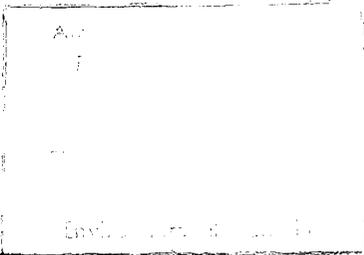


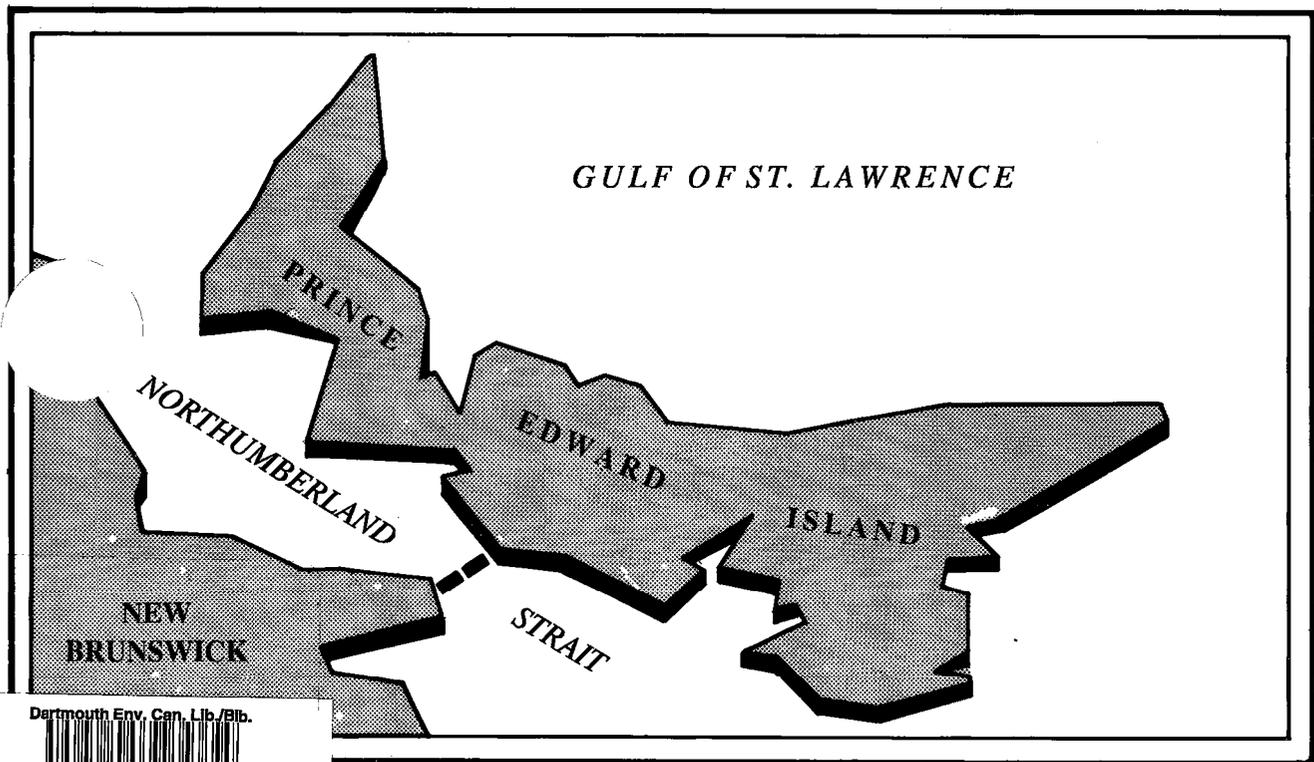


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# Environment Canada Review of the NORTHUMBERLAND STRAIT CROSSING PROJECT ENVIRONMENTAL ASSESSMENT



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REVIEW  
of the  
NORTHUMBERLAND STRAIT CROSSING PROJECT  
as presented to the  
ENVIRONMENTAL ASSESSMENT PANEL

February, 1990

Scientific and Technical  
Comments

Recycled paper.



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## 1. INTRODUCTION

Environment Canada has evaluated the Public Works Canada (PWC) submission to the Environmental Assessment Panel reviewing the proposed Northumberland Strait Crossing Project. This document summarizes our findings.

In general, we find that the complete assessment package, which includes the Bridge Concept Assessment Supplement and its support documents, the original Bridge Concept Assessment, the Generic Initial Environmental Evaluation and its associated background studies, provides a good overview of expected project impacts and possible mitigation.

None the less, Environment Canada still has concerns about the project. This report is intended to assist the Panel in identifying these areas and the proponent in addressing them. Where appropriate, recommendations on alleviation or elimination of the concerns have been made. The Department is prepared to explain or enlarge upon any of the commentary provided.

A Departmental position on the proposed Northumberland Strait Crossing Project will be presented to the Panel during the Public Hearings to be held in March.

## 2. SUMMARY

### Overview

Throughout the environmental assessment and review of the Northumberland Strait Crossing Project, Environment Canada has identified a number of key issues which have been addressed to varying degrees by Public Works Canada (PWC). These are:

- . Evaluation of critical project/environment interactions:
  - effects of the structure on ice regime;
  - wildlife and associated habitat (in particular, Cape Jourimain National Wildlife Area);
  - increased tourism and related impacts;
  - groundwater impacts;
  - sediment transport/shoreline erosion changes;
  - effects of long term climate change on the structure;
- . Contingency planning/emergency response measures
- . Environmental effects monitoring
- . Assessment of cumulative effects
- . Environmental management of the project

While PWC has endeavoured to address these issues as fully as possible, there are aspects which remain to be resolved. This summary section gives a brief overview of each of these issues, from an Environment Canada perspective.

### Effects of the Structure on Ice Regime

Early in the planning of this project, the interaction between the crossing structure and sea ice was identified as a key area of possible impact. The project must be designed so that it not only can withstand the forces generated by the constantly moving ice field, but it also does not cause significant changes in prevailing ice conditions. If the presence of a bridge structure causes increased ice accumulation in the Strait, or results in a delay in ice-out, this may have a negative effect on the overall marine environment of the area, with possible implications for the existing highly valued Strait fishery. Based on a number of studies conducted over the past three years, PWC has concluded that both the above requirements can be met.

