

Foreword by Stantec Consulting Ltd.

Because of the importance of the overall economic analysis, it was determined that Dr. Kevin W. Ker, B.Sc Agr, M.Sc, B.Ed, P.Ag, Grape and Tender Fruit Specialist, Owner, Ker Crop Management Services, Inc. and Brock University would undertake a critique of the methodology and findings of this report. This is provided in Appendix A, attached at the end of the report. Overall Kevin Ker's review indicates that there is insufficient detail provided to investigate all conclusions within the report, but that the general approach appears sound.

Dr. Ker does however suggest that the direct benefits for growers are overstated by approximately 50% based on his knowledge of the industry and selective assessment of some of the key variables. Since indirect benefits were assessed as a multiplier onto the direct benefits, this would also imply that the overall total benefit would be lower by a similar percentage.

This is not surprising, since a broad economic analysis of this type includes a number of assumptions and professional judgment. On the basis of this critique, it could be restated that the total benefit of providing irrigation within the project area could be expected to be somewhere in the range of \$100 Million to \$160 Million.

Niagara Irrigation Study – Phase II

Task # 8

Economic Benefits Report

for

Stantec Consulting Ltd.

2007

Direct and Indirect Economic Benefits of Irrigation in Agriculture/Viticulture/Horticulture

Introduction

An engineering feasibility study is underway to plan and design new infrastructure for drawing and delivering water to irrigate agricultural crops in the Niagara Peninsula. The Niagara Region planning office identified Grimsby, Lincoln, St. Catharines, Niagara-on-the-Lake and Pelham on the north portion of the peninsula to be the focus for irrigation development.

This economic benefits study forms part of the larger feasibility study. Its purpose is to estimate the economic benefits that could reasonably be attributed to an enhanced water source in comparison to existing economic conditions for growers in four product sectors.

The study's first priority was to estimate the economic benefits that could be generated for growers directly from improved access to a reliable supply of irrigation water from new infrastructure built specifically for this purpose. The study was restricted to growers of non-commodity (specialized) agricultural, floricultural and horticultural crops. Growers themselves along with marketing agencies, scientific research laboratories and industry experts provided key elements of the necessary data.

The second priority of the study was to estimate the in-direct economic benefits that would result in the Regional and National economies from any enhanced economic activity in agriculture created by enhanced water infrastructure. Industry statistics and primary research carried out by the study team were then added to the direct benefit information to estimate the in-direct benefits which could be expected as "spin-off". Tracing the indirect economic impacts relied on information about the value chains in which the growing sectors are embedded in the larger economy.

Background

Four sectors comprise the bulk of agricultural activity on the north half of the Niagara peninsula along the southern shore of Lake Ontario. On the flatland near the western end of the peninsula from the vicinity of Grimsby to St. Catharines, greenhouse operations and tender fruit production predominate with some viticulture geared toward wine-making occupying third position. Nearer the Niagara River on the eastern end of the peninsula in Niagara-on-the-Lake viticulture for wine making predominates with tender fruit and greenhouse-based enterprises occupying second and third position respectively.

Throughout this area irrigation practices can be found currently ranging from traditional overhead spray to more conservation oriented drip methods in outdoor enterprises of all types. In greenhouses, irrigation is a production requirement rather than a production enhancer as it mainly is for outdoor enterprises. Indoor production

requires high volumes of water albeit accomplished mainly with rainwater catchment and to a lesser extent with surface or ground water.

Hydroponic greenhouses use the highest volume of water per unit area. They also rely largely on rainwater capture, but the practice of water re-cycling within these highly controlled systems reduces their need to draw groundwater and/or potable water from municipal service infrastructure.

A unique area of the northern Niagara Escarpment referred to as "The Bench" lies halfway up the escarpment and is flat. Because it was once the shoreline of ancient Lake Iroquois, soil in this area has relatively high clay content. Until recently this limited agricultural activity. With the advent of European grape cultivars for winemaking came the realization that the Bench's physical characteristics and relationship to Lake Ontario blessed it with a micro-climate unique within the region. Subtle air movements greatly extend its frost-free period relative to adjacent areas with elevations both above and below. This has led to investment in technological solutions to the heavy soil problem through extensive earthworks enabling high-value viticultural activity to take place.

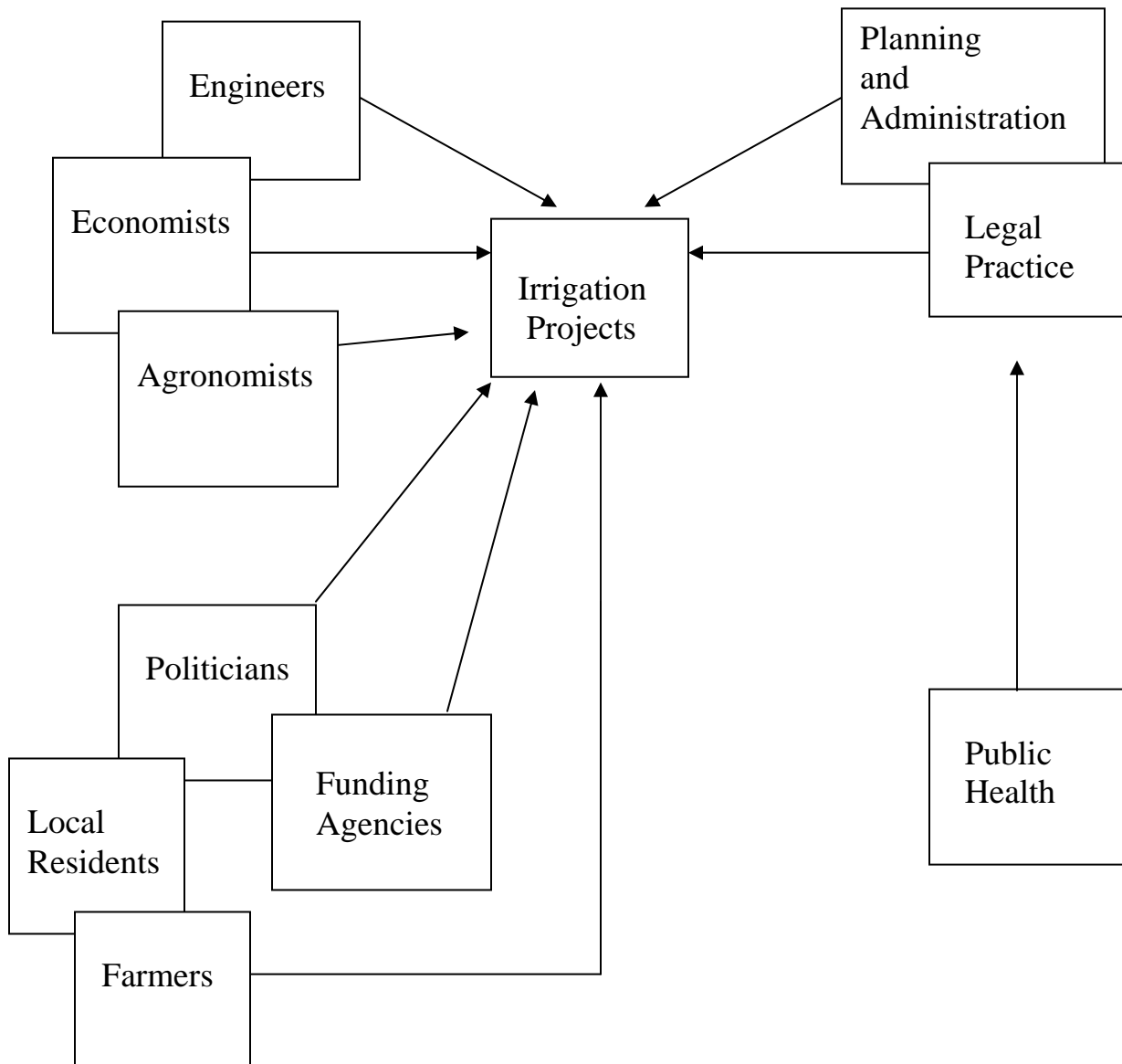
On top of the Niagara escarpment near the north side of the peninsula hardy fruit and vineyards of hardy grape cultivars for the table and juice market have been dominate for many years. This is changing at the present time owing to recent announcement of an imminent closure of the major processing plant in the area. Because no take-over or new investment in any replacement facility is evident, this part of the growing sector was excluded from consideration.

