Summary of the

Environmental Impact Assessment Report for Modifications to the Petitcodiac River Causeway

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Prepared by the New Brunswick
Department of Environment and Local Government

New Nouveau Brunswick

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1.0 INTRODUCTION

This document is a summary of the "Environmental Impact Assessment (EIA) of Modifications to the Petitcodiac River Causeway" prepared by the Department of Environment and Local Government (NBDELG) to assist the public in becoming familiar with the Project Options and understanding the information contained in the EIA Report. The Petitcodiac River Causeway is a gated dam structure with a vertical slot fishway. Completed in 1968, it was built across the Petitcodiac River between Moncton and Riverview to create a second transportation link between the communities, to offer flood protection for farmland, and to create a freshwater headpond. However, the vertical slot fishway at the causeway proved ineffective, and subsequent alterations failed to provide a solution to fish passage issues. Substantial modifications to the causeway are required to adequately provide for fish passage and the EIA process was used to identify and evaluate possible modifications.

The EIA examined four Project Options that are intended to achieve a long-term solution to fish passage and other ecosystem issues related to the causeway, including tidal exchange, sediment transport and other physical processes, and biophysical functions. It evaluated and compared the potential environmental effects of those Project Options that meet the Project Objectives, analysed proposed mitigation, and determined the significance of the residual environmental effects in comparison to current conditions and the Status Quo.

The EIA Report is the result of more than two years of research, consultation, modelling and analyses conducted by the AMEC Earth and Environmental Limited (AMEC) Study Team, on behalf of the New Brunswick Department of Supply and Services (NBDSS), pursuant to the *Clean Environment Act* -- *Environmental Impact Assessment Regulation* and the *Canadian Environmental Assessment Act*.

2.0 BACKGROUND

The Petitcodiac River causeway was constructed in 1968, and it became evident within a few months that fish passage was and would be problematic. The fishway, based on a design used for Pacific salmon and trout that could operate at a variety of water levels, was ineffective for Atlantic salmon and unsuitable for many other species. As it exists, the facility does not meet the requirements of the *Fisheries Act*.

In addition to ineffective fish passage, other problems associated with the construction and operation of the Petitcodiac Causeway and its gates have been identified:

- erosion along the banks of the headpond;
- inability to maintain stable headpond levels during the summer;
- sedimentation of the headpond upstream and downstream of the causeway;
- ice jamming at the causeway end of the headpond; and
- a number of lesser mechanical problems mainly associated with gate operation and maintenance due to sedimentation.

Following a variety of reports and actions, and based on the recommendations of a report prepared by Mr. Eugene Niles (referred to as the Niles Report, 2001), it was resolved that an EIA was necessary to evaluate potential Project Options to address these issues. NBDSS was appointed as the Proponent and a harmonised federal-provincial EIA process was established with the issuance of joint Guidelines. In November 2002, the AMEC Study Team was retained to conduct the EIA.

3.0 ENVIRONMENTAL ASSESSMENT METHODS

The Project Objectives are to achieve a long-term solution to fish passage and other ecosystem issues related to the causeway, including tidal exchange, sediment transport and other physical processes, and biophysical functions (e.g., wetlands, populations of flora and fauna, fish habitat, etc.). The fish passage Project Objective was the principal purpose of this EIA and was further defined as the unimpeded and safe movement, upstream or downstream, of fish between aquatic habitats required for their life cycle. Other ecosystem issues were for the most part directly related to the same environmental effects that caused the fish passage issues.

The EIA focussed on the following Project Options:

- Project Option 1—replacing the fishway.
- Project Option 2—gates open during peak migration.
- Project Option 3—gates open permanently.
- Project Option 4—replace the causeway with a bridge.

During the EIA process, these options were evaluated against the key objective of fish passage and those options that met the fish passage objective were assessed in detail. Other options and alternatives to these options were also considered during the EIA.

The continued operation of the gates and causeway as has been done in recent years is referred to as the "Status Quo" scenario. The Status Quo does not meet the Project Objectives, but is included in the EIA for comparison purposes. The environmental effects of the Project Options that met the fish passage objective were compared to the Status Quo and pre-causeway conditions. Elements of Full Cost Accounting were used to assist in the comparative analysis.

The scoping process began with the Niles Report, and all previous studies included within the Niles Report, which led to the identification of the project and possible options. Regulatory requirements were determined, a Technical Review Committee (TRC) was assembled, and the Guidelines and Terms of Reference for the EIA were prepared. A Biophysical Component Study, a Socio-economic Component Study, and a Hydrodynamic and Sediment Transport Modelling Component Study were carried out to address data collection needs in support of the EIA.

Thirteen Valued Environmental Components were selected for the EIA, comprising a range of biophysical, socio-cultural and economic aspects of the environment that may be affected by the Status Quo and Project Options. The EIA Report also considered the potential effects of the environment on the Project; the cumulative environmental effects in combination with other projects and activities; and the economic considerations of the causeway to date and into the future with the Status Quo and Project Options. It includes recommendations for mitigation measures and follow-up as required.

4.0 PUBLIC, STAKEHOLDER, ABORIGINAL COMMUNITY MEETINGS AND REGULATORY CONSULTATION

The consultation program for this EIA consisted of meetings and on-going liaison with the public, stakeholders, regulatory agencies, and the Aboriginal Community, as well as regular communication with the media. In addition to those issues previously identified in the Niles Report, new issues were raised pertaining to the EIA components, proposed Project Options, and the commitment of government in the

EIA Process. The complete results of the consultation process are presented in the Public Consultation Report.

5.0 DESCRIPTION OF PAST AND EXISTING ENVIRONMENT

5.1 Causeway and Control Structure

The Petitcodiac Causeway is 1,036 m long and was constructed from 1966 to 1968 using rock fill. Initially, the causeway was constructed for two lane traffic. A control structure was built on the Riverview side of the causeway and is founded on relatively weak bedrock of sandstone, shale, and mudstone. The concrete floor of the structure is a 1.2 m thick slab, about 53 m long and the full width of the structure. An energy dissipation basin was built on the downstream side to protect from erosion that could occur due to low from the headpond to the estuary. Five gate openings, each 8.84 m wide, are separated by piers for a total opening area of 269 m^2. Slots for stop logs are located at the upstream and the downstream ends of each of the original piers. In addition there is an opening on the Moncton side of the control structure in which the present fish passage facility is located. The vertical slot fishway, designed primarily to provide upstream passage for Atlantic salmon, has 19 pools, each 3 m long and 2.4 m wide, with a drop between pools of 23 cm. The slots are 30.5 cm wide.

In 1997, a two-lane bridge was constructed just upstream of the original structure in order to upgrade the crossing to four lanes.

5.2 Physical Characteristics of the Petitcodiac River Estuary

General

The Petitcodiac River estuary is unique in that the tidal range is among the largest in the world and the concentration of suspended sediment is extremely high. Before the construction of the causeway, tidal water extended upriver to Salisbury and free tidal exchange took place along the length of the river, resulting in a fairly stable channel. Following construction of the causeway, the head of tide was essentially moved to the location of the causeway, about 22 km downstream from its original location. In response, the channel reduced in depth and width and, consequently, in the volume of water in the channel. High tides are now slightly lower than before causeway construction. Movement of sediment into the headpond has resulted in a deposit (sediment plug) between 0 and 6 km upstream of the causeway that acts as a barrier to flow of the river and increases the potential for ice jams. In addition, reduced freshwater flow for operation of the fishway and for the “signal” that guides fish to the fish passage facility, is one of the primary problems associated with fish passage. Most of the recent flooding in the Moncton area has been related to drainage problems and to the inability of tributaries to effectively convey flood waters as a direct result of sediment accumulation.

Tidal Bore

Prior to the construction of the causeway, the Petitcodiac River experienced one of the most renowned tidal bores in the world. The average height was approximately 1 m, exceeding 1.5 m during the largest tides. Presently, its height varies from just a few centimetres (in conditions of adverse winds) to approximately 75 cm. This is due to the significant sedimentation within the estuary.

Sources and Fate of Sediment in the River

Sediment in the Petitcodiac River comes from the Bay of Fundy, including Shepody Bay, Chignecto Bay, and the Cumberland Basin. Sediment comes from scouring of the bottom of the bay and from erosion of clifss adjacent to the bay. About 1.0 million cubic metres of sediment comes from cliff erosion into Shepody and Chignecto Bays and Cumberland Basin. Scouring and erosion of the seabed in Chignecto and Shepody Bays by the currents supplies an additional 6 million cubic metres year. Another 0.3 million cubic metres of sediment comes from rivers and streams that are tributaries to the area, especially during the spring break up or freshets. This 7.3 million cubic metres of sediment is combined with other sediment coming from the Bay of Fundy into the Petitcodiac River on the rising tide.

The general circulation in the Bay of Fundy, west of the mouth of Chignecto Bay, is counter clockwise (inward along the eastern margins and seaward along the western margins). Water and sediment flows into Chignecto and Shepody Bay during the high tide and is transported into the Petitcodiac River along the margins of these bays. As the tide recedes and water flows from the Petitcodiac River back into Shepody and Chignecto Bays, the water with suspended sediment tends to flow through the central portion of Shepody and Chignecto Bays and out to the Bay of Fundy where a portion is deposited in the middle of the Bay of Fundy and a portion is retained in suspension and transported back toward the Petitcodiac River on the rising tide.

A portion of the sediment coming from the Bay of Fundy and derived from Chignecto and Shepody Bays and Cumberland Basin that flows up into the river is left behind as accumulation on the river banks and bottom. This results in an infilling trend of about 2 million cubic metres per year.

It is also of interest to note that the process of sediment transport into and out of the river and out into the Bay of Fundy does not appear to be related to the construction of the causeway in 1967/68. Prior to the causeway construction, there would have been a similar amount of sediment removed from Chignecto and Shepody Bays and Cumberland Basin and held in suspension up into the river and down the river and out into the Bay of Fundy where it was deposited. The construction of the causeway altered the balance of where the sediment was deposited, with a portion deposited in the Petitcodiac River and not finding its way to the middle of the Bay of Fundy. There would still have been erosion of the cliffs and seabed in Chignecto and Shepody Bays and Cumberland Basin since 1967/68 even without the causeway.

Seasonal Changes and Sediment Transport

The erosion/deposition cycle in the Petitcodiac River estuary is not consistent throughout the year due to the dynamic contribution of flow to the estuary of the Petitcodiac River. Erosion of the sediment that accumulates in the river occurs during the high flow events. There is always a high scouring flow in the spring, but there can be high scouring flows in the summer and fall as well. In the winter, frozen ground conditions can limit the scouring potential. During the times of low flow, the sediment re-accumulates on the sides and bottom of the river.

On an annual basis, about 15 million cubic metres of sediment is removed from the Petitcodiac River, past Hopewell Cape and into Shepody Bay, in “pulses” during the spring freshet or heavy summer and fall rains. As noted above, measurements have shown that the channel is infilling at a rate of 2 million cubic metres per year. Hence, over the course of a year, there can be about 17 million cubic metres of material deposited on the banks and bottom of the river with 15 million cubic metres mobilized into the Shepody Bay area during the short term events in the spring and fall. The sediment that is deposited in the river during low flow events comes out of suspension when the energy is low and is then re-suspended during the high flow events. The sediment transported out of the Petitcodiac River on the failing tide is held in suspension in Shepody and Chignecto Bays and Cumberland Basin with a portion sent to the middle of the Bay of Fundy and then a portion sent back up the river. It is unlikely that the

sediment that leaves the Petitcodiac River during the spring and fall pulses accumulates on the bottom of and Chignecto and Shepody Bays.

5.3 Atmospheric Environment

The climate in southern/southeastern New Brunswick is classified as moist continental, with the Fundy coast receiving the greatest amount of precipitation in the province. In terms of climate change, a regional cooling trend can be observed in southeastern New Brunswick and the GMA, with a decrease of approximately 0.2°C from the pre-causeway to post-causeway timeframes. Annual average precipitation has increased from 1,099 mm to 1,223 mm, and the average number of days per year with thunderstorms has increased from 15 to 19. Air quality in the GMA is considered to be relatively good, although emissions of air contaminants of concern and ambient concentrations of these contaminants are tending towards a slight increase. City of Moncton officials are not aware of any official odour complaints in the GMA in recent years. Currently, the sound character in the GMA is typical of urban environments dominated by vehicle traffic, and there appears to be no history of noise-related complaints.

5.4 Fish and Fish Habitat

Many fish species that inhabited the Petitcodiac River before the causeway was constructed have declined because of fish passage difficulties. The abundance of other species has remained similar to, or increased from pre-causeway conditions because of the headpond, but this has also created opportunities for non-native fish species. Fish species that require passage through the Petitcodiac River to complete their life cycle include American eel, American shad, Atlantic salmon, Atlantic tomcod, brook trout, gaspereau, rainbow smelt, sea lamprey, and Atlantic sturgeon. Of these, American eel are catadromous (migrating from fresh to salt waters to spawn) and the others are anadromous, migrating from the sea to freshwater to spawn. Other fish species that were identified as important to the EIA from the review of past studies and from the public consultation process are American lobster, scallops, and smallmouth bass.