Environment Canada supports the work done prior to the Bridge Concept Assessment (BCA) Supplement. However, we believe that the latest study conducted by PWC, in response to questions raised by the Panel, is incomplete, conveys an overly optimistic view of ice jamming potential, and does not fully satisfy the intent of the Panel's question.

Work performed for the BCA Supplement clearly shows that the amount of ice jammed, as predicted by computer model, is highly dependent on a parameter known as drag coefficient. In essence, drag coefficient is a measure of the amount of driving force imparted

to the ice by water passing underneath, and is a function of ice roughness. The drag coefficient used by PWC was selected from studies carried out in other geographic areas, since there are no existing data of underside roughness or drag coefficients for Northumberland Strait ice. While the value used is well supported, we believe that an accurate value, as determined from field measurement, is necessary to ensure that the results of the ice jamming analysis reflect actual conditions in the Strait.

The report should also have provided additional discussion of the effects of ice ridging and seasonal variation in predominant ice type, as well as stronger justification for using a single drag coefficient, as opposed to a range of values, as the base case for subsequent sensitivity analyses of the other parameters.

The current speed values chosen for the most recent analysis, although well supported and based on actual measurements, are not clearly discussed in terms of the Panel's request, in that it is not specified what portion or portions of the channel the values actually represent. This leaves the impression that water current values used are representative of the overall channel. The Panel, on the other hand, requested that a distinction be made between mid-channel and side-channel regimes.

Prior to execution of this project, the ice jamming computer model should be re-run, incorporating actual values in place of the assumptions used for key factors such as drag coefficient, ice strength, floe size and pier design (i.e. spacing, shape and diameter). This will be the final check of the conclusions reached based on the generic modelling conducted to date.

#### Impacts on Wildlife and Associated Habitat/Cape Jourimain National Wildlife Area

The construction and operation of the crossing project could adversely affect wildlife and associated habitat in the landfall areas.

PWC has devoted considerable effort to identifying and cataloguing the wildlife and associated habitat which could be adversely affected by the project, as well as documenting foreseeable effects. However, this effort seems to have stopped short of setting out mitigative measures, leaving that to the Environmental Management Plan of the successful developer. This approach may ultimately yield acceptable solutions, but does not lend itself to early planning in avoiding problem areas. There appear to be many details left to the discretion of the developer, with only the general guideline that disturbance to the Cape Jourimain National Wildlife Area is to be minimized.

The New Brunswick approach to the crossing will pass directly through the Cape Jourimain National Wildlife Area. Environment Canada remains concerned about the effects of the project on the National Wildlife Area, both during the construction and operational phases of the facility. Since we expect protection of this area to be a prominent component of the Environmental Management Plan which the successful developer will be required to submit, Environment Canada recommends that plans for the protection of the Cape Jourimain National Wildlife Area, as described in its Environmental Management Plan, be developed in consultation with the Canadian Wildlife Service of Environment Canada.

The study of possible impacts on bird migrations through the Strait appears to cover the main literature on the topic, however, the limited field observations are not adequate to answer the question posed by the Panel. In addition, the study does not clearly indicate the degree of importance of the Borden-Cape Tormentine area as a migratory route, nor does it provide adequate detail of the methodology used to allow specialist readers to fully evaluate its appropriateness.

#### Increased Tourism and Related Impacts

While it is recognized that the predicted increase in tourist visitation represents a significant economic and resource development opportunity to Prince Edward Island, Environment Canada remains concerned that it may also cause adverse environmental impacts extending beyond the jurisdiction of any one agency, including PWC. Increased numbers will place greater demands on available tourist attractions and place sensitive areas at risk, as overcrowding at prime attractions leads visitors to seek out less busy spots.

The assessment documents correctly identify most impacts of the project on Prince Edward Island National Park. However, the discussion of mitigation is lacking, in that there is insufficient discussion of the likelihood of success or associated cost implications (dollars and manpower). In addition, the level of detail presented in the description of suggested mitigation measures is generally insufficient to allow proper planning for implementation. This topic should be expanded upon to provide preliminary estimates of probability of success (i.e. feasibility), as well as resources required to effectively implement the proposed measures.

Although the assessment information does identify increases in traffic and visitation to the National Park area, it does not emphasize the negative aspects of congestion in an already stressed area of traffic circulation. Since aesthetics is recognized as an environmental resource, this should have been discussed.

### Groundwater

During construction, significant amounts of water will be required by the developer for activities such as concrete production. As well, potable water for drinking, showers, cooking, and related needs will be required in the work camp. The potential exists for nearby groundwater resources to be adversely affected.

PWC has specified that the winning bidder will be required to carry out an assessment of groundwater resources near its base camp. This is intended to facilitate planning for prevention of groundwater contamination or conflicts with other users. Since it is not possible to know exact requirements before the final selection, Environment Canada views this as a reasonable approach. However, it is important that any work carried out by the proponent in this regard be carefully evaluated by both provincial and specialist federal authorities.

The study described in PWC's support document for this issue clearly identifies several possible serious impacts (i.e. dewatering of nearby wells, reduction or cessation of flow in nearby streams, long term effects of blasting), but there is inadequate accompanying discussion of the ramifications of these impacts, or potential mitigative measures.

The Environmental Management Plan should, based on a comprehensive hydrogeologic evaluation of the area to be carried out by the proponent, identify a suitable source of water supply, and assess the potential effects of project related groundwater withdrawals on the availability of groundwater for domestic or other purposes. In particular, the Environmental Management Plan should provide a detailed breakdown of expected groundwater demands and an analysis of how these demands will be met. The plan should also describe potential problems, including the magnitude and significance of increasing salt water intrusion, as well as measures which would be implemented to prevent or mitigate undesired effects.