Farther south from the crest of the escarpment, agriculture in the Niagara Region is characterized by traditional "commodity agriculture" or extensive farming with large land parcels devoted to a single crop. Annual crop rotation varies the production on these parcels from year-to-year making them less amenable to irrigation.

Interest Groups and Multiple Viewpoints

When investigating the potential impact of new input alternatives to a multi-faceted industry such as agriculture, many avenues must be explored. Attitudes and capacities of various participants will ultimately determine the pattern of development, the rate of adoption and ultimately the extent to which new input alternatives can and/or will be exploited. The list of participants in the process includes farm operators, politicians, development planners and administrators, public health specialists, engineers and economists (Figure 1).

Figure 1: Irrigation project interest groups and constraints



Part I - Direct Economic Benefits

Estimation of direct economic benefits to growers was accomplished in three major steps (or “phases”), namely; 1) estimate the benefit potentials, 2) adjust the potentials in light of grower supplied information (from a survey) and 3) further adjust the benefit estimates for selected crop sectors based on judgments about business conditions within the chain of enterprises that transform raw products from growers’ fields into value-added items for final retail sale..

Phase 1 established benchmarks for direct economic benefits based on three things; 1) a weighted average of the output increases judged to be bio-physically possible from increased irrigation, 2) effects on retail market prices resulting from increased supplies of value-added products and 3) changes to production cost/unit from the use (or in some cases increased use) of irrigation.

Irrigation is presently used by a fraction of growers in all the sectors under study. Therefore, in order to estimate direct economic benefit of having easier (and less constrained) access to irrigation water, present economic operating conditions for “irrigators” and “non-irrigators” provided the point of departure.

For those growers who already use irrigation, beneficial impacts would arise from increased water use primarily through further increases of their per hectare yields. Because they are already operating high on their production function, these increases would be quite small relative to “new users”. New users seeking the same outcome would likely encounter larger production boosts because of their “lower” starting point in the steeper portion of their production function.

That is to say current irrigators will typically experience a smaller marginal impact on yield than those who are not presently irrigating. In either case bio-physical production possibilities will determine the degree of impact that irrigation can provide. The total bio-physical output enhancement potential for each crop was measured as an **average** impact for each group **weighted** by the portion of the growers occupying each group.

After estimating the bio-physical possibilities for output enhancement, the next step in the estimation process focused on the impact that the increased output coming from the Region’s growers would have on market prices. These two factors act in combination to determine the revenue enhancing possibilities from irrigation.

Using irrigation differently from current practices (by either group; irrigators or non-irrigators) also has cost implications. Cost change combined with revenue change produces a net result that provides the basic indication of irrigation’s potential to benefit growers in the Region.

At the end of phase 1, the direct benefits estimated in this manner were deemed to be **potentials** at best. If growers decide against availing themselves of the new water access, then the full amount of these potentials may not be realized.

Phase 1 Methodology

As mentioned above, estimation of direct economic benefit to growers began with measuring the change in their economic situation that could reasonably be expected to be brought about by irrigation.

Economic Profit versus Accounting Profit

To be economically profitable, an agricultural enterprise must have sufficient income to be able to pay all costs of production, taxes and opportunity costs while having some income left for discretionary use. Economic profit includes opportunity costs that can be extremely difficult to measure (especially on a whole industry aggregate level).

Accounting profit can be used as a proxy for economic profit when too many unknown factors exist. This concept is based on realized value as measured by nominal monetary transactions. Accounting profit measures the income remaining for discretionary use after all *monetary* expenses and taxes have been paid (but not opportunity costs).

Expenses are commonly grouped into two categories; 1) variable expenses (costs) and 2) fixed expenses (costs) depending on whether or not they are directly or indirectly related to the output level of an enterprise.

Fixed costs (“costs of doing business”) are those whose level is determined outside an enterprise through a process in which an enterprise’s manager has little or no control (or indirect and partial control at best). Tax rates, land values and license fees are examples of fixed costs. The specified amounts must be paid whether or not the enterprise produces and sells any product (or to enable the sale of product in the case of licenses).

Variable costs (“costs of production”) arise from the expenditure for inputs. In responding to market signals managers regulate the amounts of productive inputs used (and, hence, the level of output produced) in their enterprise’s production processes. In agriculture, crop inputs such as seed, fertilizer, machinery and labour, are among the commonly recognized production variables.

Short-Run and Long-Run Economic Effects

In addition to monetary values associated with daily business transactions, there are long-run financial aspects that might also appear relevant for measuring direct economic benefits. For example, irrigation infrastructure may have a bearing on land values.

However, including such long-run financial effects in the measure of direct economic benefit is tenuous. Existing industry participants may receive them in the short-to-intermediate run. For example, enhanced land value may be viewed as a benefit to an existing owner, but will merely be an additional cost to the next owner.

When aggregating to an industry level, these “benefits” and “costs” tend to cancel each other over time. Therefore, for the purpose of estimating direct economic benefits of irrigation, these long-run aspects were omitted by the study team. They are partially addressed in the estimation of indirect benefits on a Regional and/or National level.

Growers’ Gross Margin

Generating enough income (from product sales) to pay variable costs is the first step on the pathway toward an accounting profit. The numerical difference between variable costs and product sales revenue is referred to as “gross margin” (also as “contribution margin”). It is directly affected by 1) an enterprise’s product price in the marketplace, 2) the prices it must pay for inputs, and 3) the input/output efficiency achieved in its production processes.

Production Efficiency and Economic Efficiency

As mentioned, managers revise production plans as **relative** prices of inputs and products change over time to maintain economic efficiency in their enterprises.

The bio-physical input/output relationship (known numerically as the production function) determines the rate of transformation of any productive input (such as irrigation water) into saleable product. If the relationship between inputs and output were linear (straight line) then decision making to achieve maximum economic efficiency would be straightforward.

Agricultural input/output relationships are almost always curvilinear. Managing them requires a great deal of detailed and specialized information about the growth process. Managing variable inputs efficiently means hitting a specific point head on. This differs for each crop cultivar, soil type, micro-climate, etc. making agricultural production one of the most demanding managerial activities in the economy. Consequently farm management under dynamic physical and economic conditions is highly complicated and “experience counts” in maintaining efficiency. Experienced farmers usually excel in utilizing inputs correctly under varying relative prices and complex business constraints.

The curvilinear production functions in agriculture can be either simple or compound. Interestingly, the more complicated compound curves usually present a “narrower” decision making range creating a lower probability for error under changing price conditions.

