December 2007

Peace River Site C Hydro Project

An Option to Help Close B.C.'s Growing Electricity Gap

Site C Feasibility Review: Stage 1 Completion Report

BC hydro

FOR GENERATIONS

Peace River Site C Hydro Project Feasibility Review: Stage 1 Completion Report

The Stage 1 review of project feasibility is a review of existing studies and historical information about the Peace River Site C Hydro Project, with a view to determining whether it is in the best interests of BC Hydro customers to move to the next stage of project planning and development.

Because Site C was examined as a resource option more than 25 years ago, and again from 1989 to 1991, significant work has been done on the project. At the same time, with the study of this project spanning several decades from different perspectives, it's important to note that some of the information is historical in nature and out of date. Subsequent stages of project review would need to update project information to current standards and further explore new ideas from communities, First Nations, regulatory agencies and stakeholders.

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BCEAA	BC Environmental Assessment Act
BCTC	British Columbia Transmission Corporation
BCUC	British Columbia Utilities Commission
CEAA	Canadian Environmental Assessment Act
CPCN	Certificate of Public Convenience and Necessity
CPI	Consumer Price Index
DFO	Fisheries and Oceans Canada
DSM	Demand Side Management
EPA	Electricity Purchase Agreement
FRPA	Forest and Range Practices Act
GHG	Greenhouse Gas
GWh/yr	Gigawatt Hours Per Year
ha	Hectare
HADD	Harmful Alteration, Disruption or Destruction
IEP	Integrated Electricity Plan (2004 or 2006)
IPP(s)	Independent Power Producer(s)
KCBL	Klohn Crippen Berger Ltd.
kV	Kilovolt
LTAP	Long-Term Acquisition Plan
MW	Megawatt
PAD	Peace-Athabasca Delta
REAP	Resource Expenditure and Acquisition Plan
SARA	Species at Risk Act
SNCI	SNC-Lavalin Inc.
VAR	Volt-Ampere-Reactive

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Purpose of Report

This report was undertaken to review and summarize existing studies and historical information about Site C, a potential third dam and hydroelectric generating station on the Peace River, to review the feasibility of the project, and to determine whether it is in the best interests of BC Hydro customers to move to the next stage of project planning and development.

BC Hydro has adopted a staged decision-making process for the Site C project. A staged process allows for multiple decision-making points during project development and helps to control costs by focusing on deliverables and objectives at each stage.

The staged approach is outlined as follows:

Stage 1: Review of Project Feasibility

Stage 2: Project Definition and Consultation

Stage 3: Regulatory – Environmental Assessment

Stage 4: Engineering

Stage 5: Construction

This report concludes the Stage 1 review of project feasibility. BC Hydro recommends moving to Stage 2.

In this review, BC Hydro addressed the following questions:

1. Is the anticipated magnitude of the electricity gap significant enough, particularly in the second decade of the 20-year planning horizon, that Site C should continue to be examined as a potential resource option?
2. Have any characteristics been identified to date that suggest Site C should not be considered further as a resource option?
3. Does Site C appear to offer sufficient overall benefits relative to the alternatives to justify further investigation?
4. Will further work on Site C provide information to guide decisions regarding Site C compared with other future resource alternatives?

Stage 2, focused on project and consultation definition, is beginning with discussions with stakeholders to gain initial input into a formal consultation process. This would be followed by project definition consultation with communities, First Nations, stakeholders and regulators to better understand the benefits, costs and impacts of the project. Stage 2 would also include continued and expanded technical and environmental studies to support this consultation process and to better define the project.

Context

A gap has emerged between BC Hydro customer demand for electricity and the capability of BC Hydro's owned and contracted resources to meet that demand. In fact, for the last six years, BC Hydro has had to import electricity to meet domestic needs. The gap between the demand for and supply of electricity in the province is forecast to widen considerably over the next 20 years, particularly in the second decade of the 20-year planning period. The current forecast for electricity demand indicates that B.C.'s electricity requirements will grow by between 25 per cent and 45 per cent over the next two decades.

BC Hydro has a legal obligation to serve the public pursuant to the *Utilities Commission Act.* To meet this obligation, it is important that BC Hydro has enough electricity to meet customer demand. BC Hydro has developed plans to address the demand-supply gap, focusing on the first 10 years of the 20-year planning period. In the 2006 Integrated Electricity Plan (2006 IEP), BC Hydro proposed a strategy to meet the demand for electricity in three ways: by conserving more electricity, by buying more electricity from independent power producers (IPPs), and by building more through investing in heritage assets and investigating new resource options. Even with increased conservation, substantial purchases from IPPs, and enhancements to existing BC Hydro resources, there remains a sizeable gap in the second decade of the 20-year planning period that calls for additional resources. BC Hydro may need to consider one or more large resource options, particularly to provide firm energy and capacity.

The *BC Energy Plan,* released in February 2007, provides further direction to BC Hydro's planning around future resource options. The *BC Energy Plan* outlines provincial policies around electricity and energy, and specifically calls for BC Hydro to achieve electricity self-sufficiency by 2016 and acquire additional "insurance power" of 3,000 gigawatt hours per year by 2026. Further, the *BC Energy Plan* outlines policy objectives regarding zero greenhouse gas emissions from coal-fired electricity, making a large coal project unlikely in this planning horizon. The *BC Energy Plan* also calls on BC Hydro to acquire 50 per cent of its incremental resource needs through conservation by 2020, maintain B.C.'s competitive electricity rate advantage and ensure clean or renewable electricity continues to account for at least 90 per cent of total generation. With respect to Site C, the *BC Energy Plan* states:

> *"BC Hydro and the Province will enter into initial discussions with First Nations, the Province of Alberta and communities to discuss Site C to ensure that communications regarding the potential project and the processes being followed are well known."*

Site C in northeast British Columbia was also included in the 2006 IEP as one of the potential resources that could meet part of the demand supply gap in the latter half of the 20-year planning horizon.

Resource Options

Conservation is the first and best choice, and the *BC Energy Plan* has set an ambitious target of acquiring 50 per cent of BC Hydro's incremental resource needs through conservation by 2020.

BC Hydro has planned additional calls for power that are expected to increase the electricity supply, including from renewable resources such as run-of-river, wind and others. The calls include:

- *A Standing Offer program for clean electricity projects less than 10 megawatts;*
- *A Clean Power Call with a target of ensuring that clean or renewable electricity generation continues to account for 90 per cent of total generation; and,*
- *A Bioenergy Call process with a Request for Expressions of Interest to assess the potential of using wood fibre for power production.*

Given the existing gap between supply and demand, and the ongoing growth expected in the next 10-year period, as well as the goal to achieve electricity self-sufficiency, BC Hydro will have to consider one or more major resource additions to supply firm energy and capacity. Firm energy and capacity, or an electricity source that is dependable 24 hours a day, 365 days a year, is important to guaranteeing customers' electricity needs are met. With new targets in the *BC Energy Plan* for zero greenhouse gas emissions from coal-fired electricity generation, and zero net greenhouse gas emissions from all new generation, it is uncertain whether coal or thermal would be likely options to meet BC Hydro's customer needs within this planning period and still maintain the target of ensuring 90 per cent of electricity generation be clean or renewable. Further, the *BC Energy Plan* restates a provincial commitment to no nuclear power.

There are some challenges involved with the type of large project that is required to provide dependable electricity. Large projects, and especially large hydro projects, typically have a long lead time. This is due to lengthy construction periods and substantial requirements for stakeholder engagement and First Nations consultation, regulatory review, engineering design and construction. Of the resource options available in British Columbia, large hydro has the longest lead time.

In addition, most of the resource options available to BC Hydro are outside the Lower Mainland and Vancouver Island regions. As a result, additional Interior-to-Lower-Mainland transmission will be required in virtually all cases. Faced with uncertain resource options at this time, it is prudent to maintain the full range of options, including Site C.

Site C Project Outline

As currently defined, Site C would be located downstream from the existing Williston Reservoir and two existing BC Hydro generating facilities, G.M. Shrum and Peace Canyon. The Site C project would provide 900 MW of capacity and generate, on average, 4,600 gigawatt hours (GWh) of energy annually.

In terms of delivery, key characteristics of Site C include:

- *Site C would deliver firm energy and capacity that would be highly flexible;*
- *Energy would be available during peak periods during the day and during the peak winter period;*
- *As the third project on one river system, Site C would optimize upstream storage and regulation;*
- *Minimal greenhouse gas impact once operational; and,*
- *Energy generated at Site C would be unaffected by fluctuations in natural gas costs that could affect other forms of energy supply.*

Interim Project Cost Estimates

Site C would have a significant upfront capital cost, a long operating life and low operating costs if built. Early conceptual project estimates updated in May 2007 indicate that Site C's interim capital cost estimate is between $5 billion and $6.6 billion in nominal dollars. These estimates reflect a levelized unit cost range from $46/MWh and $97/MWh in Fiscal 2008 dollars. This interim cost estimate will be updated at each stage of the project as the project is more fully defined.

As a decision on whether to build Site C is still a few years away, any project cost estimates are only interim. As with other capital projects, the final cost estimate will be fully known only after a competitive procurement process is complete and a final bid is accepted. This occurs just prior to construction.

Given the early stage and long lead time of the project, it's clear that there is uncertainty associated with the interim Site C cost estimate at this stage. For example, there are potential design and scope changes arising out of Stage 2 work that could increase the cost of Site C beyond the upper range currently contemplated. Future stages involving consulting, the regulatory process and engineering are also expected to affect the interim project cost estimate as are future changes in interest rates and inflation. Market conditions for labour and commodities are cyclical, and are likely to be different from current conditions when construction begins.

Cost analysis indicates that despite the large initial capital cost, the levelized unit cost range is competitive, and perhaps advantageous, compared with the cost of other resource options. The interim project cost estimate will need to be updated at each stage of the review and again prior to any decision to proceed with construction.

Communities and Stakeholders

BC Hydro is committed to a comprehensive and thorough consultation and engagement process through all stages of the project. Stakeholders can expect the project development and consultation to be fair and transparent and to address concerns regarding local impacts. First, BC Hydro will undertake a pre-consultation phase to involve communities and stakeholders in the design and approach of a thorough consultation process.

BC Hydro will also be reviewing input that was received from stakeholders over the last 30 years, since Site C was first conceived. The most extensive input from stakeholders was received during the 1982 BCUC hearing 25 years ago, and the 2006 IEP consultation, which had a much broader focus than just Site C.