### Sediment Transport/Shoreline Erosion/Dredging

The presence of a bridge structure, as well as activity associated with its construction, may cause alterations in existing sediment movement patterns. Such changes may result in erosion of nearby beaches, increased suspended sediment levels in nearshore and offshore waters, or alterations in the distribution and movement of sediments at the seabed, thus potentially affecting both land use and the marine environment.

PWC's investigation of sediment transport is approached from the perspective of its effects on the design of the sub-structure. While this is certainly a critical design consideration, the matter of the structure's effects, or the effect of construction activities such as excavation or infilling, on the existing shoreline seems to have been overlooked. Further investigation is

needed. Key recommendations related to shoreline erosion were made by Eastern Designers Ltd. in their Erosion, Scour and Sediment Mobility study carried out in 1987, but have not yet been implemented. The Eastern Designer's recommendations should be reviewed to ensure that they have been adequately addressed.

The successful developer's Environment Management Plan should include a detailed analysis of potential undesired sediment transport effects (i.e. shoreline erosion), assess the need for monitoring and include provisions for addressing any problems which occur as a result of the project.

With respect to the impacts of dredging and spoil disposal, the information gathered to date and presented to the Panel is not sufficient to support an Ocean Dumping application for the amount of dredging expected with this project. When applying for a permit, the proponent will be required to provide not only chemical characteristics of the dredged material, but information on the physical characteristics of the dredged spoils for each dredging site, as well as dump site characteristics, method of dumping, and analysis of potential impacts such as habitat loss, effects on other resources, aesthetics, etc. A more complete description of requirements is contained in Part VI of the Canadian Environmental Protection Act (CEPA).

#### Long Term Climate Change

It is essential that the crossing structure be designed to withstand anticipated meteorological and oceanographic forces. Meteorological forces include those resulting from wind, snow, freezing precipitation and stresses caused by thermal expansion or contraction of structural components. Oceanographic forces result mainly from currents, waves and sea ice.

The magnitude of environmental forces is typically predicted based on historical climate data. However, evidence is emerging that while existing standards based on historical data may still be reliable indicators of what to expect in the short term, they may not be appropriate for projects with long life expectancies. Long term climate change is predicted to be of a cumulative non-linear nature, in that the rate of change during the coming half century will probably be much less than that in the 50 years which follow. In other words, environmental conditions in year 35 of the structure's life are unlikely to be significantly different from those which exist now, but there is a high probability that those in year 100 will be.

Environment Canada is concerned that the project design may not adequately take into account the long term climate change (i.e. global warming) which now appears probable. We further believe that failure to account for this phenomena could place the structure at risk in the future.

For example, the question of mean sea level rise, like other changes which may be caused by the so-called "greenhouse effect" has been largely ignored. The height of the sea level determines where on the structure marine loads will act. While some consideration of the matter has been included in preliminary analyses of cumulative effects, design implications have not been adequately considered. This is a critical oversight which could, in the long run, have negative structural consequences.

To adequately address this issue, an advisory mechanism, with Government of Canada participation, could be formed to deal with the problem of designing for long term climate change. Advice obtained through such a mechanism should, where possible, be factored into the design of the crossing structure. This approach could significantly reduce future risk to the structure and is therefore in keeping with the present government's risk minimization objectives in relation to this particular development.

#### Contingency Planning/Emergency Response Measures

In general, this topic has been well addressed. The Generic Initial Environmental Evaluation (GIEE) made a number of recommendations, and the Panel has asked for and received information regarding worst case spill scenarios. To fully ensure that the proponent is prepared to handle any environmental or other emergencies which could arise, the final Contingency Plan should be developed in consultation with agencies or groups which have responsibility for and expertise in emergency response.

#### Environmental Effects Monitoring

Environmental effects monitoring is carried out primarily to verify impact predictions, detect project-induced change in the existing environment, evaluate the effectiveness of the mitigative techniques being used and define corrective measures. It usually involves defining areas of expected or possible change beforehand, then employing measurement programs to determine whether or not such change is occurring. Normally, some degree of pre-project measurement activity is required to provide a background against which change can be measured. A well-designed plan should describe the main areas in which monitoring efforts will be concentrated, as well as indicator variables to be monitored. There should also be a description of against what background and by what means changes will be assessed.

In the BCA Supplement, PWC states its commitment to ensuring that the developer's Environmental Management Plan for this project, of which the effects monitoring program will be a component, is satisfactory to all appropriate regulatory agencies prior to final approval of the project. Environment Canada strongly supports this commitment and believes that this approach will result in an acceptable final monitoring strategy.

Assessment of Cumulative Effects

This matter has not been addressed to the satisfaction of Environment Canada. We believe that the project's impacts cannot be looked at in isolation on an individual basis. The proponent has addressed the matter from the perspective of project impacts being compounded by non-project events (i.e. acid rain), but has not assessed the possibility of synergistic interactions between two or more separate project activities. We believe this leads to an overly optimistic impression of what adverse effects might be caused by this development.

To properly address this matter, the original risk scoping work conducted in preparation of the Generic Initial Environmental Evaluation should be reviewed with particular attention to possible synergistic or additive effects of combinations of project activities. This analysis should not be limited to examining the cumulative effect of activities occurring simultaneously, but should also consider sequential effects.

Environmental Management Strategy/Environmental Management Plan

Since a project-specific IEE (Initial Environmental Evaluation) is no longer a requirement, the main tool for ensuring minimal impacts will be the developer's Environmental Management Plan (EMP). The BCA Supplement states that the EMP must be satisfactory to all appropriate agencies prior to project approval by PWC. Environment Canada firmly believes that this approach is essential to attaining the maximum level of environmental protection for this development, and therefore strongly endorses PWC's intentions in this regard.

Environment Canada urges PWC to consider the establishment of an audit mechanism to ensure developer compliance with the terms and conditions of the Environmental Management Plan and to ensure that the environmental protection objectives of the plan are being met. Environment Canada is prepared to participate in the design and operation of such a mechanism.

