

EXECUTIVE SUMMARY

INTRODUCTION

The Caissie Cape area of Grand Digue has problems with bacterial contamination of wells and failing septic systems. These problems are largely due to inadequate lot sizes and the high density of wells and septic systems. All of the residences and seasonal dwellings in the area are currently serviced by on-site sewage disposal systems (OSSDS). The public health risk, environmental degradation and negative economic impact to the area is significant and increasing.

In 2003, a group of concerned and motivated residents formed the **Caissie Cape Wastewater Committee** to try to facilitate a solution to the sanitation problems in Caissie Cape. This committee determined an engineering study was the first step toward finding a solution.

Engineering Technologies Canada Ltd. (ETC), known for their innovative approaches to rural wastewater management, met with the committee and were asked to prepare a proposal to carry out the study. The committee received funding through the New Brunswick Dept. of Environment and Local Government's *Clean Water Program* for this study.

Resident / Landowner Survey

In order to better quantify the extent of the problems with the OSSDS, a survey of residents and landowners was conducted in the spring of 2005. The survey consisted of 20 questions about the owner's property and the existing water and wastewater systems. The responses were entered into a database and, using the PID number as a common field, the database was linked to the GIS property parcel layer. A total of 783 survey forms were sent to the registered property owners according to the 2005 property assessment list obtained file from Service New Brunswick (SNB). A total of 341 surveys (43.5% response rate) were returned to ETC.

In summary, the data compiled from the survey responses themselves did not suggest a serious sanitation problem in the area. There were only a few instances of reported septic system malfunction, and relatively few reported cases of well contamination. It is however possible that the residents were reluctant to report these conditions out of concern that they would be required to rectify the problem themselves.

Also, it is noted that many respondents either did not know or did not provide an answer to certain basic questions regarding their existing on-site sewage system such as how old their system was or when their septic tank was last pumped. There is a high probability that the sewage systems on these properties are (a) near the end of their useful life; (b) substandard in design and/or installation; (c) poorly maintained, or some combination of these.

The responses to the questions regarding the long-term viability and sustainability of septic systems suggested that although most respondents didn't feel there was a problem with their own septic system, almost twice as many believe the sewage systems on their neighbour's properties

are not sustainable. When viewed in conjunction with the numerous comments added to the survey forms, it becomes more evident that a significant portion of the residents feel there is a problem.

ON-SITE SERVICING VIABILITY ASSESSMENT

The next step was to investigate the long term sustainability (viability) of existing residential lots in Cassie Cape.

Methodology

Several sources of data were obtained and compiled prior to carrying out the viability assessment. Most data was available in geographic information system (GIS) format. GIS files with parcel identification numbers (PIDs), parcel acreage, property boundaries, owners names, addresses and land use type were obtained from the New Brunswick Department of the Environment and Local Government (NBDELG). GIS files for soils mapping and wetlands were obtained from New Brunswick Department of the Natural Resources and Energy (NBDNRE). Topographic data, digital orthophotos, and elevation data were downloaded from the SNB web site.

Resident survey data was created as a GIS file by linking ETC's database, created from the survey responses, to the property layer provided by SNB. All of this information was incorporated into a master GIS database.

The main criteria which resulted in a lot being classified as non-viable for OSSDS, in descending order of priority, can be summarized as follows:

- Resident survey response for a developed lot indicated that the existing sewage disposal system was a non-standard system (ie. something other than a septic system).
- Resident survey response for the lot indicated that the owner had been denied an on-site sewage disposal permit.
- Lot area is less than or equal to 2000 sq. metres in area and is therefore far too small to satisfy specified minimum standards and/or will not accommodate the use of a "code approved" septic system constructed to meet modern standards.
- Lot area is less than or equal to 4000 sq. metres in area and has either severe or very severe soil limitations for septic systems. Such lots are considered to be of insufficient size to accommodate a septic system designed to overcome such limiting conditions.
- Lot is constrained by environmentally sensitive issues, such as coastal buffer setbacks, wetlands, stream course setbacks, beaches, or eroding bank, etc. Once the areas for the buffers or setbacks are removed from the available lot area there remains insufficient land for a modern code approved septic system.

It should be noted that commercial and institutional lots were excluded from the assessment.

In many cases, several of the above criteria for non-viability applied to an individual lot. In these cases, the lots were identified as being non-viable due to the criteria of highest priority.