Recently BC Hydro has increased collaborative public involvement, for example, through the Water Use Planning processes in the Peace region.

First Nations

Treaty and non-Treaty First Nations in the area have legal rights to be consulted about the potential impacts of the Site C project. Project impacts may need to be mitigated or accommodated. First Nations rights have been clarified by the Supreme Court of Canada. With respect to Site C, these rights are most strongly held by the Treaty 8 bands in B.C.

BC Hydro has had some recent successes in building respectful relationships and reaching agreements with local First Nations on other initiatives.

Land and Environment

The most significant environmental and social impacts would be due to flooding portions of the Peace River valley between Peace Canyon and Fort St. John, and of portions of the Moberly and Halfway Rivers.

Although many environmental studies have been undertaken with respect to the potential impacts of Site C, further study is required. Stakeholder and community engagement and First Nations consultation would help BC Hydro better understand the social and economic significance of the environmental impacts of the project, and how these impacts may be avoided, mitigated or compensated.

Other resource options would also have environmental impacts, and the Site C project should be evaluated in relation to these options. Within the context of the *BC Energy Plan*, Site C shares the benefit of BC Hydro's heritage assets in that it would have minimal greenhouse gas emissions once operational and is a renewable resource.

Regulatory Process

Should Site C advance to Stage 3 of the decision-making process, there are several federal and provincial statutes that would apply to the review of the project. Chief among these are the *Canadian Environmental Assessment Act,* the *B.C. Environmental Assessment Act, The British Columbia Utilities Commission Act,* the *Navigable Waters Protection Act* and the *Fisheries Act.* The review processes mandated by these statutes would provide a forum for community and stakeholder input, as well as consideration of mitigation and community benefit measures.

Other Issues

There are three other initiatives currently underway with potential implications for BC Hydro's operations in the Peace River area. First, the B.C.–Alberta Transboundary Water Management Negotiations might influence the regulatory processes for Site C, given the strong interest in Alberta in Peace River flows and any potential downstream impact of the proposed Site C development. Second, concerns that the construction of the W.A.C. Bennett Dam and the regulation of Peace River flows may have affected the ecosystem of the Peace-Athabasca Delta could influence consultation and engagement initiatives. Third, the environmental review of the proposed Dunvegan hydroelectric facility on the Peace River in Alberta could provide insight into issues of interest to stakeholders and regulatory agencies.

Conclusions

In response to the questions posed, the work on Stage 1 provided the following insights:

1. Is the anticipated magnitude of the electricity gap significant enough, particularly in the second decade of the 20-year planning horizon, that Site C should continue to be examined as a potential resource option?

Yes. BC Hydro has not faced a long-term supply challenge of the magnitude currently anticipated in several decades. Based on the feasibility review, and given the volume of electricity required to close the growing gap and further, to meet the goal of becoming energy self-sufficient by 2016, as well as to have an additional 3,000 gigawatt hours by 2026, it is recommended that all reasonable resource options are preserved, including Site C.

2. Have any project characteristics been identified to date that suggest Site C should not be considered further as a resource option?

No. Based on the analysis to date, no project characteristics have been identified that would render Site C unfeasible.

3. Does Site C appear to offer sufficient overall benefits relative to the alternatives to justify further investigation?

Yes. Site C offers an attractive electricity option relative to the alternatives, and further investigation into Site C is recommended. Site C would deliver firm, dependable electricity with a high degree of flexibility to meet peak periods of demand. Increasing BC Hydro's firm and flexible energy capacity could also further support the development of intermittent energy sources such as wind power. In addition, Site C would be immune to rising natural gas fuel costs that could affect other resource options and would cause minimal greenhouse gas emissions. At this stage, the estimated range of project costs is wide, but still potentially attractive relative to the cost and characteristics of other resource options.

4. Will further work on Site C provide information to guide decisions regarding Site C compared with other future resource alternatives?

Yes. Further work on the Site C project, in a staged decision-making and development process, will reduce the knowledge gaps that remain and better identify the project's benefits and impacts relative to the resource alternatives. Further work is recommended to help define the project, including project benefits and impacts and associated compensation, mitigation and avoidance options. Stage 2 work on the project involves extensive community and First Nations consultation, as well as environmental and technical studies.

Given the above recommendations, and consistent with the *BC Energy Plan*, BC Hydro is prepared to move to Stage 2 of the analysis of Site C as a potential resource option.

Introduction

1.1 A Growing Electricity Gap in British Columbia

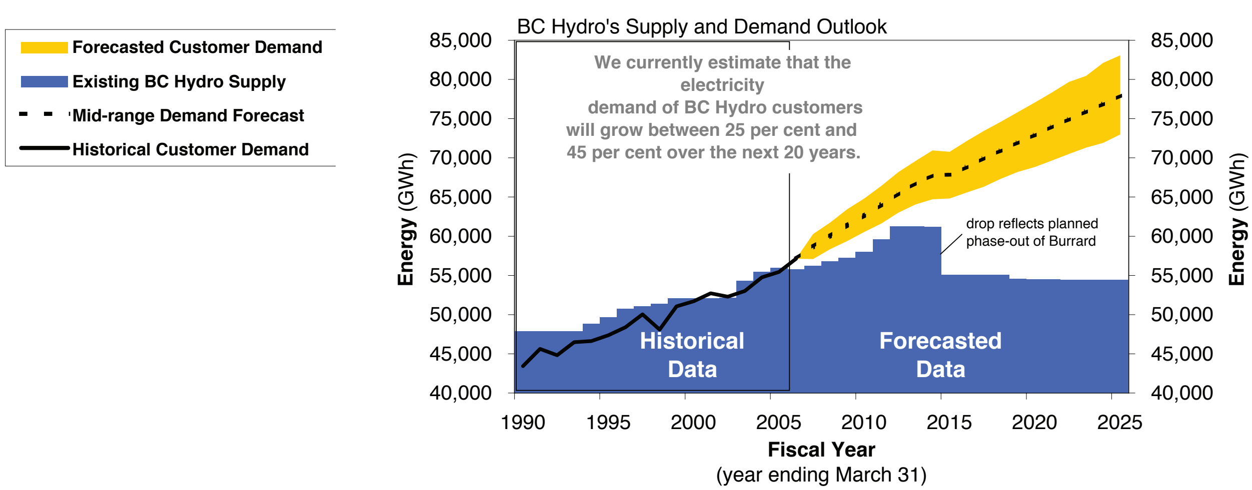
A gap has emerged between BC Hydro customer demand for electricity and the capability of BC Hydro's owned and contracted resources. This gap was described in the 2006 Integrated Electricity Plan (2006 IEP) that BC Hydro submitted to the British Columbia Utilities Commission. The gap between the demand for, and supply of, electricity in the province is forecast to widen considerably over the next 20 years, particularly in the second decade of the 20-year planning period. The current forecast for electricity demand indicates that B.C.'s electricity requirements will grow by between 25 per cent and 45 per cent over the next 20 years. The widening gap between electricity demand and supply is illustrated in Figure 1-1. While the magnitude of the gap in any particular year is uncertain, there is a consistent trend of steadily rising demand.

The *BC Energy Plan: A Vision for Clean Energy Leadership* (The *BC Energy Plan*) also calls for action to ensure that the energy needs of British Columbians continue to be met now and into the future.

BC Hydro has developed plans to address the demand-supply gap, focusing on the first 10 years of the 20-year planning period. In the 2006 IEP, BC Hydro proposed a strategy to meet the demand for electricity in three ways: by conserving more electricity, by buying more electricity from independent power producers (IPPs), and by building more through investing in existing assets and investigating new resource options. Even with the plans for increased conservation, substantial purchases from IPPs and enhancements to existing BC Hydro resources, there remains a sizeable gap in the second decade of the 20-year planning period that calls for significant additional resources. Risks to the amount of energy and capacity that can be provided by the planned demand side management (DSM) and IPP initiatives reinforces the need to investigate other resource alternatives.

The *BC Energy Plan* recognizes that the province needs to examine some large projects to meet growing demand, particularly to supply firm energy and capacity. British Columbia is fortunate to be able to consider several resource options, which could include large hydro, large biomass facilities, clean coal (not yet available) or natural gas plants. Each resource option has its own distinct attributes: the characteristics of the energy and capacity it can produce, and the social, environmental and financial costs it imposes. Large

Figure 1-1 **British Columbia's Electricity Gap**



hydro, for example, requires a particularly long lead time for development, while other large sources of firm supply must meet stringent greenhouse gas emission standards. Given the long lead time to bring on new large sources of supply, and the scope of the challenges B.C. faces, we must begin discussions of potential options now so we can fully understand the risks and advantages of each and make the required decisions in a timely manner.

The growing electricity gap in B.C. occurs in the context of rising concern about resource adequacy throughout North America. While there have been improvements in efficiency, economic growth continues to fuel electricity demand. In this context, reliance on external markets to help meet the demand-supply gap within B.C. is an increasingly risky option. Recognizing this, the province has outlined key policy actions to achieve energy security, including becoming electricity self-sufficient by 2016 plus additional 'insurance power' of 3,000 gigawatt hours of supply, on top of firm energy requirements and capacity resources, by 2026.

1.2 Site C: A Potential Resource Option

Site C, a potential third dam and hydroelectric generating station on the Peace River in northeast B.C., was identified in the *BC Energy Plan* as one of many resource options that can help meet BC Hydro's customers' electricity needs. Site C would be located downstream from the existing Williston Reservoir and two existing BC Hydro generating facilities. As currently defined, Site C would provide 900 MW of capacity and generate, on average, 4,600 GWh of energy annually. Site C would provide only a portion of the significant resources required to bridge the electricity-supply gap.

Since June 2004, BC Hydro has undertaken a feasibility review of Site C to better understand the advantages and disadvantages of the project. This preliminary analysis sought to answer four broad questions:

1. Is the anticipated magnitude of the electricity gap significant enough, particularly in the second decade of the 20-year planning horizon, that Site C should continue to be preserved as a potential resource option?
2. Have any project characteristics been identified to date that suggest Site C should not be considered further as a resource option?
3. Does Site C appear to offer sufficient overall benefits relative to the alternatives to justify further investigation?
4. Will further work on Site C provide information to guide decisions regarding Site C compared with other future resource alternatives?