Water Quality

The quality of freshwater upstream of the causeway has improved since the initial period following causeway construction, but it is still considered in the fair to marginal range as evaluated against the Canadian Council of the Ministers of the Environment (CCME) Water Quality Index (WQI). In the summer months, the total organic carbon (TOC) level in the headpond is twice as much as that for downstream locations. Dissolved Oxygen (DO) concentrations are acceptable at all depths, and total suspended sediments (TSS) are low in the headpond, but increase during periods of increased gate operation. Faecal coliforms in the headpond are higher after rain events and in the autumn.

Bacteria in the estuarine and marine waters downstream of the causeway are likely to be attached to suspended sediments, which increase with an ebbing or spring tide, and with the passing of the tidal bore. Coliform counts are much higher at low tide than at high tide, and in the summer. Peak bacteria counts at low tide near sewage outfalls suggest that complete mixing may require several tidal cycles. Faecal coliforms are generally higher at the causeway, and the gates-open condition (low tide) appears to increase faecal coliforms upstream. DO concentrations within the fishway and just downstream of the causeway range from just below the guidelines to unacceptably low. Elevated levels of mercury were found on several occasions and this may be a metal of concern. The chlorinated benzene 1,4-dichlorobenzene was found in low concentrations in the summer at Boundary Creek, the causeway, and Gunningsville Bridge. Thirteen families of polycyclic aromatic hydrocarbons (PAHs) were detected, all below the CCME guidelines except for antracene, detected at the causeway in the summer.

Sediment Quality

The 2003-2004 field programs suggest that sediment and suspended sediments are apparently not contaminated to any discernible level of concern for either metals or organic compounds. The benthic community biomass in the headpond has remained low since 1999 for sphaerid clams, gastropods, and amphipods, but there appears to be an increase in insects such as chironomids, mayflies, and trichopterans.

Commercial Fisheries

Four fish species were commercially fished in the Shepody Bay and lower Petitcodiac River estuary in the pre-causeway period: Atlantic salmon, gaspereau, American shad, and Atlantic sturgeon. Since causeway construction, gaspereau, American shad, Atlantic sturgeon, American lobster, American eel, and, to a lesser extent, Bluefin tuna, have been fished commercially in these waters. The construction of the causeway may have resulted in an improved American eel fishery near the causeway and in the headpond. However, the Atlantic salmon and American shad commercial fisheries have experienced a large decline since construction of the causeway. The effect of the causeway on brook trout and gaspereau fisheries are less clear.

5.5 Terrestrial and Wetland Environments

Wetlands

There is approximately 33% more wetland area in the Assessment Area at present than before the causeway was constructed. Approximately 97 hectares (ha) of freshwater wetlands have been formed, including 46 ha of Ducks Unlimited sites. Approximately 544 ha of saltwater marsh have formed downstream of the causeway. These areas appear to be still growing at a rate of at least 2-5 metres/year. Vegetation in the pre-causeway portions is slightly more diverse and appears more vigorous than in the "new" wetland areas.

Wildlife and Vegetation

Species at risk using the terrestrial or wetland habitats before the causeway were probably very similar to those known to exist at present, although, the relative abundance of such populations may have changed due to changes in the proportion of various habitats.

Currently, a small-to-moderate number of species at risk are known to occur in close proximity to the Assessment Area, fourteen of which are ranked S1 (a species considered extremely rare throughout its range in the province) and one that may be especially vulnerable to extirpation. No wildlife species at risk were observed during field surveys, although three plant species at risk were identified: Salt Grass, Golden Dock, and Gaspé Peninsula Arrow Grass.

Migratory Birds

Approximately 92 species of birds make some use of the open water, freshwater wetland, and/or upland habitat immediately adjacent to the headpond as breeding, foraging, resting, or migratory habitat. Nearly 70% of the birds recorded during surveys immediately below the causeway were gulls. Shorebirds made up 30% of the non-gull species. Five of the bird species reported are ranked as S1: American Peregrine Falcon, Sedge Wren, Sanderling, Baird's Sandpiper, and Upland Sandpiper. There are three Ducks Unlimited Sites within the Assessment Area, and several Environmentally Significant Areas (ESAs) that have been so designated primarily due to the presence of migratory birds.

Mudflat Productivity

Current mudflat distribution in Shepody Bay is believed to be approximately the same as it was prior to causeway construction. Within the Petitcodiac River just downstream of the causeway, channel infilling after construction caused an initial increase in the area of mudflats. Then, much of the created mudflats became vegetated and are now considered wetlands. The river mudflats that remain are less important as feeding habitat for migrating shorebirds than are those within Shepody Bay. Mudshrimp (an important forage for migratory bird species, fish, and other animals) are found to be abundant at Hopewell and progressively less abundant upriver.

5.6 Municipal Services and Infrastructure

Prior to 1968, the City of Moncton, the Town of Dieppe, and three villages on the south shore of the river were supplied with water from the Turtle Creek Reservoir. In 1963-1964, a water transmission line was constructed in a tunnel under the Petitcodiac River 1.8 km west of the causeway. In 1973 (post-causeway construction), the Turtle Creek reservoir became the water supply source for Moncton, Dieppe, and Riverview. Storage reservoirs, pumping stations, and transmission lines were added as the area developed. In 1995, a water transmission line was installed 20 m east of the causeway, parallel to the roadway, as a second supply line across the mudflats. In 1999, a water treatment plant was completed at Turtle Creek.

The installation of the first sanitary sewer systems in the GMA began in the late 1890s. Untreated wastewater was discharged directly into the Petitcodiac River and its tributaries, and the tidal action of the river effectively dispersed the wastewater. Following construction of the causeway, sediment deposits in the former river channel separated the outfalls from the new channel, resulting in sewage accumulation on the mudflats. In response, trunk sewers and pumping stations were constructed in the 1970s to collect the wastewater and discharge it directly into the Petitcodiac River at 58 outfall locations. Between 1984 and 1994, a new wastewater collection system, including a chemically assisted primary treatment system, was built to serve the three municipalities. As part of this system, a deep tunnel was constructed under the river from Boreview Park in Moncton to the site of the Main Pumping Station in Riverview.

Before the 1960s, the three GMA municipalities used ditches in many areas to transmit storm water. Prior to the installation of curb and gutter systems, these ditches were connected to existing combined sewers (sanitary and storm sewer contained in a single pipe), storm sewers or new storm water sewers. Currently, the Virginia Street Storm Water Pumping Station is located at the bend in Dieppe, at the rear of the dyke, with twin outfalls protected by armour stone. The City of Moncton has storm water systems discharging into the river, creeks, and streams in the area. Problems exist with the storm sewer system due to sedimentation of outfall structures.

Dykes, Aboiteaux, and Wharves

Acadian settlers constructed the first dykes in southeast New Brunswick over 300 years ago. Aboiteaux, wooden tunnel with gates built into the dyke, were used to protect marshland and provide farmland. Since 1968, the Provincial Department of Agriculture, Fisheries and Aquaculture has been responsible for maintaining the New Brunswick dykeland infrastructure which protects over 15,000 ha of land from the Bay of Fundy tides. Since construction of the causeway, the number of marsh bodies and total dyke lengths have not changed. However, above the causeway, the dyke structures have been destroyed or have fallen into disrepair as they have not been required after the causeway construction.

In the pre-causeway period, 12 wharves operated along the Petitcodiac River from Moncton to Alma. However, with the construction of the causeway and the subsequent narrowing of the downriver channel,

shipping declined rapidly. The wharves were used less often for freight transportation due to navigation issues resulting from the causeway and unrelated changes in the shipping industry as well as the closure of as major industries in the area. Today, there are three active wharves at Alma, Dorchester Cape, and Belliveau Village.

Other Infrastructure

The City of Moncton has developed a timber boardwalk supported on steel piles at the edge of the present river channel, with a new section completed in 2004 in front of Boreview Park. A two-storey building with a viewing deck was also constructed. The Chateau Moncton hotel was constructed on piles to the rear of this boardwalk. No shoreline protection was installed along the riverbank for the hotel project and the boardwalk. Old concrete slabs and fill material had been placed in the area over the years. As well, old timber cribwork from loading docks constructed for shipping up to the 1960s remains under some sections of the present boardwalk.

From 1948 to 1969/70, the City operated an incinerator at the end of Foundry Street. A landfill site between Bridge Street and Foundry Street South of Waterloo Street operated from 1969 to 1974. The City of Moncton operated an unconfined landfill site on tidal marsh on the north side of the Petitcodiac River, immediately downstream of the causeway, from 1971 until its decommissioning in 1992.

Adjacent to the causeway, overhead utility poles carry Aliant telephone lines and a Rogers fibre optic cable from Moncton to Riverview. There are no power lines in the immediate vicinity of the Petitcodiac River, and no gas pipelines along the shore or crossing the river. At the Gunningsville Bridge there are NB Power cables and fibre optic cables for Aliant and Rogers Cable. These will be abandoned when the new Petitcodiac River Bridge is completed in 2005.

5.7 Road Transportation Network

Although many of the provincial roads date back to the 1800s and early 1900s, it was during the 1950s to the 1970s that most of the present road network was built or reconstructed to meet new design standards. The decision by the Province to construct a causeway over the Petitcodiac River was announced in February 1964, after public discussions extending back into the 1950s. While there were numerous other non-transportation reasons at the time for selecting a causeway over a bridge, including flood protection upstream, the need for a second crossing was apparently driven by the increasing traffic congestion at the Gunningsville Bridge.

Since the mid-1970s, traffic volume on the causeway has increased by more than 10,000 vehicles per day, while traffic on the Gunningsville Bridge remained virtually the same. At present, 42,000 vehicles cross the river within the GMA each day: 68% on the causeway and 32% on the Gunningsville Bridge.

A new Petitcodiac River Bridge, just upstream of the Gunningsville Bridge, is presently under construction and is due for completion in 2005. Construction of the required network connections in Moncton is expected to be completed in time for the bridge opening. In Riverview, the bridge will initially connect to Route 114, with construction of a new road across Route 114 to Findlay Boulevard scheduled to begin in 2006 for completion in 2007.

Most of the highways within the Transportation Network Assessment Area provide an acceptable level of service with respect to traffic flow, however, Route 114 across the causeway is quite congested during evening peak conditions. The diversion of traffic to the new Petitcodiac River Bridge in 2005 will improve this situation. Route 196, the existing Gunningsville Bridge, is a substandard very narrow two-lane bridge and will be replaced by the new four-lane Petitcodiac River Bridge in 2005. Route 114 in

Riverview between the causeway and the Gunningsville Bridge is also at overcapacity, but upon completion of the "ring road" connection in 2007 between the new bridge and Findlay Boulevard, south of Whitepine Road, traffic will be diverted from this section that improve its level of service.

The highest traffic accident levels are generally experienced in the urban area of the GMA. The two highest accident rates in the GMA have occurred along Route 106 in the Downtown Moncton area (Main Street between Vaughan Harvey Boulevard and the Halls Creek Traffic Circle) and in Dieppe (Champlain Street from the Halls Creek Traffic Circle to Acadie Avenue).

5.8 Vessel Traffic and Navigation

The Petitcodiac River, at one time, supported commercial marine traffic as well as shipbuilding at a number of locations including Moncton and Salisbury. At the time of the causeway construction, the only commercial marine traffic in the Moncton area was the delivery of petroleum products from Saint John to the Irving Oil tank farm in Dieppe. This continued until the early 1980s when Irving switched to truck transportation. There has been some commercial marine traffic to and from Dorchester Cape during the post-causeway period. However, dredging efforts were unable to maintain sufficient depth at the wharf. Currently, commercial vessel traffic on the Petitcodiac River downstream of the causeway is limited to a few commercial fishing boats.

The headpond up to Salisbury supports a range of recreational boating activities, including cruising, sailing, water skiing, windsurfing, canoeing, kayaking, fishing, and hunting. But, these are constrained by the shallow water of the headpond. An annual bass fishing tournament serves local area participants, and powerboat racing and dragonboat racing have taken place on the headpond. The Tri-community Marina in Riverview provides docking facilities for approximately 22 vessels and adjacent public launching facilities are used by other recreational boaters. Since 1975, the headpond has also supported the sea cadet sailing program, with a facility near the marina that houses 15 small sailboats. Below the causeway, recreational boating is mostly limited to kayaking and canoeing due to channel infilling caused by the causeway. Commercial sea kayaking and canoeing operations are located in St. Martins, Alma, Cape Enrage, and Hopewell Rocks.

5.9 Land Use and Value

Land Use

Prior to the construction of the causeway across the Petitcodiac River, industrial and commercial development was concentrated in the urban areas of the City of Moncton, while the communities of Dieppe, Riverview, Coverdale and Salisbury were transforming into suburban communities, and forestry and agricultural activities continued in the rural areas. As a result of good land use planning and management, the communities in the Assessment Area appear to have grown in an orderly fashion. The City of Moncton, the City of Dieppe, and the Town of Riverview have responsibility for their own land use planning issues. The Greater Moncton Planning Commission administers land use for the largest part of the area, which includes the western portions of Albert and Westmorland Counties. Land use planning and management for the Dieppe area (outside the City of Dieppe) is administered by the Beaubassin Planning Commission, and for the Dorchester-Memramcook area by the Tantramar Planning Commission.

Land Value

Between 1961 and 1971, residential property values increased by 53% in Albert County compared to 19% in Westmorland County. It is possible that this difference is due in part to the growth of the suburban area of Riverview following the opening of the causeway. It is unknown if the presence of the Petitcodiac River had any effect on the value of property located in close proximity to the river prior to the construction of the causeway.