Viability Assessment Results

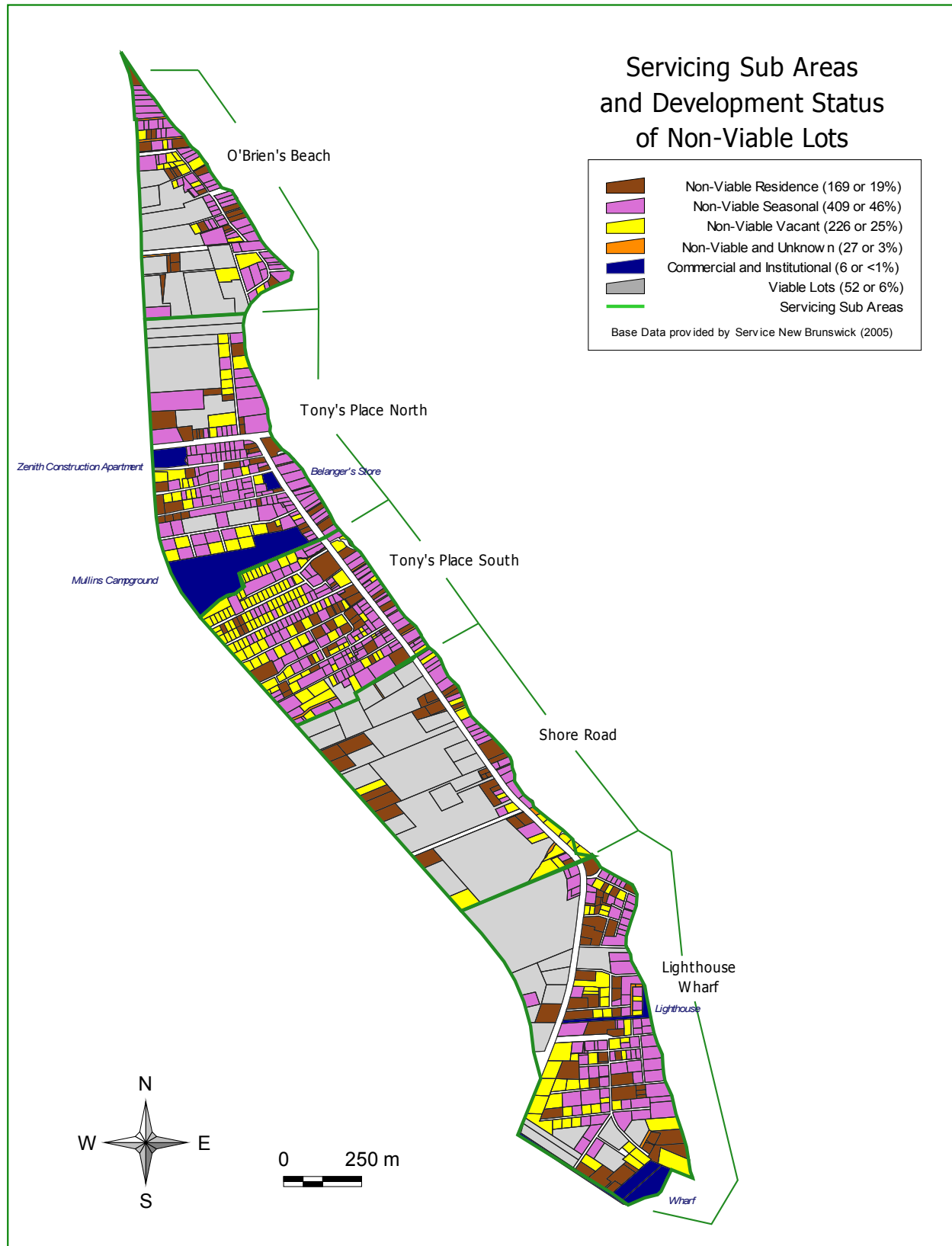
The results of the viability assessment are compiled in Map ES1. Sub areas were defined by geographically linking parcels according to proximity and density of non-viable lots. The study area was divided into the following areas:

- O'Brien's Beach (119 properties)
- Tony's Place North (179 properties)
- Tony's Place South (308 properties)
- Shore Road (89 properties)
- Lighthouse Wharf (194 properties)

The development status of the non-viable lots within the various servicing sub-areas are as follows:

Table ES1 Distribution of Developed, Non-viable Lots by Servicing sub-area.

