commercial use. As St. Catharines has expanded, residential and commercial development has occurred that has separated farmland from surface water sources, making direct access to surface water more difficult. For example, development in St. Catharines north of the Queen Elizabeth Way (QEW) corridor would make directly accessing water from Lake Ontario for farmland south of the QEW a very high cost project.

In any strategic steps to access more water from surface water sources at higher elevation – that is, above the escarpment – the co-operation and engagement of OPG and SLSMC are essential.

One of the key realities of the current situation, which the Stantec Report recognized by partitioning Niagara into districts, is that irrigation needs are not the same across the Region. In this strategy, the scope is limited to addressing irrigation needs of farmland below the escarpment, as that is where the majority of grape, tender fruit, nursery stock and greenhouses are situated. For the purposes of analysis, the Niagara farmland below the escarpment has been divided into three zones, A, B and C, as indicated in more detail at the Niagara Escarpment Commission (NEC) map at 3.2.2.

Map 3.2.2 Farmland zones below the escarpment



	LINCOLN (A)	WEST ST. CATHARINES (B)	NIAGARA-ON-THE-LAKE (C)
Primary irrigation source	Water pumped seasonally from Lake Ontario to recharge on-farm irrigation ponds	On-farm ponds to collect spring run-off and rainfall	System of drainage ditches that flow from south to north with irrigation water sourced from the Niagara River, OPG and the Canal
Organizational model	Private, jointly farmer-owned consortia	Independent farms	Municipal utility operated by the Town into which users pay
Challenges	Works satisfactorily for farms with access to surface water distribution	Severe challenges in dry years due to lack of surface water irrigation source	Maintaining sufficient flow in dry years and avoiding flooding in wet years or during rainfall surges

For the purposes of understanding the irrigation needs of Niagara farmers situated below the escarpment, it is helpful to consider the three different zones where most of the productive farmland is located. In addition to the three zones indicated on the map, there are also isolated farms or groups of farms below the escarpment, such as in west Grimsby.

While it is an oversimplification of the current situation, our high level analysis is that:

- Some growers in Zone A have taken matters into their own hands and implemented their own, privately-funded and operated solutions – the coverage of growers provided by these interim solutions needs to be expanded and the efficiency of the delivery system improved as well as its permanence
- growers in Zone B have the most acute and pressing need as there is no shared system for supplying their irrigation water needs
- growers in Zone C have a long-standing open ditch drainage system in place – while this system is also functional for irrigation, in high demand situations (in which the system is under stress, as occurred in 2016), it is prone to breakdown and shortages, due to its age and capacity; it has potential to be expanded to reach additional under-serviced farms outside its current range and to obtain buy-in from growers within its current range that are currently not participating

There is no single solution that will address the needs of every farm in Niagara. The specific irrigation needs of each farm need to be assessed individually in order to determine how much water is required and when, as there are many variables that affect the optimal amount of water:

- The amount of natural rainfall in that block
- The type of soil and the corresponding degree of water infiltration
- The type of crop including the drought resistance of the specific cultivar
- The depth that the roots have reached (correlated to the age of the plant)
- The type of groundcover
- Other climatic factors including wind, humidity, sunlight and temperature affecting the evapotranspiration rate
- Stage of growth and corresponding amount of leaf surface and fruit formation

3.3 THE PUBLIC POLICY SITUATION

RECOGNIZING CLIMATE CHANGE AS A POLICY IMPERATIVE

Over the ten years since the Stantec Report was released, there has been much more public policy focus on the impact of global climate change. To give prominence to its importance in the public sphere, the Ontario Ministry of the Environment adopted a new name in 2014, the Ministry of the Environment and Climate Change (MoECC). A similar change followed at the federal level when, in 2015, Environment Canada became Environment and Climate Change Canada. It is not only the Environment portfolios at both the federal and Ontario level that have recognized climate change as a policy imperative. In July 2016, when the federal, provincial and territorial (FPT) Ministers of agriculture met in Calgary to set the framework for the next five year agricultural policy framework, "Environmental sustainability and climate change" was identified as one of six priorities:

- Collaborative FPT action related to environmental sustainability and climate change adaptation and mitigation improves the sector's ability to manage risks, enhances productivity and contributes to economic growth. It also builds public confidence in the environmental performance of the sector.
- Support for environmental sustainability initiatives under the NPF[13] will help the sector to address agriculture's impacts on Canada's natural resources, reduce greenhouse gas emissions, and mitigate and adapt to the anticipated impacts of climate change (for example, changing growing conditions, extreme weather events, reduced water availability/quality, soil degradation and new and increased pests and disease outbreaks).[14]

There is clear policy recognition that climate change has impact on agriculture. "Reduced water availability" is one of the specific examples of the potential impact as well as "extreme weather events." This policy recognition is positive for the development of this strategy because it implies that mitigation measures, such as investment in irrigation capacity, will be supported.

Much of the focus of federal and Ontario action on climate change relates to reducing greenhouse gas emissions by moving to a lower carbon economy. In *Ontario's Climate Change Action Plan 2016-2020*, "irrigation" appears once in connection with the plan to increase urban tree planting "with funding for irrigation where appropriate."[15] While this commitment to expanded tree planting is welcome news for the nurseries in Niagara that raise trees and shrubs, the need for expanded irrigation for farmland is not identified as an action in the Plan.

When the Ontario government implemented cap and trade as a tool for reducing greenhouse gas emissions, it committed to using the proceeds from cap and trade as the funding basis for the Green Investment Fund:

- Cap and trade is projected to generate about $1.9 billion per year in proceeds. Ontario will invest this into programs that save homeowners energy and money. By law, every dollar collected through cap and trade must be invested – in a transparent way – back into projects that reduce greenhouse gas pollution, such as: public transit, electric vehicle incentives and social housing retrofits[16]

13. "NPF" is a reference to "Next Policy Framework." The five year multi-lateral agreement among the federal government, provinces and territories on agricultural policy was referred to as the 'next policy framework' and it is scheduled to take effect in April, 2018 when the current framework, known as *Growing Forward 2*, ends. Subsequent to this Calgary meeting in July 2016, the next policy framework, effective April 2018, was named the Canadian Agricultural Partnership (C.A.P.).
14. "The Calgary Statement" is on-line at http://www.agr.gc.ca/eng/about-us/public-opinion-and-consultations/consulting-on-the-next-agricultural-policy-framework/calgary-statement-towards-the-next-policy-framework/?id=1468864509649
15. Climate Change Action Plan, p. 53, accessible at http://www.applications.ene.gov.on.ca/ccap/products/CCAP_ENGLISH.pdf
16. About Cap and Trade, Benefits, MoECC website page view at https://www.ontario.ca/page/cap-and-trade-ontario

As the Ontario government continues to develop its plan for the uses of the Green Investment Fund, there is opportunity to position investment in irrigation infrastructure as a valid action to respond to climate change – it is already implicitly recognized in the Calgary statement. To strengthen the connection between investment in irrigation infrastructure and the goals of the Climate Change Action Plan, the following linkages can be made:

- Niagara's orchards, vineyards, greenhouses and nurseries are vital to local supply of fresh fruit, vegetables and ornamental products as well as wine – local supply reduces greenhouse gas emissions that would otherwise occur if the supply was transported from other parts of the world like California
- Orchard trees and vines draw carbon dioxide from the atmosphere during the growing season and sequester carbon in their root systems as they mature
- Drawing irrigation water from sources at higher elevation reduces the energy that would otherwise be required for pumping and therefore contributes to a lower carbon economy

PRESERVING THE GREENBELT

In 2005, Ontario enacted its first greenbelt legislation, *The Greenbelt Act*. In 2017, an updated *Greenbelt Plan* was published under the legislation. The only direct reference to irrigation in the 2017 Plan relates to minimizing the impact of irrigation infrastructure on vegetation protection zones.[17]

> *Infrastructure* serving the agricultural sector, such as agricultural irrigation systems, may need certain elements to be located within the *vegetation protection zone* of a *key natural heritage feature* or *key hydrologic feature*. In such instances, these elements of the *infrastructure* may be established within the feature itself or its associated *vegetation protection zone*, but all reasonable efforts shall be made to keep such *infrastructure* out of *key natural heritage features, key hydrologic features* and their associated *vegetation protection zones*.