Finally, to familiarize workers at all levels of the project with the procedures set forth in the Environmental Management Plan (i.e. storage and handling of hazardous materials), the proponent should consider implementing an employee training program, with the aim of increasing awareness of environmental protection as it relates specifically to this project.

### 3. ISSUES ANALYSIS

Environment Canada has reviewed the assessment documents presented by Public Works Canada (PWC) to the Environmental Assessment Panel. Based on this review, and the review over the past three years of various background studies and the Generic Initial Environmental Evaluation, a number of key issues which should be more fully addressed have been identified.

The major issues identified by Environment Canada in relation to this proposed development are:

- . Evaluation of critical project/environment interactions:
  - effects of the structure on ice regime;
  - wildlife and associated habitat (in particular, Cape Jourimain National Wildlife Area);
  - increased tourism and related impacts;
  - groundwater impacts;
  - sediment transport/shoreline erosion changes;
  - effects of long term climate change on the structure;
- . Contingency planning/emergency response measures
- . Environmental effects monitoring
- . Assessment of cumulative effects
- . Environmental management of the project

PWC has investigated all of these critical areas to various degrees during their environmental assessment of this major project. However, close examination of the issues reveals that not all have been satisfactorily resolved.

#### 3.1 EFFECTS OF THE STRUCTURE ON ICE REGIME

Early in the planning of this project, the interaction between the crossing structure and sea ice was identified as a key area of possible impact. The project must be designed so that it not only can withstand the forces generated by the constantly moving ice field, but it also does not cause significant changes in prevailing ice conditions. If the presence of a bridge structure causes increased ice accumulation in the Strait, or results in a delay in ice-out, this may have an undesired effect on the overall marine environment of the area, with possible implications on biological productivity in the vicinity of the project.

PWC and their consultants have made considerable progress in converging on the most likely outcome to this possible problem, and also of explaining the work done in a relatively understandable way. An initial small-scale study conducted in 1987 revealed large gaps in our understanding of the ice dynamics in the Strait. However, over the past three years, a great deal of additional information has been gathered and, based on this, PWC has concluded that the presence of a bridge structure will not cause significant

changes in existing ice conditions, either during the winter or during spring breakup.

Environment Canada supports the work done prior to the Bridge Concept Assessment Supplement. However, we believe that the latest work conducted by Public Works, in response to questions raised by the Panel, is incomplete and conveys an overly optimistic view of ice jamming potential.

There are several points which need to be clarified before Environment Canada could give its full support to the conclusions reached by PWC. These relate primarily to PWC's response to the Panel's questions regarding the ice jamming analysis which was carried out using a computer model. The Panel asked that the model be re-run to examine what effect, if any, varying certain key input parameters, such as current speed and drag coefficient, would have on the analysis results.

#### Drag Coefficient

Water-on-ice drag coefficient is a key factor in determining the magnitude of forces generated by sea ice on marine structures. Drag coefficient is essentially a measure of the amount of driving force imparted to ice by water passing underneath. It is primarily a function of underside ice roughness, with rough ice having higher values than smooth ice.

Analysis performed for the BCA Supplement clearly shows that the amount of ice jammed, as predicted by computer model, is highly dependent on drag coefficient. Thus it is important that an accurate value be utilized. The drag coefficient used by PWC (0.02) was selected from studies carried out in other geographic areas, taking into account, as far as possible, differences in ice conditions between those areas and Northumberland Strait. This value, however, is at the high end of the range typically quoted in the literature and results in a decreased tendency, from a modelling standpoint, for jams to persist, in comparison to a lower value. This, in turn, causes the model to predict that less ice will be blocked by the bridge than might actually be the case. While the argument for selecting that particular value is reasonable, the fact is there are no data on underside roughness or drag coefficients for Northumberland Strait ice. Thus, we believe that an accurate value, as determined from field measurement, is necessary to ensure that the results of the ice jamming analysis reflect actual conditions in the Strait.

Selecting a drag coefficient value from the high end of the spectrum also suggests the possibility of a higher percentage of ridging than the 10% used in this study. If the 10% assumption is to continue to be used, and it appears reasonable to do so, then this must be taken into account when choosing an appropriate drag coefficient. The report correctly notes that ice type also has a significant effect on drag coefficient, with younger, smoother

types generally offering less resistance to water movement than older, rougher ones. What is not discussed however, is that the predominant ice type will be different for each of the three ice season periods defined in the study, and the effect of this on selection of an appropriate drag coefficient.

The PWC study uses the single drag coefficient value of 0.02, as opposed to a range of values, as the base case for subsequent sensitivity analyses of the remaining parameters. Thus, the report does not tell us if the effect of modifying other parameters is the same, regardless of the drag coefficient. For example, the model may show higher sensitivity to current speed if the drag coefficient were assumed to be, say, 0.012, than it does with the value set at 0.02. This, in turn, means that the sensitivity analysis, while considered valid, does not really show the whole picture and therefore does not appear to fully satisfy the intent of the question raised by the Panel.

Similar criticism applies to the Monte Carlo simulation, with the probability density function for drag coefficient defined as having a mean of 0.02 and a standard deviation of 0.003. Since the model has already been shown to be highly sensitive to this particular parameter, an investigation of the effect of selecting a slightly lower mean or a different distribution would have given a more comprehensive indication of ice jamming potential.

#### Current Speed

Although the support document provides acceptable rationale for the water current values chosen, the values are not clearly discussed in terms of the Panel's request, in that it is not specified what portion or portions of the channel the values actually represent. The documents leave the impression that water currents used in the sensitivity analysis are representative of the overall channel. The Panel, on the other hand, requested that a distinction be made between mid-channel and side-channel regimes.

Additional discussion is also required to put the concept of surface currents into the context of the limitations of current data collection (i.e. surface currents typically are not measured directly, but may be inferred from near-surface values). In this case "surface" currents were measured at a depth of 4 metres. Some discussion of the implications of this, if any, should have been provided.