There has been about a threefold increase in the property tax base between 1968 (when the causeway was opened) and 2004. The number of occupied dwellings located in the Assessment Area increased between 1996 and 2001; however, it appears that the amount of increase in the communities of Riverview, Dieppe, Moncton, and Salisbury did not keep pace with inflation. Since the 2003 Census, values have continued to increase in at least portions of the area. The value of woodland in the Assessment Area rose substantially during the 1990s but has remained steady in recent years, as has the value of farmland. In all general categories of property located within the Assessment Area, it appears that values have continued to increase up until the present. However, it is recognised that this level of increase may not have kept pace with inflation in certain sub-sectors of the market.

There is very little empirical data available to determine if the presence of the Petitcodiac River has a measurable influence on the value of all categories of real property in the Assessment Area. Based on the examination of available sale records of "paired" vacant lots (one in close proximity to the Petitcodiac River and one non-waterfront), and taking into consideration differences in value as a result of changing market conditions over time and varied physical characteristics, an enhancement in the order of 10% was indicated for comparable lots above the causeway. However, an enhancement in the order of 5% or less was indicated for comparable lots below the causeway as well, indicating that there is a possible influence of the headpond on the value of vacant lots, but it is small.

Analysis of transactions involving the sale of properties that were improved with some type of building(s), such as residential dwellings, farm structures, commercial office complexes, industrial facilities, etc. did not reveal any evidence to support a conclusion that there is any measurable difference in values as a result of the presence of the Petitcodiac River (above or below the causeway).

5.10 Past and Present Use of Land and Resources for Traditional Purposes by Aboriginal Persons

The activities which members of the local Aboriginal Community have partaken in are mainly fishing and gathering, and, to a lesser extent, hunting. In addition, the Petitcodiac River was used by members of the First Nation community at Fort Folly as a means of transportation. Timber was also harvested along the Petitcodiac River before the construction of the causeway. Overall, traditional use of the Petitcodiac River and its shoreline areas has reportedly declined since the construction of the causeway, due to the decline in the presence and availability of the species sought. Gathering of various plant species (for food, crafts, and medicinal uses) is reported to take place at a reduced level in the wetland areas along the Petitcodiac River. Some species are no longer available in their traditional locations and are sought further down river. There is no recorded use of the headpond area by members of the Aboriginal Community.

5.11 Tourism

The GMA has long served as a service centre for the tourism and visitor industry, and as a transportation hub for both passengers and freight. In the 1960s, the high tides of the Petitcodiac River, Shediac Beach

(Parlee Beach Provincial Park), Magnetic Hill, Fundy National Park and Hopewell Rocks were promoted as the major natural attractions of the area. Other tourism activities included the parks, museums, bird watching, shopping, restaurants, game farm, and golfing. The Fundy tides and the tidal bore were promoted by both Greater Moncton and the provincial government. However, with the diminished tidal bore, there has been less emphasis on the tidal bore as a key attraction.

Currently, the tourism sector is estimated to be responsible for 31,000 person years of employment in New Brunswick, generating $272 million in tax revenues with total provincial tourism expenditures in 2002 of $1.2 billion. Moncton accounted for over 28% of this total, and the importance of the GMA and surrounding area would be even greater.

5.12 Recreation

Recreation in the Assessment Area prior to the causeway construction included recreational fishing and bird watching, with some recreational boating. Currently, recreational fishing in the Petitcodiac River system is focused primarily on smallmouth bass and brook trout above the causeway, and tomcod and striped bass in the lower Petitcodiac River estuary. The GMA continues to provide many opportunities for bird watching, and the Moncton Naturalists' Club has published a guide to Birding in the Moncton Area. Walking paths have been constructed along the Petitcodiac River below the causeway, and the Trans-Canada Trail uses both shores of the river. There are also trails along Fox Creek, Jonathan Creek, Halls Creek, and Mill Creek. Recreational boating occurs regularly in the headpond, including power boats and small sail boats. Recreational boating downstream of the causeway is primarily canoeing and kayaking due to the channel infilling that has occurred from the causeway.

5.13 Labour and Economy

The GMA economy in the 1950s and '60s was dominated by such employers as CN Railway and other transportation and distribution companies. By 1971, the major employers were service industries, along with retail and wholesale businesses, transportation, communications, and manufacturing. The resource-based industries accounted for less than 1% of the employment. Currently, the Moncton Area population is about 120,000 and is among the fastest growing areas in New Brunswick, with average earnings at or slightly above the provincial average (2001) and an unemployment rate (2001) of 8.1% versus 12.5% for the Province. The principal occupations for the Moncton area labour force include sales and service occupations (27%), business, finance and administration (22.5%), and trades, transport and equipment operators (13.5%). Agriculture and other resource-based industries account for only 1.5% of total employment.

5.14 Heritage and Archaeological Resources

It is likely that the Petitcodiac River has been the site of human activity for close to 10,000 years, and an Aboriginal campground may have existed near Hall's Creek before its displacement by Europeans. The only known locations of archaeological or heritage features within the confines of the Petitcodiac riverbanks are the Acadian aboiteaux and dykes. There are also shipwrecks in the area but their locations are not known. It is probable that unrecorded and/or unidentified archaeological sites still remain along the Petitcodiac River.

5.15 Public Health and Safety

Vehicular Accidents

Accident occurrences on the causeway and Gunningsville Bridge are relatively high although still lower than traffic accident levels elsewhere in the urban area of the GMA. There were no fatal accidents on either the causeway or the Gunningsville Bridge from 2001 to 2003.

Non-vehicular Accidents

There are no available records or any available data on non-vehicular accidents or incidents in or near the Petitcodiac River before the construction of the causeway. Anecdotal information indicates that boating accidents and other non-vehicular accidents are not known for the headpond, and a gate operator was unaware of any gate operation incidents within the last 14 years. Apparently, every 2 or 3 years there have been near-death incidences involving people getting stuck in the mud downstream of the causeway.

Groundwater

A groundwater survey in 1992 and 1993 indicated widely varying levels of sodium and chloride in residential water supplies in the GMA. Most of the wells had sodium and chloride levels that were well below the Canadian Drinking Water Quality Guidelines however, except for a few wells upstream of the causeway near Coverdale and Salisbury.

It was also reported that sodium and chloride levels in wells in close proximity to the Petitcodiac River downstream of the causeway were well below the Canadian Drinking Water Quality Guidelines. Therefore, the observed high levels of sodium and chloride near Coverdale and Salisbury could be attributed to the presence of subsurface marine sediments and the occurrence of salt deposits near the groundwater wells.

Surface Water Resources

Due to the long-term disposal of sewage, urban and agricultural runoff, and to sedimentation caused by the construction of the causeway, the Petitcodiac River and headpond have periodically experienced levels of pollution that have exceeded regulatory guidelines. Between 1984 and 1994, the GMSC designed and built a wastewater collection and treatment system to serve the three area municipalities. The outfall from this treatment facility is situated downstream of Outhouse Point on the south shore and the effluent from the treatment is discharged to the Petitcodiac River.

The headpond has been used in the past as a source of water for fire water-bombers. During a forest fire in 2004, water-bombers and helicopters obtained water from the headpond, and the headpond has been used on occasion by the Town of Riverview Fire and Rescue for training purposes and as an emergency fire-fighting water source. There are other sources of water that can be accessed and chemical fire retardants are generally more effective and often used instead of water.

Human Disease Vectors

The marsh-type areas (both freshwater and saltwater) in the Petitcodiac River provide perfect conditions for mosquito reproduction, as the stagnant waters provide good habitat. Spray programs have been in place since 1997 within the Tri-Communities to attempt to control larvae densities. West Nile Virus is spread by the Culex mosquito species, which have fed off the blood of infected birds. The Culex mosquito can breed in saltwater marsh, but is now believed to preferentially breed in freshwater impoundments, like the headpond. No dead birds have tested positive for the virus in New Brunswick

and, as of August 2004, no mosquito pools in New Brunswick have been confirmed positive. No cases of West Nile Virus were reported in birds or humans in New Brunswick in 2004 or 2005.

Flooding and Flood Risk

Pre-causeway, some areas proximal to the river or its tributaries were prone to occasional flooding during higher than normal or storm tides, or failure of the dyke infrastructure. The construction of the causeway resulted in the narrowing of the river and tributaries which has exacerbated flooding of the tributaries. Infilling of marshland has also exacerbated the flood risk for dykelands below the causeway. Potential flooding problems are also associated with the operation of the causeway gates, ice jams, or sediment build-up against the gates when they are not in operation.

Human Food Resources

Historically, the Petitcodiac River hosted many migratory species including Atlantic salmon, smelt, striped bass, sea-run brook trout, gaspereau, and shad. In the post-causeway construction period, the river experienced many alterations and consequently has been unable to support the species richness. Through the 1970s, the majority of migratory fish stocks declined annually, as reflected in poor angling landings.

The end of recreational harvesting of goose tongue and samphire greens in the headpond area, is attributed not to the causeway, but to lifestyle changes and the passing of traditions.

6.0 EVALUATION OF THE STATUS QUO AND PROJECT OPTIONS IN ACHIEVING THE FISH PASSAGE PROJECT OBJECTIVE

The existing fish passage issues include a number of impediments to fish passage. These include predation, difficulties in negotiating the fishway, gate management, dissolved oxygen (DO) barriers, seasonal sediment plug that extends several kilometres downstream of the causeway, and lack of attraction flow for fish due to water level elevations lower than highest tide.

An exhaustive evaluation of fisheries facilities in New Brunswick, Canada and elsewhere in the world was conducted to identify potential fishway solutions. It was evident that the issues associated with the causeway fish passage facility were difficult to overcome at the Petitcodiac River Causeway.

As noted previously, the Project Options that have been considered are:

- Project Option 1—replacing the fishway.
- Project Option 2—gates open during peak migration.
- Project Option 3—gates open permanently.
- Project Option 4—replace the causeway with a bridge.

The Status Quo does not meet the Project Objectives and was included in the EIA for comparison purposes.

With respect to Project Option 1, fish passage technologies that have been applied at other facilities were evaluated in detail and determined to not be applicable to the Petitcodiac River facility. This is mainly due to the unique characteristics of the Petitcodiac River (low and highly variable rate of freshwater flow, high tidal range, and high suspended sediment concentrations) and the variety of fish species requiring migration. None of the other facilities examined could provide fish passage, upstream or downstream, for

all of the fish species requiring passage at the causeway (Atlantic tomcod, rainbow smelt, gaspereau, brook trout, American shad, American eel, sea lamprey, Atlantic sturgeon, and Atlantic salmon). It was concluded that a new fishway or gate management strategy is not feasible to provide upstream and downstream passage for these fish species. Hence, Project Option 1 does not meet the fish passage Project Objective.

Fish migration for the nine key species noted above occurs year round. Project Option 2 considered opening the gates only in the spring and fall, thus preserving the headpond for the summer months. But this would not provide passage for all of the identified fish species requiring migration at the causeway. Therefore, Project Option 2 does not meet the fish passage Project Objective. Project Option 2 is also burdened with other issues such as continued sediment accumulation in the headpond, ice-jamming at the gate piers, and the summer and winter headpond would be brackish and unsuitable for freshwater fish species.

Project Options 3 and 4 both meet the fish passage Project Objective as they allow free tidal exchange and the movement of fish species that require passage.

7.0 PROJECT DESCRIPTION AND IMPLEMENTATION

Design Criteria for the Project Options, in addition to the main Project Objective of safe and unimpeded passage of fish, included:

- provision of unimpeded and safe movement of fish, upstream and downstream;
- arresting the current infilling trend within the river;
- protection of species regulated by SARA or the New Brunswick *Endangered Species Act*;
- free passage of ice;
- protection of wetland area that provides water quality treatment for the former Moncton Landfill and the integrity of the landfill itself;
- reduction of potential for flooding at the traffic circle at the north end of the causeway;
- protection of the former Moncton Landfill, the water service line, and other infrastructure; and
- design life of at least 100 years.

To meet the Design Criteria and Project Objectives, mitigation strategies built into the design of all Project Options include erosion and scour protection at the former Moncton Landfill and along critical riverbank locations. Compensation for affected facilities or operations is also included. Most importantly, the Project Options have been designed to address the infilling and “other ecosystem issues” related to the reduction of the tidal prism as identified in the Project Objectives.

A three-staged implementation strategy applies for each Project Option, to ensure that predictions made in this EIA are verified before irreversible decisions are made for the next stage:

- Stage 1—Design, construction of preparatory works, and communication prior to opening the existing gates;
- Stage 2—Open existing gates during ice free periods; and
- Stage 3—Construct the structure required for the preferred Project Option.