In order to contain costs and effort to a level that is appropriate for an early stage of project evaluation, the preliminary analysis was conducted primarily as a desk-based exercise using information and materials available internally. In addition, BC Hydro constrained its investment in this evaluation to a level of detail that is broadly consistent with an early stage review. Such a review seeks to determine the practicalities of a project through the identification of any attributes that could render it unfeasible. Because of these limitations, knowledge gaps remain that would need to be addressed in the second and subsequent stages of evaluation.

The purpose of this report is to summarize existing studies and historical information about Site C, to review project feasibility and determine whether it is in the best interests of BC Hydro's customers to move to the next stage of project review, and to suggest next steps and recommendations.

There is a cautionary note with respect to the information contained in this report. The Site C project has a long, complex history in British Columbia. Many aspects of the project have been studied at different times, across several decades from different perspectives using varying techniques and different degrees of rigour based on the requirements of the time.

The facts contained in this report are the best known at this time and based on previous studies. Additional study and evaluation of the project including consultation with stakeholders and First Nations is expected to uncover new facts and perspectives that would revise the information contained in this report, and inform future decisions about Site C as a potential resource option.

1.3 A Staged Approach

The development of a large hydroelectric project such as Site C requires a long lead time relative to other resources, typically ranging from 10 to 12 years from early evaluation to full commercial operation. In comparison, other resources such as coal, natural gas or wind generation can be developed in four to seven years, about half the time that it would potentially take to develop Site C. Sufficient early work must be completed to maintain the option to build a large hydroelectric plant for a given in-service date. Projects such as Site C that require long lead times present particular challenges: early upfront evaluation and development work is required to preserve the in-service date; the early evaluation work must rely on long-range forecasts of both the future need for electricity and the characteristics of the various resource options; and there tends not to be a hard deadline to drive their schedule.

Success with respect to a large project such as Site C could have two outcomes. The project could be investigated, justified and built such that it achieves the objectives of its sponsor. Alternatively, the project could be investigated within budget and then abandoned in favour of other resource options, postponed, or drastically redesigned after sufficient investigation. Typically, a significant investment is required to evaluate whether a large project should fall into the second category. According to some international large project experts, the cost of the evaluation work ranges from between two and five per cent of the ultimate cost of the project. Based on the low end of this range, an investment of approximately $100 million – including the costs associated with this Stage 1 and subsequent stages of evaluation – could be required to ultimately determine whether Site C should proceed to construction.

Given the long lead time and the scope of the evaluation and development work, and in keeping with best practices for large capital projects, BC Hydro proposed a staged approach to developing the project at the Fiscal 2005/2006 Revenue Requirements Application hearing. A staged approach was developed to serve two key purposes. First, it allows for multiple points for decision-making and builds in milestones at which a decision can be made to continue advancing and maintaining the project as a viable option, or to postpone, redesign or abandon the project. Second, the staged approach serves to control costs by focusing on the deliverables and objectives of each stage.

Five stages are currently envisaged:

Stage 1: ***Review of Project Feasibility***

This report concludes Stage 1 and serves to summarize existing studies and historical information about Site C and to review project feasibility.

Stage 2: ***Project Definition and Consultation***

This stage involves further project definition and comprehensive engagement with communities, stakeholders and regulators, consultation with First Nations and discussion with the Province of Alberta to better understand the benefits, costs, impacts and risks of the project.

This stage will begin with a pre-consultation phase where initial discussions with key stakeholders, communities and First Nations will inform the design of a comprehensive consultative process. Stage 2 also includes further project definition, including environmental, engineering and socio-economic impact studies.

By the end of Stage 2, and all stages of the project, the cost estimates would be thoroughly updated.

Stage 3: ***Regulatory: Environmental Assessment***

Stage 3 involves BC Hydro's application for required major permits. As currently defined, Stage 3 involves BC Hydro preparing for and filing applications under the federal and provincial *Environmental Assessment Acts* and under the BC Utilities Commission. This includes BC Hydro consulting with agencies, First Nations and the public, gathering required information and preparing application documents. The regulatory agencies would then review the applications, consult as required with other agencies, First Nations and the public, and make recommendations to issue or not issue the relevant certificates.

Public, community and First Nations consultation continues through all stages.

Stage 4: ***Engineering***

Stage 4 would involve detailed engineering design work that would finalize the project design and construction plans. Preliminary engineering could also occur at earlier stages to advance project timelines.

Stage 5: ***Construction***

Construction is estimated to take about seven years. Upon completion of construction, the plant and associated facilities would be moved into operational service, and would be operated in accordance with all agreements and approvals.

As with any significantly large capital infrastructure project, there is uncertainty and risk about the project schedule, particularly in the earlier stages. At the same time, it is important to develop an indicative project schedule to anticipate an in-service date and understand implications of schedule changes.

With the exception of the last stage (construction), every stage would conclude with BC Hydro's full review of the project and a decision by the Province of B.C. as to whether to proceed to the next stage of project development. The staged process has been designed to provide the critical information at each stage to inform future decisions, including updating the context at each stage with a greater understanding of resource options, load forecasts and project implications. Public, community and First Nations engagement continues and cost estimates are thoroughly updated through all stages.

Prior to the start of construction, the Province of B.C. would have the option to proceed, cancel or defer further work on the project and to pursue alternatives with shorter lead times. It could make this decision with the benefit of the knowledge gained from future integrated electricity plans that would include updated information about load and price forecasts, assessments of the capability of existing resources, progress in terms of conservation and the acquisition of electricity from IPPs, and improvements in both conventional and emerging generation technologies.

1.4 Provincial Government Policy Context

Consideration of Site C as a potential resource option is undertaken in the context of, and is guided by, the *BC Energy Plan*. Government policy objectives and actions are contained in the document: *The BC Energy Plan: A Vision for Clean Energy Leadership*, released in February 2007. The policy actions listed below are particularly relevant to the Site C project.

- *Self-Sufficiency by 2016: Ensure self-sufficiency to meet electricity needs, including "insurance". Electricity generation and transmission infrastructure require long lead times. This means that over the next two decades, BC Hydro must acquire an additional supply of "insurance power" beyond the projected increases in demand to minimize the risk and implications of having to rely on electricity imports.*
- *All new electricity generation projects will have zero net greenhouse gas emissions.*
- *Ensure clean or renewable electricity generation continues to account for at least 90 per cent of total generation.*
- *Maintain our competitive electricity rate advantage.*

By providing reliable supply with dependable capacity and energy, Site C could potentially support the government's commitments to clean electricity generation. As the *BC Energy Plan* states, "the chief advantage of a hydro system is that it provides a reliable supply with both dependable capacity and energy, and a renewable and clean source of energy. Hydropower produces essentially no carbon dioxide relative to the other large resource options."

Site C could be a valuable component to the provincial government's plan to achieve self-sufficiency while maintaining competitive prices and zero net greenhouse gas emissions.

The plan further indicates that *"BC Hydro and the Province will enter into initial discussions with First Nations, the Province of Alberta and communities to discuss Site C to ensure that communications regarding the potential project and the process being followed are well known."*

The *BC Energy Plan*'s direction to move to Stage 2 of project development allows the opportunity to further explore project implications and potential benefits.

Expected Need and Resource Alternatives for the Period 2015 to 2025

Chapter 2

2.1 Introduction

BC Hydro has a legal obligation to serve the public, as defined in Section 38 of the *Utilities Commission Act:*

> *"A public utility must (a) provide, and (b) maintain its property and equipment in a condition to enable it to provide a service to the public that the commission considers is in all respects adequate, safe, efficient, just and reasonable."*

To meet this obligation, it is important that BC Hydro has enough electricity to meet customer demand. The economic and social consequences of insufficient electricity supply are considerable. These include increased costs for ratepayers as a result of importing energy during crisis periods, and reduced economic growth as companies relocate to more reliable and cost-effective electricity jurisdictions.

To manage the risk of not having enough electricity to meet demand, BC Hydro and the British Columbia Transmission Corporation (BCTC) adhere to certain planning criteria related to the supply of capacity, energy and transmission capability. The capacity and transmission criteria are based on standards specified by North American regulatory bodies and industry organizations. These planning criteria are described in Appendix 1.

Between 1965 and the early 1990s, BC Hydro enjoyed substantial surplus generation capability and reserve margins well in excess of those specified in the current planning criteria. Over the last decade, reserve margins have declined and brought the system close to a balanced state. Going forward, the system is expected to remain much closer to the minimum reserve margin requirements. In fact, BC Hydro has been a net importer of electricity for the last six years.

At the same time, BC Hydro's existing asset base is aging and requires substantial investment to maintain its reliability. In particular, the Burrard Generating Station is a very old thermal plant. BC Hydro anticipates replacing the energy and capacity produced by the plant by the middle of the next decade.

As a capital-intensive business, BC Hydro utilizes a long-term process to plan investments, acquisitions and other programs to ensure it meets demand. This is grounded in a policy framework set out by the provincial government and a set of objectives around minimizing costs and ensuring reliability. Key inputs include the load forecast; forecasts of gas and electricity prices; assessment of the present and future condition of BC Hydro's current assets and contracts; and an inventory of the potential resource options. BC Hydro develops portfolios of resources that adhere to provincial policy requirements and BC Hydro and BCTC planning criteria. These portfolios are then evaluated against decision criteria, which take into account the perspectives of First Nations and stakeholders as well as incorporate risk. Based on the results of this process, BC Hydro develops a long-term acquisition plan that prescribes the investments and actions required to meet the objectives.

The data in this chapter is drawn from the 2006 Integrated Electricity Plan (2006 IEP), submitted to the British Columbia Utilities Commission (BCUC) in March 2006 and amended in August 2006. Since this filing, the province released the *BC Energy Plan* in February 2007, setting out policy direction that affects potential resource options now and in the future. Key elements of the *BC Energy Plan* that potentially affect expected need and resource alternatives are:

- *All new electricity generation projects will have zero net greenhouse gas emissions;*
- *Zero greenhouse gas emissions from coal-fired electricity generation;*
- *Set an ambitious target to acquire 50 per cent of BC Hydro's incremental resource needs through conservation by 2020;*
- *Ensure clean or renewable electricity generation continues to account for at least 90 per cent of total generation; and,*
- *Ensure self-sufficiency to meet electricity needs, including "insurance".*

These policy directives and their potential impacts are further outlined in this chapter.