The updated *Greenbelt Plan 2017* clearly recognizes that the goal of protecting the countryside and enhancing the overall quality of life requires "agricultural viability and protection:"

> Protection of the *specialty crop area* land base while allowing agriculture-supportive *infrastructure* and value-added uses necessary for sustainable *agricultural uses* and activities[18]

While there is no explicit recognition of the value or need for irrigation in the recently updated Greenbelt Plan in order to fulfil the objectives of the original *Act*, irrigation is encompassed within "agriculture-supportive infrastructure". The second, third and fourth of eleven objectives of the *Act* relate directly to agriculture and the fifth recognizes that "hydrological functions" need to be maintained, restored and improved.

- to sustain the countryside, rural and small towns and contribute to the economic viability of farming communities;
- to preserve agricultural land as a continuing commercial source of food and employment;
- to recognize the critical importance of the agriculture sector to the regional economy;
- to provide protection to the land base needed to maintain, restore and improve the ecological and hydrological functions of the Greenbelt Area;[19]

17. *The Greenbelt Plan 2017*, s. 4.2.1 General Infrastructure Policies, p. 41, accessible at http://www.mah.gov.on.ca/AssetFactory.aspx?did=18549
18. *Ibid*, s. 1.2.2, Protected Countryside Goals, p. 4
19. *The Greenbelt Act*, s. 5

There is recognition in these objectives of the *Act* that public policy that restricts agricultural land from development and requires that it continue in use for farming, also has a responsibility to ensure the economic viability of the farmland. As irrigation is essential for achieving economic viability in Niagara farmland, the *Act* implicitly recognizes the public responsibility to enable that irrigation to occur as part of the "protection to the land base." The *Plan* recognizes that infrastructure will form part of that protection in order to sustain the land in agricultural use.

What is the convergence between policy measures to reduce greenhouse gas emissions in moving towards a lower carbon economy, on the one hand, and policy measures to protect the landbase and preserve its natural features, on the other? In both cases there is a shared commitment to reducing and minimizing the impact of human activity on the natural environment. In the former, it is the human activity related to the combustion of fossil fuels in particular and the release of carbon dioxide into the atmosphere in consequence. In the latter, it is human activity that has led to the loss of wetlands and natural habitat. However noble and well intentioned these policy goals, there needs to be recognition that farming is a constructive human activity that is essential to the preservation and nurturing of human existence and thereby rightfully prioritized in public policy decision-making. Inasmuch as irrigation is essential to achieving the best outcomes from high value agriculture in Niagara, access to irrigation water needs to be recognized as a high public policy priority for the Region.

3.4 THE REGULATORY FRAMEWORK FOR ACCESSING AND USING WATER FOR IRRIGATION

This section has been contributed by CJ Agren Consulting Inc. with support from BluMetric Environmental Inc. This consulting team reviewed the current set of legislation and regulations affecting irrigation in the Niagara Region. They were tasked with identifying the agencies and specific legislation that could create impediments to accessing water.

BACKGROUND AND ANALYSIS

Access to water is governed mainly through the Permit to Take Water (PTTW), a process under the Ontario Water Resources Act (OWRA), administered by the Ministry of Environment and Climate Change. Water uses for livestock production are exempt from the permit process. Farmers relying on irrigation for crops have a straightforward process when water is sourced from edge of their field. However, things can become very complex as soon as the source of water is located elsewhere in the landscape. OMAFRA publishes Best Management Practices (BMPs) including ones for water use and irrigation. When a farmer is challenged with respect to irrigation practices, there is recourse to use the *Farm and Food Production and Protection Act* to defend its practices.

The PTTW process is designed to force local consultation, as water is a shared resource. Members of the local community may raise issues directly with MOECC or it can raise them through the Niagara Peninsula Conservation Authority.

In the case of the Niagara Region, land use planning is complex as several agencies interact in this space, all with slightly different mandates, ranging from protection of the environment, managing the water resources, to preserving natural and ecological features. The agencies responsible for these functions report to various Ministries which can further complicate their overlapping roles. At the federal and international level, the Boundary Water Treaty between Canada and the US, dating back to 1909, governs some aspects of water use. At the municipal level, there is an upper and lower tier system of government in place. For example, all the municipally supplied potable water in the Region is treated in plants owned and operating by the Region (upper tier) but it is sold wholesale to the local (lower tier) municipalities by which it is distributed and billed to water users. Coordination across the array of multiple agencies is complex and requires a strategic approach in order to get issues resolved.

With respect to irrigation where the water body source is external to the farm, there are several agencies involved with interests in commenting on the use of water for irrigation purposes. They may also have jurisdiction related to the development of pump stations and potential water delivery infrastructure. For example, expanding a pumphouse structure, even if owned and operated by the local municipality, requires a development permit. The Queenston pumping station operated by NOTL is located on protected land that falls under the oversight of the Niagara Escarpment Commission (NEC).

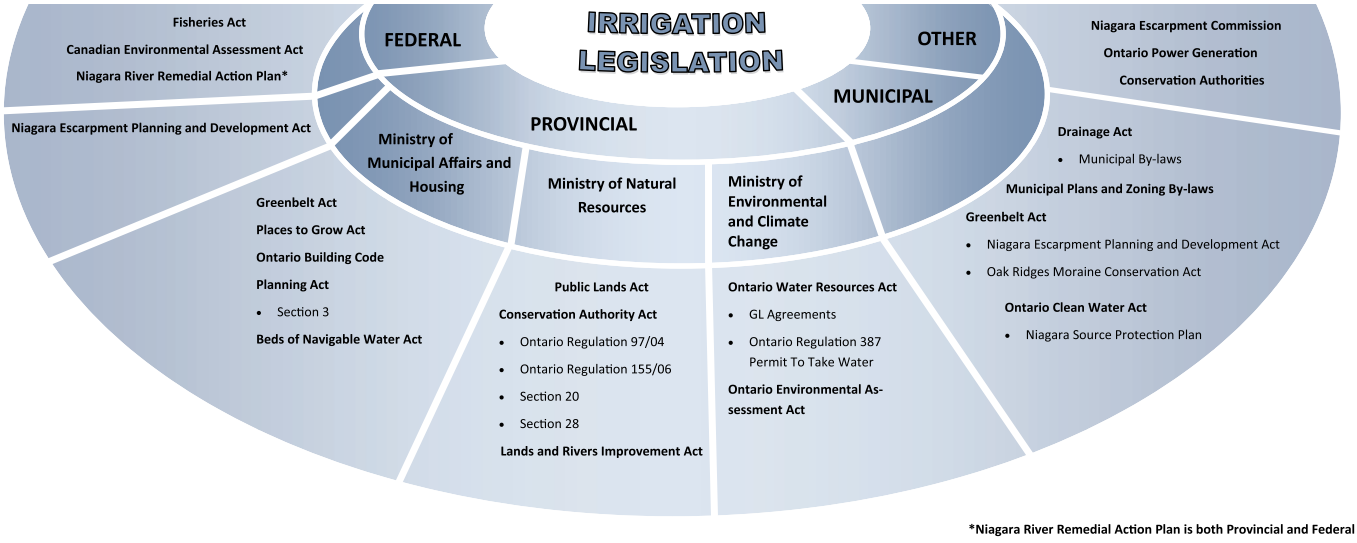
The NEC recently completed a review of its policies with respect to the Greenbelt Plan 2017, the Oak Ridges Moraine Plan and the Growth Plan for the Golden Horseshoe. The work resulted in a Policy Document outlining how the NEC operates. While the report clarifies what activities require permits, their permit approval process is extremely slow and can take up to nine months. These delays are unworkable for agriculture especially when circumstances create acute and time sensitive needs.