Stage 1 is common to all of the Project Options and will involve the following activities:

- A channel will be excavated through the sediment plug located 0 to 6 km upstream of the causeway to assist in establishing the desired channel evolution. The channel will have a base width of 10 m at elevation 0 m. The means of excavation and disposal location of excavated material will be identified and the necessary environmental approvals obtained.
- The water supply pipeline upstream of the control structure will be affected when the gates are opened to two way flow and will need to be moved further below the river channel bottom elevation. The invert of the water supply pipeline must be lowered to elevation -6 m from its current elevation of -2 m.
- Bank protection will be placed on the Moncton side of the channel from Gunningsville Bridge to Halls Creek.
- Additional protection material will be placed to protect the linear park and trail in that area.
- An assessment of the potential for local scour at the upstream end of the control structure's concrete slab will be undertaken and, if necessary, measures implemented to prevent scour.
- An examination of all sewer and drainage outfalls along the river that could be affected by the Project Option will be undertaken and measures developed and implemented as required to ensure their continued operation.
- To prevent erosion of the former Moncton Landfill due to storm surges, the toe will be protected with riprap.
- To reduce the degree of flooding at the traffic circle, the drainage channel on the east side of the causeway will be improved with a protection dyke and outlet works. Also, drainage from the storm sewer system that flows east along Salisbury Road toward the causeway will be diverted into the headpond.
- The dykes and aboiteaux upstream of the causeway will be repaired/restored to prevent saltwater inundation of land (e.g., agricultural lands, Ducks Unlimited sites).
- A compensation plan will be developed for loss of the Tri Community Marina.
- A detailed gate opening strategy for Stage 2 will be developed in conjunction with NBDOT and DFO.
- The Environmental Management Plan (EMP), including the supporting plans and procedures (e.g., Environmental Protection Plan (EPP), Follow-up Program), will be developed (discussed further in Section 1
- All necessary construction approvals will be obtained.
- The design of Project Option 3 will be advanced.

This process will take one to two years. Stage 2 (opening the gates) can commence after Stage 1 is completed with the gates opened during the spring freshet and closed in the November or December to prevent ice jamming at the control structure. Stage 2 can be operated until the project option is implemented in Stage 3.

7.1 Project Option 3

Project Option 3 involves permanently opening the gates, removing the fishway and all but the middle pier, strengthening the remaining pier, and constructing a new four-lane bridge deck. This would

effectively provide for two openings of 33 m and 35 m, for a total open channel width of 68 m. The estimated time to completion of Project Option 3 is 5 to 6 years.

7.2 Project Options 4

For the purpose of the EIA, three alternative means have been developed for carrying out Project Option 4 (to replace the causeway with a bridge).

Project Option 4A

Project Option 4A involves construction of a new 170 m bridge, 50 m downstream of the existing gates and the removal of the entire gate structure and fishway. This will provide a river channel width of 72 m. The existing control structure walls and bottom sills will be left in place. The estimated time to completion of Project Option 4A is 5 to 8 years.

Project Option 4B

Project Option 4B involves construction of a new 280 m bridge, 50 m downstream of the existing gates that would afford a range of potential openings from 72 to 225 m. The estimated time to completion of Project Option 4B is 5 to 10 years.

Project Option 4C

Project Option 4C involves construction of a new 315 m bridge in the central portion of the causeway and filling in the existing control structure. This will provide an effective channel width of about 225 m. The estimated time to completion of Project Option 4C is 6 to 10 years.

7.3 Status Quo

Although it is considered the “Do Nothing” option, there are some physical works that will be required under the Status Quo. The following erosion protection measures should be put in place within a few years:

- North (Moncton side) of the river at the location of the old landfill near Gunningsville Bridge.
- North (Moncton side) of the river adjacent to Château Moncton Hotel.
- At the toe of the former Moncton Landfill between the causeway and Jonathan Creek.

The measures described for the Project Options to improve drainage at the traffic circle and reduce flood risk should be undertaken as well.

A detailed flood risk assessment would be necessary to identify the magnitude of flooding under the Status Quo, and to provide the basis for developing a flood protection plan and to quantify the potentially substantial costs required for mitigation. Annual operation and maintenance of the control structure and the causeway will still be required and all five gates will require a retrofit within the next 15 years.

7.4 Accidents and Malfunctions

Given the implementation of the Environmental Management Plan (EMP), the unique nature of the Petitcodiac River, and the accidents assessed specifically as part of other VECs, the residual accidents and malfunctions with the greatest potential for significant environmental effects include hazardous material spill; former Moncton Landfill protection failure; unplanned erosion (beyond the pre-causeway river channel); and agricultural or wetland dyke failure. Although such events are considered unlikely to occur, necessary precautions will be taken to prevent any accident and malfunction events throughout all stages of the Project Options and to minimize any environmental effects should they occur.

7.5 Environmental Management

An Environmental Management Plan (EMP) will be developed during Stage 1 of the Project Option and may be updated as required as a result of on-going monitoring. The EMP and its supporting documents and procedures will be submitted to NBDELG and other regulatory authorities for review and approval prior to Stage 3.

The purpose of the EMP is to protect the environment for the life of the Project Option by ensuring compliance with regulatory requirements; ensuring that the effects of any accidents and malfunctions are minimised; and verifying the accuracy of predictions in the EIA and the effectiveness of recommended mitigation. The EMP will also define and identify roles and responsibilities, accountability, and reporting procedures.

The Environmental Protection Plan (EPP) is a vital common reference document designed to ensure that the commitments of the EIA and other regulatory permits are followed. The EPP will contain Standard Operating Procedures (SOPs) that describe the best practice mitigation measures to be used during construction and operation, and an Emergency Response and Contingency Plan to ensure safe, quick, and effective response to unexpected and emergency situations (i.e., accidents and malfunctions).

A Follow-up Program will be designed and executed to fulfil the need for and the requirements of a Follow-up Program as outlined in the Guidelines and CEAA. The objectives of the Follow-up Program will be to verify the accuracy of the EIA; and determine the effectiveness of any measures taken to mitigate the negative environmental effects of the Project Options.

8.0 FUTURE ANTICIPATED CHANGES TO THE RIVER

A range of approaches, referred to as the predictive tools in this EIA, were used to describe the future anticipated changes to the Petitcodiac River in response to the Status Quo and Project Options. These predictive tools included: the experience of the AMEC Study Team with the Petitcodiac River System; interviews with people familiar with the history and evolution of the Petitcodiac River; analyses of patterns and trends of the Petitcodiac River; empirical relationships, river engineering and hydraulics formulations; and computer modelling.

Under the Status Quo, the channel downstream of the causeway will continue to infill. The tidal volume will continue to decrease. Equilibrium is not anticipated to occur for another 70 years. It is anticipated that tidal elevations in the Moncton area will increase by about 0.2 m due to infilling. Flooding risk under open water conditions will increase under the Status Quo due to infilling both upstream and downstream of the causeway. The improved drainage measures at the traffic circle may alleviate some of the flooding that has occurred there. Current DO problems downstream of the causeway will continue and likely

worsen with the Status Quo. Existing ice jamming and channel narrowing will continue and worsen under the Status Quo.

Project Options 3 and 3, 4A, 4B, and 4C will arrest and reverse these problems. Full tidal exchange will occur up to Salisbury and the headpond will become estuarine. The channel will increase in width and depth, and the tidal prism will increase, more for Project Option 4 than Project Option 3. Flooding risk will be reduced in the long-term, under the Project Options scenarios, due to this improved conveyance capacity and improved drainage measures at the traffic circle. Decreased deposition is also expected to reduce the frequent flooding experienced at the culvert under the traffic circle on the Moncton end of the causeway. DO and other water quality problems in the river will be improved by the greater dilution provided by a free tidal flow.

Although it is evident that the tidal bore will be improved under the Project Options, it is not likely to return to pre-causeway dimensions.

9.0 ENVIRONMENTAL EFFECTS ANALYSIS

Note that the term "Project Options"in the Effects Analysis includes Project Options 3, 4A, 4B, and 4C; specific mention of a Project Option is given when warranted.

9.1 Atmospheric Environment

Atmospheric Environment refers to the layer of air near the earth's surface to a height of approximately 10 km, characterised by three key aspects: climate; air quality; and sound quality (noise). For this assessment, a fourth key aspect is odour.

A *significant negative residual environmental effect* on climate is one that results in a substantive increase to provincial releases of greenhouse gases (i.e., > 1% of total provincial CO_2 emissions) or a substantial loss in carbon sinks (i.e., > 1% of carbon sinks in Southern New Brunswick).

A *significant negative residual environmental effect* on air quality is one that degrades the quality of the air such that the emissions of air contaminants of concern lead to an exceedance of the ambient air quality standards, as defined in the New Brunswick *Air Quality Regulation – Clean Air Act*. For the purposes of this assessment, the air contaminants of concern are defined as particulate matter (PM), fine particulate matter (PM_{10}), sulphur dioxide (SO_2), nitrogen oxides (NO_X), and carbon monoxide (CO).

A *significant negative residual environmental effect* on odour is one that results in a noticeable change in the character, intensity, or frequency of odours in the Assessment Area, such that the resulting odours would frequently (i.e., >10% of the time on an annual basis) and substantially interfere with the normal conduct of business, or the normal enjoyment of the use of properties by a group of people, as defined in the *Clean Air Act*.

A *significant negative residual environmental effect* on sound quality is one that creates a "nuisance" at the nearest residential property by causing sound pressure levels that frequently (i.e., more than 10% of the time on an annual basis) exceed 65 dB_A on a sustained and permanent basis at the nearest noise sensitive area (NSA); or, where ambient levels already exceed 65 dB_A, by frequently causing ambient sound pressure levels of more than 10 dB_A above background.

Evaluation of Potential Environmental Effects

Climate

There are no features of the Status Quo that would result in substantive changes to greenhouse gas emissions, regional climate, or microclimate in the Assessment Area. The potential negative environmental effects of the Status Quo on climate are predicted to be not significant.

With the Project Options, the replacement of the headpond by a tidal river may result in some small-scale changes to microclimate upstream of the current causeway location, but these changes would not likely be measurable on a regional, provincial, or global basis. The loss of wetlands and other vegetation, which serve as a carbon sink to absorb carbon dioxide in the atmosphere, as a result of the Project Options will be relatively small on a regional scale. Many of the existing wetlands did not exist prior to the construction of the causeway, and it is expected that some of these wetlands may be enhanced, and other wetlands could be created. In summary, the potential negative environmental effects of the Project Options on climate are predicted to be not significant on local, regional, provincial, national, and global scales.

Air Quality

Any changes to air quality in the GMA under a Status Quo situation would likely be the result of other factors rather than being directly attributable to the Status Quo. The potential negative environmental effects of the Status Quo on air quality are predicted to be not significant.

During construction of the Project Options, emissions from heavy equipment and airborne dust from construction activities will be localized, intermittent and of short duration. Several mitigation measures will be applied during construction to minimize the potential environmental effects to air quality. Any emissions that may occur as a result of the operation of the Project Options are not expected to negatively affect air quality in the GMA, nor are they expected to be detectable from current levels. No increase in vehicle traffic is expected solely as a result of the future operation of the Project Options. Overall, the potential negative environmental effects of the Project Options on air quality are predicted to be not significant.

Odour

Odour has not historically been of major concern in the GMA, and it is expected that odour in the Assessment Area as a result of the Status Quo would be similar to, or no worse than, the odours experienced in the past. The potential negative environmental effects of the Status Quo on odour are predicted to be not significant.

There are no unique aspects of construction of the Project Options that would be expected to lead to an increased incidence of odours. Upon implementation of the Project Options, any sewage present in the tidal waters may be carried further upstream by the tidal action of the river, and sewage may enter the river directly from municipal sources, including combined sewer outflows from the City of Moncton during extreme rain events or from subdivisions lacking treatment facilities. However, significant odours are not expected to occur due to the dilution that will be associated with the increased tidal exchange. While there may be some localized or short-term odours from the decay of previously submerged vegetation or from exposed mudflats, these odours are not expected to result in any loss of use or enjoyment of properties by local residents. The potential negative environmental effects of the Project Options on odour are predicted to be not significant.

Sound Quality

While there may be localized reductions in commuter vehicle traffic noise as a result of other planned projects (e.g., the new Petitcodiac River Bridge), the potential negative environmental effects of the Status Quo on sound quality are predicted to be not significant.

During construction of the Project Options, noise can be expected as a result of construction activities. Mitigation will be accomplished by keeping the equipment in good working order and equipped with mufflers, as well as by restricting construction activities to daytime hours, where warranted, and in compliance with the City of Moncton Excessive Noise Bylaw. Although there are residences within the vicinity, the construction activities will be relatively limited in duration, and noise levels are not expected to adversely affect the enjoyment of these properties. Construction noise is expected to cause environmental effects that are not significant. During operation, there are no features of the Project Options that would be expected to result in increased noise in the Assessment Area. However, removal of the reflective headpond and restoration of the former mudflats and wetlands will attenuate sound propagation. Given the proposed mitigation during construction, the potential negative environmental effects of the Project Options on sound quality are predicted to be not significant to positive.

Future Trends (2055, 2105)

Any potential changes to the Atmospheric Environment that may occur in the Assessment Area by 2055 and 2105 would likely to be the result of more global factors (e.g., global climate change), rather than as a direct consequence of either the Status Quo or the Project Options.

Accidents and Malfunctions

There are no foreseeable features of the Status Quo or the Project Options that would result in accidents or malfunctions that would lead to a significant negative environmental effect to the Atmospheric Environment. The potential environmental effects of accidents and malfunctions, for both the Status Quo and Project Options, are predicted to be not significant.

Summary

The potential environmental effects of the Status Quo and Project Options on the Atmospheric Environment (climate, air quality, odour, sound quality), in consideration of the proposed mitigation measures and the negative residual environmental effects significance rating criteria, are predicted to be not significant.

