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Bulk Water Exports: Environmental Concerns and Business Realities

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I. INTRODUCTION

Hydrologists expect the demand for water will continue to increase with the world's growing population. As a result, some have predicted that by the year 2025, as many as 3.5 billion people will be living in water stressed or water scarce countries, compared to 500 million people in 2002. Water scarcity is also exacerbated as peoples' lifestyles become more industrialized and thus more consumptive on a per capita basis.

The aim of this paper is to concentrate on one aspect of the complex issue of water exports, namely, the feasibility and practicality of a water export business and its various impacts. The issue of water exports will be put in perspective, because if such exports are not attractive from a business point of view, it is unlikely that such exports will ever take place.

The term *water exports* will be used in this paper to refer to bulk transfers of water from one location to another using tankers or water bags. This kind of transfer is generally considered a type of medium scale export, as opposed to sales of bottled water (small scale) and watershed diversions (large-scale).

II. THE CONTROVERSY

Per capita, Canada has an overall water surplus and is considered to have the potential to be a prime exporter of water, especially to the United States. Those supporting trade in water consider it a practical and legitimate solution to problems of global water allocation. One of the conclusions reached at the 1992 International Conference on Water and Environment in Dublin, supported the notion of water as an economic good.

This potential practice is not without controversy, especially in Canada. Some point to the apparent illogicality of it being acceptable to sell and trade in non-renewable natural resources, such as oil and natural gas, but not in water, which is considered a renewable resource. Supporters also contend that water exports are no different than removing water for other industrial reasons, such as supplying a beverage industry or a farm in terms of social and environmental impacts.

Those who are opposed to the selling of Canadian water give various reasons to justify their opposition. First, many reject the idea on the basis that water is one of Canada's most precious resources and is an integral part of Canadian heritage and national identity. Second, it is argued that water is essential to life itself and national supplies should be preserved intact. At the international level, existing agreements, like NAFTA, do not clearly note whether water resources are a tradable resource, such as timber and oil, or a non-tradable resource. The Council of Canadians and others have repeatedly pressed the federal government to take a decisive stance banning water exports and to completely exclude water resources from any multi-lateral trade agreements of which Canada is a member.

When the Canadian government released the NAFTA Manual in August 1992 (an overview of the treaty) it stated that NAFTA applies to water that is packaged in bottles or shipped in tankers, because these are considered products. In February 1999, the Foreign Affairs Department announced a strategy to prohibit bulk water removals from Canada for export. It affirmed that the provisions of any trade agreement, such as NAFTA, do not cover water in its natural state.

Currently, all provinces except for New Brunswick have passed legislation prohibiting bulk water exports. In Nova Scotia, the 2000 Water Resources Protection Act prohibits the export of bulk water. Exceptions to these policies abound, however. Quebec law allows bulk-exports if the water is used to produce electric power. The laws banning bulk water exports in Alberta, Manitoba, and Nova Scotia allow exceptions to be made by cabinet or legislature.

Further, the Government of Canada bases the distinction it uses to ban or allow different kinds of water removals on the method by which water is going to be transferred, rather than on the quantity that is removed, the practicality of transfer or the impacts that the removal will have on the environment. The environmental and social impacts of water removal are not less negative if a given volume of water is to be bottled, used for irrigation, or transferred in other ways, if the volumes withdrawn are large enough. This suggests that the reason for the bulk-water export controversy is, at base, symbolic. As such, bulk water exports continue to receive occasional attention from the media and from the public, as politicians and/or business investors raise the issue during changes of government or as new business plans are proposed.

To be able to examine the practicality of water exports, this paper will assume that this ban on bulk water exports does not exist and that obtaining an export license is possible.

Making this assumption does not imply support for it, but does allow for testing the assumption that such exports are a practical business opportunity.

III. THE BUSINESS PLAN

A business plan deals with the question of an activity's practicality. It is an attempt to list those elements that go into supporting an activity and their associated costs. These costs are then compared to the expected revenues to be gained from those paying for the products of the activity. If the plan shows a positive return, this return is compared with other potential uses for the investment to see if the activity, in this case bulk water exports, is worth pursuing.