Simpler, gently curved functions associated with inputs such as water and primary plant nutrients have much wider decision making ranges. Input decisions are very sensitive to varying pricing conditions. These production functions pose much higher risk of error. Irrigation management is regarded as one of the most difficult farm management challenges.

Farmers’ typical coping strategy is to adopt a “consistent” approach and hope that natural events and market conditions make them ‘right’ (or ‘nearly right’) more frequently than ‘wrong’ over time. In this context “wrong” can either be “too costly” by applying too high levels of variable inputs or “too miserly” by not applying enough.

Measuring Current Productive Efficiency

Under varying operating conditions the decision to adjust production always rests on three variables, 1) the current transformation coefficient (from the current operating position on the production function), 2) the price/unit of the input (or package of inputs) and 3) the price received for the resulting unit(s) of product. Missing the target (usually because of insufficient knowledge) means unachieved net benefit on either side (too much or too little input used).

Insufficient scientific information is available to allow the study team to judge how efficiently current agricultural enterprises in the Niagara Region are operating. Nor could the team judge their performance in terms of hitting efficiency targets as market conditions vary from time-to-time.

However, some studies have been done recently which measure the cost of production per acre currently being experienced (on average) for various crops. This information in comparison with sales revenue and acreage under cultivation allowed the study team to identify an “expected” a gross margin/acre for the crops grown in the two sectors producing food items. These gross margins are considered to be the “before” scenario with respect to the appearance of new irrigation infrastructure.

Market Price Effects

When considering the possible outcome of output expansion in a crop sector it is important to judge the impact it might have on market price at the consumption level. Generally speaking, point sources of origin for agricultural products are numerous and widespread. Sources close to market have transportation cost advantages. Distant sources must be more productive to compete. Local markets obtaining the majority of their produce from distant sources (such as Southern Ontario markets) give local growers several advantages.

Firstly, local growers, by virtue of their collective “smallness”, are price takers so their actions to expand shipments are unlikely to pose downward pressure on product market prices.

Secondly, by being near to a large urban market, Niagara Region growers have a transportation cost advantage for perishable products (edible or inedible – fresh fruit or flowers) over their import competitors most of whom ship across border from considerable distances. Shorter transport time-to-market for nearby growers also creates a “time-on-the-vine” opportunity to increase quality vis-à-vis long distance shippers. This is particularly important for the tender fruit sector.

Finally, physical nearness brings familiarity (and perceived traceability) in consumers’ minds – both valuable aspects in today’s safety conscious food market.

Demand systems analysis was deemed to be unnecessary for estimating market price effects in support of estimating direct economic benefits. In the authors’ opinion, irrigation’s potential to expand the output of both food and non-food items produced in the Niagara Region will not likely result in downward price pressure for the above-mentioned reasons.

It is possible in today's quality conscious food market that delivery of more local produce into large nearby markets (urban Toronto) could actually create a price premium. It would attach to Niagara products arising from their greater "visibility".

The upward trend of population alone could bolster prices without regard to the collective action of local growers. Add to that catering to food safety interests and seekers of higher quality relative to more distant products (global imports) may presently be one of the greatest opportunities for local producers. In fact it may pay them to develop quality and expand output at the same time.

For items produced in the Niagara Region for export, a similar expectation arises from other reasoning but similar in certain key aspects.

Inflation Effects

Inflation in the general economy can create extra management issues for any industry. Product prices may increase over time from forces that have nothing to do specifically with their production. The same can be true for the cost of productive inputs. Oftentimes the two will not rise at the same rate over time. General inflation is, after all, an average of pricing throughout the economy.

In agriculture, input costs for a wide range of farm products have been rising faster than product prices. This puts pressure on growers to maintain profitability and is referred to as the "Cost-Price Squeeze".

Narrowing profit margins over time give rise to a search for more productive methods. New production methods (incl. Technologies) potentially ameliorate the cost-price squeeze in five ways, namely; 1) increase revenue, 2) reduce cost, 3) increase both revenue and costs – with the revenue increase dominant, 4) decrease both revenue and cost – with the cost decrease dominant and 5) increase revenue while reducing costs (number five is obviously the "dream solution").

All five increase the "gap" (in the **short run**) between revenue and cost. This "buys time" in an inflationary economy because it pushes the point at which rising cost overtakes rising revenue throwing the enterprise into a money losing position farther into the future. In agricultural enterprises this is observed when new technology **reduces cost per unit of revenue**. Any technology that works to increase revenue by a larger percentage than it increases costs reduces the cost per unit of revenue allowing inflating revenues to outpace inflating costs. A more subtle way for this to occur is when any **relatively** low cost technology added to the mix of inputs "dilutes" the cost pool so as to increase the ability of the revenue stream to outpace cost inflation.

The study team found that irrigation has the potential to achieve this for many of the crops grown in the Niagara Region especially those in the tender fruit sector. While extremely difficult to measure in the aggregate, it is worth remembering that this is a "positive driver" in the overall benefits scenario which would heighten the interest in irrigation by experienced growers. Call it "extra benefit – type A".

If the **rate** of inflation could also be changed for one side of the profit equation or the other (revenues or costs) it could alter the **long-run** profit prospects for an industry as well.

The cost price squeeze might be eliminated if the two rates of inflation become the same. This means that the profit margin will stay the same (in nominal terms) through time thereby keeping an enterprise out of a loss position in perpetuity. While losing ground in **real** economic terms (reducing investment incentives) the enterprise could remain in business.

If the two rates were to differ after the introduction of the new technology (with cost inflation less than revenue inflation) then the profit margin would be widening over time. Thus the enterprise is able to grow in real terms and investment is attractive. In one part of the tender fruit sector this case was deemed to be possible (even likely). Again, while extremely difficult to measure in the aggregate, it is worth remembering that it is a “positive driver” in the overall benefits scenario. Call it “extra benefit – type B”.

Irrigation was judged to be able (potentially) to play both roles in selected portions of the sectors in the study area. Again the tender fruit sector was the most likely to reap these sorts of benefits. The study team considers these “positives” to be worth bearing in mind when interpreting the benefit estimates provided.

Using current (unadjusted) market prices, the next step was to estimate the potential that enhanced access to water for irrigation poses for changing either the level of market returns or the level of variable production costs (or both). From this an “after” gross margin/acre (on average) was constructed and compared to the “before” gross margin. The difference provided the “average potential direct benefit” per acre as the starting point (for each crop).

The land area under cultivation for each crop as reported in the recent economic impact study was used to aggregate per acre benefits to an industry total. This was deemed to be the “Annual Potential Direct Benefit” for all growers in study area. The total annual potential direct benefit for the sector was then the sum across all crops (eg. tender fruits).

Investment in the proposed project is a decision to commit resources long term. Twenty-five years was suggested as a “reasonable” life expectancy for the proposed irrigation works before major renovation might become necessary. The present value of an annual benefit stream as estimated above was calculated using the current Government of Canada bond rate.

Phase 1 Results

Considerable complexity was found among the four major agricultural sectors operating in the study area. The tender fruit and grape growing sectors stood out as most likely to benefit from enhanced access to raw water for irrigation. They are not necessarily the largest agricultural generators of economic activity in the Region but rather are the places where irrigation will have the biggest beneficial impact over-and-above current business operation. Production research literature revealed a small number of studies conducted during the past twenty years. Irrigation studies specifically

related to the crops grown in the study area are few and far between. Although they suggested output enhancements from irrigation, reports varied from a low of 4% to a high of 16% relative to non-irrigated production. After interviewing industry experts the study team adopted 10% as a benchmark of bio-physical possibility. The benefits considered for the purpose of this study were from output increase rather than other aspects such as risk mitigation during drought, etc.. Such additional benefits may exist but are extremely difficult to estimate.