9.2 Fish and Fish Habitat

The key elements of the Fish and Fish Habitat VEC are sediment quality, water quality, fish and other aquatic animal species including species at risk, and fish habitat. These elements overlap to a considerable extent.

A *significant negative residual environmental effect* on sediment quality is one that results in the concentration of specific parameters exceeding Canadian Council of Ministers of the Environment (CCME) sediment Probable Effect Levels (PEL) on Aquatic Life for a sufficient period of time and over a sufficient area that an exceedance of the significance criteria for fish and aquatic animal species (see below) may occur.

A *significant negative residual environmental effect* on water quality would be one that results in the concentration of specific parameters exceeding background concentrations and the CCME Guidelines for the Protection of Aquatic Life.

A *significant negative residual environmental effect* on fish and aquatic animal species in general is one that:

- affects fish and other aquatic animals in such a way as to cause a decline in abundance or change in distribution of these common and secure population(s), of indicator/representative fish species over one or more generations within the regional population, and natural recruitment may not re-establish the population(s) to its original level; and/or
- affects species at risk not under the protection of the Species at Risk Act (SARA) or the New Brunswick Endangered Species Act such that:
  - the aquatic habitat within the Assessment Area is altered physically, chemically, or biologically, in quality or extent, in such a way as to cause a change or decline in the distribution or abundance of a viable fish population that is dependent upon that habitat such that the likelihood of the long-term survival of these uncommon and/or non-secure population(s) within the regional population is substantially reduced as a result; and/or
  - the direct mortality of individuals or communities substantially reduces the likelihood of the long-term survival of these uncommon and/or non-secure population(s) within the regional population; and/or
  - in the case of "Species of Special Concern" listed in Schedule 1 of SARA, the Project activities are not in compliance with the objectives of management plans in place at the time of Project construction; and/or
- affects species listed in Schedule 1 of SARA as "Extirpated", "Endangered" or "Threatened" and results in a non-permitted contravention of any of the prohibitions stated in Sections 32-36 of SARA; or in contravention of any of the prohibitions stated in Section 3 of the New Brunswick Endangered Species Act.

A *significant negative residual environmental effect* of the Status Quo or Project Options on fish habitat would be one that results in a non-compensated harmful alteration, disruption or destruction of the spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes.

Evaluation of Potential Environmental Effects

Sediment Quality

Historically, the only contaminants of concern in sediment from the Petitcodiac River that marginally exceed the CCME Interim Sediment Quality Guidelines are polycyclic aromatic hydrocarbons (PAHs) and arsenic, which enter the aquatic environment from atmospheric fallout or runoff. No apparent environmental effects are occurring at present. The Status Quo will likely result in a more elevated concentration of arsenic because of infilling of the river, however, this is not anticipated to result in significant environmental effects. Sediment erosion and deposition under the Status Quo is likely to release ammonia to the water, but not cause any significant or negative residual environment effect. Overall, the environmental effects of the Status Quo on sediment quality are predicted to be not significant.

With the Project Options, the renewed tidal flow and tidal prism in the headpond will likely result in more erosion of the shoreline and riverbed sediment, diluting any contaminants present in the sediment. The

potential negative environmental effects of the Project Options on sediment quality are predicted to be not significant.

Water Quality

Under the Status Quo, water quality will remain in the fair to marginal range of the CCME Water Quality Index, or will deteriorate even more as a result of urban, industrial and agricultural growth in the watershed. Overall, the potential negative environmental effects of the Status Quo on water quality are predicted to be significant.

The re-establishment of an estuarine environment, under the Project Options, will cause increased non-flood freshwater flow, increased tidal prism, and increased tidal flushing of the Petitcodiac River. These factors will likely cause positive environmental effects for water quality issues, including higher DO concentrations downstream of the causeway. Of the options considered, Project Options 4B/4C will more closely approach the water quality and environmental conditions of pre-causeway times. Both Project Options 3/4A and 4B/4C are likely to have water quality conditions that will aid fish migration. In summary, the potential environmental effects of the Project Options are predicted to be positive with respect to water quality and parameters to sustain aquatic life.

Fish/Other Valued Aquatic Animal Species

Although some aquatic species benefit under the Status Quo (e.g., smallmouth bass, chain pickerel, eel, and possibly gaspereau), the Status Quo does not meet the fish passage Project Objective. Overall, the potential negative environmental effects of the Status Quo on fish/other valued aquatic animal species are predicted to be significant.

The Project Options involve the establishment of renewed tidal flow into the headpond created by the causeway and the mitigation of other fish passage issues such as the sediment plug and downstream DO barrier, as well as a reduction in predation for most species. While smallmouth bass and other non-migratory freshwater species will be eliminated from the area, suitable freshwater habitat will continue to exist for them elsewhere in the Petitcodiac River system. These losses or reductions are balanced by the achievement of the fish passage Project Objective, and the overwhelmingly positive effects on fish populations that use the Assessment Area for life cycle purposes. The Project Options are not anticipated to adversely affect scallops and/or lobster. If the follow-up program demonstrates negative residual effects on lobster and/or scallops, the fishers should be compensated accordingly. Therefore, the environmental effects of the Project Options on fish/other valued aquatic animal species are predicted to be not significant to positive.

Fish Species At Risk

The Petitcodiac River Atlantic salmon is a member of the genetically distinct Inner Bay of Fundy salmon population that is now protected under the federal *Species at Risk Act*. In the Petitcodiac River system, the Atlantic salmon population declined drastically after construction of the causeway and establishment of the headpond. The causeway has also been a cause of the extirpation of the American shad population in the Petitcodiac River, which has also lead to the extirpation of the dwarf wedgemussel, a species protected under the federal *Species at Risk Act*. The fish passage issues will continue under the Status Quo and will therefore continue to limit the potential for the recovery of Atlantic salmon, American shad and subsequently the dwarf wedgemussel, and is therefore considered to be a significant negative residual environmental effect. The Project Options will all have potential positive environmental effects on the Inner Bay of Fundy Atlantic salmon and the dwarf wedgemussel as they will remove the likely cause of the current endangered status of these species and will provide an opportunity for these species to be successfully reintroduced.

Invasive Fish Species

The smallmouth bass and chain pickerel are not native to the Petitcodiac River or to New Brunswick and are therefore considered to be invasive species. The development of the causeway moved the downstream extent of the range of these freshwater fish from Salisbury to the causeway. This may have allowed these species to obtain access to freshwater tributaries that enter the headpond, such as Turtle Creek, which is known to have a fishable smallmouth bass population. The muskellunge is a large predator that is a non-native member of the chain pickerel family and has become well established (unintentionally) in the Saint John River system. The freshwater habitat that exists in the headpond is suitable, but not ideal, to the muskellunge should this fish be accidentally or illegally introduced to the Petitcodiac River. The Status Quo will continue to provide the possibility for these and other invasive freshwater fish species to become established in the Petitcodiac River and to invade freshwater watercourses between Salisbury and the causeway. The Project Options will convert the area between the causeway and Salisbury back to an estuarine environment thereby reducing the potential further spread of these invasive freshwater fish species.

Fish Habitat

As the Status Quo does not meet the fish passage Project Objective, the potential negative environmental effects of the Status Quo on fish habitat due to fish passage issues are predicted to be significant.

The Project Option will have very positive environmental effects on fish habitat (fish passage) in the Petitcodiac River and will meet the fish passage Project Objective. The Project Options will have negative environmental effects on lentic freshwater habitat, as the primarily freshwater region of the headpond will be incorporated into the tidal reach of the river. However, it is anticipated that the negative residual environmental effects on freshwater fish habitat will be compensated for by the improvements to fish passage and the opening up of new habitat to estuarine and diadromous fish species and the environmental effects are therefore predicted to be not significant to positive.

Future Trends (2055, 2105)

Under the Status Quo, the trends for Fish and Fish Habitat will continue until approximately 2075. Eventually, the accumulation of sediment primarily from estuarine sources will have decreased the headpond volume considerably and the channel dimensions will be reduced, providing less fish habitat then currently exists.

For the Project Options, equilibrium will occur when the channel dimensions correspond to the new tidal prism volume. Once equilibrium is reached, the positive effects on Fish and Fish Habitat will remain relatively constant for each Project Option.

Accidents and Malfunctions

During heavy precipitation events or flash floods, there is the potential for erosion control structures to fail at the former Moncton Landfill, resulting in leaching or erosion of potentially toxic substances into the river, and a potential risk to fish and fish habitat. Uncontrolled leaching of the landfill is actually more probable under the Status Quo situation. During Project Option implementation, protection measures will be followed as described in the EMP. Mitigation measures outlined in the EMP will also protect against accidental spills of hazardous materials used during construction and provide for safe and effective clean-up and the environmental effects of accidents and malfunctions on Fish and Fish Habitat are predicted to be not significant.

Summary

The headpond creates habitat for freshwater aquatic species such as smallmouth bass and chain pickerel, and may benefit American eel and gaspereau. However, sediment and water quality continue to worsen under the Status Quo, and the causeway adversely affects many fish species by providing a barrier to fish passage; the Status Quo does not meet the fish passage Project Objective. Overall, the negative environmental effects of the Status Quo on Fish and Fish Habitat are predicted to be significant.

The potential environmental effects of the Project Options on Fish and Fish Habitat, alternatively, are predicted to be not significant to positive. The environmental effects on sediment quality will be not significant, water quality will improve, and the potential for fish passage will be achieved (i.e., the Project Options will meet the fish passage Project Objective). The loss of freshwater aquatic species in the headpond area (mostly invasive species) will be compensated for by the positive environmental effects on estuarine, marine, and diadromous fish species, and should the Follow-Up Program determine substantial negative environmental effects on commercial fisheries as a result of the Project Options, the fishers will be compensated for that loss.

9.3 Terrestrial and Wetland Environment

The key elements of the Terrestrial and Wetland Environment VEC are wetlands, wildlife and vegetation, migratory birds, mudflat productivity, and Managed Areas.

A *significant negative residual environmental effect* on wetlands is one that would result in a net reduction of wetland function and/or quality below that which existed before the causeway was built (from documented 1962 air photos).

A *significant negative residual environmental effect* on wildlife and vegetation would be one that:

- affects wildlife or vegetation ,or plant or wildlife habitat, in such a way as to cause a decline in abundance or change in distribution of these common and secure population(s) of indicator/representative wildlife species over one or more generations within the regional population, and natural recruitment may not re-establish the population(s) to its original level; and/or
- affects species at risk not under the protection of SARA or the New Brunswick Endangered Species Act such that:
  - the terrestrial or wetland habitat within the Assessment Area is altered physically, chemically, or biologically, in quality or extent, in such a way as to cause a change or decline in the distribution or abundance of a viable wildlife or vegetation population that is dependent upon that habitat such that the likelihood of the long-term survival of these uncommon and/or non-secure population(s) within the regional population is substantially reduced as a result; and/or
  - the direct mortality of individuals or communities substantially reduces the likelihood of the long-term survival of these uncommon and/or non-secure population(s) within the regional population; and/or
  - in the case of “Species of Special Concern” listed in Schedule 1 of SARA, the Project activities are not in compliance with the objectives of management plans that are in place at the time of Project construction; and/or

- affects species listed in Schedule 1 of SARA as "Extirpated", "Endangered" or "Threatened" and results in a non-permitted contravention of any of the prohibitions stated in Sections 32-36 of SARA; or in a non-permitted contravention of any of the prohibitions stated in Section 3 of the New Brunswick Endangered Species Act (NB ESA).

Significant negative residual environmental effects on migratory birds would be the same as for wildlife and vegetation.

A *significant negative residual environmental effect* on mudflat productivity is one that causes a decline in area or change in distribution of migrating shorebird populations dependant upon it, particularly the Semipalmated Sandpiper, over one or more generations such that natural recruitment may not re-establish the population(s) to its original level.

A *significant negative residual environmental effect* on Managed Areas is one that results in the loss of or substantive damage to the Managed Area over pre-causeway, or pre-constructed, conditions.

Evaluation of Potential Environmental Effects

Wetlands

The construction of the causeway resulted in the infilling of much of the river channel with sediment. Much of this infilled material was subsequently colonized by wetland vegetation. As a result, the overall area of wetlands along the Petitcodiac River had increased substantially by 2005. However, while there is more wetland area at baseline conditions than there was pre-causeway and it is likely this trend will continue under the Status Quo, the type and characteristics of the wetlands have changed substantially since causeway construction. There are now freshwater wetlands upstream of the causeway, rather than saltwater marshes. In addition, the saltwater marshes that have formed downstream do not have the same characteristics (i.e., species diversity, tidal influence) as the saltwater marshes that were lost upstream or as the downstream saltwater marshes prior to construction of the causeway. Therefore, the overall environmental effect of the Status Quo on wetlands is considered to be negative and significant as compared to baseline conditions and pre-causeway conditions.

The Project Options will result in wetland distribution, quality and function that is more similar to pre-causeway conditions, and is therefore considered to have a positive environmental effect. Prior to construction of the selected Project Option, there is a need to restore/improve some of the dykes surrounding DU wetlands and agricultural land.