#### Pier Spacing/Configuration

Although this was not asked for by the Panel, Environment Canada is concerned about the sensitivity of the model to pier spacing and ice floe size. Earlier analyses show that reducing pier spacing from 273 to 175 metres would increase the frequency of jams only slightly. Reducing spacings to 125 metres, however, would significantly increase the frequency of jams for the given ice floe size distribution. The majority of the jam behaviour modelling

work done to date has been based on certain initial assumptions about key parameters such as pier spacing and pier shape, width, etc. The final design may vary considerably from this assumed configuration. Therefore, prior to final approval of the selected design, the potential for ice jamming should be re-evaluated, incorporating actual values (where available) in place of the earlier assumptions used for key factors such as drag coefficient, ice strength, floe size and pier design (i.e. spacing, shape and diameter). The analysis should take into account the comments presented throughout this section. This will be the final check of the conclusions reached based on the generic modelling conducted to date.

### 3.2 IMPACTS ON WILDLIFE AND ASSOCIATED HABITAT

The project has the potential to impact wildlife and associated habitat in the landfall areas, particularly during the construction phase, but also during the ensuing operational phase.

PWC has devoted considerable effort to identifying and cataloguing the wildlife and associated habitat which could be adversely affected by the project, as well as documenting foreseeable effects. However, this effort seems to have stopped short of setting out mitigative measures, leaving that to the Environmental Management Plan of the successful developer. This approach may ultimately yield acceptable solutions, but does not lend itself to early planning in avoiding problem areas. We are pleased, however, that PWC has committed to seeking the advice of Environment Canada (and others) prior to endorsing the successful developer's Environmental Management Plan, and also with the general guideline that disturbance to the Cape Jourimain National Wildlife Area is to be minimized.

#### Cape Jourimain National Wildlife Area

The New Brunswick approach to the crossing will pass directly through the Cape Jourimain National Wildlife Area. During the environmental evaluation of the project, Environment Canada has assisted PWC in better understanding and defining the sensitive environmental components of this unique area. We remain concerned about the effects of the project on the National Wildlife Area, both during construction and later, during the operational phase of the facility. It is anticipated that protection of the National Wildlife Area will be a prominent component of the successful developer's Environmental Management Plan, with possible impacts and corresponding mitigative measures clearly described in terms which lend themselves to effective implementation. To fully ensure that this important wildlife area receives the maximum protection possible, the successful developer's plans for the protection of the Cape Jourimain National Wildlife Area, as described in its Environmental Management Plan, should be drawn up in consultation with the Canadian Wildlife Service of Environment Canada.

In addition to the overall concern stated above, there were several observations made with specific reference to the documents submitted to the Panel by PWC. In the BCA Supplement, for example, Question B-1 has been answered in detail from a Prince Edward Island point of view. However, the answer given should also have included discussion of impacts on the New Brunswick side adjacent to the crossing.

#### Bird Migration

The study "Impacts on Bird Migrations Through the Strait (Support Document for Question E)" appears to cover the main literature on the topic, however, the limited field observations are not adequate to answer the question posed by the Panel.

The support document notes that radar studies carried out in the early 1970's "gave an indication of the overall importance of the Borden-Cape Tormentine area as a migratory route", but fails to tell the reader what this indication was. Is the area critically important? Moderately important? The degree of importance of the area must be clearly understood in order to allow a proper assessment of the risk which the development poses.

To better allow specialist readers to judge the appropriateness of the methodology used for the study described in the support document, details such as time of day, duration of observations and numbers of birds seen should have been included. The study also did not cover spring migration (March, April and May) and, in fact, consisted of 4 separate days of observation in September and October. The main fall migration period covers the months of October, November and December. Thus, the field observations are not considered representative of either spring or fall migration patterns.

### 3.3 INCREASED TOURISM AND RELATED IMPACTS

Environment Canada is concerned about the possible environmental impacts of increased tourism on Prince Edward Island. We acknowledge that increased tourism represents a significant economic opportunity to Prince Edward Island and that other agencies have a role to play in planning for the expected increase. In particular, the Canadian Parks Service will have to re-assess the capability of Prince Edward Island National Park facilities, and provincial tourism officials will need to do the same for areas under their jurisdiction. Environment Canada believes that this increase in tourism will have impacts extending beyond the jurisdiction of any one organization, including PWC. Increased numbers will place greater demands on available tourist attractions and may place sensitive areas at risk, as overcrowding at prime attractions leads visitors to seek out less busy spots. PWC's role is to lend assistance in providing the quantitative information which those agencies require to plan effectively.

By and large, Environment Canada believes that the BCA Supplement represents the most detailed identification of impacts to date, but that the treatment of mitigation is somewhat less thorough.

The report "Impacts on Terrestrial Habitat (Support Document for Question B)" correctly identifies most impacts of the project on Prince Edward Island National Park. However, it falls short in its discussion of mitigation by suggesting techniques without much apparent thought to the likelihood of success or associated cost implications (dollars and manpower). For example, while the discussion of impacts on the National Park does identify most of the likely impacts, the only real discussion of mitigation is the last paragraph on page B-6, where it is stated that "it is anticipated that through planning for sustainable development, many of these impacts can be mitigated." This type of recommended mitigation statement contains insufficient detail to allow effective planning for implementation, and tends to oversimplify the issue. To rectify this shortcoming, the discussion of suggested mitigation for impacts resulting from increased tourism should be expanded to include preliminary estimates of probability of success (i.e. feasibility), as well as resources required to effectively implement the proposed measures.

As an example of the sometimes less than thorough treatment of mitigation, in the support document's discussion of trampling of sand dune vegetation, reference is made to techniques used successfully in Prince Edward Island National Park "to control and repair much of the trampling damage". The implication here is that these measures are easily accomplished when, in fact, sand dune rehabilitation is a lengthy process and often "hit and miss" in its effectiveness. Enforcement measures are also very labour intensive and thus extremely costly.

The support document identifies increases in traffic and visitation to the National Park area, but does not emphasize the negative aspects of congestion in an already stressed area of traffic circulation. At current levels of visitation, vehicle parking facilities are often overused during peak periods, as evidenced by numerous vehicles parked on the roadside. Since aesthetics is recognized in the document as an environmental resource, this should have been discussed. An additional aspect of this particular impact is the concept of reduced visitor experience as a result of reduced aesthetics, overcrowding, etc.