There are some examples of countries that have occasionally imported fresh water from other countries, but none appear to be on a long-term basis. For instance, Korea and Taiwan import some of their water through tanker shipments. Japan underwent a severe drought in 1994, so the country imported bulk water to augment the existing supplies. Similar situations have happened in some of the islands of the Caribbean and the Pacific where water was shipped in by tankers to help alleviate the water shortage situations. For the business model, information from a few available water export project proposals submitted in areas such as Alaska was used. The value of this analysis lies in providing a hypothetical model that reasonably resembles the processes of a water export business.

Environmentally, taking water for export may or may not only affect aquatic and terrestrial species, but all the human communities living close to the watersheds from which the water is removed. Removing water from watersheds could result in shortages in drinking water supplies to nearby communities, which are dependent on that resource and affect summer irrigation. The removal of large quantities of water also affects water quality, since the concentration of pollution and contaminants increases when dilution decreases.

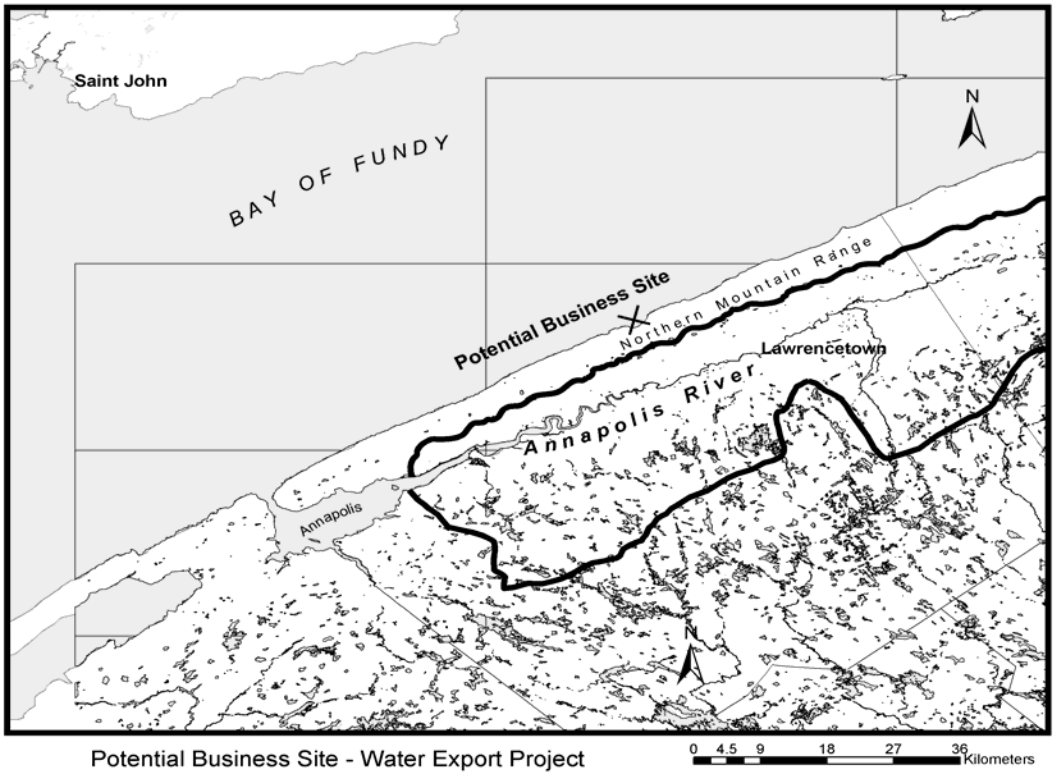
As an alternative to water imports, there are other ways that water-short regions have tried to augment their supplies. For instance, there are approximately 11,000 desalination plants in 120 countries. The cost of desalinated water is gradually coming down and the cost of freshwater is gradually going up but there remains a sizeable gap between the two. About 1% of the world's supply of potable water is currently provided by desalination. Desalinated water is almost always used to supply potable water, but not as water to be used by industry or for irrigation. Analysts have claimed that, although the cost of desalinating saltwater is decreasing, the capital costs of constructing a desalination plant still make the product quite expensive.

IV. THE ANNAPOLIS VALLEY SITE

For the purposes of this paper, a hypothetical water export business is devised for a rural area of Nova Scotia, the Annapolis Valley, and the existing conditions in that area are examined. A number of studies have been conducted in the Annapolis Valley examining the situation of its water resources. Data about the area's environment, economy, surface water resources, and population are available. Since the water data available for the

Annapolis Valley is for surface water resources (mostly rivers), only surface water is considered for this export project. Demands on these water resources by other potential users and existing users must be accommodated. After studying the conditions in the Valley in terms of the local population, environment, and economy, as well as current water usage patterns, the Annapolis River (Figure 1) was seen as suitable to be used for water exports.