2.2 A Growing Electricity Gap

The focus of this chapter is primarily the period from 2015 to 2025. The 2006 IEP identified the demand-supply gap that has emerged between BC Hydro customer demand for electricity and the capability of BC Hydro's owned and contracted resources to meet demand. The 2006 IEP states that: "While in the past, B.C. has enjoyed significant surpluses of generating capability, for each of the last six years BC Hydro has been a net importer of electricity." This demand-supply gap is forecast to widen considerably over the 20-year planning period, particularly in the second decade, based on projected increases in customer demand and the likely replacement of Burrard Thermal Generating Station's energy and capacity after Fiscal 2013/14. The widening gap is illustrated in Figure 1-1.

To understand the nature of the gap, the associated uncertainty, the plans in place to mitigate it and the future actions that will be required to bridge it, it is necessary to consider the factors behind its estimation, as outlined below.

2.3 Forecast Load

Load forecasting is central to BC Hydro's long-term planning. BC Hydro's "Electric Load Forecast" is updated annually and provides information on where, when and how electricity could be required over the following 20 years. The current forecast indicates that B.C.'s electricity requirements will grow by between 25 per cent and 45 per cent over the next 20 years.

Since demand projections are based on estimates of future conditions, they are not precise and are subject to being updated. The Electric Load Forecast is sensitive to a number of variables, including population growth, electricity intensity and economic conditions. This uncertainty becomes more pronounced with forecasts that are further into the future. As a result, there can be significant changes in long-term forecast demand from year to year.

A depiction of the variation in BC Hydro's forecast demand is provided in Figure 2-1. The graph shows successive demand forecasts made from 1995 through 2006, the uncertainty band around the current demand forecast and the degree to which they have varied. This highlights the need to focus on a range of potential demand forecasts, rather than a single point forecast.

2.4 Forecast Supply

There are a number of existing, planned and potential resource options to fill the demand supply gap.[1] BC Hydro's Long-Term Acquisition Plan (LTAP) identifies the following significant new resources. Additions over the first 10 years (Fiscal 2005/06 to Fiscal 2014/15) of the 20-year 2006 IEP study horizon include:

- *Demand Side Management (DSM);*
- *Contracts with IPPs for new incremental electricity supply; and,*
- *Resource Smart projects.*

2.4.1 Demand Side Management

It's clear that energy conservation is the first and best option as a low-cost resource to help meet the electricity gap. Since 1989, BC Hydro's Power Smart program has helped customers to be more efficient, use power more wisely and ultimately use less to lower the requirements for new supply resources. Power Smart has already achieved savings of more than 4,000 GWh/yr. As described in the LTAP, the current DSM program, initiated in 2001, consists of two modules that are expected to deliver 2,700 GWh/yr of energy savings by 2015 and fulfill a substantial amount of the currently projected shortfall in the supply-demand balance over the 20-year planning horizon.

BC Hydro is already planning to develop and pursue three new DSM programs that are expected to deliver annual energy savings of 3,300 GWh/yr and reductions in peak demand of 400 MW by Fiscal 2014/15; and annual energy savings of 7,300 GWh/yr and reductions in peak demand of 1,100 MW by Fiscal 2024/25.

[1] The supply forecast in the 2006 IEP load resource balance includes both existing and "planned" resources. For the purposes of the 2006 IEP, planned resources are defined as those projects and programs that BC Hydro has decided to pursue and is taking actions to acquire. Planned resources have not necessarily received regulatory approval.

The *BC Energy Plan* increases the emphasis on DSM by setting an ambitious target to acquire 50 per cent of BC Hydro's incremental resource needs through conservation by 2020. However, as impressive as Power Smart's results are, conservation is just one part of the solution.

2.4.2 Electricity Purchase Agreements with IPPs

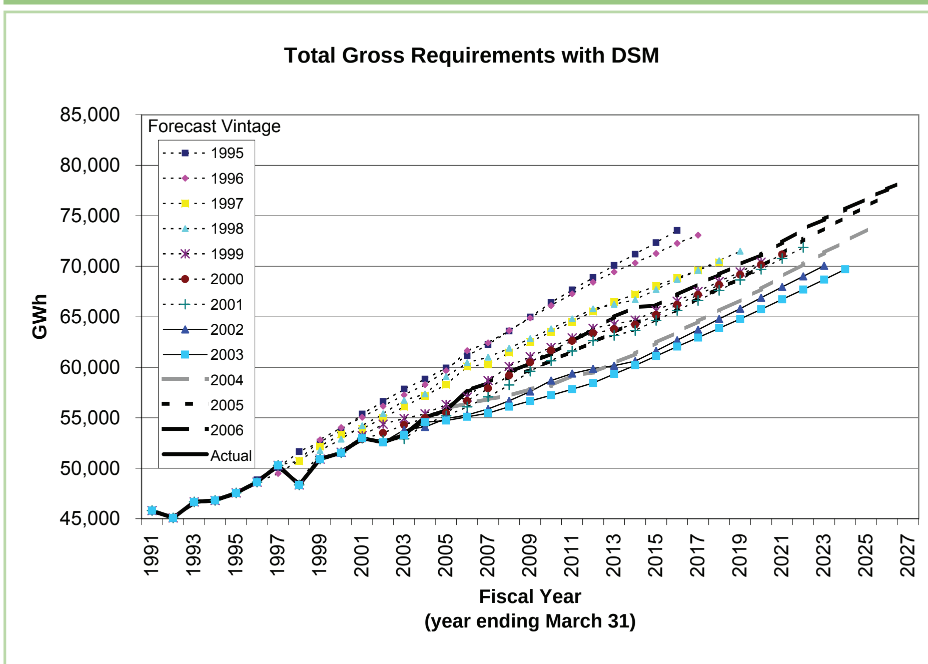
BC Hydro currently has 91 contracts with IPPs at either the operational or pre-operational stage. When and if developed, these projects will represent approximately 15,000 GWh/yr of energy and 3,600 MW of installed capacity. There are currently 44 projects in commercial operation providing 8,000 GWh/yr of energy. The other 47 projects are at various stages of development. A planned Clean Power Call is also expected to target approximately 5,000 GWh/yr for delivery. In addition, BC Hydro launched the Bioenergy Call process with a Request for Expressions of Interest to assess the potential of using wood fibre for power production. BC Hydro has also announced a standing offer program for clean electricity projects of less than 10 megawatts.

The cost of the electricity from the calls, the quantity of energy and capacity that would be acquired, and the firmness, reliability and correlation to load of the acquired power are uncertain and dependent on market conditions, supply gaps and the competitive procurement process under the calls. In addition, there are a number of reasons why some IPPs with EPAs may not be completed, meet their in-service dates, or deliver power as expected following completion.

2.4.3 BC Hydro Heritage Assets

BC Hydro's generation assets provide up to 49,000 GWh/yr of firm energy capability. This includes 42,600 GWh/yr of firm energy from the hydroelectric system and approximately 6,400 GWh/yr from the thermal generating stations (primarily Burrard). Typically, much of the thermal energy capability is replaced by more economic short-term market purchases or non-firm energy from BC Hydro's hydroelectric system. The dependable capacity of the BC Hydro hydroelectric facilities is approximately 9,800 MW. The dependable capacity of the thermal resources is 910 MW for six units at Burrard and 46 MW at Prince Rupert Generating Station.

Figure 2-1 **Actual vs. Forecast Electricity Demand 1990–2025 (predicted)**



2.4.4. Burrard Thermal Generating Station

Burrard, also a heritage asset, is an aging natural gas-fired generating station consisting of six turbine generator units of approximately 150 MW each. While Burrard currently contributes to BC Hydro's firm energy and dependable capacity, its thermal efficiency is low by current standards. BC Hydro currently plans to continue to rely on Burrard for dependable capacity (910 MW), firm energy (6,100 GWh/yr) and voltage support functions until the end of Fiscal 2013/14,[2] and to replace its energy and capacity with other resources by 2014.

The timing of the retirement of Burrard as a source of firm energy and capacity will ultimately reflect an assessment of economics and risk relative to current and future calls and market prices for electricity. While Burrard may be phased out more gradually, current planning assumes that operation of Burrard will cease by Fiscal 2014/15. If Interior-to-Lower-Mainland transmission reinforcements are delayed, the operation of Burrard may need to be extended.

2.4.5 Investing in BC Hydro's Heritage Assets

Since 1987, BC Hydro has implemented its Resource Smart program to invest in existing BC Hydro facilities to improve their output. Four Resource Smart projects are currently planned to upgrade existing facilities by adding incremental energy and/or dependable capacity. These projects, combined with three completed Resource Smart projects, are expected to provide an additional 300 GWh/yr of energy capability and 90 MW of new dependable capacity by Fiscal 2011/12.

There are several potential new Resource Smart projects that could help meet the need for additional capacity by Fiscal 2010/11, including the addition of a fifth generating unit at Revelstoke that will provide approximately 500 MW of capacity. There are three remaining units – Revelstoke Unit 6, Mica Unit 5 and Mica Unit 6 – that could add approximately 1,400 MW of dependable capacity in total and some additional firm energy.

These investments are consistent with the *BC Energy Plan* direction that calls for "investing in upgrading and maintaining the heritage asset power plants…to retain the ongoing competitive advantage these assets provide the province."

2.5 Electricity Gap Scenarios

In addition to a substantial investment in DSM and a continuation of BC Hydro's acquisition of electricity through competitive procurement, significant resources are required for the latter half of the 20-year planning period to address BC Hydro's supply-demand gap for electricity.

Figures 2-2 through to 2-5 show the supply-demand gap in terms of firm energy based on different supply assumptions. A balanced system would have a gap of zero. Variability in load forecast is represented by the grey band.

2.6 Resource Alternatives

The gap is the starting point for defining how much and when energy and capacity will be required. The 2006 IEP identifies the resource options available to bridge the demand-supply gap over the next 20 years. Each has different characteristics, risks and cost.

BC Hydro highlights the need to consider available supply options in its 2006 *Challenges and Choices* document:

> *As part of BC Hydro's responsibility to ensure we meet the province's electricity supply for the future, we are looking at a variety of options to fill our future needs and the gap that is emerging in the years ahead. Each of these options comes with its own economic and social benefits and costs; each comes with its own environmental advantages and risks. Each must meet the appropriate standards and regulations set by various levels of government.*

BC Hydro continues:

> *Given the scope of the challenges our province faces, delaying these discussions is not an option. We must begin the discussions of all potential options now so we*

[2] Until Fiscal 2008/09 only three units of dependable capacity (457 MW) and firm energy (3,050 GWh/yr) are available.

can fully understand the risks and advantages of each and make the required decisions in a timely manner.