SERVICING sub-area	Developed Non-Viable Building Lots	Total no. Non-Viable Building Lots	Total No. Building Lots	% of Developed Non-Viable Building Lots	Primary Reason for Non-Viable
O'Brien's Beach	84	107	119	71%	Small Lots, and Buffer
Tony's Place North	137	169	179	77%	Small Lots, and Holding Tanks
Tony's Place South	178	307	308	58%	Small Lots
Shore Road	49	70	89	55%	Buffer, Small Lots
Lighthouse Wharf	130	178	194	67%	Small Lots, and Soil
TOTALS	578	831	889	65%	



Map ES1: Servicing Sub-areas and Development Status of Non-viable Lots

Tony's Place North has the largest percentage of non-viable building lots which have already been developed and most of these are seasonal cottages on small lots. A significant number of the lots have non-standard sewage systems and many are within the 30 metre buffer for the shoreline and the small creek running through the area.

The Lighthouse Wharf sub-area has very similar conditions to Tony's Place North. 67% of the non-viable lots are already developed and almost half of these are year round residences. Although the lots in this area tend to be a bit larger than the extremely small lots (<2000 sq.m.) found in some of the other sub-areas, there are more severe underlying soil problems in this area. The entire area has soils which have either severe or very severe limitations for septic systems.

Using the following criteria, the five sub-areas were prioritized according to which areas were in the greatest need for an off-site servicing solution.

- Density of developed lots;
- Percentage of lots which are already developed and non-viable;
- Whether the sub-area is predominantly for residential or seasonal (cottage) use;
- Patterns or trends in the responses from the residents survey indicating problem conditions;
- Degree of limitation with respect to the installation of septic systems.

It was determined that all five sub-areas have a high to very high level of need for an off-site servicing solution.

OFF-SITE SERVICING SOLUTIONS

There are three main components in any off-site wastewater servicing system:

- 1) Wastewater collection
- 2) Wastewater treatment
- 3) Dispersal or direct discharge (continuous or seasonal) of the treated effluent.

These components were considered separately in order to arrive at the most appropriate and cost effective wastewater management solution.

For the purpose of this study, a *septic tank effluent pump* (STEP) collection system was used for cost analysis. Although this system provides many advantages, confirmation of the most appropriate and cost effective collection system approach should be carried out as part of a more detailed engineering study.

Two approaches to off-site servicing were considered:

- Installation of one community wide, *centralized* collection, treatment and dispersal/discharge system
- Installation of two or more, *cluster* collection, treatment and dispersal/discharge systems located relatively close to the area being served.

Each of these approaches have advantages and can incorporate the use of innovative or alternative (I/A) collection, treatment or dispersal systems. The community of Cassie Cape could be serviced by three clusters of 296 equivalent dwelling units.

In consultation with the steering committee, the following five options for wastewater treatment and dispersal were short listed for detailed evaluation:

1. Textile Packed Bed Filter (PBF) & Subsurface Dispersal System
2. Facultative Lagoon with Seasonal Spray Irrigation
3. Facultative Lagoon with Seasonal Direct Discharge
4. PeatLand™ System
5. Communal Septic System.

These systems differ from each other in implementation and land area requirements but all of the systems treat the wastewater by means of microbial digestion and/or filtration.

The quality of treated effluent from these treatment systems is variable. Depending on this quality level, the treated effluent can be disposed of in one of two ways. A direct discharge disposes of the effluent directly to a water course or ocean. A *land based effluent dispersal* (LBED) system disposes of the effluent to the soil. Both of these systems must be designed using good engineering practices such that the effluent can be assimilated by the natural system.