Table 1: Total Potential Direct Economic Benefits

Sector	First Annual	25 Years Cumulative
Tender Fruit	\$ 7,657,074	\$ 254,931,985
Grapes	\$ 5,619,269	\$ 148,058,440
Horticulture	\$ 228,248	\$ 5,706,200
Greenhouse	\$ 309,371	\$ 7,734,275
Totals	\$ 13,813,962	\$ 416,430,900

Source: Task 8, Technical Memo 3

Phase 1 focused on potential benefits to growers. For them to be realized in fact depends on growers' willingness to embrace new irrigation possibilities as they present themselves. The figures in Table 1 are based on a scenario in which all growers simply follow suit and implement whatever irrigation system is appropriate to their crops as soon as access to a new source of raw water is provided.

Phase 2 used the results of the grower's survey and addressed the questions of grower acceptance, willingness to pay, time for transition, etc.. This produced "likely realizable" estimates of direct benefits.

The survey was designed to elicit growers' opinions and attitudes toward the project. It did not include questions about the growers' current productivity, profitability or other aspects of their enterprises' current performance. Their responses suggested their intentions about irrigation if and when new infrastructure for delivering water might be provided. These responses formed the basis for judging and/or adjusting (usually downward) the estimated benefit potentials from Phase 1.

Phase 2 – Methodology

Phase 2 also required careful consideration of the nature of the adjustment decision-making process that would unfold in the growers' management regime. Individual growers will be faced with decisions that may entail changes to their current management practices. Moreover, they will likely need to adjust current marketing arrangements if greater quantities of produce are the result of the new irrigation

possibilities. These things may bear upon their cost structures in complicated ways. Some current cost items may decrease whereas others may increase.

The same may be true for market returns. The functional yield concept pointed out that some revenue streams may diminish as the new use of irrigation takes effect (smaller proportion of undersize fruit for example) while others increase (higher proportion of premium priced output). Confronted with such possibilities each grower must weigh the advantages and disadvantages to arrive at the final decision to adopt or avoid the new alternative. The established method for quantitatively measuring the before and after effects is called partial budgeting.

Partial Budgeting to Measure the Impact of a Change

To decide to irrigate or change irrigation practice, growers' analytical approach must be able to embrace four "before/after" types of change, namely; 1) increased revenue, 2) increased costs, 3) reduced revenue and 4) reduced cost. These four partial budgeting elements combine to identify the conditions under which a proposed change may (or may not) be adopted. These factors can interact in eight possible combinations to produce an outcome that might not always spell positive net benefits.

For most crops grown in the Region, some growers presently irrigate. For these growers, having new and different water access creates a potential for changing their cost structure, their revenue structure or both. Decisions will hinge on whether the new alternative gives any economic advantage over their existing practices. To achieve that, the new alternative competes directly with other water delivery systems.

For growers not presently irrigating, the decision is essentially the same. However, irrigation will only need to improve their economic performance from a non-irrigation baseline. If their reason for not irrigating was owing to other factors such as location, etc., then the new infrastructure will have to address these before any managerial decision. This may be a more likely possibility for the proposed project than simply competing with existing alternatives.

The potential direct grower benefits (Table 1) were developed from detailed knowledge of pricing schedules, cost of production statistics, cost structure measurements and grower's opinions about the impact on crop yields achievable through irrigation. Interest rates and expected rates of change in both returns and direct costs of production were based on price indices and the average Canadian Government bond rate for the past ten years.

Each sector uses different inputs. Some are priced differently over time. Particularly in the case of crop protectants, costs borne by growers have inflated much faster than general inflation in the economy. In some instances new materials have been introduced into the market either to combat new crop diseases or ones that were difficult to control in the past. In such cases high prices for these materials have contributed to the variation in production costs observable across fruit crops in particular..

The adjusted estimates for the potential direct benefits awaiting growers when they might adopt new irrigation infrastructure represent changes to their gross margins when both the input pricing and product revenue effects have been taken into account.

Results of the Grower Survey

The growers' survey results show patterns of response consistent with various characteristics of their enterprises such as; year-round versus seasonal production, present levels of irrigation in use, general production system requirements and geographic proximity to water sources.

The grower survey also yielded a wealth of information that opens many research possibilities. With sufficient "data mining" fairly accurate estimates of enterprise level impacts of the proposed irrigation infrastructure may be possible. Other researchers may also observe patterns among the grower responses that may be helpful in the planning process.

Information from the grower survey provided insight into growers' expectations about changes to the components of the partial budgets when enhanced access to irrigation became a reality. The study team gained insight into how the decision outcome might emerge in practice. Most important for estimating "realizable" benefits, information from the survey suggested rates of adoption specific to all four sectors.

Detailed statistical analysis may be able to discern response patterns that would support the development of a formulaic approach to measuring a rate of technology adoption specific to each sector. Lacking the time and resources for in-depth statistical analysis, the study team relied on response percentages and verbatim commentary from respondents. The study team used portions of the data to suggest adoption percentages for each of the four sectors.

Adoption Rates for New Irrigation Infrastructure

The "adjusted" direct benefits were placed on a timeline. Using the concept of diffusion of innovation, the timeline indicated what portion of the direct benefits would be captured in the first 5 years and over the first decade.

Because of a single factor, namely; dependence of the production system on irrigation to produce a product capable of achieving the highest market price potential, we expect that the tender fruit sector will have the highest adoption rate. Therefore, it should not take long for the sector to completely capture the potential benefits shown above (Table 1). Additionally, the size of the sector's potential benefit will keep it in a dominant position from a planning viewpoint.

Because of two main factors, namely; sophistication of the production system and the current level of irrigation usage we expect that the grape growing sector will have the lowest adoption rate. Therefore, it will take longer for the sector to completely capture the potential benefits shown above (Table 1). However, the size of the sector's potential benefit will keep it in second position among the four sectors with respect to the total benefits to be derived from increased use of irrigation.

Detailed managerial adjustments in the vineyards and the need for field proofs will understandably slow the rate of adoption. From the verbatim commentary, we discern a high level of interest in irrigation amongst grape growers. If the sector was not

currently loosing the area's only grape juice processor, there would be both greater interest in irrigation and greater economic potential to be gained.

Because the horticulture sector encompasses significant year-round growing activity, we expect that it will also have a high adoption rate. However, from a planning perspective the 12 month operation poses a special caveat in order for the sector to adopt new irrigation infrastructure. For the outdoor portion of the sector's activities the adoption rate should be high no matter which type of raw water delivery system may materialize. For the indoor part of the sector (approximately three quarters of its total water usage), the adoption rate will be low to nil for an open channel system but high (approaching 100%) for a pipeline system. Not knowing which system might materialize from the planning process, the study team suggests a "middle-of-the-road conservative" adoption rate be used for this sector. Thus, it may take longer for the sector to completely capture the potential benefits shown above (Table 1). Taken together with the relatively small water requirements necessary to mitigate the risks they face using their present water sources (primarily drought avoidance) the sector is expected to play only a "supporting" role from a planning perspective.

Phase 2 Results

Table 2 presents the direct benefit estimates adjusted according to survey results.