Figure 2-6 illustrates the approximate availability of various resources in British Columbia. The resources with the greatest potential availability are coal and natural gas followed by wind and large hydro. Other resource types do and will continue to play an important part in BC Hydro's supply portfolio. These resource options are affected by the *BC Energy Plan*. Specifically, the policy direction that there be zero greenhouse gas (GHG) emissions from coal-fired electricity generation and zero net GHG emissions from thermal electricity generation means that it is prudent for BC Hydro not to rely on new gas projects or coal-fired electricity in British Columbia for this planning horizon.

2.6.1 Resource Options Outside British Columbia

In addition to B.C. resource options, there are potential resource options outside the province. For example, there are a number of potential opportunities to acquire power from Alberta, including contracts with existing or new thermal projects or with cogeneration projects in the oil sands. The likelihood of significant surplus electricity cogeneration from the latter, however, has diminished recently as a result of technological changes in the oil sands process and the strategic intent of the oil sands developers to focus on oil production rather than electricity production.

A potential challenge related to the acquisition of power from outside B.C. is the reliability of the transmission lines between the two provinces. The import of power from Alberta is often subject to transmission limitations at peak times and, as a result, it is unlikely that it could be considered a firm capacity resource for B.C. without significant additional transmission capacity. There is typically more transmission capacity available from the United States, but this would require further assessment.

Further, the *BC Energy Plan* requires BC Hydro to achieve self-sufficiency by 2016 and to acquire an additional 3,000 gigawatt hours of "insurance" by 2026. This means a reduced reliance on imports over time, and that BC Hydro needs to meet the electricity gap through B.C.-based options such as conserving more, buying more from IPPs, investing in existing assets and potentially developing Site C.

2.6.2 Resource Options

The key characteristics considered in the evaluation of resource options are the capacity and energy they provide, location, associated environmental and social impacts, price, and the required time to develop them. The energy and capacity a resource provides also varies in terms of firmness, the annual and daily profile of the energy delivery, and the flexibility in scheduling generation. In order for BC Hydro to meet its expected demand, it needs to have a certain amount of reliable energy available 24 hours a day, 365 days a year.

Annual Profile: A firm resource can be relied upon in one of two ways: it can reliably deliver a certain amount of energy on an annual basis, and/or it can reliably provide power at peak times during November to February coincident with BC Hydro's highest load.

In evaluating the annual profile of the energy delivered by a resource, consideration is given to the extent to which it matches the profile of BC Hydro's energy requirements. If a chosen resource is not firm, BC Hydro may need to acquire additional energy and/or capacity resources to meet these requirements. A poor match also means that the resource will draw on BC Hydro's storage capability to shift the energy into the peak load period. For example, generation from hydroelectric resources without storage will typically peak during the spring and early summer, at the time when BC Hydro's loads are at their lowest. Much of this energy would need to be effectively stored for later use during higher load periods.

Daily Profile: As with the annual profile, it is also important to consider whether the daily profile of the energy delivered by a resource matches the daily profile of BC Hydro's energy requirements, which typically peak in the late afternoon and early evening.

Flexibility: The annual and daily profiles are closely associated with flexibility. Flexibility reflects the degree to which a resource can be shut down or curtailed during times when loads are low or market prices are below production cost, and the degree to which generation can be dispatched at full output in peak load times or at times of high market prices.

Location: Location is important as it drives the need for transmission investment. Other than DSM, most potential resources are located outside of the Lower

Mainland and Vancouver Island regions and therefore put increasing burdens on the Interior-to-Lower-Mainland transmission system.

Environmental and Social Impacts: Environmental and social impacts are important as they can translate into future financial obligations as societal values change. They can also affect the degree to which a project will be accepted by communities and First Nations and the likelihood of regulatory approvals.

Price: Price and price risk are critical features in terms of maintaining BC Hydro's low cost advantage.

Development Lead Time: Development lead time refers to when work on a resource option needs to begin in order for an option to be ready for a given date. In some cases, the transmission required to transport power from a resource to the load centre has a longer lead time than that of the supply resource itself.

There are considerable differences in the expected development time required for each resource option and in their expected life. Figure 2-7 provides a summary of the lead time required for the various electricity resource options and their expected useful life. The lead time required for major transmission lines exceeds that required for all resource options except for "Large Hydro."

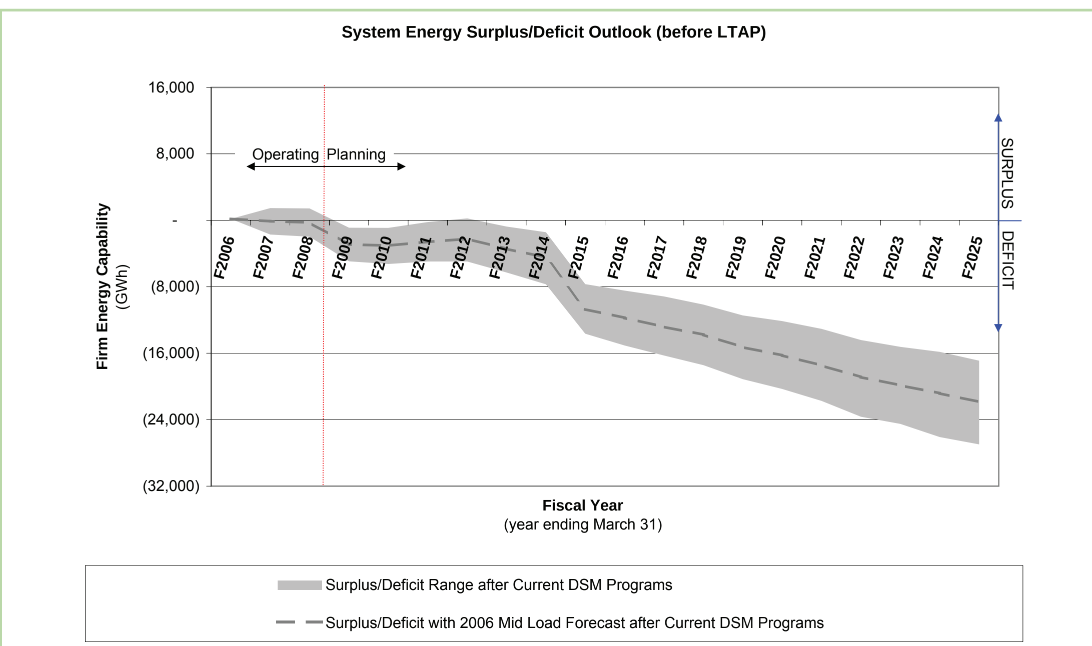
Table 2-1 and Table 2-2 provide a summary of the characteristics of the electricity resource options.

2.6.3 Site C Project Characteristics

In conjunction with the upstream storage of the Williston and Dinosaur Reservoirs, Site C would be able to provide energy that is highly dispatchable and that could help match the system's resources to demand. These characteristics are shared by the Peace Canyon and Revelstoke facilities, which are also downstream of major reservoirs. As described in the Facility Asset Plan for G.M. Shrum:

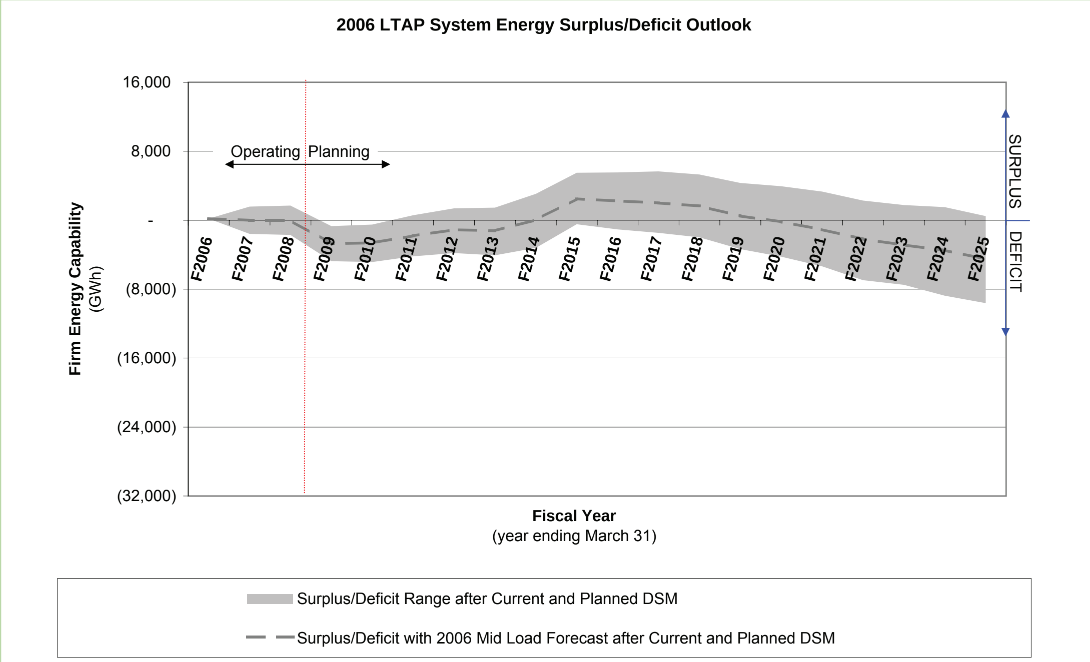
> *Williston and Dinosaur reservoirs allow BC Hydro to manage instantaneous demand while providing ancillary services, when necessary, to the provincial grid. Ancillary services include operating and spinning reserve, voltage support, black start, VAR compensation and rotating energy. [G.M. Shrum] and [Peace Canyon] can shape generation into peak times of the day while maintaining flows downstream of [Peace Canyon] for fisheries and ice management. Also, the large storage capacity allows BC Hydro to limit generation at these plants while importing electricity during periods when market prices are low.*

Figure 2-2 **B.C.'s Electricity Gap (2006 Before Long-Term Acquisition Plan [LTAP])**