### 3.4 GROUNDWATER

The crossing project will place significant demands on local groundwater resources. In particular, large amounts of water will be required by the developer for construction activities such as concrete production. As well, potable water for drinking, showers, cooking, etc. will be required in the work camp. The potential

exists for nearby groundwater resources to be adversely affected. PWC has specified that the winning bidder will be required to carry out an assessment of the groundwater resources near its base camp. Environment Canada agrees with this requirement, as it will facilitate adequate planning to prevent groundwater contamination or conflicts with other users. Since it is not possible to know exact requirements before the final selection, this is a reasonable approach. However, it is important that any work carried out by the proponent with regard to groundwater resources be carefully evaluated by both the province whose groundwater may be affected and specialist federal authorities.

The study described in PWC's support document for this issue could have been more complete through the addition of an objective "to determine the potential impacts of construction infrastructure on the groundwater aquifers of the respective landfall areas". This includes all demands/stresses introduced due to the project and any that remain after construction as part of the ongoing operation of the crossing, be it a bridge or tunnel.

The statement in the support document that "Any wells located within this zone of influence may be partially to completely de-watered depending on their proximity to the tunnel incline." should be accompanied by a discussion of mitigation for what is obviously a serious impact. If this worst case scenario is a possibility, as the statement clearly implies, it is appropriate to plan for this.

The document also points out the potential for the "reduction or cessation of stream flow (near Borden) during low flow periods as a result of tunnel de-watering". If the tunnel option is to be seriously considered, then the implications of this situation in terms of other uses of these waters, as well as effects on wetlands and fish habitat, needs to be addressed.

The document does not address the long term effects of blasting strongly enough. This technique, which could be extensively used for tunnel construction, can cause irreversible and dramatic changes to existing groundwater flow patterns, and this impact should be more fully studied.

Finally, there is mention of inducing contamination from "agricultural fields, landfills and other man-made infrastructure" and that impacts of these can be determined by monitoring. More effort should have been put into prediction of these type of impacts. Specifically, contamination sources and activities causing the contamination should have been identified. Additional thought on prevention of these impacts is needed.

To adequately address groundwater issues, the Environmental Management Plan should, based on a comprehensive hydrogeologic evaluation of the area to be carried out by the proponent, identify

a suitable source of water supply, and assess the potential effects of project related groundwater withdrawals on the availability of groundwater for domestic or other purposes. In particular, the Environmental Management Plan should provide a detailed breakdown of expected groundwater demands and an analysis of how these demands will be met. The plan should also describe potential problems, including the magnitude and significance of increasing salt water intrusion, as well as measures which would be implemented to prevent or mitigate undesired effects.

### 3.5 SEDIMENT TRANSPORT

The presence of a crossing structure, or activities associated with its construction, could adversely affect nearby shoreline, as well as the marine environment. Possible effects include erosion of nearby beaches, increased suspended sediment levels in nearshore and offshore waters and alterations in the distribution and movement of sediments at the seabed.

#### Shoreline Erosion

PWC's investigation of sediment transport problems is approached from the perspective of its affects on the design of the sub-structure, a predominant concern being undermining of the support piers. While this is certainly a critical design consideration, the matter of the structure's effects on the existing shoreline seems to have been overlooked.

Federal policy considers shoreline erosion to be a natural process for which the government cannot be held accountable. However, exception to this policy is made when the effect is induced by commercial navigation or the presence of a federal government structure, as would be the case with the crossing. In light of this, PWC should consider the need for monitoring of shoreline erosion. In this regard, to effectively monitor for these potential effects requires certain background information, such as a detailed understanding of the existing sediment regime in the immediate vicinity of the proposed structure, as well prediction of possible effects. The requirement for this information was noted by Eastern Designers Ltd. in their Erosion, Scour and Sediment Mobility study carried out in 1987 on behalf of PWC. Two of the report's most important recommendations regarding shoreline erosion effects were:

" 1. A baseline survey of the geomorphology and sediments in the near-shore zone (0 to 10 metre depth) is required to enhance our knowledge of the coastal zone in this area, improve the accuracy of the littoral sediment transport modelling and to identify changes after the bridge is constructed.

2. The effect of near-shore spacing on the littoral transport regime should be investigated in a physical model."

To the best of our knowledge, these recommendations have not yet been implemented. Environment Canada therefore urges that the recommendations made in Eastern Designers' "Erosion, Scour and Sediment Mobility Study" be reviewed to ensure that there are no unresolved questions in this area. As well, the study conclusions should be reassessed in light of the differences between its assumptions about the structure and the final design.

In addition, the Environment Management Plan should evaluate the need for addressing sediment transport effects in its monitoring plan and include provisions for addressing any shoreline erosion/accretion problems which occur as a result of the presence of the structure.

#### Dredging and Spoil Disposal

With respect to the impacts of dredging and spoil disposal, as discussed in section G of the BCA Supplement and its accompanying support document, the information gathered to date and presented to the Panel is not sufficient to support an Ocean Dumping application for this project. Based on Environment Canada's Interim Ocean Dumping Sampling Guideline, at least 23 sediment samples would be required for a project where removal of 300,000 cu.m. (estimate for the crossing project) of dredged spoils is expected. To date, only four samples have been analyzed. The report downplays the importance of sample collection by stating that "a few" additional sediment samples will be required.

In addition, the data provided in support of an Ocean Dumping application will have to include not only chemical characteristics of the dredged material, as is given in the assessment document, but information on the physical characteristics of the dredged spoils for each dredging site. Also required would be dump site characteristics, method of dumping, and analysis of potential impacts such as habitat loss, effects on other resources, aesthetics, etc. A more complete description of requirements is contained in Part VI of the new Canadian Environmental Protection Act (CEPA).