Table 2: Adoption Percentages and Direct Economic Benefits (adjusted)

Sector	Potential Annual Benefits	Adopt Rate (%/yr.)	Realized Annual Benefits (year 5)	Realized Annual Benefits (year 10)	Realized Annual Benefits (average)
Tender Fruit	\$ 7,657,074	70	\$ 7,638,467	\$ 7,657,029	\$ 7,328,916
Grapes	\$ 5,619,269	45	\$ 5,336,460	\$ 5,605,036	\$ 4,934,209
Greenhouse & Nursery	\$ 537,619	60	\$ 532,114	\$ 537,563	\$ 501,781
Totals	\$ 13,813,962	Na	na	na	\$ 12,764,906

Industry experts provided anecdotal information suggesting that constraints may exist within each sector that would limit the implementation of output expanding technology no matter what the growers may intend. The most commonly cited things are supply contracts to processors and pricing agreements driven by forces that are centred outside the area.

Phase 3 of the direct benefit estimation involved reviewing the value chains in the study area's agricultural sectors to judge whether constraints arising out of market

structure pose serious threats to growth in the grower level. The study team is skeptical whether the sectors in the Region should be researched from a Market Structure, Conduct and Performance perspective. Certainly this study cannot achieve such an analysis within its timeline or resources.

Anecdotes are heard that growers' intended actions may be pre-empted by systemic constraints that place pressure on their decision-making autonomy. It is well known that in agricultural product value chains, concentration of business ownership can create loci of market power. In such situations business decisions about responses to market signals are often driven from the level within the value chain with the most economic leverage.

For example, growers who supply on contract to a highly concentrated processing sector "farther up the chain" might find their decision-making independence severely constrained when output levels are concerned. The processors' analysis of the market and their subsequent decisions about the total supply level that will bring the highest may price become "the rule" to which growers are forced to conform (or find other markets). Some pundits argue that the wine grape sector exhibits this structural power imbalance.

It is true that in product lines where consumer demand is somewhat unresponsive to price (inelastic demand) the correct commercial strategy is to "short the market" which will keep retail prices (and hence, sales revenue) high. This can be particularly pernicious to economic progress when consumers can be "induced" to be price unresponsive by the non-price marketing campaigns mounted by those enterprises holding the most market power.

Inelastic retail demand might currently exist for Canadian wine sold in the local urban market. However, the growers' organization is strong and discussion and negotiation up and down the value chain is always ongoing wherein growers' interests are put forward. This suggests that growers would not be stonewalled if they acquired new technology that would enable output to expand while maintaining cost efficiency.

Faced with a lack of definitive research on this aspect of the industry in the Niagara Region, the study team was forced to render a judgement as to whether any special constraining conditions exist. The study team can provide no factual evidence on which to base another adjustment of estimated direct benefits. The study team suggests applying an arbitrary "constraint index" to allow a sensitivity analysis "of a sort".

The team was sensitive to the possibility that the pundits are correct and that market structure conditions do exist that limit growers' output possibilities and hence, their decision whether or not to alter their irrigation practices. Table 3 contains best-and-worst case estimates under conditions with and without constraining factors.

Worst case reasoning was arbitrarily based on a 50% reduction in potential direct benefits. On the other hand, a best case scenario is presented based on an estimate of the additional direct benefits which would be available to grape growers if the table and juice value chain had not recently experienced the loss of the area's major processor. If that event had not happened, potential direct benefits could be 30% higher than estimated.

Special “extra” adjustments to the direct benefit estimates were done as cautionary. Only if it becomes proven that market power imbalances exist in fact should benefit estimates be further decreased. And only if new alternatives emerge for the juice grape sector such as conversion to Vidal for ice-wine production and/or a new processor comes to the area should the estimated benefits be increased. The study team allows that care is necessary to avoid overly optimistic or pessimistic interpretation for planning purposes.

Phase 3 - Results

Table 3: Direct Economic Benefits – with constraint sensitivity

Sector	Potential Annual Benefits	Adjusted Annual Benefits	Constraint Index (%)	Annual Benefits (best case)	Annual Benefits (worst case)
Tender Fruit	\$ 7,657,074	\$ 7,328,916	0	\$ 7,657,074	\$ 7,328,916
Grapes	\$ 5,619,269	\$ 4,934,209	(-50) (+30)	\$ 7,473,628	\$ 2,809,635
Greenhouse & Nursery	\$ 537,619	\$ 501,781	0	\$ 537,619	\$ 501,781
Totals	\$ 13,813,962	\$ 12,764,906	Na	\$ 15,668,321	\$ 10,640,332

Part II Indirect Economic Benefits

Benefits Accruing to the Niagara Regional Economy

Estimating the indirect benefits to the regional economy involves “**following the money**” through the value chains of each agricultural sector. Because the estimates of direct grower benefits was based on the concept of gross margin, the starting point goes back to the cost and return structure found in each sector.

Similar to the growers’ decision framework described above, partial budgeting concepts apply to the tracing of economic flows in the regional economy. For example, one expected result of the project is that irrigation activities will increase. This, in-turn, could bring increased costs (grower expenditures into the economy) into the estimate. Of course, the estimated direct benefit to growers also involved increased sales into the value chain within the regional economy. At each level of the value chain similar adjustments may occur involving any or all of 1) increased costs, 2) increased revenues, 3) decreased costs and 4) decreased revenues at every step. Different from the process of estimating direct benefits, the net effects on the cost side and the revenue side must be traced separately because they each represent flows through the value chain.

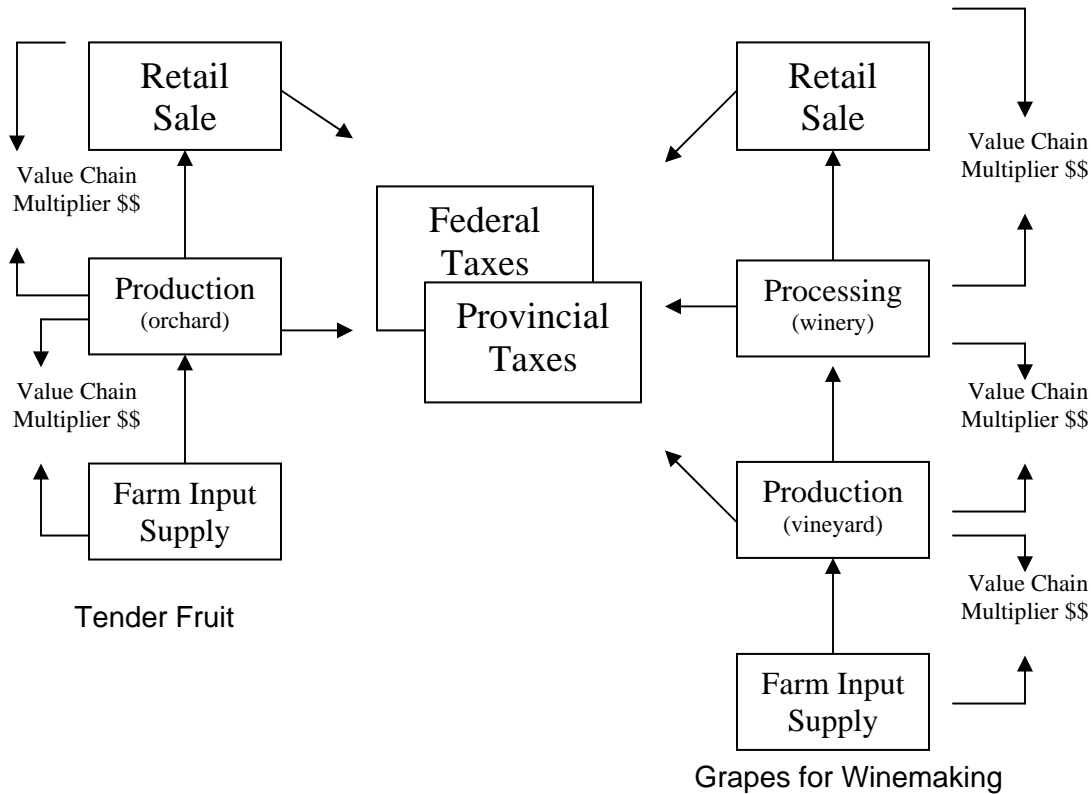
Direct benefit to growers is located at their level in a value chain. At each level of the value chain similar decisions about how to deal with increased raw product supply may occur involving any or all of 1) increased costs, 2) increased revenues, 3) decreased costs and 4) decreased revenues at every step. Different from the process of estimating direct grower benefits, the net effects on the cost side and the revenue side had to be considered separately. This is because they each involve transactions representing cash flows throughout the value chain.