The Town of Niagara-On-The-Lake sources water for its irrigation system from the Niagara River, OPG reservoirs and from the Welland Canal. The PTTW is obtained at the municipal level. Farms which draw water from the open ditch irrigation system report their water-taking to the municipality so that it can satisfy the reporting requirements under the PTTW process.

NOTL's Drainage and Irrigation Superintendent provided the consulting team with a tour of existing key assets for accessing irrigation water and outlined opportunities that lie ahead to further enhance the open ditch irrigation system used in NOTL. As climate change impacts are felt in the Region, the expectation is that irrigation water demands to support existing farms will continue to increase and there is opportunity to expand the coverage provided by the current system to additional farms in NOTL. When these additional lands are developed for high value horticultural uses, the demand for irrigation water in Zone C will increase.

When farmers or municipal managers responsible for irrigation deal with regulatory agencies, they can experience difficulties as the staff at the agencies are often challenged to understand the needs for irrigation and site-specific issues that may need to be addressed. This communication interface can be further strained because the objective of the permitting agency may be the enhancement of the *natural* environment or ecology which the regulator may perceive to be at cross purposes with *human* farming activity. Increasingly there is a need for secondary studies, such as an archeological assessment, to be undertaken in order to support applications for any kind of "works." Additional assessments may involve additional Ministries with their specific interests in the development of an irrigation system being brought into the application process.

The following Figure has been prepared to provide an overview of key agency players and what legislation governs their activity. (It does not depict the role of the International Joint Commission, the joint body that oversees the use of shared water resources between the US and Canada).

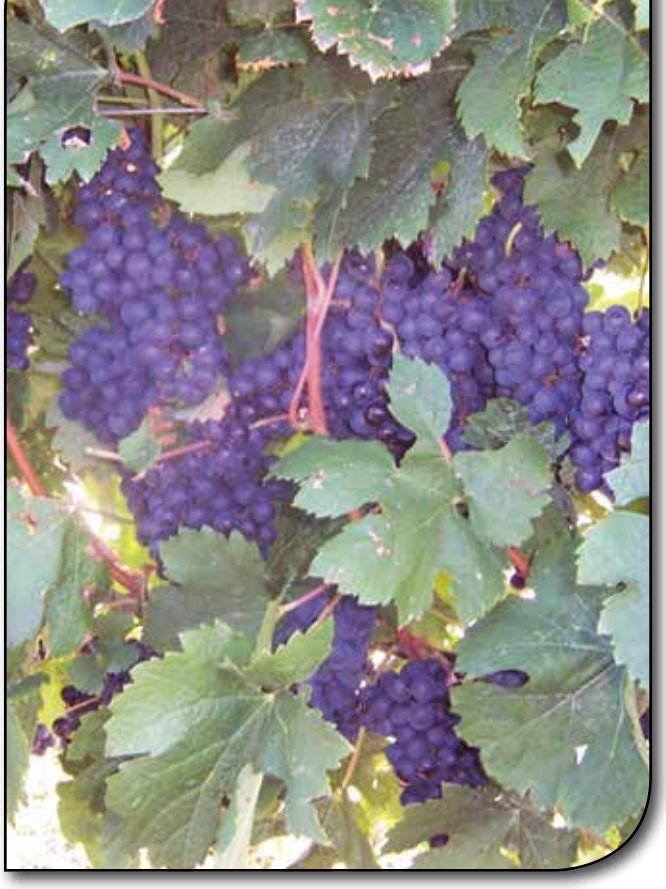


*Niagara River Remedial Action Plan is both Provincial and Federal

Legislation impacting irrigation in Ontario is entirely based on environmental and ecological issues with emphasis on planning instruments. The lead Ministry for land use planning, the Ministry of Municipal Affairs, is responsible for *The Greenbelt Act* whereas the Niagara Escarpment Commission has accountability to the Ministry of Natural Resources.

After undertaking a review of the regulations, the writers concluded that there is no specific regulatory barrier to accessing irrigation water in Niagara. What they discovered is the complexity of the web created by overlapping mandates with different priorities and planning elements applicable to each narrow or specific area of interest.

3.5 THE CASE FOR PUBLIC INVESTMENT IN NIAGARA IRRIGATION INFRASTRUCTURE



MORE EXTREMES IN PRECIPITATION AND TEMPERATURE FORECAST

The summers in Niagara for the two consecutive years, 2016 and 2017, were very different. The summer of 2016 was characterized by sparse rainfall and record heat. The summer of 2017 was characterized by abundant rainfall and lower maximum daytime temperatures. This variability in climate is one of the predicted consequences of global climate change – more extremes in climate patterns are forecast.[20] The prolonged low rainfall conditions experienced by growers in Niagara in the dry and hot summer of 2016 demonstrated the importance of and the need for irrigation to supplement natural rainfall. A news report in the *St. Catharines Standard* described conditions in the summer of 2016:

> Routine 32°C temperatures, ongoing fire bans in Niagara and desert-like forecasts. It all adds up to what an Environment Canada authority says is the region's driest 3½-month stretch in recorded history. "It's forgotten how to rain here," said senior climatologist David Phillips. "And it's like a weather-free zone," added Phillips, in stark contrast to rain-drenched Western Canada. "The other story is not just the heat but about how very dry it is." When Vineland Station data is calculated, there has been 86 millimetres of precipitation since May, when a normal amount for that month would be 262, Phillips said. The previous driest Niagara period was in 1934, with 84 millimetres to the end of July. But when you factor in the first week of August, when Vineland got a 31-mm deluge in 1934, it gives us in 2016 the all-time-dry prize. "We could say from May 1 to Aug. 8, certainly at Vineland, there hasn't been a drier such period than what we've seen this year," Phillips said.
>
> So far, Vineland Station has recorded 26 days with temperatures above 30°C. In an entire summer, there'd normally be 13. That said, the average temperatures have not yet been record-breaking. The real story has been the dryness. In eight days of August, the Niagara weather station has seen 3.2 mm of rain when it would usually see 19.4. In July, 48.1 mm fell, when a normal would be 85.1. [21]

Because the summer of 2017 did not create the same drought stress as conditions in 2016 did, it is important not to allow short term memory to create a sense of complacency about irrigation needs in Niagara. Rains were so abundant in 2017 that the water level of Lake Ontario rose to record levels, as indicated in the graph below which compares 2017 levels with 2016. (Water levels are being used as a proxy measurement of rainfall in the Lake Ontario watershed). Lake Erie experienced a similar trend based on data collected at the Fairport, OH monitoring station. Not only did 2017 see more rainfall, but it came at times in heavy downpours that created significant run-off and conditions for localized flooding. In addition to rain in 2017, Niagara experienced serious hail storms in June which caused significant fruit damage.[22]

20. Jennifer Penney ScD, *Adapting to climate change: Challenges for Niagara* (2012)
21. Don Fraser, *St. Catharines Standard* on-line edition, August 10, 2016, "The summer of 2016 is Niagara's driest ever" Source: http://www.stcatharinesstandard.ca/2016/08/09/niagara-drier-than-1934
22. Although it is outside the scope of this strategy to assess the extent to which their use may increase, some Ontario berry growers are relying more on "covered agriculture" systems, referred to as "tunnels" and "hoop houses." The expanded use of field covers creates more run-off in extreme rain events. Covered agriculture has advantages in protecting against hail and birds but requires irrigation.