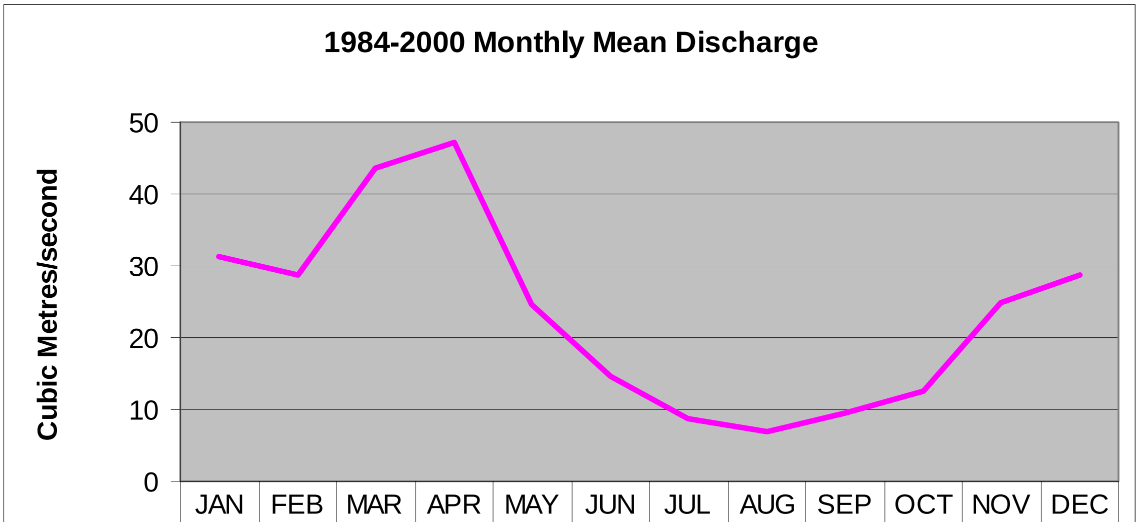
Figure 1. The Annapolis River Watershed in Western Nova Scotia.



The Annapolis River system comprises three parts. The river flow data collected by Environment Canada for its Water Survey of Canada, taken at Lawrencetown, provides information about the total flow of the river throughout the year. The records available for this station date from 1984 until 2000.

When considering the river's discharge, it is important, for purposes of this project, to look at the monthly variations in flow as these will provide useful information about the potential impacts of water removal on other users. The river flow data collected by Environment Canada provides information about the total flow of the river throughout the year (See Figure 2). Because the river flow varies greatly from month to month, if water is to be extracted for an export project, it should be removed during the months between October and June. The water may be collected during the wet months and stored in a reservoir, until it is transferred into a tanker. The specific location could be easily determined by testing samples of water from various points along the river.

Figure 2. Monthly Mean Discharge of the Annapolis River (1984-2000).



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Series2	31.4	28.8	43.5	47.1	24.6	14.7	8.64	6.94	9.54	12.5	24.9	28.7

Source: Water Survey of Canada, 2004

None of the towns in this area use streams or rivers for their water supplies. Further, there is significantly less agricultural demand for the water of the Annapolis River compared to the other rivers of the Valley. Information is sparse on the actual quality of the water of the Annapolis River. The available information, however, indicates that the river's water is of better quality than that of other rivers in the Annapolis Valley watershed. Since this project assumes that exporting water is legal, the exporter must utilize the same licensing procedure as any person seeking a license to withdraw water for industrial use. Currently, withdrawing water from a surface water source in Nova Scotia, such as a river or a lake, requires a license from the Department of Environment if the amount is to exceed 23,000 litres per day. The cost of the license is very low.

V. IDENTIFYING AND ACCESSING THE MARKET

In addition to choosing the right location for water extraction, it is essential to conduct a market analysis. This analysis led to consideration of the southern Texas/ northern Mexico coast. Unlike the Caribbean islands or parts of Central America, North American local water rates are known and payment methods are simple. Both economic prosperity and population growth are putting pressure on the State of Texas' limited water supplies. In 1996, the Texas Water Development Board and the Texas Natural Resource Conservation Commission reported that readily available water to meet the needs of the State is no longer obtainable through normal extraction. Texans have been warned by their state officials about their water consumption and advised to reduce it by 25% over the next two decades.