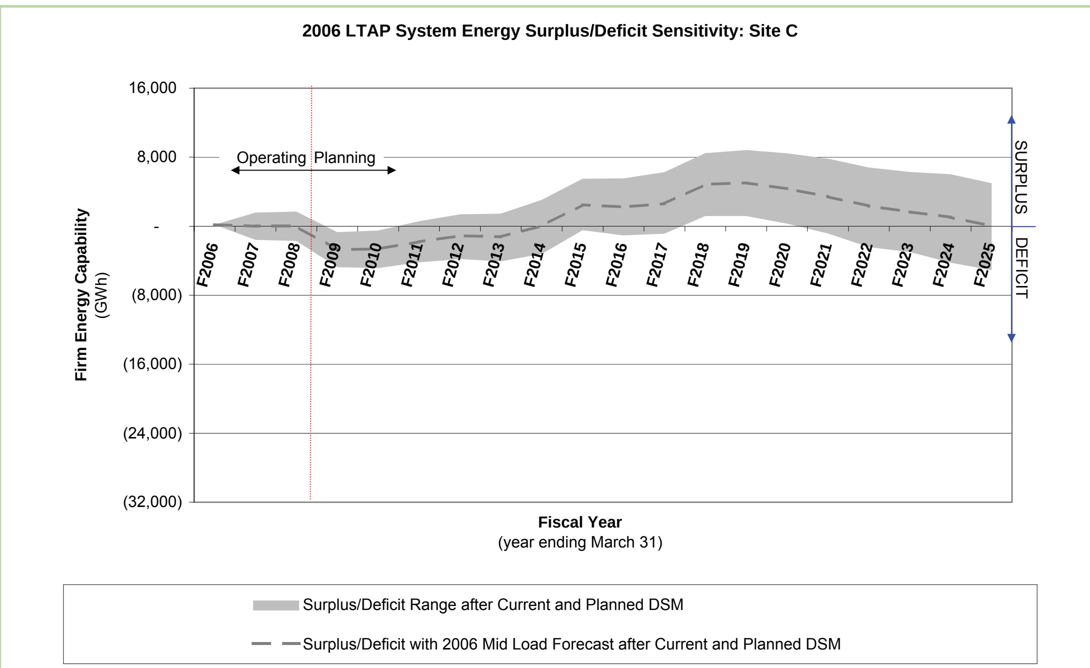
Resource Supply includes the expected volumes from the Fiscal 2006 Call and ongoing DSM programs. It does not reflect planned future activities identified in the LTAP, such as future competitive procurement processes, DSM programs, Resource Smart programs, or other potential acquisitions. The gap begins in Fiscal 2009 and continues to grow. The widening gap highlights the significant electricity supply that needs to be developed.

Figure 2-3 **B.C.'s Electricity Gap (2006 LTAP)**



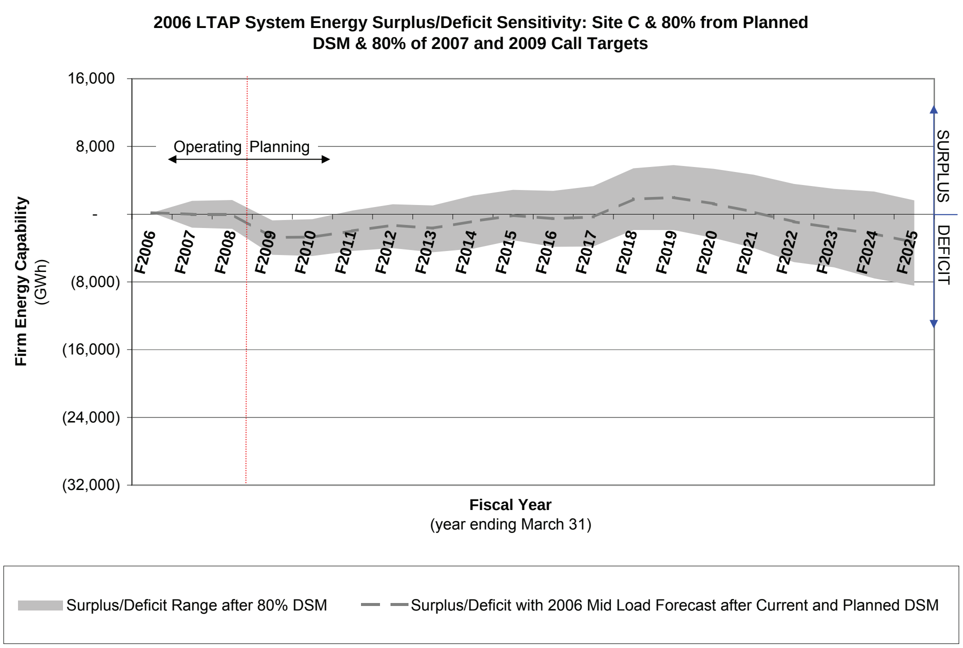
In addition to the resource supply assumptions in Figure 2-2, Figure 2-3 incorporates planned volumes from the Fiscal 2007 and Fiscal 2009 Calls as well as future DSM programs and Resource Smart programs. Depending on the load forecast, the gap is substantially mitigated in five to seven years but eventually arises again as load grows.

Figure 2-4 **B.C.'s Electricity Gap (2006 LTAP with Site C)**



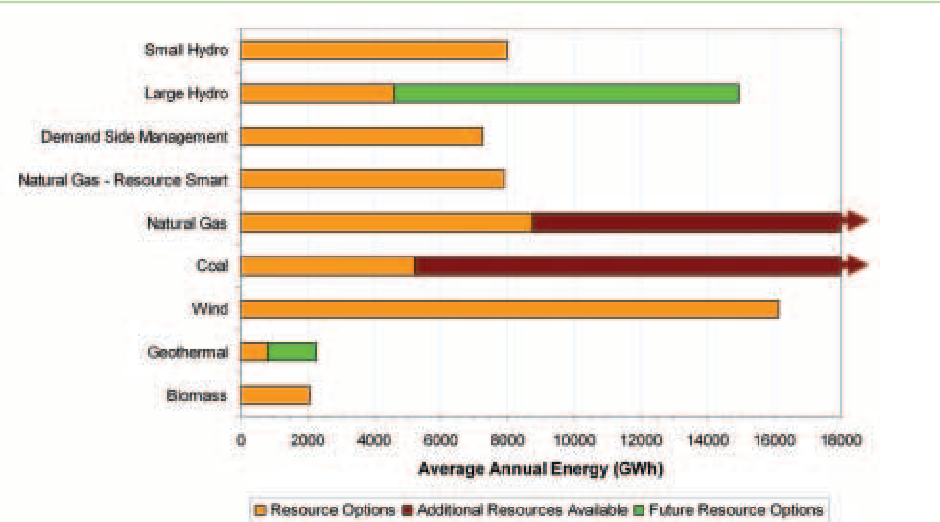
Here, Site C is added to the resource supply assumptions in Figure 2-3 assuming a 2017 in-service date.

Figure 2-5 **B.C.'s Electricity Gap (2006 LTAP, Site C, 80% Planned DSM and 80% Calls)**



Here, resource supply is based on an assumption of 80% of volume of energy from the Fiscal 2007 and Fiscal 2009 calls and from the planned DSM programs. Other resource assumptions are consistent with those in Figure 2-4.

Figure 2-6 **Potential Electricity Generation Resource Availability in B.C.***



** Solar and tidal power are potential future resource options, but currently have limitations for large-scale use.*

From an operating standpoint, Site C would act as an extension and integral part of the Peace River system capable of providing firm capacity and energy that would be very flexible.

As with BC Hydro's other Peace River facilities, energy would be available during peak hours within the day and during the peak winter period. The environmental and social impacts associated with Site C are reviewed in Chapter 6.

2.7 Resource Choices of Other Jurisdictions and Around the World

In many jurisdictions throughout North America, policy makers, regulators and utilities are struggling with the same planning issues related to the supply and demand for electricity as British Columbia. Most jurisdictions, particularly those in the United States, have fewer potential resource options than B.C. Based on projects in the planning and development phases, gas and coal-fired generation are both expected to play a continuing role for base-load supply in the U.S. Gas generation offers short lead times and can be sited close to load centres to avoid transmission constraints. Although coal-fired generation can be economic given the high cost of gas, and technological improvements have been able to enhance efficiencies and reduce greenhouse gas emissions, there are significant commercial and technical challenges to entirely eliminating greenhouse gas emissions. There has been and will likely continue to be a greater emphasis on the role of renewable generation, such as wind. Nuclear power is receiving further consideration in the U.S. given the cost of fossil fuels, concern about greenhouse gas regulation, improved performance from the nuclear fleet, and recent policy changes that have streamlined the regulatory framework for nuclear power. Nuclear power is also under consideration in Ontario.

In contrast, there has been a resurgence in proposals for development of large hydroelectric facilities in Canada, with recent proposals in Quebec, Manitoba and Newfoundland and a number of projects in development. This has been driven by favourable economic circumstances, including relatively high fossil fuel prices, relatively low interest rates and concern about greenhouse gas emissions.

Throughout the world, resource choices are generally driven by the magnitude of the need and the availability of options. Gas, coal and nuclear power are all being relied on to meet growing demands. In countries with untapped hydro potential, such as China, Turkey, Iran and India, substantial new hydroelectric development is underway.

2.8 Transmission Issues

Transmission is an important concern as most resource options are located in the interior of the province, remote from the load centre. The BCTC plans, manages and operates BC Hydro's transmission system. New transmission lines and other transmission system upgrades increase the transmission network's capability to transfer electrical power from generators to loads. Decisions about the inclusion of, and timing for, a transmission option to support resource portfolios will depend on the mix and sequence of supply-side and demand-side options.

Deficiencies in transmission system capacity decrease reliability, increase power losses and increase operating complexity. Adding a transmission line to the existing transmission system will increase the network's power transfer capability, while at the same time reducing losses. Building a new transmission line is a capital-intensive option with a long lead time and impacts on the local environment and communities. Projects involving upgrading existing transmission lines usually have much shorter lead times because regulatory requirements are reduced. Upgrading existing equipment can increase transmission capability, particularly in the short term. Most upgrade options result in higher system losses and usually provide only limited improvement in power system capability. In addition, they make system operations more complex and, in the long term, would result in higher overall transmission system costs due to increased system losses and rapidly escalating unit capital costs. Upgrading existing lines and other equipment can increase the capability of the existing network.