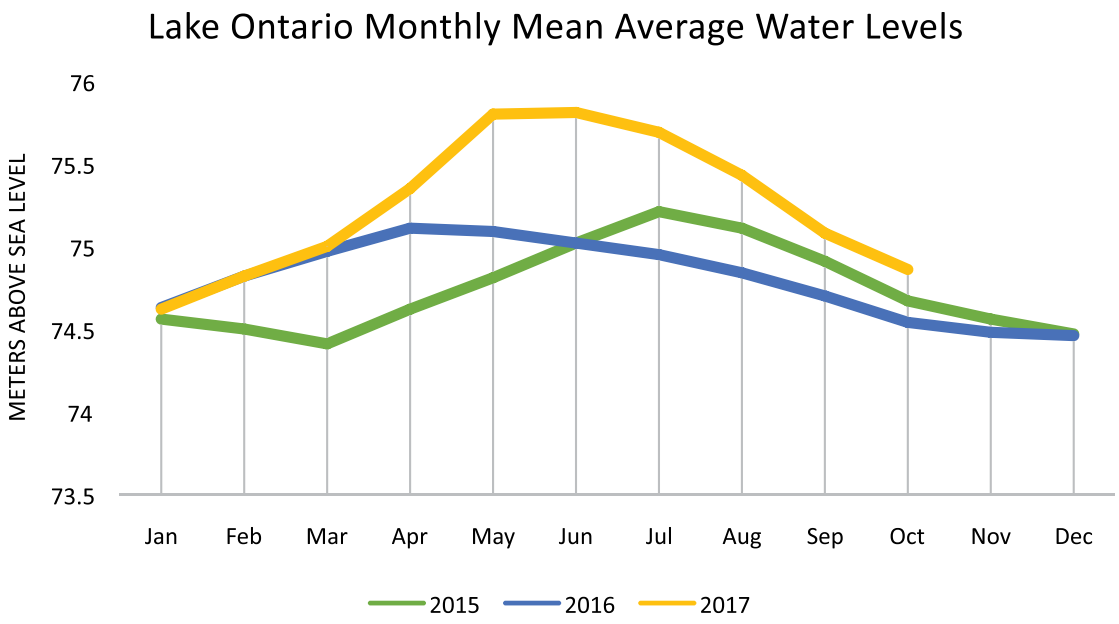


Figure 3.5.1 Lake Ontario Water Level During 2017 (Source: US Army Corps of Engineers Detroit)

Irrigation is an essential part of a risk management strategy to protect against global climate change. The first pillar in the case for public investment in Niagara's irrigation infrastructure is the need to address global climate proactively for sake of Niagara's farmers. Ensuring that farms have access to sufficient water is the right thing to do.

ECONOMIC BENEFITS OF IRRIGATION

The benefits of irrigation in Niagara vineyards[23] have been studied and shown to contribute to:

- Higher yield
- Improved shoot growth (indicative of better nutrient utilization)
- Reduction in pest problems
- Improved enology (higher sugar, corrected pH and potassium, avoiding atypical aging (ATA)
- Improved vine vigour

23. Rebecca Shortt and Kathryn Carter, OMAFRA, *Grape irrigation and Soil Moisture Monitoring 2013-2015*, citing work undertaken by Dr. Andy Reynolds, Brock University

For growers, irrigation is a valuable risk management practice to protect against drought and its adverse consequences for fruit yield, fruit quality and plant longevity. Because the majority of field agriculture in Niagara below the escarpment is dedicated to perennial crops – grape vines, fruit trees and nursery stock – the impact of inadequate water extends more than a single year event in which it occurred. Growers report that drought stress from one year affects bud development and therefore yield in the subsequent year as well as reducing the bearing life span of the vine or tree. In a worst case scenario, drought stress can cause vine or tree mortality, especially among young plants that have not established deep root systems.

Although the primary benefit of irrigation is to supply the crop with sufficient moisture, the application of irrigation water can also reduce temperatures during periods of heat stress. Drip irrigation, in particular, can also allow nutrients to be delivered ("fertigation") in an environmentally responsible way to encourage maximum take-up by the target crop and minimal nutrient discharge to the environment. For selected crops like berries, the ability to deliver water on cold spring nights can also serve as a frost damage mitigation tool.

There is a cost-benefit equation between the costs of sourcing and applying irrigation water and the benefits in the form of greater returns from each acre of land in production that are gained as a result, as compared to forgoing irrigation. The sharp contrast in natural rainfall between 2016 and 2017 will provide a benchmark for measuring the differences in yield and quality between the two years when the 2017 yield data is available. As previously noted, because there were hail events that damaged crops across much of Niagara in the 2017 growing season, it is difficult to remove all the factors that may account for differences between the years and isolate the impact of water availability only. In the 2007 Stantec study, a high level economic benefit analysis was undertaken and arrived at the following "worst case" estimate of direct economic benefits[24]:

SECTOR	MOST CONSERVATIVE ANNUAL ESTIMATE
Tender Fruit	$7.3 Million
Wine Grapes	$2.8 Million
Horticulture & Greenhouses	$.501 Million
Total	$10.6 Million

Although there has been a positive change in number of farms that are able to access irrigation water, as an order of magnitude estimate, this calculation of the direct economic benefit to be gained from better access to irrigation water stands as an order-of-magnitude indicator of the overall economic dividend and shows the relative gain for each crop category.

The second pillar in the case for public investment in Niagara's irrigation infrastructure is the direct economic benefit that will occur, not only to the farms, but to the communities in the Region and to the Province and nation as a whole. The Stantec report includes economic multiplier calculations in which these broader benefits were estimated. As previously noted, the objectives of the *Greenbelt Act* recognize the responsibility of government to contribute to the economic viability of agriculture in the Greenbelt. In order to recover the maximum returns from the productive farmland of the Region below the escarpment, reliable access to irrigation water is essential. It therefore becomes a public policy priority to determine the best way to provide that access and to provide funding towards it.

24. Direct Economic Benefits Table 3, *Stantec Phase 2 Project Report*, Economic Benefits Report, p. 6.2

4. SWOT Analysis

The assessment of the sector's strengths, weaknesses, opportunities and threats (SWOT) has been compiled from input provided by about forty growers at a meeting held on October 30, 2017 as well as from interviews conducted with government experts and other stakeholders. The session on October 30 was facilitated by the Associate Director of Queen's University's Executive Decision Centre using software that enables participants to simultaneously feed in their input and then vote to rank the consensus priorities. [There is a photo of the session on p. 20.]

In addition to the facilitated session, in which input was instantaneously displayed on the screen for all participants to consider, a paper survey was completed to capture basic information about the participating growers and other stakeholders present. About 80% of the growers present completed the survey. The four other stakeholders included OMAFRA and Niagara Region staff.

4.1 PROFILE OF THE PARTICIPATING GROWERS

The following information was gained from the grower survey results.

- The growers who participated in the session represented tree fruits, vineyards, greenhouses and nursery stock.
- Approximately one-third came from Niagara-on-the Lake, one third from west St. Catharines, and one third from Lincoln
- Most participants either had full decision-making responsibility for or strong influence over the irrigation decision as to when to water and how much to apply
- Participants were about evenly split between those currently using drip irrigation and those using overhead irrigation – some users of the latter classified their advanced sprinkler systems as overhead
- About 10% of the growers have no access to irrigation water other than natural rainfall, about 10% use municipal water (greenhouses), 10% use an on-farm well, and the balance either rely on the open drainage ditches (NOTL) or on-farm ponds where their water is stored. About 10% of the growers have means of recharging their pond with water delivered by pipeline.
- Nearly half the growers who responded indicated that they have been denied water for irrigation at a critical time

4.2 STRENGTHS

STRENGTHS AND ADVANTAGES WITH RESPECT TO IRRIGATION WATER IN NIAGARA
Proximity to a good water source: creek, lake, municipal line or hydrant connection
Reliable, sufficient supply of water
Capacity to recycle water (multiple passes of water through the farmland or greenhouse)
Large pumps to move sufficient volume in appropriate time frames
Ability to collect rainwater from building roofs including greenhouses
Well organized, municipal system for delivery of irrigation water in Niagara-on-the-Lake
Efficient delivery systems to conserve water when applied to crops
Dedicated extension staff from OMAFRA with expertise in irrigation technology and methods