Wildlife and Vegetation

The Status Quo will have a negative, but not significant, environmental effect on wildlife and vegetation (including species at risk) that are dependent upon wetland habitat, as the headpond will continue to limit the extent of the more desirable saltwater wetlands. Terrestrial habitat will not be substantially affected by the Status Quo.

The potential environmental effects of the Project Options on wildlife and vegetation are mostly related to the changes in wetland area or type; however, construction-related activities may create a temporary noise disturbance in habitat adjacent to the activity.

The conversion of freshwater wetland to saltwater wetland upstream of the causeway will result in wildlife and vegetation species composition more closely resembling those of pre-causeway conditions. The loss of some saltwater wetland downstream of the causeway that has formed as a result of the causeway is not expected to have significant environmental effects on regional populations of flora and

fauna, as additional saltwater habitat will be created upstream of the causeway. Mitigation proposed for changes in wetland habitat is the same as is described for Wetlands, above, including the protection of existing DU wetlands upstream of the causeway, and the total amount of wetland habitat will continue to exceed pre-causeway levels.

The Project Options are not expected to have significant environmental effects on wildlife species of special conservation concern. The potential loss of a few individuals of the plant species of special conservation concern (salt grass, golden dock, and Gaspé peninsula arrow grass) is not expected to have a significant environmental effect on their regional populations, and these species may recolonize within the available habitat.

Migratory Birds

The Status Quo will continue to result in increased wetland area and will subsequently have a positive environmental effect on migratory birds as a greater premium is placed on wetland area then wetland function and quality.

Construction activities have the potential to affect habitat quality through noise disturbance and through the relatively sudden loss/change in wetland habitat following opening of the gates. However, these environmental effects will be of a short duration. Mitigation includes releasing the majority of the headpond water during the spring freshet to avoid drops in water level during the migratory bird nesting season. The conversion of freshwater wetland to saltwater wetland upstream of the causeway will lead to species composition that more closely resembles that of pre-causeway conditions. Mitigation for the loss of saltwater wetland habitat downstream of the causeway is described under Wetlands, above. The breeding habitat for migratory bird species of special conservation concern will not be affected by the Project Options, and mudflat productivity in Shepody Bay will be affected positively. Overall, the environmental effects of the Project Options on migratory birds is anticipated to be not significant.

Mudflat Productivity

Mudflat productivity, defined in this EIA by the abundance of mudshrimp, is linked to the success of shorebird populations, including a substantial portion of the world-wide population of the Semipalmated Sandpiper.

During the post-causeway period, Petitcodiac River mudflat area has been declining due to vegetation by wetland plants, and this trend will continue under the Status Quo. Therefore, the environmental effects of the Status Quo on mudflat productivity are predicted to be negative, but not significant, as sufficient productive mudflat will remain in Shepody Bay. The narrow bands of mudflats in the Petitcodiac River are considerably less important as feeding habitat for migrating shorebirds than the much larger and productive mudflats in Shepody Bay.

The Project Options will substantively increase the mudflat area upstream of the causeway. Although the Project Options may reduce overall mudflat area downstream of the causeway, due to channel widening, the overall mudflat productivity in the estuary may increase due to the potential to deposit eroded sediments from the river onto the mudflats in Shepody Bay. The environmental effects of the Project Options on mudflat productivity are therefore predicted to be positive.

Managed Areas

The Status Quo is expected to have positive environmental effects on Lower Coverdale Island and Outhouse Point as these areas have benefited from the increased sedimentation of the Petitcodiac River resulting from the causeway.

The Project Options will erode sediments in the Petitcodiac River and discharge them in Shepody and Chignecto Bays. As a result, Environmentally Significant Areas at Outhouse Point and Lower Coverdale Island, which were formed as a result of the causeway, will be partially eroded and approach pre-causeway conditions, and are therefore considered as not significant. Mitigation includes the restoration/improvement of the dykes surrounding Ducks Unlimited sites.

Future Trends (2055, 2105)

Under the Status Quo, the estuary should approach a relatively constant cross-sectional geometry after about 70 years. Therefore, the trends for wetlands, wildlife and vegetation, migratory birds, mudflat productivity, and Managed Areas, as described previously, will continue until approximately 2075, after which time wetland and mudflat area will remain relatively constant.

Accidents and Malfunctions

There is a possibility that hazardous materials used during construction of the Project Options could be accidentally spilled, and a potential during heavy precipitation events or flash floods for erosion control structures to fail at the former Moncton Landfill. Protection measures will be followed as described in the EMP and the environmental effects of potential accidents and malfunctions on the Terrestrial and Wetland Environment are therefore not likely, and should they occur, are predicted to be not significant.

Summary

The Status Quo would continue to result in negative environmental effects on wetlands, wildlife and vegetation, migratory birds, and mudflat productivity; and positive environmental effects on ESAs (Lower Coverdale Island and Outhouse Point). The Project Options will arrest and reverse the sedimentation process and will restore wetlands, mudflats and associated flora and fauna towards pre-causeway conditions. However, the total wetland area will decrease from baseline conditions, so the overall environmental effects of the Project Options on the Terrestrial Environment are considered as negative, but not significant.

9.4 Municipal Services and Infrastructure

Municipal services and infrastructure include wastewater and stormwater sewers, water mains, dykes and aboiteaux, walking trails, utilities, and former landfills constructed along the banks of the Petitcodiac River. Key issues regarding infrastructure located along the banks of the river and headpond are erosion, sedimentation, ice jamming, ice damming, and increased flooding associated with the environmental effects of the Status Quo and Project Options. An associated issue is in regard to municipal services and the potential interference that the Status Quo and Project Options may have on water and wastewater services.

A *significant negative residual environmental effect* on municipal services and infrastructure is one that results in an uncompensated decrease in the integrity and/or functionality of municipal services and infrastructure over 2005 baseline conditions within the Assessment Area.

Evaluation of Potential Environmental Effects

Water Distribution Systems

The Status Quo is not expected to affect water distribution systems in the Assessment Area. The Project Options have the potential to expose the water transmission line that crosses the Petitcodiac River through

the causeway. Mitigation includes lowering the water line below the current river bottom, and the environmental effects are therefore predicted to be not significant.

Sanitary Sewer Systems

The Status Quo will have a significant negative environmental effect on the GMSC sewer as problems associated with blockage of the overflow flapgates continue to increase. The increase in tidal flow and erosion of sediments associated with the Project Options will have a positive effect on the GMSC overflow flapgates by reducing blockages. The Project Options could result in erosion damage to sewer infrastructure adjacent to the river and/or require modifications to the infrastructure as a result of sediment build-up. Mitigating these effects is addressed in the implementation strategy for the Project Options. Overall, the environmental effects of the Project Options on sanitary sewer systems are predicted to be not significant to positive.

Storm Sewer Systems

The Status Quo will have a significant negative environmental effect on storm sewer systems as problems associated with blockage of aboiteaux flapgates and drainage ditches continue to increase. The increase in tidal flow associated with the Project Options will decrease the sediment build-up at aboiteaux and drainage ditches. Changes to the river channel position could result in erosion damage to storm sewer infrastructure adjacent to the river and/or require modifications to the infrastructure. Mitigating these effects is addressed in the implementation strategy for the Project Options. Overall, the environmental effects of the Project Options on storm sewer systems are predicted to be not significant to positive.

Dykes and Aboiteaux

The Status Quo will not have any significant negative environmental effects on dykes or aboiteaux in the Assessment Area. Project Options have the potential to flood dyked lands upstream of the causeway; however, mitigation will include the repair/improvement of these dykes prior to Project Option implementation, or compensation for losses due to flooding and the environmental effects are therefore predicted to be not significant.

Other Infrastructure

The Status Quo and Project Options, with mitigation protecting the former Moncton Landfill and compensation for loss of the marina, will have negative residual environmental effects on other infrastructure in the Assessment Area that are predicted to be not significant.

Future Trends (2055, 2105)

The Status Quo and Project Options will have similar environmental effects on municipal services and infrastructure in the future (2055, 2105) as in 2025. Under the Status Quo, the negative environmental effects will continue to worsen as sedimentation in the river downstream of the causeway continues. Environmental effects of the Project Options will not alter substantially over 2025, as the sanitary and storm sewer systems and dykes and aboiteaux will be functioning and the former Moncton Landfill will be protected.

Accidents and Malfunctions

There is a potential during heavy precipitation events or flash floods for erosion control structures to fail at the former Moncton Landfill. To reduce the possibility of this occurring, protection measures will be

followed as described in the EMP and the environmental effects of accidents and malfunctions on Municipal Services and Infrastructure are therefore predicted to be not significant.

Summary

The Status Quo will have significant environmental effects on Municipal Services and Infrastructure. Blockage of overflow flapgates, aboiteaux flapgates, and drainage ditches will continue and worsen under the Status Quo. In contrast, increased tidal flow associated with the Project Options will increase erosion of sediments, ice, and snow, and improve the functioning of this infrastructure. Both the Status Quo and Project Options (with mitigation for the loss of the marina and protection of the former Moncton Landfill) will have potential environmental effects with respect to water distribution systems, dykes and aboiteaux, and other infrastructure that are not significant. Overall, the potential environmental effects of the Project Options on Municipal Services and Infrastructure are predicted to be not significant to positive.

9.5 Road Transportation Network

The Road Transportation Network is defined as the public road and bridge infrastructure, and the traffic conditions within the Assessment Area. This includes all provincial roads that run alongside and/or cross the Petitcodiac River or run alongside the mouths of its tributaries. Infrastructure and traffic are concentrated in the GMA, which is the area most likely to be affected by changes as a result of the Project Options or Status Quo.

A *significant negative residual environmental effect* is one that results in a substantial reduction in the Level of Service (LOS), continuous or semi-continuous obstruction of traffic flow, or the permanent physical loss of any portion of the road transportation network as a result of the Project Options or the Status Quo.

Evaluation of Potential Environmental Effects

The Status Quo is not expected to cause a substantial decrease in LOS or an increase in accidents. However, there are segments of the existing road transportation network that experience flooding during high tide or during high tide in combination with certain storm conditions. The Status Quo may further deposit sediment into tributaries, resulting in a potential increase in flooding of certain areas. Flooding, in turn, has the potential to physically damage roads and alter traffic flow. As a result, the potential negative environmental effects of the Status Quo on the Road Transportation Network are predicted to be significant.

During construction activities, Project Options 4A and 4B each require a minor disruption (1 lane for a few days) to traffic during the joining of the bridge approaches to the causeway and the interchange connections in Riverview. Traffic will be confined to 2 lanes on the causeway during construction of Project Option 3, and Project Option 4C will require the construction of a temporary 2-lane roadway bypass. The temporary decrease to 1 or 2 lanes during construction of the Project Options will be offset by the new Petitcodiac River Bridge, which will be in operation by the time of construction, and will not result in a substantial decrease in LOS. During operation, the Project Options will not affect the LOS or cause an increase in accident occurrences, and are expected to decrease the flooding risk for roads. Overall, the potential environmental effects of the Project Options on the Road Transportation Network are predicted to be not significant to positive.

Future Trends (2055, 2105)

The Status Quo and Project Options will have similar environmental effects on the Road Transportation Network in the future (2055, 2105) as in 2025.

Accidents and Malfunctions

The potential exists for a hazardous material spill to temporarily impact the traffic flow rate and patterns; however, long lasting effects are not anticipated. Vehicular collisions would only result in a temporary disruption to traffic patterns and rates. There is a potential during heavy precipitation events or flash floods for erosion control structures to fail, which could be a risk to the Road Transportation Network. Protection measures will be followed as described in the EMP and the environmental effects of accidents and malfunctions on the Road Transportation Network are predicted to be not significant.

9.6 Vessel Traffic and Navigation

A *significant negative residual environmental effect* is one where the Project Options or Status Quo restricts or degrades the existing potential for Vessel Traffic and Navigation in the Assessment Area such that there is a non-compensated net loss of the potential for Vessel Traffic and Navigation.

Evaluation of Potential Environmental Effects

The current but limited opportunities for vessel traffic and navigation will be maintained under the Status Quo, but with increasing limitations on navigability due to continued infilling of the river. The potential environmental effects of the Status Quo on Vessel Traffic and Navigation are predicted to be significant.

Construction activities may temporarily affect Vessel Traffic and Navigation above or below the causeway, but these disturbances would be temporary and of short duration. During operation, navigation along the Petitcodiac River will resemble pre-causeway conditions. The Project Options and subsequent restoration of the tidal prism is anticipated to provide or increase the opportunity for recreational boating throughout the Petitcodiac River as far upstream as the Village of Salisbury. The opportunity for commercial vessel traffic will return as far upstream as the City of Moncton. Overall, the potential environmental effects on Vessel Traffic and Navigation are predicted to be not significant to positive.

Future Trends (2055, 2105)

The Status Quo and Project Options will have similar environmental effects on Vessel Traffic and Navigation in the future (2055, 2105) as in 2025. Under the Status Quo, sedimentation downstream of the causeway will have reached equilibrium by approximately 2075, while the environmental effects of the Project Options will not occur substantially beyond 2025, as restoration of the natural estuarine ecosystem will begin to occur immediately after implementation of the selected Project Option.

Accidents and Malfunctions

Accidents and malfunctions are not anticipated to affect Vessel Traffic and Navigation and are therefore predicted to be not significant.