The specific target market chosen for the hypothetical project was the City of Brownsville, Texas, near the mouth of the Rio Grande River. The city's government, like the State as a whole, has a problem serving its water needs. The city stores water from the Rio Grande River, treats it, and distributes it. The city and its surrounding communities have a population of 140,000 and require 11.1million m^3/yr. The City government, however, anticipates that this will be insufficient in the long-term as the flow of the Rio Grande reaching its mouth is decreasing. One of the projections is that if the city maintains its current rate of demand, the water resources in current use will be completely depleted by 2010. The city also competes for the river water with other, fast-growing upstream communities on both sides of the Rio Grande. The city has been searching for alternative supplies of water, including desalination. A proposed plant would treat brackish ground water and produce approximately all of Brownsville's needs.

In this water export project, removing 3% of the Annapolis River's daily flow from October until June will provide much more water than what Brownsville needs for its present total consumption or hopes to get from desalination. If 3% of the daily discharge of the Annapolis River were to be removed from October until March, 13.2 million m^3 of water would be available for export annually..

The present price charged for water in the local municipality is a good indicator of what the market will bear. For purposes of comparison, current water rates for the residents of the City of Brownsville are \$0.56 m^3. This price does not include sewage treatment or other charges. Prices for imported water can make the cost of desalination more competitive. For instance, the price of distributed desalinated water in southern California ranges from \$0.78--1.45/m^3 (All cost figures are expressed in \$CDN)

Tankers

There are a number of considerations that have to be noted when considering the use of tankers to move water. Because the density of oil is 22% less than water, the ship will not be able to transport as much water by weight as oil. Further the methods of acquiring ships are complex.

There are several ways to access tankers. The first would be to purchase a tanker as an asset for the hypothetical company. A 300,000 DWT VLCC (very large crude carrier) would cost between \$32-44 million. A different option is to 'charter' the shipping operation to another company that owns tankers. One method of doing this is a 'spot charter', which is a one-time charter of a vessel between a specified loading and discharge port. Spot charter prices include all costs of the voyage. Another type is a 'time charter', which is defined as a form of charter where the owner leases his vessel and crew to the charterer for a stipulated period of time.

One VLCC of the above size would not be sufficient to transfer the annual quantity of water discussed above. Consider the following information: the water route distance between Halifax and Brownsville is 3,678 km. The total amount of water transferred in 26 two-week trips would be 6.5 million tonnes, which is half of the target volume (13.2

million m^3). At least two VLCCs making a total of 52 trips would be needed to transfer enough water to meet Brownsville's needs. .

The depth of water along the shoreline of the Bay of Fundy enables the navigation of ships that require large drafts, such as VLCCs . The water removed from the river will be pumped through pipelines that would transfer it to a storage reservoir located along the shore. Then the water will be transferred by pipelines to the VLCCs. Both the Saint John NB shipyard and refinery to the northwest of the loading site already handle large tankers and oil shipments, which implies that transportation routes through the Bay's natural environment have already been established.

VI. THE VIABILITY OF THE PROJECT

Breakeven analysis is also referred to as cost-volume-profit analysis. The quantifiable costs are usually divided into:
Sunk costs- these are costs that are usually not included in the analysis because they had already been incurred.
Fixed or non-recurring costs- these are usually capital costs that are not incurred on a regular basis, such as the purchase of a tanker or the building of a facility or a plant. .
Variable or recurring costs- these are systematic costs that are incurred on a continuous basis during the operation of the project, such as salaries, overhead, and rent.

When making a decision about a project or an alternative, a breakeven analysis aids the entrepreneur in determining when the project is profitable economically. Project economics, however, are not the only factor that needs to be considered to approve a project, especially since some costs and benefits may not be quantifiable in dollar values. The value of intangible costs and benefits should be quantified to the greatest extent possible. Variables that may not have a dollar value, such as sustainability and equity should still be considered by the decision-maker.

Since investments require a number of years to yield a return, the analysis of costs and revenues extends over the years projected for the project. Therefore, it is necessary to determine a discount rate that will be used to convert the future monetary values to the present value so that they are comparable.
To calculate the present value of a future value the following formula is used:

$$\mathbf{PV = FVn / (1+R)^{n}}$$

Where PV = present value
FVn = future value at the end of n years
R = discount rate

After the values of the future costs and benefits are discounted to the present, it is possible to calculate the net present value (NPV), which is equal to the present value of the costs subtracted from the present value of benefits:

NPV = PV (benefits) - PV (costs)

A project is considered cost-effective if the estimated value of its future benefits outweighs its costs over the same period.