4.3 WEAKNESSES

WEAKNESSES AND VULNERABILITIES WITH RESPECT TO IRRIGATION WATER IN NIAGARA
Not enough water to support irrigation needs during dry periods – vulnerability is very high in years where there is sparse rainfall -- ponds are not naturally replenished and natural watercourses like creeks might be below normal levels
Government regulators complicate access to irrigation water and increase costs of access – *a specific example is identifying a manmade drainage ditch as a fish habitat and requiring minimum flow to be maintained*
The cost of obtaining delivery of water for irrigation is high when it has to be drawn from a municipal source or trucked in by a potable water delivery service
Quality of water can be a concern if there is contamination from neighbouring properties or if the water is sourced from a creek with high mineral content
Reliability of supply is a concern for various reasons including (a) other users taking water earlier in the flow when supplies are tight (b) breakdown of critical pump equipment (c) regulatory intervention such as cancelling a PTTW in a low rainfall year when supply is absolutely vital
Water delivery infrastructure is aging and therefore has issues related to reliability and capacity
One of the characteristics of farms in Niagara below the escarpment is that they are made up of many small parcels and those under common ownership tend to be scattered rather than contiguous – this array of orchards and vineyards makes it more difficult for any one owner to get water to his or her blocks from a single investment or single hook-up and adds to the costs
Accessing sources from which to take water can be challenging in view of (a) the distance to be covered (b) manmade obstacles in the way such as the QEW or development (c) elevation – water may need to be pumped uphill from Lake Ontario
Minimum wage increases – irrigation on farm is labour intensive to set up, operate, and uninstall at the end of a season. Increases in minimum wage will increase the cost of irrigation.

4.4 OPPORTUNITIES

OPPORTUNITIES TO ACCESS AND USE IRRIGATION IN NIAGARA
With additional funding, capital projects could be undertaken to expand irrigation water delivery infrastructure and provide more farms in Niagara with water security
The water is naturally flowing the right direction, from south to north, from higher elevation to lower elevation, to the lands where agriculture is prevalent – harness the natural flow to reduce pumping costs
There are quarries that could be repositioned in their rehabilitation plans as reservoirs to hold water at higher elevation and release it with gravity flow to service farmland below
Expanded use of drip irrigation will improve the efficiency of water use
Establish a one-stop clearing point for regulations that enable irrigation water to be readily used by getting all the regulators on the same page and supporting irrigation in Niagara
Expand the NOTL model of municipality-grower collaboration to other parts of the distribution system west of the canal – this model can be used for coordinating and funding irrigation needs
Expanded use of irrigation water will strengthen the ability to farm and provide higher productivity (higher yields, higher quality)
Undertake a program to construct more retention ponds to increase water storage capacity on farm
Expand the use of municipal water for irrigation purposes as a deliberate strategy
Increase the quantity of water captured from drains and recirculated on the farm
Expand the use of roof collection strategies to capture and store water
Use drainage ditches and creeks as water carriers by pumping water in during dry years

4.5 THREATS

THREATS AND RISKS TO ACCESSING AND USING IRRIGATION IN NIAGARA
Government regulation and enforcement as well as rising costs associated with compliance. A related issue is inconsistent interpretation of regulations.
Insufficient funding towards and rising costs of maintaining the current infrastructure
Too many regulatory fingers in the pie that do not see providing water for irrigation as part of their mandate and may, in fact, impede it
Risk of contamination of a water source (example: *e. coli* levels)
Inadequate communication to convince the broader public of the importance of irrigation to Niagara (i.e. lack of societal and political commitment)
Obtaining voluntary cooperation with neighbouring farms to portion the available water supply
Obtaining long term commitment from farmers in the same locale on funding and using expanded irrigation delivery infrastructure
Increasing residential development encroaching on farmland bringing increased risk of vandalism to pumps and lines
High cost of maintaining open ditches for irrigation in view of silting, erosion and plant growth (including invasive species like Phragmites) as well as their impact on reducing flow and water quality
Abrupt imposition of water restrictions in a dry year when farms need the water the most

4.6 ON-FARM INVESTMENT PRIORITIES

At the session on October 30, the facilitator asked growers about the top thing they would do on their farm to use irrigation water more effectively and efficiently, if they had the funding to do so.

- Use electric (rather than diesel-powered) pumps in order to run more quietly and therefore be able to be used throughout the night
- Expand the use of automation including the use of artificial intelligence watering systems
- Improve on-farm water storage and retention capacity (expanding the number of ponds)
- Deliver water optimally to the plants using drip irrigation
- Improve monitoring of moisture conditions and responses to watering in order to better determine when and how much water to apply

4.7 IMPACT OF 2016 DROUGHT

At the session on October 30, the facilitator asked growers to rank the impact of the dry summer in 2016 on their operation, by choosing options from a list and having the option of putting forward other alternatives to those listed. In order of precedence, the following responses were provided:

- Diminished yield
- Quality drawbacks (reduced fruit size was one specific factor cited)
- Stress on plant productivity that continued into the following year
- Reduced plant health and increased plant mortality
- Increased operating costs (pressure on margin) related to labour and energy
- Long term setback to the business
- Owner morale diminished

5. Strategic Action Plan

5.1 STRATEGIC VISION

Farms in Niagara have reliable access to irrigation water used efficiently and safely to sustain their productivity

This vision is intended to establish a responsibility hierarchy.

- The primary responsibility is the provision of sufficient irrigation water to the farm. The vision does not assign that responsibility to any party, public or private, as the recommendations of the plan propose that this responsibility is shared. The Niagara-on-the-Lake open ditch irrigation system is a model in that respect in which the growers and the Town work together. NOTL effectively operates an irrigation utility which recovers its costs from the farmers and the farmers, in turn, have representation on the municipal committee which acts like a board responsible for its operation.
- The second responsibility relates to how the water is used once it is provided to the farm. The vision states that it will be used "efficiently and safely."
  - *Efficiently* means that the water is used wisely and is conserved, that is, it is applied to the crop at the optimal times and in the optimal quantities. OMAFRA has excellent materials to provide guidance to farmers on when and how much water to apply. OMAFRA extension staff have a perception that farmers have a tendency to wait too long before applying water in dry conditions and so it is possible to conserve overmuch. When the water is there, use it.
  - *Safely* is included in the vision because the water that is being used for irrigation has not been treated to render it potable. For food safety reasons, therefore, it is important to ensure contamination risks are assessed and mitigated.
- The phrase "to sustain their (i.e. the farms') productivity" emphasizes the reason why the vision is valid, that is, why reliable access to irrigation water is in the public interest. Sufficient irrigation water translates directly to more productive plants with higher yields of better quality fruit. That outcome, in turn, increases the overall financial returns of the grower. The word "sustain" was chosen to indicate that the benefits from accessing irrigation water must exceed the costs, otherwise the system would not be sustainable; that is, reliable access to irrigation water must contribute to the farms' profitability.
- The qualifier, *reliable* access, was included in the vision to indicate that the source of irrigation water must be one that the growers can count on and not one susceptible to irregularities in flow or high risk of breakdown.

5.2 STRATEGIC PRINCIPLES

5.2.1 GROWERS HAVE A RESPONSIBILITY TO BEAR A SHARE OF THE COSTS FOR IRRIGATION DELIVERY SYSTEMS

This principle has been well established in several precedents.