9.7 Land Use and Value

Land Use and Value refers to the current state or function of private and public land, and the market value of that land, within the zone of influence of the Petitcodiac River. The Assessment Area includes both sides of the Petitcodiac River from the Village of Salisbury to the causeway, and from the causeway to the mouth of the river at Shepody Bay.

A *significant negative residual environmental effect* is one where the Project Options or Status Quo result in a change or disruption that restricts or degrades present land uses such that the current activities cannot continue to be undertaken at current levels, or causes a non-compensated decrease in market value of property (compared to baseline market value).

Evaluation of Potential Environmental Effects

It is believed that the Status Quo will maintain all current access to property, and current land use (residential, commercial, recreational, and agricultural) is not expected to be negatively affected. However, the continued narrowing of the river channel may lead to increased flooding of the properties along the river and its tributaries. As a result, property owners could see a decrease in market property value and an increase in property insurance rates. For these flood-related reasons, the potential environmental effects of the Status Quo on Land Use and Value is predicted to be negative and significant.

While access to and/or a view of the Petitcodiac River and headpond may influence certain owners or buyers, the presence of the estuary or headpond is not currently a price discriminator for residential property. Examination of sales records for vacant lots upstream of the causeway indicated that there is a 10% premium for waterfront lots versus non-waterfront lots; while records of sale downstream of the causeway indicated a 5% premium. Decreased risk of flooding as a result of the Project Options will help prevent increases in insurance rates and subsequent decreases in property value. Also, restoration of tidal exchange and the natural estuarine ecosystem may become selling features for some prospective buyers. Where tidal saltwater flooding could affect agricultural lands, dykes will be built or restored to protect these lands from flooding. Any loss of future agricultural productivity as a result of the Project Options would be compensated and the potential environmental effects are predicted to be not significant to positive.

Future Trends (2055, 2105)

The Status Quo and Project Options will have similar environmental effects on Land Use and Value in the future (2055, 2105) as in 2025.

Accidents and Malfunctions

Although the potential exists for a hazardous material spill to temporarily impact Land Use and Value, long-lasting effects are not anticipated. To reduce the potential during heavy precipitation events or flash floods for erosion control structures to fail, protection measures will be followed as described in the EMP. Failure of agricultural dykes could affect agricultural land use and value, especially by damage caused by salinity of the water. The dykes will be repaired and maintained according to the EMP developed for this Project and a long-term inspection program will be developed to ensure their effectiveness. Remedial action will be taken as prescribed and necessary in the event of failure of the dykes and the environmental effects of accidents and malfunctions on Land Use and Value are predicted to be not significant.

9.8 Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons refers to the use of lands and resources within the zone of influence of the Petitcodiac River or on adjacent lands potentially affected by the Status Quo and Project Options. It includes contemporary hunting, fishing, and gathering activities for subsistence purposes, as well as the use of lands and resources for social and ceremonial activities.

A *significant negative residual environmental effect* is one where the Project Options or Status Quo would result in an unmitigated long-term Project-induced negative change in the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons or Aboriginal Communities. If it was determined that negative changes to the access to, or the availability of, such land and resources to members of the local Aboriginal community was the result of the Project, this would be considered a negative environmental effect.

Evaluation of Potential Environmental Effects

The Status Quo is anticipated to continue and potentially increase the reported significant negative environmental effects to the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons that have resulted since the construction of the causeway.

The Project Options are anticipated to reverse, at least partially, the current river and shoreline conditions that have decreased the availability of land and resources since construction of the causeway. The restoration of fish passage and the natural estuarine conditions will likely improve fish stocks and support a more natural and dynamic community of wildlife species and the potential environmental effects are therefore predicted to be positive.

Future Trends (2055, 2105)

The Status Quo and Project Options will have similar environmental effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons in the future (2055, 2105) as in 2025.

Accidents and Malfunctions

Although the potential exists for a hazardous material spill to temporarily impact Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, long-lasting effects are not anticipated. There is a potential during heavy precipitation events or flash floods for erosion control structures to fail, which could result in the erosion of land adjacent to the Petitcodiac River and hunting and gathering activities in these areas. Protection measures will be followed as described in the EMP and the environmental effects of accidents and malfunctions are predicted to be not significant.

9.9 Tourism

Tourism is identified as commercial activity realized by the attraction of visitors to the tourism area. It should be noted that tourism interests and activities are constantly changing due to factors such as demographics, education, and technology.

The Assessment Area for the Tourism VEC comprises the tourism endowments and related activities associated with the Petitcodiac River from Salisbury to Chignecto Bay, with a focus on the river and its

shoreline areas. The economic implications extend to the GMA, the Westmorland/Albert Counties region, and to the Province of New Brunswick.

A *significant negative residual environmental effect* is one that restricts or degrades the ability of the tourism industry to attract consumers to the area such that the activities cannot continue to be undertaken at 2005 baseline conditions, or causes a substantial decrease in tourist market value.

Evaluation of Potential Environmental Effects

The tidal bore has been reduced to a very minor phenomenon in 2005 and will be diminished even further under the Status Quo by 2025, and this is considered a significant environmental effect. Continued narrowing of the Petitcodiac River channel may have a negative environmental effect on recreational tourism activities currently based on the river, although use of the current trail system will not be affected.

In contrast, the Project Options are expected to benefit Tourism by restoring tidal exchange to the Petitcodiac River and increasing the tidal bore. Under Project Options 4B/4C, boating activity may increase as bigger recreational vessels may be able travel upriver during high tides. In general, the Project Options are expected to create greater opportunities for natural-based tourism in the GMA, and an increase in tourism levels would ultimately create spin-off business for the retail and service industries. Therefore, the environmental effects of the Project Options on Tourism are predicted to be positive.

Future Trends (2055, 2105)

The Status Quo and Project Options will have similar environmental effects on Tourism in the future (2055, 2105) as in 2025.

Accidents and Malfunctions

The potential exists for a hazardous material spill to impact and degrade wildlife and wetland habitat (which could be tourist attractions); however, long lasting effects are not anticipated. The potential during heavy precipitation events or flash floods for erosion control structures to fail will be mitigated by following protection measures described in the EMP and the environmental effects of accidents and malfunctions are predicted to be not significant.

9.10 Recreation

For the purpose of this EIA, Recreation is defined as any physical activity and supporting infrastructure located on the Petitcodiac River, along the shores of the river, or the headpond, that are reliant on the river for the enjoyment of those activities. The key issue is that any changes to the river upstream (the headpond) and downstream of the causeway as a result of the Status Quo and Project Options may lead to changes in recreational opportunities.

A significant negative residual environmental effect is one that results in net losses in recreational opportunity, over 2005 baseline conditions, that cannot be compensated.

Evaluation of Potential Environmental Effects

Construction of the causeway resulted in both positive and negative environmental effects that have resulted in changes to the type, location, and nature of recreational opportunities. Under the Status Quo, environmental effects on Recreation are anticipated to be negative upstream of the causeway due to the continued sedimentation of the headpond and the resulting restrictions to use by larger recreational

watercraft. Under the Status Quo, environmental effects on Recreation are anticipated to be negative and significant downstream of the causeway due to continued infilling that will further restrict recreational navigation, the tidal bore that will remain in its reduced state, and the native recreational fish stocks such as Atlantic salmon and American shad that will continue to not have an opportunity for recovery.

The Project Options will restore the natural estuarine ecosystem, potentially increasing bird watching opportunities and new recreational boating activities upstream of the causeway. Closure of the Tri-community Marina and the sea cadet training facility will be compensated. Although local freshwater fish species will be eliminated under the Project Options, the opportunity will be created for native fish stocks to return to the system and the potential for recreational fishing will likely increase due to improved fish stocks and species diversity. Downstream of the causeway, recreational boating opportunity will be restored to near pre-causeway levels, and new recreational opportunities such as kayaking the tidal bore, may result. Therefore, the potential environmental effects are predicted to be positive.

Future Trends (2055, 2105)

The Status Quo and Project Options will have similar environmental effects on Recreation in the future (2055, 2105) as in 2025. It is expected that municipal investment in recreational infrastructure will continue.

Accidents and Malfunctions

Although the potential exists for a hazardous material spill to affect and degrade wildlife and wetland habitat (which could be recreational attractions), long-lasting environmental effects are not anticipated. Protection measures described in the EMP will reduce the potential for erosion control structures to fail during heavy precipitation events or flash floods, and the environmental effects of accidents and malfunctions are predicted to be not significant.

9.11 Labour and Economy

The Status Quo and Project Options will generate labour employment and expenditures within the local and provincial economies during the construction, operation, and maintenance phases. Employment and economic activity may also be created or lost in other sectors of the economy, such as commercial fishing, agriculture, or tourism, as a result of the Status Quo or Project Options. These economic changes will indirectly affect other production and service sectors of the local and provincial economy through the "spin-offs" of indirect employment and economic activity generated or lost in those other sectors.

A *significant negative residual environmental effect* on labour is one that directly affects the current supply and demand of skilled and unskilled labour, ultimately causing degradation to the production base such that there is an uncompensated net loss of employment opportunity.

A *significant negative residual environmental effect* on the economy is one that induces negative changes in the regional economy of the GMA.

Evaluation of Potential Environmental Effects

All current employment opportunities associated with the Petitcodiac River and the headpond are expected to continue under the Status Quo, including on-going maintenance of the causeway and affected infrastructure. However, the Status Quo will continue to result in the loss of the opportunity to commercially fish within the Petitcodiac River for navigational reasons and may have caused the loss of

the Atlantic salmon and American shad fishery and is therefore considered to result in a significant negative environmental effect.

The Project Options will have positive environmental effects on Labour and Economy due to employment associated with their engineering, design, construction, and maintenance, as well as the potential for related business opportunities. In addition, the Project Options will create more tourism-related service, construction, and operation opportunities by returning the Petitcodiac River to a natural estuarine ecosystem and are not anticipated to result in a negative environmental effect on commercial fisheries.

Future Trends (2055, 2105)

The Status Quo and Project Options will have similar environmental effects on Labour and Economy in the future (2055, 2105) as in 2025.

Accidents and Malfunctions

Although a hazardous material spill could affect tourism and recreation activities linked to the local labour force and economy, long-lasting environmental effects are not anticipated. Protection measures described in the EMP will reduce the potential for erosion control structures to fail during heavy precipitation events or flash floods, and the environmental effects of accidents and malfunctions are therefore predicted to be not significant.

9.12 Heritage and Archaeological Resources

Heritage and Archaeological Resources are defined as any physical remnants found on top of and/or below the surface of the ground that inform us of past human use of and interaction with the physical environment. For this EIA, Heritage and Archaeological Resources will also include historic structures and palaeontological resources. Significant archaeological resources are defined as those sites, such as living areas, that can inform us on the lifeways of First Nations and early European settlers on the Petitcodiac River. Individual artefacts are not typically considered significant as they provide only minimal information on the past.

A *significant negative residual environmental effect* is a project-related disturbance to, or destruction of, an archaeological or heritage resource (including palaeontological resources) considered by the provincial heritage and archaeological regulators to be of major importance due to factors such as rarity, undisturbed condition, spiritual importance, or research importance, that cannot be mitigated.

Evaluation of Potential Environmental Effects

Neither the Status Quo nor the Project Options are predicted to cause any damage or destruction to the historic shorelines (i.e., pre-causeway shorelines) of the Petitcodiac River, which is where Heritage and Archaeological Resources are thought to be located. Therefore, the potential environmental effects of the Status Quo and Project Options on Heritage and Archaeological Resources are predicted to be not significant

Future Trends (2055, 2105)

The Status Quo and Project Options will have similar environmental effects on Heritage and Archaeological Resources in the future (2055, 2105) as in 2025.

Accidents and Malfunctions

In the event of a hazardous material spill along a shoreline, contaminated soil will have to be excavated and disposed of. The provincial regulator may, depending upon the potential of the location, require that a licensed archaeologist be present as the soil is excavated in the event that the contaminated site is actually an archaeological site.

It is anticipated that agricultural dyke failure may affect Heritage and Archaeological Resources should the resultant flooding erode pre-causeway shorelines. However, the likelihood of archaeology sites existing in agricultural areas is minimal due to previous disturbance by activities such as plowing.

There is a potential during heavy precipitation events or flash floods for erosion control structures to fail, which could result in the erosion of pre-causeway shorelines in the Assessment Area and may potentially affect Heritage and Archaeological Resources. To reduce the risk of this occurring, protection measures will be followed as described in the EMP, and the environmental effects of accidents and malfunctions are therefore predicted to be not significant.

9.13 Public Health and Safety

The Status Quo and Project Options have the potential to result in environmental effects on public health and safety. These environmental effects may arise primarily from accidents (i.e., vehicular/non-vehicular accidents) and unplanned events, or through changes in the environment that may have implications for public health and safety (i.e., groundwater quality and quantity, contaminated effluents, disease vectors, flooding).

A *significant negative residual environmental effect* is one that results in an increase in risk to public health and safety over 2005 baseline conditions.

Evaluation of Potential Environmental Effects

Vehicular Accidents

The Status Quo is not expected to have any environmental effects on vehicular accidents in the Assessment Area. The Project Options may increase tourism-related traffic due to restoration of the estuary and improved tidal bore, but any increase in traffic during construction or operation of the Project Options is expected to be offset by the new 4-lane Petitcodiac River Bridge, which will be in operation by the time of construction. Mitigation during construction and maintenance activities, as outlined in the EMP, will ensure the safety of the motoring public, and the environmental effects are therefore predicted to be not significant.