The Project Stages and Relevant Costs

Stage I: Extracting and Storing Water

In this phase of the project, water will be collected from the Annapolis River. As noted above, the amount of water removed to is approximately 13.2 million m^3 annually. The point of extraction will be downstream of Lawrencetown, but before the tidal water mixes with the river's freshwater.

To remove the water from the river, a pumping station and a pipeline will be installed. The cost of purchasing and installing the pipeline will be approximately $845,000 while the cost of the pump is $15,000. The capital cost of purchasing the pump and pipeline will be $860,000. Since the pipe will extend first up the mountain and then down, the water will by siphoned naturally which will reduce the costs of pumping it along the pipes. The energy cost of operating the pump is approximately $2000 per day. If the water is pumped out of the river during six months of the year, the yearly pumping cost would be $360,000.

Stage II: Loading the VLCC

Six pumps will be needed to pump the water through pipes from the reservoir to where the tanker is moored. Sending the water in pipelines to the moored tankers is a cheaper way to load the tankers than constructing a wharf and docking facilities. The cost of the six electric pumps is approximately $200,000 while the cost of constructing the pipelines is $350,000. The yearly cost of powering the pumps is approximately $625,000.

Stage III: Transporting the Water to Brownsville

When the tanker reaches the port in Texas it is emptied and the water is sent to Brownsville. Once emptied, the VLCC returns to the Annapolis Basin. The cost of operating both tankers (including labour, fuel, overhead, insurance, minor repair and maintenance costs) is $13,340,000 per year, while the cost of yearly maintenance for the tankers is $200,000. As mentioned above, the transferred water will require some treatment during its transportation in the tankers. The estimated preliminary treatment cost is $13,400 yearly. The calculations will assume that the tankers are running at full capacity.

Other Costs and Cost Summary

In addition to the costs that have been indicated during each of the project's three stages, there are still a number of miscellaneous annual costs that will need to be considered, whether tankers or water bags are used, for transferring the water:

- office space, office staff, security and technician ($300,000)
- provincial yearly water fee (approximately $5,250)
- other overhead ($200,000)

Figure 3 summarizes all the costs identified for the project and indicates their yearly values using VLCCs:

Figure 3. The Project's Anticipated Costs at Each Stage for the First Year Using Tankers. (All figures are rounded to $10,000.)

Stages of the Project	**Non-Recurring Costs**	**Recurring Yearly Costs**
Stage I	4,860,000	**360,000**
Stage II	3,550,000	**625,000**
Stage III	73,000,000	**13,553,400**
Miscellaneous Costs	50,000	**505,250**
Totals	**81,460,000**	**15,040,000**

Following are some additional assumptions made regarding the operations of the project:

- For the financing of the project, it is assumed that the investor is successful in obtaining a standard commercial financing
- The insurance costs of the tankers will not be considered.
- The project will be expected to operate for at least ten years and so the analysis will extend over this period. This is important because of the high capital investment in the project, especially since the water is to be transferred using VLCCs.
- Also, to insure stability and security for both the buyer and the supplier, the supply contract used will require that the buyer make regular and constant yearly purchases. This type of contract is described as a 'take or pay contract' in the oil and gas industry. Such a contract ensures a reliable and secure supply of water for Brownsville. From the exporter's perspective, this kind of contract will ensure that the removed water will always be sold. Without a guarantee of this nature, financing would be impossible..

It is clear that a number of costs are not included in this scenario. This has the effect of lowering the calculated costs and thus making the project's profitability, if any, more attractive. The important consideration is whether the project is viable, even with these lower cost figures. If not, then a fuller exposition would only make the scenario worse.

Sensitivity Analysis

A sensitivity analysis is carried out to compare the results of the project for two different discount rates. The prices used for water are $0.56/m^3 (which is the price that is currently charged to the residents of Brownsville) and another price that approximates breakeven. The discount rate affects the results of the project. The discount rate is chosen based on the required rate of return and the anticipated measure of risk. The discount factors used in this project's calculations are 8%, and 10%. 8% is chosen because it has been used in projects in the oil and gas industry. The 10% discount rate is arbitrarily chosen for sensitivity comparison purposes.