Agricultural Value Chains

The length of a value chain is defined by the number of levels in the industry “above” the farm through which raw farm products must pass on their way to becoming refined products ready for final consumption. Enterprises doing business in each level generate economic activity. Additionally, there are enterprises operating in levels “under” the farming sector where growers’ expenditures to acquire productive inputs (such as seed, fertilizer **and water**) result in economic activity.

The number of levels (Figure 2) in the value chain varies for different sectors (and/or products).

Figure 2: Value Chain Examples – Tender Fruit & Wine Grapes (simplified)



The figure is an oversimplification of the true product pathway in each sector included in this study. But it illustrates the notion that longer pathways involve more changes in ownership before products reach the final (retail sales) level. Each change in ownership creates more cumulative economic activity so that the concept of a value chain “multiplier” becomes relevant to the search for indirect economic benefits.

Each time material changes ownership (sale & purchase) there is also an opportunity for taxation. The relevant taxes in this case (PST & GST) accrue to agencies outside the Region. Thus, there can be “leakage” associated with the “within Region” economic flows as well as economic activity occurring outside the Region.

When growers purchase inputs that originate from manufacture (ownership) outside the Region the “leakage” of economic benefit to other jurisdictions increases. The portion of economic activity that stays within the Region for each level in a sector’s value chain is the “retention factor”.

There is an overall value chain multiplier that relates grower level revenue from raw product sales to the final retail value of the refined products that result. In value chains where little intermediate processing takes place, this multiplier is relatively small. However, in a value chain where a significant amount of intermediate processing occurs and where the nature of the refined product is substantially altered (such as in winemaking), the overall value chain multiplier can be much larger.

The overall markup between farm gate and retail should agree quite closely to the sum of markups through the “above the farm” portion of the value chain. Differences in the retention factors explain the discrepancy. To estimate indirect benefits, the study team decided to consider each level and develop an average overall value chain multiplier for the tender fruit and wine grape sectors.

Niagara Region Tender Fruit Value Chain

The Tender Fruit sector’s value chain was considered to have four levels (two “above”, the grower level and one “below”). From grower level upward a multiplier of 1.5 accounts for the markup necessary for viable business transporting product. Because the major share of cost in this activity is labour, a retention factor of 85% for the regional economy was applied.

The uppermost level involves significant economic activity outside the Region owing to the geographic destination of the majority of the produce. A multiplier of 2.5 accounts for markup to final retail prices for produce passing through this level on its way to consumers. However, the retention factor is quite low (15%) owing to the degree of externality of economic activity.

The grower level is also labour intensive and has less “leakage” of economic activity from the Region. A relatively high (83%) retention factor (with a multiplier of 1) was assigned to the grower level (sales taxes plus 2% for externality represented the “leakage”).

Expenditures from the grower level “downward” in the value chain (to input suppliers) are considered to have a lower retention factor (52%). Inputs are procured by businesses in this level from economic entities (manufacturers, etc.) owned outside the Region which increases “leakage” thereby diluting the retention of economic benefit for capture within the Region’s economy.

Overall an average value chain multiplier of 1.5 and an average retention factor of 58.75% were applied to direct grower benefits to estimate indirect benefits which would be captured by economic activity within the Region.

Niagara Region Wine Grape Value Chain

The Grapes for Winemaking sector’s value chain was considered to have five levels (three “above”, the grower level and one “below”). From the grower level upward a multiplier of 2.5 was assigned to account for the “in-house” activities which transform the product (at the winery). Major shares of cost in this activity are for labour and capital equipment. Because some portion of equipment’s value accrues to economic entities outside the Region, amortized acquisition costs of equipment dilute the retention factor relative to a set of activities which involve mainly labour. A retention factor of 75% for the regional economy was applied to this step in of the value chain.

In the winemaking sector many activities are involved in preparing and moving product into position for the retail level of the value chain. While not as capital intensive

as winemaking itself, a multiplier of 1.2 was applied to account for business viability in packaging and transportation of final products. However, a significant portion of these activities involves economic activity outside the Region which reduced the retention factor to 54%.

The uppermost level's economic activity occurs mainly outside the Region owing to the geographic destination of the produce and ownership of the major part of the retailing function. A very high multiplier of 6 accounts for markup to final retail prices. However, the retention factor is quite low (15%) partly because of the externality of economic activity and especially because of the tax levied at point of retail sale.

The grower level is labour and capital intensive with little "leakage" of economic activity from the Region. Sales taxes plus 4% suggested assigning a relatively high (81%) retention factor (with a multiplier of 1) to the grower level.

Expenditures from the grower level "downward" in the value chain (to input suppliers) are considered to have a low retention factor (45%). This is a result of expensive and specialized inputs being procured by businesses in the input supply level from economic entities (manufacturers, etc.) owned outside the Region.

Overall an average value chain multiplier of 2.34 and an average retention factor of 54% were applied to direct grower benefits to estimate indirect benefits which would be captured by economic activity within the Region.

Niagara Region Horticulture & Greenhouse Value Chain

A different approach was taken for the value chain effects on the Regional economy in the case of the horticulture & greenhouse sectors. The direct economic benefits estimated for these two sectors were not based on improvements to gross margin performance but rather on cost reduction stemming from a lower cost source for water over-and-above their on-site sources and instead of their existing off-site sources. Water required over-and-above their owned sources that must be procured in times of risk mitigation (drought and/or untimely rainfall events) can come at extremely high cost for some growers. This can make their risk management decisions difficult and risky in themselves.

The study team regarded the estimated direct benefits (based on the possibility of cost savings) as an opportunity for the growers. If they used the monetary resource to increase production, then indirect benefits could in-turn be estimated by applying a single "grow site to retail" multiplier and a retention factor representing complete capture of all after sales tax benefit. A multiplier of 2.5 and a retention factor of 85% were used.

Table 4: Value Chain Parameters and Total Regional Annual Indirect Benefits

Sector	Annual Direct Benefits	Value Chain Levels	Value Chain Multiplier (average)	Retention Factor (%) (average)	Regional Annual Indirect Benefits
Tender Fruit	\$ 7,328,916	4	1.5	58.75	\$ 11,470,281
Wine Grapes	\$ 4,934,209	5	2.34	54	\$ 22,338,274
Horticulture & Greenhouse	\$ 501,781	2	2.5	85	\$ 1,066,285
Totals	\$ 12,764,906				\$ 34,874,840

By applying the concepts of value chains, the impact on the regional economy was estimated to be nearly three times the total direct economic benefit to growers.