Non-Vehicular Accidents and Unplanned Events

The Status Quo may slightly increase the number of boating accidents and strandings due to increased sedimentation of the river, but is not expected to have any environmental effects on the use of the headpond as an emergency fire-fighting water source. Therefore, the potential negative environmental effects of the Status Quo on non-vehicular accidents and unplanned events are predicted to be not significant.

Restoration of pre-causeway tidal flow with the Project Options will create the potential for increased accidents due to boating activities (e.g., people stranded in the mud). Mitigation includes signage and education in boating safety to warn boaters of the potential danger. The headpond will be lost as a fire-

fighting water source; however, other acceptable sources of water are nearby (i.e., Bay of Fundy and Shediac Bay) and chemical fire retardants are generally more effective and more often used than water, and the environmental effects are therefore predicted to be not significant.

Groundwater Quality and Quantity

Neither the Project Options nor the Status Quo are expected to have significant negative environmental effects on groundwater quality or quantity over 2005 baseline conditions.

Contaminated Effluents and Re-Distribution of Contaminants

Under the Status Quo, water quality downstream of the causeway is expected to continue to deteriorate and faecal coliform concentrations to increase, which could affect recreation and food resources (i.e., plants and fish). Upstream of the causeway, the Status Quo is not expected to have significant negative environmental effects on contaminated effluents over 2005 baseline conditions; however, the recreational water quality throughout the Assessment Area will at times continue to be unsuitable for many recreational water purposes. In summary, the potential negative environmental effects of the Status Quo on contaminated effluents are predicted to be significant.

In contrast, the Project Options are expected to improve water quality conditions upstream and downstream of the causeway by restoring tidal flow, increasing the assimilative capacity of the river. Widening of the river channel has the potential to erode the former Moncton Landfill, which could result in the leaching or erosion of potentially toxic substances into the river. Mitigation will ensure protection of the landfill from erosion; however, there exists a potential during heavy precipitation events or flash floods for erosion control structures to fail. To reduce the possibility of this occurring, protection measures will be followed as described in the EMP, and the environmental effects are therefore predicted to be not significant to positive.

Human Disease Vectors

The *Culex* mosquito, a human disease vector for the West Nile Virus can breed in saltwater marsh but prefers freshwater impoundments like the headpond. Ultimately, the presence of the headpond may lead to increased risk from the virus, if found in the region. However, the potential environmental effects of the Status Quo on human disease vectors is predicted to be not significant as the virus is not yet found in New Brunswick. The Project Options are expected to decrease the amount of habitat required by the *Culex* mosquito and consequently have a positive environmental effect on public health and safety, should the virus occur in the GMA.

Flooding

The Status Quo will have negative environmental effects on flooding in the Assessment Area as the conveyance capacity of the river continues to decrease. The Status Quo also poses the risk of catastrophic failure of the causeway, as sediments accumulate against the gates in periods when the gates are not operated and estuarine or river ice result in ice jams at or in the vicinity of the gates. Under a heavy fall rainfall and associated high flows, there is a risk of flooding both upstream and downstream of the causeway, and along the Petitcodiac River in the GMA. The potential negative environmental effects of the Status Quo on flooding are therefore predicted to be significant.

Conversely, the potential environmental effects of the Project Options on flooding are predicted to be positive. Restoration of tidal flow and flushing will keep the main channel open, increase its conveyance capacity, and prevent ice accumulation. Increased erosion of accumulated sediments will reduce the infilling of creeks, marshlands, and drainage ditches, enabling the system to accommodate increased

flows during tides and rainfall events. As well, failure of gate openings at the causeway will no longer be an issue. Although a flooding risk at Moncton and upstream of the causeway will still exist when a heavy rainfall is associated with a storm passage, the flood risk is reduced under the Project Options as compared to the Status Quo, more for Project Options 4B/4C than for Project Options 3/4A, and the environmental effects are therefore predicted to be positive.

Future Trends (2055, 2105)

The Status Quo and Project Options will have similar environmental effects on public health and safety in the future (2055, 2105) as in 2025. Future trends will continue for the Status Quo as the negative environmental effects on contaminated effluents, disease vectors, and flooding continue to worsen as deposition of sediments in the river downstream of the causeway continues. Environmental effects of the Project Options will not alter substantially over 2025, as restoration of tidal flow will continue to flush contaminated effluents from the river and prevent infilling of creeks, marshlands, and drainage ditches, which result in flooding.

Summary

Overall, the potential negative environmental effects of the Status Quo on Public Health and Safety in consideration of the negative residual environmental effects significance rating criteria are predicted to be significant as a result of continued infilling of the river and its tributaries, which leads to deteriorating water quality conditions and increased risk of flooding.

The potential environmental effects of the Project Options on Public Health and Safety in consideration of the proposed mitigation (i.e., former Moncton Landfill protection) and the negative residual environmental effects significance rating criteria are predicted to be not significant to positive, as increased erosion and tidal flow will improve water quality conditions and decrease the risk of flooding in the Assessment Area.

10.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT OPTIONS AND THE STATUS QUO

The aspects of the environment that may cause a change in the design or construction of the Project Options and the Status Quo include the following: sediment transport process; tidal prism; weather; flooding; ice; climate change and earthquake activity.

Mitigation for potential effects of the environment on the Project Options (e.g., rip rap of erodible shorelines) is inherent in the planning and engineering design presented in this EIA Report. In addition, Stage 1 of the Project Options implementation plan will further define the mitigation for construction and operation of the Project Options and monitoring and follow-up, as described in Chapter 12, will further minimize the likelihood of a substantive effect of the environment on the Project Options from occurring. In consideration of the likely effects of the environment on the Project Options and the proposed mitigation (including monitoring and follow-up), the residual effects of the environment on the Project Options are determined to be not significant.

In contrast, the Status Quo will continue to result in a changing environment that will in some instances result in an effect of the environment on the Status Quo that is significant (e.g., increased flooding risk due to decline in channel conveyance).

11.0 CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT

The cumulative environmental effects of past, present, and future actions that overlap with those of the Status Quo and Project Options are consistent with those identified in the environmental effects assessment and assessment of the effects of the environment of project. Future actions including other future development projects (e.g., City of Moncton Assomption Boulevard Phase II and Vaughan Harvey Boulevard Extensions) do not contribute in substantive ways to cumulative environmental effects.

Importantly, the Status Quo contributes substantively to cumulative environmental effects that are significant, including the persistence of Fish and Fish Habitat issues that are significant (i.e., not meeting the fish passage Project Objective). By contrast, in meeting the Project Objectives, the Project Options contribute to positive cumulative environmental effects due to changes to the Petitcodiac River estuary that afford the restoration of fish passage and the overall ecosystem benefits (tidal exchange, sediment transport and other physical processes and biophysical functions). No additional mitigation is required to address cumulative environmental effects beyond those measures proposed for the Project Options.

12.0 ECONOMIC CONSIDERATIONS

The original causeway construction cost between $18,000,000 and $24,000,000 in 2004 dollars. Similar costs would have been expended to build a bridge. The capital and operating cost of the Status Quo going forward from 2005 are, on the surface, relatively small for maintenance and operation of the gates, and occasional major repairs (i.e., $666,800 every 15 years). However, the undefined but substantial costs associated with elevated flood risk that will result in increased magnitude and frequency of flooding, and/or increased insurance rates, must be factored in. It is estimated that the cost of sewage treatment improvements to address current water quality issues alone is in the order of $36,400,000.

The avoided future costs of sewage treatment alone under the Status Quo clearly offset the cost of implementing Project Options 3 and 4A, and a substantial portion of Project Options 4B and 4C. The costs of Project Options 4B and 4C would likely be fully or almost entirely offset by future avoided costs of the Status Quo when the avoided cost of flood protection, damage, or property insurance are factored in, along with other identified costs.

The Status Quo on the whole has many costs associated with the significant negative environmental effects predicted, but in addition, there are the consequences of ongoing violation of the Fisheries Act that have not been quantified as part of this study. Conversely, the Project Options in meeting the Project Objectives will overall result in many benefits that on the whole will result in even greater net benefits (e.g., tourism, commercial and recreational fishing, navigation, etc.).

Capital and Operating Costs of the Project Options				
Activity	Project Option 3	Project Option 4A	Project Option 4B	Project Option 4C
Sub-total Stage I	$18,430,000	$20,390,000	$20,390,000	$21,610,000
Sub-total Stage II	$3,120,000	$3,960,000	$5,080,000	$7,000,000
Sub-total Stage III	$12,530,000	$17,600,000	$29,140,000	$78,660,000
Total Costs	$34,080,000	$41,950,000	$54,610,000	$107,270,000
*all values in 2004 dollars and include 25% contingency				

13.0 FOLLOW-UP PROGRAM

A Follow-up Program will be implemented to meet the requirements of both the Guidelines and CEAA, and will be consistent with the implementation strategy for each Project Option. The Follow-up Program focuses on an adaptive management approach to verify the conclusions and the effectiveness of mitigation, and in the unlikely event of unanticipated changes to the river or failure of mitigation measures, be used to update the EMP before each construction stage is implemented.

14.0 CONCLUSIONS

The Status Quo and Project Options 1 and 2 do not meet the Project Objectives, whereas Project Options 3 and 4 with modifications do.

Project Option 3 is the least costly to build and operate, but does not have the enhanced benefits of Project Options 4B and 4C (increased sediment erosion and tidal exchange).

Project Option 4B affords a greater degree of flexibility should predicted sediment erosion and increased tidal exchange be found to be less than predicted under Project Options 3 or 4A.

Project Option 4B can have the widening in the causeway opened beyond that in Project Options 3 and 4A, if necessary, but could avoid that cost if not necessary.

Project Option 4B could be constructed in phases with the initial phase involving removal of the control structure, followed by subsequent phased removal of portions of the causeway, thus deferring some of the capital cost while at the same time achieving an optimal opening width.

Project Option 4C is the most costly Project Option and has inherent construction risks (dredging or cofferdam failure and proximity to the former Moncton Landfill immediately downstream) that are much greater than the other Project Options.

The overall cost of the Project Options would appear to be totally or at least partly offset by the avoided cost of the Status Quo.

The complete EIA report is approximately 376 pages long (not including appendices) and contains extensive detailed information, maps and tables. For those interested in reviewing the full EIA report, copies have been placed at the locations indicated below:

ENVIRONMENT AND LOCAL GOVERNMENT OFFICES:

· 428 Collishaw Street, Moncton, 856-2374
· 20 McGloin Street, Marysville Place, Fredericton, 444-5382

FIRST NATIONS:

· Fort Folly First Nations, 38 Bernard Trail, Dorchester

MUNICIPAL OFFICES:

· Village of Alma, 8 School Street
· Ville de Dieppe, 333 Avenue Acadie
· City of Moncton, 655 Main Street
· Village of Riverside-Albert, 5823 King Street
· Town of Riverview, 30 Honour House Court

REGIONAL PUBLIC LIBRARIES:

· Dieppe Public Library**,** 333 Acadia Avenue
· Hillsborough Public Library, 2849 Main Street, Unit 2
· Memramcook Public Library, 540 Centrale Street
· Moncton Public Library, 644 Main Street, Suite 10
· Petitcodiac Public Library, 31 Main Street
· Riverview Public Library, 34 Honour House Court
· Sackville Public Library, 66 Main Street
· Salisbury Public Library, 3215 Main Street

SERVICE NEW BRUNSWICK OFFICES:

· 770 Main Street, Assomption Building, Moncton

15.0 OPPORTUNITIES FOR PUBLIC COMMENT

Following the release of EIA documentation for review, the public is invited to comment on the report and attend the public meeting which is scheduled as follows:

November 29, 2005

7:00 p.m.

Coverdale Recreation Centre

50 Runnymeade Road, Riverview, NB

To register to make a presentation at the public meeting, please contact the Department of the Environment and Local Government (DELG) at (506) 453-3700 (collect). The public meeting will also provide opportunity for general comments.

To submit **written comments, which should be received on or before December 14, 2005** or 15 days following the date of the public meeting, please forward them in the official language of your choice to:

Project Assessment Branch – Petitcodiac River Causeway Project
C/O the Department of Environment & Local Government
P.O. Box 6000 (20 McGloin Street), Fredericton, NB E3B 5H1
Tel: (506) 444-5382, Fax: (506) 453-2627, Email: EIA-EIE@gnb.ca

At the end of this period, a summary of public input will be prepared and made available to the public. At any time after this date, the provincial Cabinet may make a decision relevant to the Project.

16.0 CONTACT INFORMATION

For further information concerning the EIA process, please contact:

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Project Assessment Branch, Department of the Environment and Local Government
P.O. Box 6000, Fredericton, NB E3B 5H1
Telephone: (506) 444-5382, Fax: (506) 453-2627
Email: serge.gagnon@gnb.ca

For further information regarding the public consultation process, please contact:

Michelle Daigle, Public Consultation Coordinator
Communications and Educational Services Branch,
Department of the Environment and Local Government
P.O. Box 6000, Fredericton, NB E3B 5H1 Telephone: (506) 453-3700, Fax: (506) 453-3843

Email: michelle.daigle@gnb.ca

For further information on the Petitcodiac Causeway EIA Study, please contact:

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