Finally, there are a number of technical errors and inaccuracies in Table 2 of the support document. That table summarizes the results of chemical analyses carried out on four samples collected from the crossing corridor, as well as historical data from the area. First, since the concentrations for the samples collected from the crossing alignment were determined on a dry weight basis, the phrase "dry weight" should have been included, for clarity. The number of samples should have been indicated, to give the reader a feel for the statistical significance of the data presented. The unit for Oil and Grease concentration should be ppm (parts per million), not ppb (parts per billion) as given here. In footnote 1, the unit for PCB concentration should be ppb, not ppm. The term "need to know" is not accurate as used in the footnote related to DDT concentration. The reference to the

regulated limit for DDT as being 1% of the bioassay-derived concentration shown to be toxic to sensitive organisms is correct, but because no bioassay method has been specified in CEPA, an interim limit of 100 ppb is being used. Lastly, it should be noted that recently, PAH compounds have been added to the list of chemicals for which analysis is required in support of an Ocean Dumping application. These details should be attended to in any subsequent summary of sediment data, such as might be contained in the successful developer's Environmental Management Plan or an Ocean Dumping application.

### 3.6 LONG TERM CLIMATE CHANGE

A bridge structure across Northumberland Strait must be designed to withstand loads (forces) resulting from atmospheric and marine environmental conditions. Atmospheric loads include wind, snow, freezing precipitation and stresses due to thermal expansion or contraction of structural components. Marine loads consist primarily of currents, waves and sea ice. The magnitude and location of these marine forces depend on water depth and the elevation of mean sea level. It is critical that the proposed bridge structure be designed to withstand these naturally-occurring forces.

Existing standards used by designers to estimate environmental or climatic loads are based primarily on historical data. Evidence is emerging that while these standards may still be reliable indicators of what to expect in the short term, they may not be appropriate for projects with long life expectancies. Long term climate change is predicted to be of a cumulative non-linear nature, in that the rate of change during the coming half century will probably be much less than that in the 50 years which follow. In other words, environmental conditions at the end of year 35 of the structure's life (at which point in time the government of Canada assumes total responsibility for the operation and maintenance of the facility) may not be markedly different from those which exist now, but there is a high probability that those at the end of year 100 (design life of the structure) will be.

Environment Canada's major concern is that the project design may not adequately account for the long term climate change (i.e. global warming) which now appears probable.

A good example of this can be found on page 6-4 of the BCA, where it is stated that "The extremes of air temperature and their duration are well documented for the project site." This suggests that present temperature data are sufficient for future planning, whereas temperatures may increase by 5 or more degrees Celsius over the next 100 years. Other examples can be found throughout the various assessment documents.

PWC has stressed from the outset its intention to carry out this project in a way which minimizes risk to the government of Canada, and thereby to the general public. The risks associated with the development fall into three main categories: financial, engineering and environmental. Our concern relates directly to the engineering risk resulting from environmentally-driven forces, but has implications for the financial risk also. If the bridge is built to conform to present standards, it may not be adequate to withstand future environmental forces.

The situation is further compounded by the supposition that regardless of how well the structure is maintained, it will surely not be in as good condition at year 100 as it was in year 1, or even year 35. Thus, it will be less able to withstand even the loads for which it was designed, let alone loads which may have increased.

As presently planned, the developer will operate and maintain the crossing for a period of 35 years, after which it will be operated and maintained by the federal government for at least the next 65 years. Having such a long time span introduces several unusual considerations. First, the individuals involved with this project today will almost certainly not be around in 35 years, so personal or professional liability is not really a factor. Also, the consortium has little reason to worry about the fate of the structure after year 35, having at that point fulfilled its contractual obligations, as well as exhausting the revenue-generating portion of the contract. So the developer's priorities, although perfectly understandable, do not lend themselves to ensuring that the remaining life of the structure is problem free.

In addition, it is not the responsibility of the designers to look into this matter, as it is not their role to second guess existing standards. Instead, Environment Canada believes it is the federal government's responsibility to ensure that the design standards for this project, as well as others of similar duration, are adequate to protect the safety and financial interests of future generations of Canadians. This is not only an appropriate overall philosophy, but is in keeping with the present government's risk minimization objectives in relation to this particular development.

#### Mean Sea Level Rise

One aspect of long term climate change which may have particular consequence for the structure is the question of mean sea level (m.s.l.) rise. Sea level elevation determines where marine forces will impact on the structure. Like other impacts which may be caused by the so-called "greenhouse effect", m.s.l. rise has been largely ignored in the planning of this project. Some consideration of the matter has been included in preliminary analyses of cumulative effects, but design implications of mean sea level rise have not been adequately considered. Environment Canada believes this is a critical oversight which could, in the

long run, have negative structural consequences. Admittedly, if there is a 1-2 metre rise in mean sea level over the next century, the fate of the fixed link will perhaps be only one of many issues, but the planned time span of the project makes it a suitable candidate for beginning to address the matter.

As an example of the inadequate consideration of mean sea level change, it is stated on page 6-5 of the BCA Supplement that " The additional effects of a long-term sea level rise, estimated to be 0.3 m/100 years, were also reviewed. Any design will incorporate this anticipated increase over the structure's 100 year life." In this case sea level rise was considered, but not to the extent recommended by Atmospheric Environment Service. AES recommends that designs incorporate a minimum mean sea level rise of 1 metre/100 years.

To adequately address this issue, an advisory mechanism, with Government of Canada participation, could be developed to deal with the problem of determining design parameters which take long term climate change into account. Advice obtained through such a mechanism should, if possible, be factored into the design of the crossing structure, as well as future projects designed for long service lives. Environment Canada is prepared to assist in the development and operation of such a mechanism.

### 3.7 CONTINGENCY PLANNING/EMERGENCY RESPONSE MEASURES

In general, contingency planning has been well addressed. The Generic Initial Environmental Evaluation made a number of recommendations, and the Panel has asked for and received information regarding worst case spill scenarios. To fully ensure that the final Contingency Plan is adequate to handle environmental or other emergencies which could arise, it is suggested that the final Contingency Plan be developed in consultation with agencies or groups which have specialized knowledge of and expertise in emergency response matters, such as Environment Canada and provincial Environment Departments.