There are currently four key bottlenecks, or constraints, in the bulk 500 kV transmission system:

- *Lower Mainland to Vancouver Island;*
- *Interior (Kelly/Nicola) to the Lower Mainland;*
- *Selkirk Area (Kootenays) to Kelly/Nicola (South Central Interior); and,*
- *North Coast.*

These bottlenecks place constraints on building portfolios due to the lead times of the associated reinforcement projects. The impacts of these existing bottlenecks can be mitigated or exacerbated by the choice of resource options. Strengthening the inter-regional bulk transmission system mitigates regional imbalances in demand and supply and provides a greater choice of resource portfolios, particularly in the short term.

An increase in Interior-to-Lower-Mainland transmission is required at its earliest in-service date of Fiscal 2013/14 by all portfolio options shown in the 2006 IEP except the portfolio of substantial additional thermal generation in the Lower Mainland and Vancouver Island region.

The time required for major transmission upgrades often exceeds the time required to develop the supply options. The risks associated with the development of major transmission infrastructure are also considerable. To facilitate resources remote from BC Hydro's load centre, commitments for transmission may be required well in advance of commitment to supply resources. Failure to achieve DSM objectives could heighten the need for additional transmission.

2.9 Issues & Recommendations

The issues associated with defining the expected need for electricity and resource alternatives for the period from 2015 to 2025 include the fact that the forecasted size of the supply-demand gap is expected to change each year as it is dependent on actual load growth, progress made in electricity coming online by independent power producers and success of conservation programs and demand side management.

The staged decision-making process for reviewing Site C allows the most current forecast and issues to be considered at each stage.

Figure 2-7 **Development Lead Time Requirement and Useful Life of Electricity Resource Options**

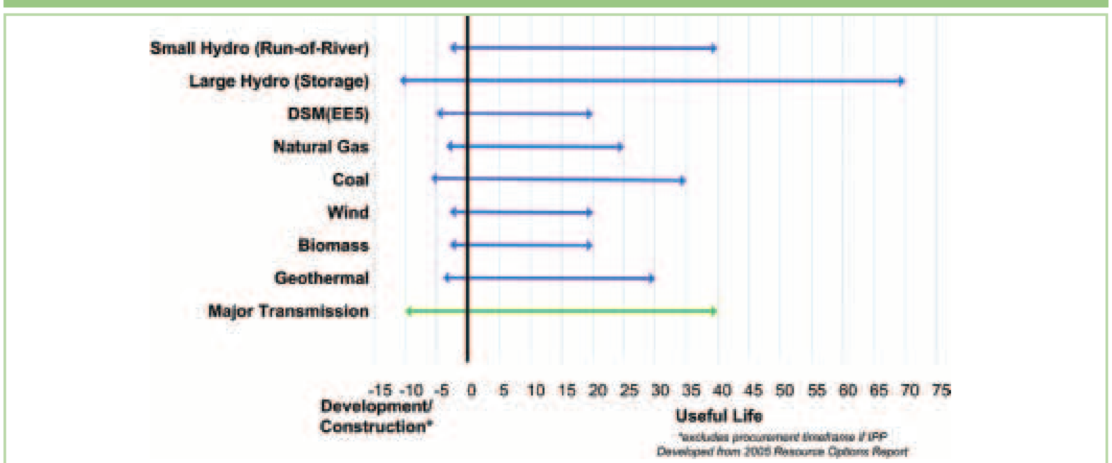


Table 2-1 **Energy and Capacity Attributes of the Electricity Resource Options**

	ENERGY	CAPABILITY	PORTFOLIO CONSIDERATIONS
SMALL HYDRO (run-of-river)	*Intermittent energy delivered on a seasonal basis*	*Low dependable capacity*	*Requires other resources that provide dependable capacity; may aggravate system constraints in May-June timeframe when load is low and minimum generation requirements are high.*
HYDRO (with storage)	*Dispatchable, firm energy subject to minimum flow obligations*	*Dependable capacity, particularly in conjunction with storage*	*Supports intermittent resources by providing some system shaping capability; subject to low water years; further dependence on water as "fuel".*
DSM	*Reliable reduction in firm energy requirements (once obtained)*	*Reliable reduction in firm capacity requirements (once obtained)*	*Potentially a very attractive "resource"; avoids transmission cost.*
NATURAL GAS	*Dispatchable, firm energy*	*Dependable capacity*	*Provides base-load or intermediate load capability; high level of optionality; will need to meet zero net greenhouse gas emissions as per BC Energy Plan.*
COAL	*Dependable, firm, base-load energy*	*Dependable capacity*	*Provides base-load energy and capacity; will need to meet zero greenhouse gas emission target in BC Energy Plan.*
WIND	*Intermittent energy*	*Low dependable capacity*	*Requires other resources which provide dependable capacity. May be coincident with load (dependent upon location).*
BIOMASS	*Dependable, firm base-load energy*	*Dependable capacity*	*Provides base-load energy and capacity.*
SOLAR	*Intermittent energy*	*Low dependable capacity*	*Most installations of technology are at a small scale. Cost barriers currently may prevent it being adopted at a wide scale.*
TIDAL	*Intermittent energy*	*Moderate dependable capacity*	*Commercial applications of the technology are under development.*

Table 2-2 **Other Attributes of Electricity Resource Options***

	Financial Cost	Environmental Impacts		
	*COST DRIVERS**	*AIR**	*LAND*	*WATER*
SMALL HYDRO (run-of-river)	• *Low operating cost* • *No fuel cost* • *Large initial capital investment*	*None*	*Affects wildlife habitat, traditional and recreational uses, agriculture*	*Diverts a portion of stream flow; may affect recreational uses*
LARGE - SCALE HYDRO (such as Site C)	• *Low operating cost* • *No fuel cost* • *Large initial capital investment*	*Minimal*	*Affects wildlife habitat, traditional and recreational uses, agriculture*	*Changes portion of river inundated; may affect flows downstream and fish habitat*
CONSERVATION	• *Low operating cost* • *No fuel cost* • *Can require large initial capital investment*	*None*	*None*	*None*
NATURAL GAS	• *Significant fuel cost* • *Low operating cost* • *Moderate capital investment*	*Nitrous Oxides largely controllable, Carbon Dioxide emissions must be offset.***	*Limited to plant site*	*Consumptive water use*
COAL	• *Even split between fuel cost (coal) and service on capital*	*Some Sulphur Oxide or Mercury emissions; Carbon Dioxide emissions must be captured.*	*Footprint would include mine and transportation infastructure*	*Consumptive water use*
WIND	• *Low operating cost* • *No fuel cost* • *Large initial capital investment*	*None*	*Visual impact of towers; typically located on ridges or on coast*	*Potential impacts on ocean floor, mammals and fisheries at offshore sites*
BIOMASS	• *Low operating cost* • *Low fuel cost* • *Large initial capital investment*	*Dependent upon fuel burned; possible local air impacts*	*Limited to plant site*	*Consumptive water use*
SOLAR	• *Low operating cost* • *No fuel cost* • *Large initial capital investment*	*None*	*Utilizes buildings; no change to existing footprint.*	*None*
TIDAL	• *Moderate operating cost* • *No fuel cost* • *High capital cost*	*None*	*Limited to powerhouse footprint*	*May affect fish, marine mammals and fishing operations*

* Based on emissions during operation. However, all resources except conservation have a GHG impact during construction and filling of reservoirs (for hydro with storage).

** In addition, the *BC Energy Plan* mandated that 90 per cent of total electricity continues to be clean or renewable, which means no more than 10 per cent may be generated through options such as coal or natural gas.

History of the Site C Project

Chapter 3

3.1 History from the 1950s to 1985

3.1.1 1950s

In the 1950s, the first steps were taken to develop the hydroelectric potential on the Peace River. Exploratory surveys undertaken in 1956 by a predecessor company to BC Hydro showed that the Peace River canyon possessed the basic requirements for a hydroelectric dam that would create the largest man-made reservoir in the world. In addition to potential sites at Portage Mountain (as W.A.C. Bennett Dam, Williston Reservoir and G.M. Shrum Generating Station were collectively known at the time) and Peace Canyon, alternatives for the development of the Peace River between Peace Canyon and the Alberta border were explored. In 1958, five potential sites were identified: Sites A, B, C, D and E. These sites are illustrated in Figure 4-7.

3.1.2 1960s

The development of the Peace River for hydroelectric power began in earnest following the creation of BC Hydro in 1962. The W.A.C. Bennett Dam and the G.M. Shrum generating station began generating electricity in 1968. At the time, a dam site at Site E near the B.C.-Alberta border was considered in conjunction with a dam site upstream at either Sites A, B, C, or D to develop the potential hydroelectric resource between the Peace Canyon Dam and the Alberta border. In 1967, geological reconnaissance determined that Sites B and D were unattractive due to unstable geology, while Site A would require the removal of significantly more overburden. Sites C and E alone remained viable options.

3.1.3 1970s

BC Hydro continued to undertake significant hydroelectric construction projects throughout the province in the 1970s. The Peace Canyon Dam and generating station began operation in 1980. Further investigation continued in the Peace River area for the appropriate location for a third dam in the Fort St. John, Site C area. In 1976, three alternate dam sites were investigated. The present Site C location was determined to be topographically and geologically preferable to the two other sites and was selected as the site for the 1976 feasibility study. At the time, a concrete gravity dam similar in design to Peace Canyon was envisaged.

In 1978, preliminary design work was undertaken which confirmed that the current Site C location was the best option. The design work proposed an earthfill dam, as the type and strength of the foundation bedrock made a concrete gravity dam unfeasible.

BC Hydro began a passive land acquisition program, providing owners of land who would be directly affected by the potential project with the option to sell their property to BC Hydro. Public consultation for the Site C project began in 1975. Public meetings specific to Site C began in 1977, and a Site C information centre was opened in Fort St. John in 1980.

3.1.4 1980s

In September 1980, BC Hydro applied to the provincial government for an Energy Project Certificate for Site C. In 1981, the government referred the application to the British Columbia Utilities Commission (BCUC) for review under Part 2 of the new *BCUC Act*. The review called for an examination of the project's justification, design, impacts and other relevant matters. The government specifically directed the BCUC to recommend whether an Energy Project Certificate should be issued, and if so, to stipulate the conditions that should be attached.

The BCUC held formal local First Nations and community hearings to hear and examine evidence on all aspects of the project. Intervenors expressed opinions on most aspects of the application. The social and economic impacts featured most prominently. The issues most frequently raised by those who were critical of the development were the loss of agricultural land and the potential loss of portions of a river valley. Many speakers referred to the impact of Site C on the local climate. Concerns relating to the financial aspects of Site C included the cost of Site C, the amount of debt to be incurred by BC Hydro and the potential burden on BC Hydro's customers. The primary concern of First Nations speakers was the threat posed by Site C to their way of life and livelihood.