Value chain calculations involve many parameters that are difficult to accurately estimate and are subject to constant revision as prices and productivity throughout the many enterprises in the chain vary through time. However, the number of parameters by itself helps to insure that inaccuracy in measuring any among them will have a small impact on the overall outcome.

The technical report on in-direct benefits included narrative about other avenues for in-direct benefits to emerge in the Regional economy. They were not part of the numerical estimation process and are not reported here for that reason. However, the long-term prospects for greater indirect benefit to the Region than those presented here are very favourable.

Benefits Accruing to the Ontario Provincial Economy

Estimating the benefits which would accrue to the Provincial economy (over-and-above those at the Regional level) involves following the same value chains but with a view to measure the value added which the retention factor did not capture. For example markups which appear level-by-level in the chain as products move outside the region "accrue" to the "outside" economy. The difference between total finished product value (retail) and local (in this case farm gate) value accrues to the extra-regional economy.

Extra-regional benefits in this study are labeled "Provincial" (outside Niagara Region) and "National". Note that total benefits to the Provincial economy are actually the sum of direct grower benefits, Regional indirect benefits and Provincial (extra-Regional) indirect benefits because the first two categories are subsumed within geographical Ontario.

Most of Niagara's agricultural products (especially food) reach final consumption in Ontario (or depart from Canada via Ontario) so that the lion's share of the values added within the supply chain accrues to Ontario-level agencies (enterprises and government). Thus the extra-regional portion of the Provincial share of economic activity can be considered as residual to the Regional economy net of claims by National interests (in this case merely GST).

The term which we have applied to represent this share is called the "accrual percentage". It is important to note that the sum of the retention factor (Regional), the first accrual percentage (extra-Regional Provincial) and the second accrual percentage (National) is one hundred (or 100%) representing a complete tally of values added throughout the value chain.

Applying the accrual principal to the same value chains as discussed above yielded the following estimate (Table 5) of economic activity which would be generated in Ontario beyond the confines of the Niagara Region. The values stem from the increased output deemed to be expectable from grower's collective use of the proposed irrigation infrastructure in the cases of tender fruit and wine grapes and from reduced cost of obtaining "emergency" water during times of drought in the greenhouse and outdoor horticulture sectors.

Table 5: Total Annual Provincial Indirect Benefits

Sector	Regional Annual Indirect Benefits	Value Chain Levels	Value Chain Multiplier (average)	Accrual Factor (%) (average)	Provincial Annual Indirect Benefits
Tender Fruit	\$ 11,470,281	4	1.5	35.25	\$ 23,066,385
Wine Grapes	\$ 22,338,274	5	2.34	40	\$ 80,580,320
Horticulture & Greenhouse	\$ 1,066,285	2	2.5	9	\$ 753,926
Totals	\$ 34,874,740				\$ 104,400,631

The most notable figure is associated with grapes for wine. That is because of the large markup which occurs in the final stage of the value chain and subject to a large tax levied on alcoholic beverages. The entire amount of nearly 86 million dollars spawned by just under five million dollars of direct grower benefits (a 10% increase in the value of output from this sector) implies that the sector presently represents nearly a billion dollars to the general economy. Although the direct benefit to tender fruit growers is estimated to be higher than for wine grape growers, the smaller farm-to-retail markup results in less (although substantial) overall economic benefit.

Benefits Accruing to the Canadian National Economy

Finally, following the value chains to their ends resulted in an estimate of economic benefits accruing to the National economy. In this study it is GST on the economic activity discussed above. While there may be other benefits associated with having a prosperous agricultural industry in a Canadian destination for domestic and international tourists, estimates of the value of such things were not included in this study.

Again the accrual principal using GST as a percentage yielded the following (Table 6) estimates of National indirect economic benefits.

Table 6: Total National Annual Indirect Economic Benefits

Sector	Regional Annual Indirect Benefits	Value Chain Levels	Value Chain Multiplier (average)	Accrual Factor (%) (average)	National Annual Indirect Benefits
Tender Fruit	\$ 11,470,281	4	1.5	6	\$ 1,383,983
Wine Grapes	\$ 22,338,274	5	2.34	6	\$ 4,834,819
Horticulture & Greenhouse	\$ 1,066,285	2	2.5	6	\$ 45,236
Totals	\$ 34,874,740				\$ 6,264,038

Obviously, income tax would greatly enhance the estimates of public sector benefits. However, direct grower benefits were estimated as enhancements to gross margins without knowledge of growers' fixed costs. Without this knowledge it is impossible to arrive at an estimate of income tax paid by the enterprises in the agricultural sector. The same holds for the rest of the enterprises in the value chain. Even if income tax were added to the analysis, the total picture may change only slightly. The shares ending up in public sector agencies vis-à-vis private hands would be somewhat different but the total benefit (to someone) would be unchanged.

Table 7: Total Direct and Indirect Economic Benefits of the Proposed Project

	Tender Fruit	Wine Grapes	Horticulture & Greenhouse	Total
Direct Grower Benefits	\$ 7,328,916	\$ 4,934,209	\$ 501,781	\$ 12,764,906
Regional Indirect Benefits	\$ 11,470,281	\$ 22,338,274	\$ 1,066,285	\$ 34,874,840
Provincial Indirect Benefits	\$ 23,066,385	\$ 80,580,320	\$ 753,926	\$ 104,400,631
National Indirect Benefits	\$ 1,383,983	\$ 4,834,819	\$ 45,236	\$ 6,264,038
Total	\$ 43,249,565	\$ 112,687,622	\$ 2,367,228	\$ 158,304,415

Summary and Conclusions

The estimation of economic benefits which could arise from enhanced access to water for irrigation of agricultural and horticultural crops in the Niagara Region began with a detailed analysis of bio-physical possibilities at the grower level. The likelihood of growers' realizing these possibilities was estimated from information collected directly from growers via a specialized survey.

These two bodies of information provided the basis for estimating the "direct" economic benefits expectable from the proposed irrigation infrastructure project. Market price effects from altered supply and demand conditions were dismissed on the grounds that the Region's growers en-masse supply only a small portion of the total product demanded by Ontario consumers.

The crop sectors were limited to Tender Fruit, Grapes for winemaking, Greenhouse vegetables and horticultural/floricultural products and horticultural crops grown outdoors.

The first two were considered likely to evidence an output expansion from enhanced use of irrigation. A 10% increase in the **value** of sector output was chosen as possible from both sectors albeit for different reasons.

In the case of tender fruit the increased output value stems largely from the yield having a larger proportion of fruit able to command a price premium and secondarily from a modest increase in yield per orchard unit (tree, acre, hectare, etc.). In the case of grapes for winemaking the increase arises from a combination of higher yield (less thinning while maintaining BRIX values), expansion of vineyard acreage over time (5 – 10 years) and increased focus on the higher valued classes of grapes at the same time.

The other sectors were seen to provide most of their water from rainwater capture and owned wells with some additional water drawn from connection to municipal systems. The proposed irrigation project was seen as a substitute for only the “make-up” or “drought emergency” water drawn from non-owned sources. The extent to which this portion of the sectors’ water needs could be supplied at a reduced cost provided the basis for estimated direct grower benefit.

Indirect benefits were estimated by examining the value chain of enterprises which move raw farm products from the grower level to final consumption and which move productive inputs into the growers’ hands. Markups for added value and taxation of the transactions involved provided the basis for estimating the added economic activity that would be spawned by improved gross margins (from output expansion, value enhancement and cost reduction) at the grower level. The estimates were separated into “Regional”, “Provincial” and “National” accruals as the value chains were followed upward toward final retail sales and downward through input suppliers from the grower level.