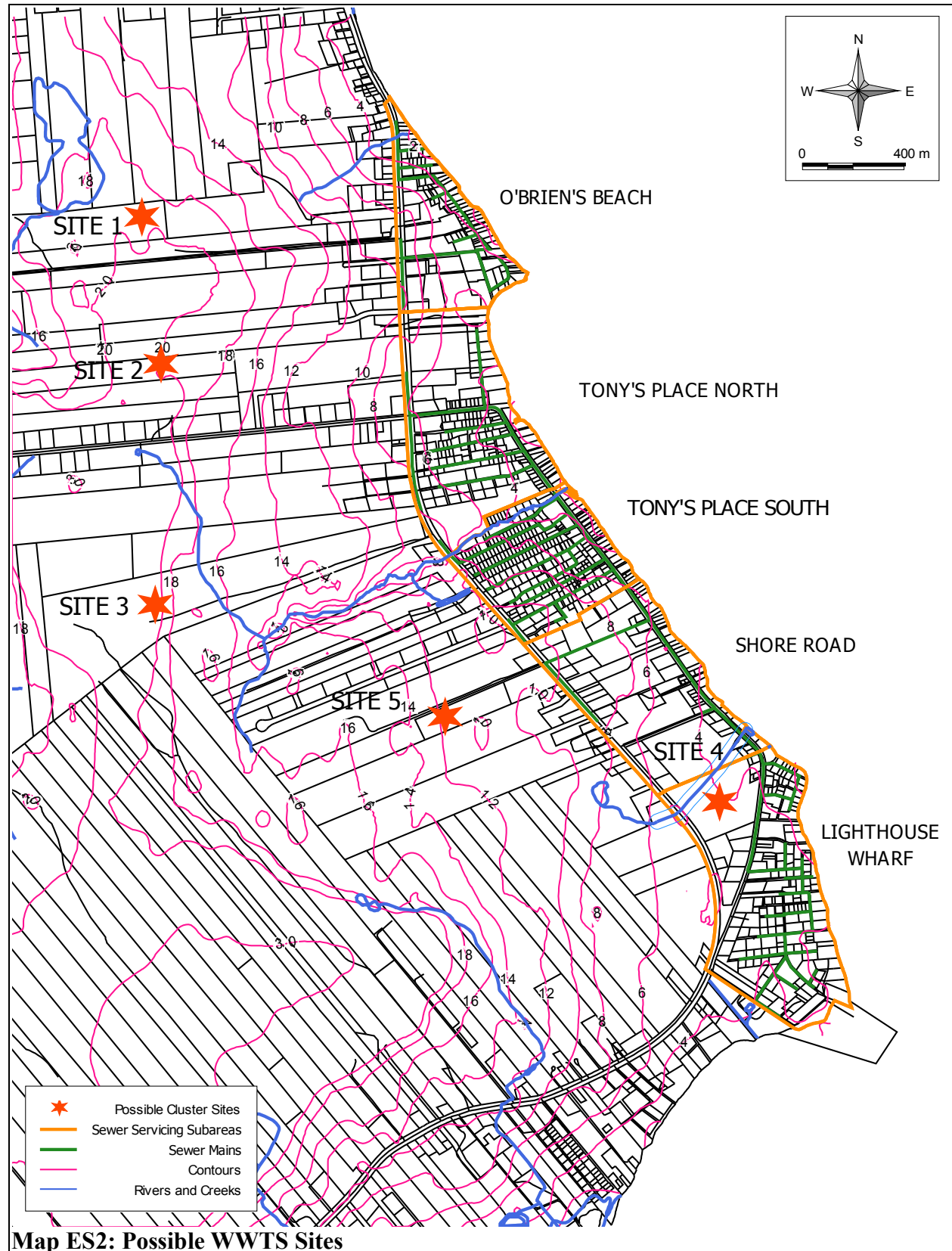
POSSIBLE SITES FOR WWT/LBED SYSTEMS

ETC requested input from the steering committee to suggest possible sites for a central or cluster wastewater treatment (WWT) and LBED system. For preliminary screening purposes, several criteria were identified.

In November 2005 Kelly Galloway, P.Eng. of ETC traveled to Caissie Cape to investigate five potential sites for cluster systems. Steering committee member, Gilles Gallant of Gallant Septic Service Ltd. provided access to each site and also provided a backhoe for digging one or two exploratory test pits at selected sites.

A detailed evaluation of subsurface conditions was beyond the scope of the present study. However, the investigation was useful in providing an indication of the kinds of subsurface conditions which can be expected and implications for sewage treatment and effluent dispersal.

Map ES2 shows the location of the five sites. In general, sites 1, 2, and 3 consisted of high dry land with deep, permeable, sandy soils. The groundwater table was at a depth of about 1.8 m or greater at sites 1 and 2 and at a depth of about 1.2 metres at site 3. Bedrock was at a depth of greater than 1.8 metres at sites 1, 2 and 3.



The deep sandy soils found at sites 1, 2 and 3 are conducive to high effluent application rates utilizing conventional trenches or subsurface drip irrigation. Because of the high permeability of the sand deposits, these sites are not considered ideal for a lagoon system. If one was used, a synthetic and/or geocomposite liner would be necessary.