- The growers in Lincoln (Zone A) that formed their own private consortia to draw irrigation water from Lake Ontario have financed their system 100%, both with respect to capital and operating costs, except to the extent that they may have accessed any grants towards setting it up under the *Growing Forward 2* program.
- Growers in NOTL (Zone C) pay the municipality according to charges determined every year for their access to irrigation water. The 2017 rates are: $13.50 per acre per year for farms over 20.1 acres in size to cover operations and $19.85 per acre for capital.[25] NOTL separates the ongoing operating costs from major capital costs to upgrade and enhance the system. These costs do not include the costs incurred by the farm operator to pump the water from the irrigation ditch and pipe it to the blocks of orchard or vineyard where it is needed. In addition to the energy required to operate the pump, there is labour to oversee the placement of the irrigation delivery equipment and to monitor the water application. As well, the farm operator has to cover the capital cost of the pump and on-farm irrigation infrastructure. Growers that are not current users of the NOTL system that choose to gain access are charged a buy-in charge. The charge is scaled in five acre block intervals. The interval of 25.1 to 30 acres is charged $8,235 as a one-time buy-in charge in order to provide equity with long-standing users whose capital contributions over many years have built the system.
- Growers participating in the LADII project previously described pay 100% of the operating costs and paid a substantial amount of the capital costs. Grants offset a portion of the original up-front capital cost.

Among the reasons why this principle is important is that it increases the sense of responsibility for using the resource efficiently when there is a direct cost associated with accessing the resource. In the first and third example above, the growers bear the costs according to a formula in part correlated to the quantity which they take from the system in any given year. In the second example, because there is no practical way to meter the water drawn from the open ditch irrigation system, growers bear costs based on their acreage that has access to the water source, as a kind of proxy for the amount of load that they might be expected to put on the system. The cost of participating in the system cannot be solely correlated to the quantity taken because there is both a fixed cost and variable cost component to delivering the water. Even in a wet year like 2017, when it is possible that only a small amount of water will be taken, the fixed costs of operating the infrastructure will still be incurred.

It is a long-standing principle of democratic government that where there is payment for a quasi-public good, there should also be representation. In each of the examples above, growers have representation on the body that operates the water distribution system. In the first and third examples, they are represented as shareholders in a private corporation. In the second example, they are represented by grower appointees to a committee of NOTL Council.

25. Niagara-on-the-Lake Municipality website, http://www.notl.org/content/irrigation-drainage#Irrigation

5.2.2 PUBLIC INVESTMENT IN MAJOR IRRIGATION INFRASTRUCTURE IN NIAGARA REGION IS ONE PROACTIVE WAY TO MITIGATE CLIMATE CHANGE RISK

This public responsibility arises from two distinct factors.

- Government recognizes that climate change will have a significant impact on farming in Canada and that mitigation measures are necessary to support farmers in proactively managing the risk of climate change. Irrigation is one such vital measure in Niagara. Moreover, through the Green Investment Fund, government has a source of funds by which to make investments to offset climate change impact.
- Different than in the Leamington context, the public has mandated, through the Greenbelt Act and Greenbelt Plan 2017, that agricultural land in Niagara must be preserved in that use and is not available to be sold for development. With that mandate comes the responsibility to ensure that the land has the highest productive return and irrigation is essential to realizing that potential.

5.2.3 BECAUSE IRRIGATION IS NOT PROMINENT AS AN IMPORTANT PRIORITY IN PUBLIC POLICY DOCUMENTS OR RECOGNIZED IN MANY PROVINCIAL INITIATIVES, THERE IS A COMPELLING NEED TO RAISE THE POSITIVE PROFILE OF IRRIGATION IN THE PUBLIC SPACE AND OBTAIN RECOGNITION AS A HIGH PRIORITY

Examples of the scanty mention of irrigation have been given from recent Ontario government public policy documents, including the Climate Change Action Plan 2017 and the Greenbelt Plan 2017.

5.2.4 TO THE FULLEST EXTENT POSSIBLE, IRRIGATION WATER SOURCES WILL RELY ON GRAVITY FOR CONVEYANCE AND DISTRIBUTION RATHER EXTERNALLY SUPPLIED ENERGY TO PUMP WATER

Niagara's farmland below the escarpment is uniquely situated with primary surface water sources at higher elevation, above the escarpment. This favourably positioned store and flow of water is currently utilized for Zone C but is not available to Zone B notwithstanding its close geographic proximity.

The goal of relying on gravity, taking advantage of the higher elevation of the water sources, is directly related to the Climate Change Action Plan (CCAP), as the less energy that is used, even if sourced from renewable electricity coming from hydro generation, is beneficial. There is an opportunity cost to using that energy to pump water. If it is not used to pump water, the energy is then available to support goals of the CCAP, such as the transition to more electric vehicles, for example.

In order to access water sources at higher elevation, significant cooperation and engagement with the SLSMC and the OPG will be required and intense negotiation will need to take place. A clear signal from both federal and Ontario governments that they are supportive of this strategic principle and expect cooperation from these entities that have accountability to them will be essential.

Until specific engineering calculations are made, it is not possible to verify with certainty, but the expectation is that the quantity of water required from sources above the escarpment, given that it is highly seasonal, is not material to the total flows and capacity available.

In the Stantec Report in 2007, the option of drawing water from two sources above the escarpment was considered for the West District (in this document, referred to as Zone B), and rejected. In the ten years that have passed, the emerging focus on climate change justifies a reconsideration of that position.

In the Boundary Waters Treaty of 1909, which among other watercourses, sets the stage for uses of Lake Erie water flowing northward into Lake Ontario, the following priorities are set out.

The following order of precedence shall be observed among the various uses enumerated hereinafter for these waters, and no use shall be permitted which tends materially to conflict with or restrain any other use which is given preference over it in this order of precedence:

1. Uses for domestic and sanitary purposes;
2. Uses for navigation, including the service of canals for the purposes of navigation;
3. Uses for power and for irrigation purposes.[26]

The significant point is that the use of Lake Erie water flows for power generation is ranked equally with its use for irrigation purposes and both are ranked after its use for ship transportation in the canal.

5.2.5 INTEGRATE IRRIGATION INTO ALL PUBLIC WORKS AND PRIVATE INFRASTRUCTURE PLANNING IN NIAGARA

Because of the very high capital cost associated with building dedicated pipelines for the delivery of raw water, there could be substantial cost savings obtained by piggybacking their construction onto to other projects and costing them at a marginal cost basis, that is, the incremental cost of the additional pipeline with the core project picking up the core costs.

No water main should be extended or replaced, no road constructed or reconstructed, no sewer installed or replaced, no natural gas pipeline laid, without examining the possibility of laying a raw water irrigation pipeline at the same time. Other long term planning considerations include:

- working with the owners of quarries when they are developing rehabilitation plans to determine to what extent quarries could serve as irrigation reservoirs in future planning – among considerations that would need to be assessed as part of the feasibility of using quarries as irrigation reservoirs is their water quality and the source(s) that will be used for their replenishment
- mapping all pipelines that traverse the Region to determine any unused or under-used assets that could be modified for an alternative use, that is, delivering irrigation water

While this principle is important in order to identify cost savings, it is not intended to preclude the need for dedicated investment solely for irrigation purposes when the need justifies it.

26. *Boundary Waters Treaty*, Article VIII. Articles III, IV and V were terminated in 1950 and replaced with an updated treaty. The diversion of Niagara River water for power generation purposes is covered in that treaty.

5.3 STRATEGIC ACTION STEPS

There are three areas in which strategy calls for action to move forward.

5.3.1 FORMATION OF A NIAGARA IRRIGATION LOCUS FOR COORDINATION AND ACTION

The word *locus*, meaning "a particular position, point or place," was chosen advisedly so as not to be overly prescriptive as to the precise form this role needs to take. It is evident that there is at present no specific "champion" of the needs of growers for access to irrigation water in Niagara. Although many parties support and bring goodwill to this cause, it does not have sufficient focus and profile. The recommendation is that this locus be staffed by a full-time position for a minimum two year period with specific deliverables and corresponding budget. At the end of the two year period, the value of the role would be assessed and a determination made on whether to continue it, change it, or end it.