Finally it must be emphasized that all the benefits in this study are **primary** representing first cycle economic activity. The various ways that people and/or agencies might spend their additional earnings was not considered. These things would lead to further estimation of secondary, tertiary, quaternary (and so on) benefits. In any case this suggests that the benefits estimated in this study are conservative. The true economic impact of enhanced irrigation in the Niagara Region may be larger.

APPENDIX A
Peer Review by Dr. Kevin Ker

Review of Economic Benefits Report - Niagara Irrigation Study phase II Task #8

This review was undertaken to assess the report for its conclusions and procedures to ensure the document followed acceptable research procedures, reviews and estimations to arrive at potential economic impacts for the use of irrigation within specific regions of Niagara. There is no doubt that irrigation has an important role in agriculture especially for wine grape and tender fruit production.

In general the report highlights the large number of factors that must be considered to establish direct and indirect benefits. The methodology used is sound and reliable and was applied in a consistent manner. However, there are some conflicting items and other items that need clarification in order to establish how the benefits values at the grower level were derived as these form the basis for all other indirect economic benefits calculated.

It would be useful to include in the report the specific data reports used for the entire document so that they could be referenced to check assumptions and estimations. There is no indication how the dollar value for direct economic benefit was established for each sector or from what specific data sources the economic values are derived. There is a suggestion that biophysical production from irrigation may be 10% for tender fruit and wine grapes but nothing to indicate how the base dollar values were arrived at and how the direct economic benefit was calculated. Is there a possibility that the calculations might have inadvertently included production of tender fruit and wine grapes outside of the Niagara region (marketing board reports include all of Ontario data - gross returns and production) not just for Niagara region? There is need to demonstrate that the economic benefits to be generated are for those areas that would have access to the suggested irrigation plan and has not inadvertently used provincial production data or statistics. This again could be adequately explained by citing specific reference documents used to enable adequate review.

There is reference to a grower survey, but there is no indication of the total number of surveys distributed to growers, the mechanism of distribution and the response rate for this survey. Further, there is no indication of the % of total production that those responding may represent. Professionals familiar with the Niagara region have suggested that 80% of the production of tender fruits and grapes (for winemaking) are under the control of 20% of the growers. A stated breakdown of the survey and mechanism for testing of the survey instrument for clarity and understanding would be beneficial.

In Niagara on the Lake, it has been suggested by the NOTL irrigation committee that currently over 80% of the grape land and 80 % of current tender fruit production in NOTL is being irrigated. The efficiency of this irrigation is not known. In the west Niagara district, it has been suggested that up to 25% of wine grapes and 50 % of tender fruit lands are using irrigation or have access to irrigation.

The report does not indicate the % of total lands for tender fruit and winegrape in each proposed irrigation district that are currently under irrigation or have access to irrigation but choose not to irrigate. The report author has indicated marginal or small gain for these lands from a new irrigation system. It may well be that a large portion of the current lands are already at optimum production and irrigating so the total industry increase in production may not be at the 10% value but lower. Without having data to indicate what land areas are under irrigation it is hard establish realistic potential gains for both tender fruit and wine grapes and if the 10% increase is attainable.

However, if there were no irrigation currently being used then it is expected that gross production values would be lower than currently achieved. Additionally, the report does not indicate the % of total lands that would not have access to irrigation under the proposed design (for example – the bench and escarpment lands of West Niagara, Grimsby, etc). Knowledge of the above data would help in verifying or validating the assumption of a 10% biophysical increase for tender fruit and grapes is reliable or possible. Also, averaging production per acre/ha based on commodity might provide greater insight into economic impact (fresh market versus processing peaches value), vinifera versus hybrid wine grapes (not all areas of Niagara can grow vinifera grapes) and the development of the estimated value used.

All of the fundamental benefits are based on primary production values at the grower level. Therefore, there is need to provide a greater breakdown as to the method of estimating acreage (new acreage to irrigation relative to existing acreage under irrigation) for deriving the initial potential direct economic benefit (annually and 25 years cumulatively). For tender fruit, acreages attributable for production to separate fresh market from processing (peaches, pears, and cherries) would be useful as processing prices are negotiated collectively, and are not affected by proximity to market, which are suggested positive price determinants.

There is some confusion with respect to grape values developed. On page 3 the author indicates the exclusion of the juice grape industry from the study. I am unsure if the values attributable to the juice sector (acreage and dollar values) have been removed as the author suggests (p15), or that potential direct economic benefit for grapes could have been 30% higher if the juice grape industry had not lost its major processor.

This is somewhat misleading as the juice grape sector production has been relatively consistent at 10,000 tonnes annually for the last five years with a farm gate value of about 3.7 million dollars annually. An increase of 10% in this sector would have only been about 370,000 dollars or about 6 % of the value suggested on page 11 (Table 1).

The 10% increase in value attributed to wine grapes alone, using a 5 year average at the farm gate using GGO (Grape Growers of Ontario annual reports) data would suggest that a 10 % increase in value would be closer to \$4.6 million for the entire industry including all of Ontario production and not the \$ 5.6 million suggested by the author. If one uses the adjusted \$ 4.6 million value and then eliminating approximately 20 % of production that would not be from Niagara (15%) and those lands in Niagara not within the irrigation

plan (5%), the value estimate annually would be closer to \$ 3.7 million annually versus the \$ 5.6 million from Table 1.

Table 2 is unclear on how the adjusted Direct Economic Benefits values were derived by any suggested formulae. The only adjusted value was for grapes and this was 88% of the original potential value. It is not clear how the 88% value was derived and under what criteria. If one uses this 88% value and the \$3.7 million estimate, the adjusted value would be closer to \$3.25 million annually for wine grapes. It is not stated why grapes were adjusted and tender fruit was not adjusted. Time constraints and resources were mentioned as limiting factors but does not explain why there are adjustments for one commodity and not another within this report.

An in depth checking of the data sets for the tender fruit industry might possibly reveal an overestimate of the farm gate benefit for the tender fruit sector as for the grape (wine) sector)

The methodology for **Part II Indirect Economic Benefits** is organized in a logical manner and adequately represents potentials based on known data and provides realistic estimations for retention, leakage and value chains. However, these final values are likely to be modified downward as they are based on original direct grower benefits estimated in Part 1. If the above initial direct economic values are modified, the multiplier effect for indirect economic benefits for all sectors (regional, provincial and national) would be affected as all calculations are based on the basic direct grower benefit values.

Using grapes as the example and the revised annual economic benefit of \$ 3.25 million, Table 4 regional annual indirect benefits would be \$14.7 million instead of the \$22.3 million. In Table 5 the provincial indirect benefits would be \$53 million versus the \$ 80.6 million suggested. Finally using the same factors, Table 6 National Indirect benefits, the new grape value would be \$3.2 million instead of the \$ 4.83 million in the table. For Table 7 the adjusted grape values total would be approximately \$74.2 million versus the \$112.6 million in this report.

Even with the revised estimates suggested for grapes, the total for direct and indirect economic benefits of this project would exceed \$100 million annually

There is definite benefits from irrigation for all of the industries with substantial spin off benefit to the region, the province and nationally. To provide a more definitive financial benefits estimate, it would be prudent to provide the full reference data reports used to develop preliminary estimates and to collect and verify a larger survey larger data set to enable one to extract specific information relative to each industry and the internal components that make up it gross economic returns at the farm gate.