COST EFFECTIVENESS ANALYSIS (CEA)

The cost effectiveness of each of the five treatment and dispersal system options was determined using a life cycle (present value) analysis. The present value (PV) of construction, engineering, land, operating and maintenance, and equipment replacement costs are calculated for a specified planning period. The life cycle analysis considers the time value of money by using a discount rate. The discount rate adjusts expenditures in future years to current dollar values so costs incurred across time can be compared to each other in present dollars. Assumptions used for this analysis include:

- 20 year planning/amortization period.
- Nominal discount rate equal to 5.37%
- Inflation rate for maintenance costs equal to 3%
- Land appreciates at a rate of 3%
- Percentage of eligible capital costs covered by non-repayable grants ranges from 66.6% (an expected minimum grant level) to 75%

A CEA was conducted for two levels of funding, 66.6% and 75%, for wastewater collection, treatment and dispersal/discharge systems. The results of this analysis are summarized in Table ES3 and Table ES4. The facultative lagoon with spray irrigation (Option 2) was the most expensive system from a life cycle perspective. It also required the most land and would require the greatest setbacks to residential areas. As a result, this option was not recommended for further consideration. Furthermore, the analysis has shown that the PeatLand system (assuming no allowances for infiltration and inflow) (Option 4a) is the least cost option from a life cycle perspective; however, we cannot recommend designing this system as a first phase without including an allowance for infiltration and inflow (I&I).

A summary of the capital costs for collection, treatment and dispersal for a one *prototypical cluster* and a centralized system to service the entire community is included in Table ES2.

Table ES2: Summary of Capital Costs for Different Wastewater Management Options.

Option No.	Option 1	Option 3	Option 4b	Option 5
Description	Textile PBF & Subsurface Dispersal	Facultative Lagoon & Direct Discharge	PeatLand, 100% Allowance for I&I	Communal Septic System
One Cluster System	\$4,888,226	\$4,900,464	\$6,168,337	\$4,810,667
Centralized System for Entire Community	\$14,664,679	\$14,701,393	\$18,505,010	\$14,432,002

Table ES3: CEA 66.6% Funding

Option No.	Option 1	Option 3	Option 4b	Option 5
Description	Textile PBF & Subsurface Dispersal	Facultative Lagoon & Direct Discharge	PeatLand, 100% Allowance for I&I	Communal Septic System
Present Value	\$1,358,498	\$1,001,103	\$1,481,981	\$1,155,269
Projected Annual Sewer Rate Treatment Portion	\$445	\$382	\$518	\$396
Projected Annual Sewer Rate Collection Portion	\$334	\$334	\$334	\$334
Combined Projected Annual Sewer Rate	\$779	\$716	\$852	\$730

Table ES4: CEA 75 % Funding

Option No.	Option 1	Option 3	Option 4b	Option 5
Description	Textile PBF & Subsurface Dispersal	Facultative Lagoon & Direct Discharge	PeatLand, 100% Allowance for I&I	Communal Septic System
Present Value	\$1,184,725	\$845,398	\$1,210,233	\$985,882
Projected Annual Sewer Rate Treatment Portion	\$380	\$318	\$420	\$335
Projected Annual Sewer Rate Collection Portion	\$269	\$269	\$269	\$269
Combined Projected Annual Sewer Rate	\$649	\$587	\$689	\$604

RECOMMENDATIONS AND NEXT STEPS

Having analysed the viability of on-site sewage servicing, and the technical and economical feasibility of off-site sewage servicing, we propose the following three options for further consideration for wastewater management in the Cassie Cape area.

1. A lagoon treatment system sized for total retention of seasonal flows with a seasonal discharge to a nearby river or stream may be the least expensive option from a life cycle perspective. A receiving water assimilative capacity study would be needed as a next step to proceed with this option.
2. Treatment system with land based effluent dispersal system. Further study would be required to investigate the possible impacts of the effluent on local ground water supplies.
3. A treatment system with continuous discharge to an outfall located in the Northumberland Strait or Shediac Bay. An outfall permit and further analysis of the cost and design requirements for the construction of the outfall would be required. The implementation of a continuous discharge would result in a permanent shell fish closure within a 300 metre radius of the outfall.

Following are our recommendations and suggested next steps.

- Consult with the residents to present these initial cost estimates and rates.
- Survey residents to determine their willingness to pay for a sewer system and organize the results by sub-area.
- If there are inadequate funds to sewer the entire community, then consider proceeding with a phase I pilot project for one or two of the sub-areas. This would provide an opportunity to demonstrate the selected technology and allow the utility to gather data on infiltration and inflow.
- Determine if a seasonal discharge to an inland stream would be acceptable to NBDELG which would be necessary for option 1 above. Carry out an assimilative capacity study of the receiving water body.
- Carry out detailed subsurface evaluations of possible WWTS sites for issues that may affect the cost of preferred options.
- If a land based effluent dispersal method is preferred over a direct discharge, investigate the potential impact of nitrate from the effluent on ground water quality.
- If a land based effluent dispersal method is preferred over a direct discharge, carry out a groundwater mounding analysis to confirm maximum hydraulic application rates.
- If a direct discharge is preferred, carry out an assimilative capacity study of the receiving water body.