Deliverables

- To work with the growers in Zone B, the City of St. Catharines and OPG to contract for an engineering feasibility assessment of conveying water from sources above the escarpment at Decew Falls to the farmland at lower elevation, including the best way to store water centrally for distribution in periods of high demand. The assessment would determine the number of growers with serious interest in accessing water, the number of acres and their location, and the organizational model for managing the construction and operation of the water distribution system. Completion: Fall 2018
- To serve as the irrigation "ambassador" for Niagara with representative bodies in order to build relationships – presentations will be made to the Niagara Region Council, NOTL Council, Lincoln Council, and St. Catharines Council, Niagara Escarpment Commission, the Niagara Peninsula Conservation Authority, the Greenbelt Foundation, and the staffs of Ministers at OMAFRA, MNR, MMA, MoECC and the Ministry of Energy, and key farm organizations representing Niagara growers including Grape Growers of Ontario and Ontario Tender Fruit Growers.[27] Boards of key stakeholders should also be considered including OPG and SLSMC. Completion: Fall 2018.
- To work with NOTL's Drainage and Irrigation Superintendent and the Irrigation Committee of NOTL Council on a five year plan with cost estimates for improving the capacity, reliability and coverage area of the open ditch drainage system in Zone C. Completion: May 2018 [28]
- To coordinate action among growers involved in independent water-pumping consortia in area A to determine what opportunities for synergies exist in pumping and flowing water and how to reduce labour and maintenance costs through greater efficiencies. The feasibility of one common intake, extended further into the lake, and one common pumping station, offering greater efficiency and redundancy for back-up, is one of the possible infrastructure outcomes that could be further developed. Should a request for public infrastructure funds be made for Niagara, it is important to determine to what extent a portion of the funds could be used in Lincoln (Zone A), as well as NOTL (Zone C) and St. Catharines (Zone B). This action step is intended to enable that determination to be made. Completion: December 2018
- To assess what tools might be needed to strengthen the profile and priority given to irrigation needs in planning including the possibility of specific legislation for the purpose. The ultimate goal would be to have meaningful input, if not primary decision-making authority, on decisions affecting irrigation by regulatory bodies. Completion: December 2018

27. In this area of water resource management there are several agencies currently reviewing their policy frameworks. Accordingly, it is critical that a common message be articulated that speaks to the priority of agriculture's need for water security. Once the message has been articulated the stakeholder group needs to be diligent in tracking all policy initiatives within the agencies noted in this submission and select the appropriate champion to deliver the message in person and in writing.
28. A complementary aspect of the role proposed is to work with funding program policy staff to ensure that irrigation works are recognized as an eligible cost in public infrastructure programs, to open the door for NOTL to apply.

- To develop a series of communication and education projects aimed at a broader public audience to increase awareness of and public support for the importance of irrigation. Completion: December 2019
- To undertake and build a complete irrigation profile for Niagara below the escarpment including accurate maps with current irrigation and drainage assets, geographical areas serviced and potential areas for development. Completion: December 2019
- In the event of unusually dry conditions in a future year, the irrigation champion would organize a Crisis Response Committee of key stakeholders including the Region, NOTL, Lincoln, St. Catharines, OPG, and SLSMC, as well as representative growers, to ensure that among water priorities, irrigation was addressed in a timely and responsible way to provide as much relief to growers as possible and that communication was coordinated and consistent
- To have standing in the planning process for the Region to ensure that irrigation needs are top of mind when all major projects are under consideration and to examine options for enhancing irrigation delivery in accordance with strategic principle 5.2.5

Budget and Other Resource Requirements

- The skills required for this position may not necessarily all be vested in one person and therefore the lead person responsible will need resources to be able to out-source specific expertise needed
- The budget therefore needs to cover the salary and benefits of the lead person responsible as well as providing resources to cover those needs that will be out-sourced
- The position could be staffed by secondment from regional or provincial government for a two year term
- The budget for the engineering feasibility assessment for Zone B is expected to be at least $100,000 and will be the single largest external cost
- Efforts should be made to secure grants towards the cost of the position from such sources as the Federation of Canadian Municipality's Climate Change Fund
- The position will need an office and access to office support services as well as a budget for digital and other forms of communication

What should this "locus" be named?

While it is tempting to propose the name "Irrigation Niagara," during the course of the interviews conducted, the observation was made that the word "irrigation" does not necessarily have favourable connotations with the full spectrum of the public. For those whose interests lie in returning land use to its natural state, "irrigation" tends to convey human activity that is not aligned with nature. Therefore, consideration needs to be given to alternative ways of describing delivering essential water to living plants for the benefit of our food supply. While finding the name or term that best resonates with the public is beyond the scope of this plan, an accompanying moniker that conveys more natural activity might be an effective complement to "Irrigation Niagara", such as "Watering Niagara From Root to Fruit." This expression emphasizes the positive reason why watering is done, that it is in the public interest. An alternative, longer version of the expression is, "Watering Niagara From Soil Root to Local Fruit."

5.3.2 INCREASE PUBLIC AWARENESS OF THE NEED FOR AND VALUE OF NIAGARA IRRIGATION

Enhancing mutual understanding and awareness of the priorities and mandates of all stakeholders is a good way to find an agreeable solution to complex environmental issues. For example, finding a way to share a limited common resource such as water for irrigation purposes requires:

- An understanding of the regulatory process
- An understanding of the mandates of several different agencies
- An understanding of the complexity of water use in different sectors of agriculture including how and where water is used and when water is required.

To facilitate the process of information sharing between stakeholders, *information tours* and *open houses* will be scheduled and promoted.

Before any information tours and open houses are scheduled, it will be important to prepare education and outreach materials to be circulated among key stakeholders. These materials could include (but are not limited to) topics such as average water demand in different agricultural settings/ crops, typical irrigation equipment in the area, a short description on why and how water gets used in different types of agricultural settings, selection of good case studies to feature relevant BMPs in agricultural irrigation and a description of the socio-economic benefit of agriculture in the Region. The tours and open houses would be conducted by invitation only and include the presentation of education and outreach materials and showcase the information with site visits to some key locations.

Areas in Ontario where this approach has proven to be very effective include Holland Marsh, the Innisfil Creek Watershed and Waterloo Region. Their materials could be examined for proven communication ideas and adapted. An active, current contact list of key individuals associated with different agencies has proven to be very helpful in breaking down barriers. Ongoing communication and accessibility are necessary once an agreed-upon water resource management strategy has been accepted by the stakeholders.

Although the responsibility for the delivery of this activity is proposed for the role outlined in 5.3.1, it has been identified as a separate strategic action in order to emphasize its importance. A possible starting point, before developing any materials and messages, is to undertake a survey to determine the current level of public awareness. The survey results will also provide a benchmark to see how effective outreach work is in "moving the needle" towards greater understanding and public support. The use of social media and earned media is recommended in public communications in order to maximize impact and minimize cost.

5.3.3 REQUEST CLIMATE CHANGE FUNDING FOR PUBLIC IRRIGATION INFRASTRUCTURE TO ENABLE PROJECTS TO MOVE FORWARD AND URGE THE DELIVERY OF C.A.P. FUNDING FOR INDIVIDUAL GROWER PROJECTS ON FARM

At this stage, while the broad need for irrigation infrastructure has been defined, more work is required in order to determine the best use of public investment. Based on early stage discussion, the order of magnitude of the public-private investment is expected to be in the $50 million range over five years. This investment will be needed to make improvements to the open ditch irrigation system in NOTL and to address irrigation access west of the Canal in Zone B and in Zone A. The NOTL portion includes resources for addressing the deposition of silt in the Virgil dams and automating the ability to vary flows in this section of Four Mile Creek.