Calculations demonstrate how the net present value of the project changes with the change in water prices and discount rates. In the case of a discount factor of 10%, the present value of costs after 10 years is $188,905,760 and the present value of income or benefits is:

For the price of $0.56/m^3 = $ 48,005,485

For the price of $2.37/m^3 = $188,275,834

The breakeven point for this project is slightly above $2.37/m^3 because at that price the PV of costs and benefits are almost equal.

Using a lower discount value, however, decreases the breakeven point somewhat. For instance, a discount value of 8% considered for 10 years changes the present value of costs to $197,403,360 while the present value of income is:

For the price of $0.56/m^3 = $ 44,487,117

For the price of $2.30/m^3 = $197,165,384

Therefore, the breakeven point of the project occurs slightly above the price of $2.30/m^3 of water.

If only to break even, the price should be increased by over quadruple (4X) what Brownsville presently charges its residents ($0.56/m^3). Further this breakeven price is greater than the lower range of desalination costs noted above (the minima ranges between $0.78—1.91/m^3), making desalination a competitive alternative to importing water.

VII. EVALUATION

The project is clearly unprofitable. The basic reasons relate to the large capital investment required in establishing the business and particularly in purchasing the tankers. Chartering may change these calculations somewhat, but savings do not seem likely, if only because of the variable nature of spot rates over a 10 year period and the constant rate changes that would be ongoing under the time charter format. As well, the operating cost of the project is quite high, though if the price of fuel were to decrease, or if the discount rate is lowered, the costs of the project will also decrease.

In terms of environmental 'costs', the potential consequences of removing water from the river depend greatly on the amount of water actually withdrawn. The impact on the downstream estuarine and marine ecosystems of removing 3% of the daily flow for six months from the river should not be significant as the riverine environment is already adapted to wide variances in runoff and flows throughout its seasonal flows. If the amount of water to be removed were to increase, given that such a project were profitable to operate and expand, the impacts could become more pronounced.

Though the political controversy in Canada over bulk water exports assumes that these make business sense, it is clear from the above case that this is wrong. Neither decades of opposition to a phantasm nor the few proposals made by start-up businesses to export water in this manner make any sense. One can only assume that both groups have other motives in mind when presenting their ideas and concerns to government and the public.

VIII. TECHNOLOGY AND RESURRECTION

A potential transportation alternative to tankers is to use fabric polyurethane bags. This is a relatively new technology that many smaller companies are developing. These bags have been used to export water from mainland Greece to nearby islands..

The capital costs of water bag usage are much lower than for tankers. The price of one water bag with a capacity of 275,000 DWT could be as low as $150,000. To meet the needs of Brownsville, at least four bags should be transferring that amount of water each year. For scenario purposes, the capital costs of the tug boats are estimated at $1.2 million each while the four bags cost approximately $600,000. The operating and maintenance costs of the bags, as well as maintenance are assumed to be 20% of the capital cost of the tugs and bags, which is approximately $600,000 annually. Therefore, water bags offer a substantial reduction in capital costs for the water export project, though operating costs will be higher. Non-recurring costs are $10.1 million and recurring costs are $1.9 million annually.

Alternatively, Medusa Water International recently claimed that when water bags are used for water exports, the costs are reduced to half of the cost of using tankers. Our projection of the total cost of using bags, if their cost were equal to half the costs of the tankers, which were noted above, is $40,730,000 for non-recurring costs and $7,520,000 for yearly recurring costs.

Under either scenario, the breakeven point for the project, if water bags are used, goes down significantly. The breakeven water price for this project is between $0.32-1.15/m^3 if a discount rate of 8% is applied for 10 years and one or the other assumption noted above is made about project costs. The lower end of this range is below the Brownsville retail price for water of $0.56/ m^3 and the whole range is competitive with desalinated water cost estimates.

Water bag technology has not been adequately tested over long distances and long time periods. Were water bag technology is proven to be satisfactory in terms of long-distance ocean transport, this option could be considered instead of using tankers.

Technological change, therefore, does have the potential to drive down transportation costs. If this technology begins to diffuse and become more reliable, projects similar to the one suggested in this exercise could become more attractive and may actually be undertaken. This will attract larger players, such as oil companies and international water companies into this business. Then, the controversy over bulk water exports will stop being a game of political symbols and nuisance law suits between interest groups, governments, small business players and speculators and will begin to get serious.