### 3.8 ENVIRONMENTAL EFFECTS MONITORING

Environmental effects monitoring is carried out primarily to verify impact predictions, detect project-induced change in the existing environment, evaluate the effectiveness of the mitigative techniques being used and define corrective measures. It usually involves defining areas of expected or possible change beforehand, then employing measurement programs to determine whether or not such change is occurring. Normally, some degree of pre-project measurement activity is required to provide a background against which change can be measured. A well-designed plan should describe the main areas in which monitoring efforts will be concentrated,

as well as indicator variables to be monitored. There should also be a description of against what background and by what means changes will be assessed.

In the BCA Supplement, PWC states its commitment to ensuring that the developer's Environmental Management Plan for this project, of which the effects monitoring program will be a component, is satisfactory to all appropriate regulatory agencies prior to final approval of the project. Environment Canada strongly supports this commitment and believes that this approach will result in an acceptable final monitoring strategy.

A critical aspect of an effective Environmental Effects Monitoring program is the concept of attributability. Simply measuring an effect is not enough: it must be clearly attributable to the project. The key to being able to do this is pre-project measurement of indicator parameters. The measurements should therefore start before construction, and as far in advance as practically possible to maximize the ability to distinguish naturally occurring change from that induced by the project. This approach also works in favour of the proponent, in that it enhances the capability to distinguish between reasonable and unreasonable claims for damage compensation.

A description of the proponent's Environmental Effects Monitoring plans should be a key requirement of the Environmental Management Plan. The plan should detail the main areas in which monitoring efforts will be concentrated, as well as outlining indicator variables to be monitored, and against what background changes will be assessed.

### 3.9 ASSESSMENT OF CUMULATIVE EFFECTS

This matter has not been addressed to the satisfaction of Environment Canada. We believe that the impacts of this project cannot be looked at in isolation on an individual basis. The matter has been addressed from the perspective of project impacts being compounded by non-project phenomena, but the proponent has not assessed the possibility of synergistic interactions between two or more separate project activities or impacts. We believe this leads to an overly optimistic impression of what adverse effects might be caused by this development. For instance, the initial analysis might indicate that the effects of light, dust, exhaust fumes and noise are, when considered separately, not significant. However, if one considers that these effects will probably not be occurring separately, but concurrently, it seems reasonable to suggest that the combined effect could be more significant. The same logic applies to sequential effects.

This comment was also put forward during our review of the Generic Initial Environmental Evaluation. At that time, further analysis

was deferred to the Specific IEE. However, since the Specific IEE is no longer required, this remains to be addressed.

To address this matter, the original risk scoping work conducted in preparation of the Generic Initial Environmental Evaluation should be reviewed with particular attention to possible synergistic or additive effects of combinations of project activities.

### 3.10 ENVIRONMENTAL MANAGEMENT OF THE PROJECT

#### Environmental Management Plan

Since a project-specific IEE (Initial Environmental Evaluation) is no longer a requirement, the main tool for ensuring minimal impacts will be the developer's Environmental Management Plan (EMP). The BCA Supplement states that the EMP must be satisfactory to all appropriate agencies prior to project approval by PWC. Environment Canada firmly believes that this approach is essential to attaining the maximum level of environmental protection for this development, and therefore strongly endorses PWC's intentions in this regard.

The developer's overall environmental management strategy will be outlined in the Environmental Management Plan which is required prior to commencing the project. This document, when prepared, should clearly describe the specifics of the project, identifying the environmental objectives of the management team, and detailing the measures which will be undertaken to meet these objectives.

Environment Canada urges PWC to consider the establishment of an audit mechanism to ensure developer compliance with the terms and conditions of the Environmental Management Plan. This would help ensure that the environmental protection objectives of the plan are being met. Environment Canada is prepared to participate in the design and operation of such a mechanism, if requested by PWC. As one possibility, this function could be carried out by a committee of technical specialists with representation from PWC, Environment Canada, Fisheries and Oceans, and appropriate provincial agencies. This approach was used successfully by PWC during the preparation of the Generic IEE.

#### Environmental Protection Plan

An Environmental Protection Plan (EPP) will be a key component of a successful Environmental Management Plan, in that it will be the document which spells out the day-to-day do's and don't's required to meet the EMP's objectives (i.e. storage and handling of hazardous materials). However, in order for the Environmental Protection Plan to be effective, the initiative to adhere to its terms must come from the top. The labourer or heavy equipment operator will only attach importance to the EPP if he or she knows that it is a priority for the management team. Therefore, to familiarize workers at all levels of the project with the

procedures set forth in the EPP and the terms and conditions of the Environmental Management Plan, the proponent should consider implementing an employee training program, with the aim of increasing awareness of environmental protection as it relates specifically to this project.

#### 4. CONCLUSION

The Northumberland Strait Crossing Project is an ambitious undertaking for which there are few precedents in the world, let alone in similar environmental conditions. As such, there is no benchmark with which to predict impacts through direct comparison. This, in turn, dictates the application of known scientific principles in an attempt to: 1) identify all possible impacts; 2) identify mitigation for those which, upon investigation, appear most probable and; 3) determine if the remaining uncertainties or unmitigated impacts are acceptable. Over the past three years, Public Works Canada has attempted, where possible and with the assistance of resource departments such as Environment Canada, to satisfy these three requirements within the constraints of time, money and scientific capability.

It is virtually impossible to be certain of predictions involving as many variables as those in the natural environment. While the analyses carried out to date by PWC have not revealed any foreseeable impacts which are obviously completely unmitigable or would cause permanent environmental damage, a number of possible adverse environmental effects have been clearly identified. Therefore, Environment Canada believes that the questions and comments presented in this document must be addressed and resolved to ensure maximum consideration of environmental issues, should a decision be reached to proceed with the development as proposed. We further believe that the preparation of the Environmental Management Plan will represent a significant opportunity to do this, and the Department is prepared to assist PWC in that endeavour.