As noted in 5.3.1, there is an urgent need for an engineering feasibility study to develop a plan and cost estimate to provide service for growers in Zone B that currently do not have access to irrigation water. Following the public-private partnership model used in Zone C for NOTL, the ownership of the public infrastructure would vest in the City of St. Catharines and the operating costs and future capital needs, once the initial infrastructure had been commissioned, would be 100% covered by growers. OPG has indicated that it is willing in principle to work with the City on determining how to withdraw water from Twelve Mile Creek for this purpose but is not willing to work with a grower consortium in view of the greater risks involved in the latter kind of partner. The feasibility study therefore needs to determine two separate categories of cost:

- The estimated one-time capital cost for the optimal design – while OPG's strong preference is for water to be drawn from Twelve Mile Creek below its discharge at Decew Falls when its primary energy value[29] has been extracted, as noted earlier in this report, there would be significant energy savings from not having to pump water, and the optics of the project would be greener, if the water could be drawn from the escarpment reservoirs above and piped to servicing the farms below by controlled gravity feed. The extent to which OPG would need to be compensated for the loss of energy value of any water diverted and drawn above the escarpment for irrigation would be a matter of negotiation. In the *Boundary Waters Treaty* of 1909, water for irrigation has equal ranking with water for power generation.
- The estimated operating costs to growers for accessing the water – before any decision to proceed with a project could be made, growers would need to be committed to using the system in sufficient numbers to make it economically feasible, and for growers, in turn, to make that commitment, they would need to know a reasonable estimate of the annual cost to participate in the system. One advantage of a pipeline system, as is recommended for Zone B, over NOTL's open ditch system, is that water can be metered and the quantity delivered to each user determined. (Another advantage is that the annual maintenance costs are less as ditches require constant attention to remove plant growth, debris and silt that impede water flows). However, as in the LADII model and NOTL model, growers can expect to be billed both a fixed annual cost for having connection to the system, regardless of the volume of water which they draw, as well as a charge correlated to their usage of the system. Growers can expect to be required to make a ten year commitment to bearing that annual cost. The costs to growers which have elected to participate in the current NOTL open ditch distribution system can serve as a reference point for what level of costs is economically justifiable.
- These two cost categories are inter-related because the capital cost will be affected by sizing requirements and the length and location of pipeline that needs to be laid. A major design decision will relate to the extent of the seasonality of the system since a system that delivers water only in the growing season will be lower cost to build. Should greenhouse users need access to the water year-round or a secondary use, such as fire protection, be required in the design specifications, then the capital cost will be higher.

There is significant engineering work that needs to be done and costed before any requests for large scale funding can be made specifically.

Growers' individual needs for upgrading irrigation systems on farm must also be addressed by the funding envelope. In the design of the expected next iteration of C.A.P. bilateral programming, delivered by OMAFRA or designated agents such as the Ontario Soil and Crop Improvement Association, irrigation projects need to be encouraged that:

- enhance the conservation of the water resource;
- reduce operating costs through such means as greater automation of valves and expanded use of sensor technology;
- allow uses that are consistent with OMAFRA's BMPs.

29. Energy value is also captured from water discharged into Twelve Mile Creek from the Decew Falls Generating Station downstream at Pt. Dalhousie at the Heywood Generating Station. This station is owned and operated by the local distribution utility and not by OPG.

6. Questions and Answers

6.1 How much water do fruit and vegetables grown in Niagara (grapes, tender fruit, greenhouse peppers) typically contain and why is it relevant to know?

- By volume, most of the types of fruit grown in Niagara (grapes, peaches, pears, plums, nectarines) contain about 82% to 85% water, as measured by volume, and the commonly grown greenhouse vegetables (peppers, tomatoes, cucumbers) contain about 92% to 95% water.[30]
- It is relevant to know this fact in public communications about water use since the water absorbed by the root systems of the vineyards, orchards, berry plants, and greenhouse food-bearing vines in Niagara ends up either being released into the atmosphere through leaf transpiration or in the fruit or vegetable that is eaten by a consumer.
- The key point is that water that is applied to crops for farming is sometimes characterized as being "used" but it is important to distinguish water use from other utility use such as a fossil fuel like natural gas – it would be more accurate to say that the water is transformed as it is not lost. It will be available to be re-used over and over again through the hydrologic cycle.
- At this time when there is significant public concern over the use of non-renewable resources like natural gas, and the effect of the corresponding greenhouse gas emissions on global climate change, it is essential to ensure that the public understands water in a completely different context that poses no environmental threat by being used for irrigation.

6.2 Is it necessary to restrict irrigation practices in Niagara to *drip* irrigation and discourage the use of public cost-share funding for *overhead* irrigation systems?

No. There are pros and cons to both overhead and drip irrigation systems. Advances in overhead irrigation systems have made their water use and distribution more efficient. One advantage of overhead irrigation systems is that they can contribute to lower canopy temperatures on hot summer days and that additional benefit can be important to fruit quality on high value crops. When irrigation water is applied through overhead systems, and the water comes in direct contact with fruit surfaces, there is an increased food safety risk that does not arise when the water is applied to the roots, well away from contact with the fruit, using drip irrigation. To the extent that overhead irrigation is a grower's system of choice, there is a greater need for attention to the plan showing how the risk of applying irrigation water that comes in contact with the fruit is being managed and monitored.

30. http://healthyeating.sfgate.com/list-fruits-vegetable-high-water-content-8958.html

6.3 Can on-farm drains under vineyards and orchards be used as a means for delivery of irrigation water?

Like the open drainage ditches in NOTL themselves, which have a dual purpose in carrying away excess water during periods of heavy rainfall, as well as delivering irrigation water during dry periods when it is needed, on-farm drains could also potentially be used for a dual purpose that includes delivering irrigation water. Some research has been done in Canada to determine its efficacy. As a general practice, it is not recommended, because there are many variables which affect how effective this method of irrigation delivery is, including the type of soil and the condition of the drainage tiles themselves. Consistency of the slope through laser-levelling would be an essential pre-requisite in order to obtain even flow rates. There is a risk that the water would be unevenly distributed down the drainage tile in terms of the plants' ability to access it and therefore that the results could be less than satisfactory. The primary advantage in using existing drainage tiles is that it could reduce both the capital and operating cost of irrigation infrastructure needed on farm.

6.4 In the event of an acute crisis similar to 2016 arising before the enhanced infrastructure in Zones B and C can be implemented, what other short term options could be considered for enabling growers to access critical irrigation water?

- The option of setting up an arrangement for tankering water to farms in distress to recharge their irrigation ponds was raised in an interview. There are several challenges with this option. First, there is no known water station for filling tankers with raw water pumped from a surface water source. All the private tankers currently hauling water in Niagara are dedicated to potable water obtained from municipal filling stations. A tanker filling station would need to improvised on short notice in order to provide for rapid filling and quick turnaround. Second, the quantity of water that could be delivered through this means is modest relative to the need if only one or two tankers were dedicated to the task given the weight of water constraining the size and capacity of tankers. Third, the cost of delivery would be high and proportionate to the distance of the delivery point from the filling station. Fourth, a PTTW would need to be obtained for the filling station to access raw water from a surface water source. Fifth, the tanker(s) would need to be dedicated for use for hauling untreated water and that requirement could present a challenge in finding available equipment.
- The option of using the municipal water distribution system for supplying water to farms for irrigation with existing access to the system was raised. In a distress situation, this option might be the least cost way of getting water where it is needed to farms that are connected to the municipal system or which have hydrants within range. Neither the Region, as the water wholesaler, nor the lower tier municipalities, as the water retailers, is open to considering a 'distress rate' for bulk irrigation water delivered through existing municipal infrastructure. There is potential for growers to access more municipal water for irrigation as a temporary solution in a time of crisis. With planning and coordination, irrigation water could be drawn at off-peak times during the night, to optimize the capacity of the water treatment and distribution system but that option would require that growers have storage capacity on farm. There are other considerations that need to be addressed if the potential to use an increased volume of municipal water is pursued as a stop-gap solution. These include (a) the effect of the water on the health of specific plants if, for example, there are any traces of chlorination present and (b) the effect on the water delivery system if the water user is not located on a continuous loop of water main.