Those voicing support for the project included some associations representing province-wide stakeholders who favoured adding reliable electricity supply. There were also regional stakeholders who spoke in favour of development because they preferred hydroelectricity over coal and other resource options. Some others also supported the project as a means of economic development in the region.

In 1983, the BCUC released its report and recommendations.

> *[While] the Commission recognizes that major impacts will result from the Site C project, the Commission concludes that they are not so large as to make them unacceptable. Provided that appropriate conditions are placed on Hydro and the government responds to the special needs created in the region, the impacts can be successfully and acceptably managed.*

The BCUC nonetheless concluded that:

> *An Energy Project Certificate for Site C should not be issued until (1) an acceptable forecast demonstrates that construction must begin immediately in order to avoid supply deficiencies and (2) a comparison of alternative feasible system plans demonstrates…that Site C is the best project to meet the anticipated supply deficiency.*

In November 1983, the Lieutenant-Governor in Council denied the application by BC Hydro for an Energy Project Certificate for the Site C project.

The BCUC also recommended the cancellation of the flood reserve downstream of Site C since "without such a measure the possibility of further agricultural reserve loss in the region would remain." In 1985, the flood reserve was cancelled by the province.

3.2 History from 1989 to 1991

In 1989, the potential need for new supply before 2000 was identified. BC Hydro revisited the prospect of proceeding with Site C and began further preparatory work on the project. A public consultation committee was created, and local municipalities and key interest groups in the region were invited to discuss and review the project.

At the time, BC Hydro decided to transfer engineering design to the private sector. Following a competitive selection process, a joint venture of Klohn Crippen Consultants Ltd. (now Klohn Crippen Berger Ltd. or KCBL) and Shawinigan Integ (which was subsequently acquired by SNC Lavalin Inc. or SNCI) were selected as prime consultants for Site C. Their mandate was to prepare tender designs for the early contracts; undertake studies and investigations to advance the design of major structures; and to review, modify as necessary and accept responsibility for the preliminary design by BC Hydro. Preparatory engineering activities for Site C commenced in 1989 and continued in 1990. In March 1991, a decision was made to suspend engineering and other work as opportunities for demand-side management and gas-fired generation appeared to be more attractive ways to meet demand.

The Peace Site C Summary Status Report was completed in 1991. That work is now 16 years old and must be updated due to factors such as changes in design standards.

3.3 History from 2000 to the Present

3.3.1 Early 2000s

In 2000, the Peace Williston Advisory Committee, a public advisory committee to BC Hydro's Board of Directors, requested the *Site C Lands: Economic Opportunities Assessment Impact Assessment* to determine the regional economic implications of BC Hydro and the Crown holding Site C lands for potential future hydroelectric development. The report concluded that there were no major economic impacts on individual sectors of the economy, although there were some localized, non-quantified impacts on population, agriculture, tourism and some services.

In preparation for the 2001 resource plan, BC Hydro reviewed the scope of the Site C project, including regulatory requirements, project costs and the overall project schedule as well as alternative sites to develop the hydroelectric potential between Peace Canyon and Site C. The review was to take place over a two-year period, with an estimated cost of $2 million. An initial approval of $1 million was given for the first year of work. After completion of the first year of work, BC Hydro cancelled its plans to produce a resource plan because of the pending provincial Energy Policy. As a result, further work on Site C was postponed.

3.3.2 2004 Integrated Electricity Plan (2004 IEP)

In March 2004, BC Hydro filed the 2004 Integrated Electricity Plan (2004 IEP). The 2004 IEP concluded that the Site C project was "technically sound with significant investigation and design." It recommended to:

> *Maintain Peace River Site C as it is economic and the portfolio NPV results are relatively insensitive to different gas and electricity price scenarios. It has a long lead time, so discussions with First Nations and stakeholders need to be initiated and studies need to be completed to preserve Site C as a resource option for capacity and energy needs ten years from now.*

The 2004 IEP identified "consulting with First Nations, engaging stakeholders, and pursuing licensing and environmental assessment processes" as the required next steps on the project.

3.3.3 2006 Integrated Electricity Plan and Fiscal 2007/2008 Revenue Requirements Application

BC Hydro filed the 2006 IEP in March 2006. Site C was selected for inclusion as a resource option on account of its "apparent low unit energy cost and minimal greenhouse gas impact." The preliminary analysis showed that Site C was "within the range of costs of other resource options [but that] further analysis is required to develop a robust range of capital cost estimates that reflect the significant costs uncertainties with the project." In the Fiscal 2007/2008 Revenue Requirement Application, BC Hydro provided an estimate of the Fiscal 2007 Stage 1 costs of approximately $10 million. By end of Fiscal 2007, approximately $7.7 million had been spent for Stage 1 summarizing project information and reviewing project feasibility.

Original Project Outline

4.1 The Peace River System

The Peace River system plays a key role in British Columbia's integrated electrical system, providing approximately one-third of BC Hydro's annual energy production from G.M. Shrum and Peace Canyon generating stations. Williston Reservoir is the largest of the two multi-year storage reservoirs in the province. Multi-year storage reservoirs have storage capacity greater than their average annual water inflow volume. Generation from the Peace is a crucial swing resource for the provincial integrated electricity system. This flexibility is used to match generation to overall load and electricity demand over periods ranging from minutes to multiple years.

4.1.1 The Peace River

The Peace River originates in the Rocky Mountain Trench at the confluence of the Finlay River, which flows from the north, and the Parsnip River, which flows from the south. The Peace River flows northeast through Alberta where it meets the Riviere des Rochers, the main discharge from the Peace-Athabasca Delta and Lake Athabasca, and then turns north into the Slave River, which flows into the Great Slave Lake in the Northwest Territories. From Great Slave Lake, the Mackenzie River flows northwest into the Arctic Ocean. At approximately 4,200 kilometres long, the Finlay-Peace-Mackenzie system is the second longest continuous stream in North America.

4.1.2 The W.A.C. Bennett Dam and G.M. Shrum Generating Station

The W.A.C. Bennett Dam, Williston Reservoir and G.M. Shrum Generating Station together comprise what was known during development as the "Portage Mountain Project."

The W.A.C. Bennett Dam is 183 metres high and stores, or impounds, the Peace River and upstream tributaries to form the Williston Reservoir. With a surface area of 177,000 hectares, the Williston Reservoir is the largest hydroelectric reservoir in North America. It is a multi-year storage reservoir, which means that it can be drawn down from full to its minimum level over four years to mitigate the impact of exceptionally low flow conditions in B.C. It is used to retain or store water in wet years for use in subsequent years. Within a year, it stores water during periods of high runoff and relatively low energy prices (late April to early July), which is then used during subsequent high demand or high priced periods in summer and winter. The W.A.C. Bennett Dam regulates flows in the Peace River.

G.M. Shrum Generating Station, adjacent to W.A.C. Bennett Dam, houses 10 generating units with a maximum continuous generating capacity of 2,730 MW. On average, G.M. Shrum generates 14,179 GWh of energy a year, which is about 28 per cent of BC Hydro's annual energy production. A project to expand the capacity of G.M. Shrum by 90 MW is now in the development stages and is expected to be online by 2011.

4.1.3 Peace Canyon Dam and Generating Station

The Peace Canyon hydroelectric facilities are located 23 kilometres downstream of the W.A.C. Bennett Dam. The 61-metre-high dam raises the Peace River to form Dinosaur Reservoir, which extends back upstream to G.M. Shrum. It is a narrow reservoir with a surface area of 890 hectares and is generally confined within the steep rocky slopes of the Peace River Canyon.

The Peace Canyon Generating Station is a four-unit power plant with maximum generating capacity of 694 MW. On average, it has generated 3,263 GWh of energy a year.

Peace Canyon is essentially a "run-of-the-river" project, using water that has already been used to generate power at G.M. Shrum. As a result, the Peace Canyon Dam has a relatively small reservoir compared with the amount of energy produced and a limited ability to re-regulate discharge.

4.1.4 Proposed Site C Dam and Generating Station

The Site C hydroelectric project would be the third hydroelectric facility on the Peace River. As currently conceived, the 60-metre dam would be 83 kilometres downstream of Peace Canyon. It would be seven kilometres southwest of Fort St. John, just downstream of where the Moberly River enters the Peace River, and 62 kilometres upstream from the Alberta border. The reservoir, with a surface area of approximately 9,310 hectares, would extend back to the tailrace at Peace Canyon.

The Site C project, as currently defined, would consist of six generating units with a total capacity of 900 MW. It would contribute an average of 4,600 GWh of electricity annually and 4,000 GWh of firm energy.

Site C would take further advantage of the regulation of the Peace River by the W.A.C. Bennett Dam, generating electricity from water that has already flowed through the G.M. Shrum and Peace Canyon generating stations. Most of the inflow into the reservoir would come from Peace Canyon, but the Halfway River and, to a lesser extent, the Moberly River would also contribute some flows.

Figure 4-1 provides a map of the area.

Figure 4-2 provides an elevation view of the Peace River system.

4.2 Comparison to Other BC Hydro Facilities

Table 4.1 provides a comparison between Site C and other BC Hydro hydroelectric facilities. Site C would fall in the second tier of BC Hydro generating facilities in terms of generating capability, well behind G.M. Shrum, Revelstoke and Mica. It would provide capacity comparable with that produced at BC Hydro's Seven Mile station, with a reservoir similar in area to the Revelstoke Reservoir.

4.3 Major Components of the Site C Project

The main project components are described below and listed in Table 4-2. Figure 4-3 provides a visual illustration of the main project components.

4.3.1 Major Civil, Electrical and Mechanical Components

4.3.1.1 Earthfill Dam

As originally designed, the dam would be designed as a zoned earthfill dam consisting of a central impervious core with outer shells of sands and gravels. The dam would be approximately 1,120 metres long at the crest and 60 metres high above river level. The base of the impervious core would be set in a trench excavated through the river bed and into the base rock to provide a watertight seal. The design would be based on Canadian best practice standards for large dams and would meet all regulatory requirements.

4.3.1.2 Reservoir

Based on current designs, the reservoir created by a dam at Site C would flood approximately 5,340 hectares of land to create a total water surface of about 9,310 hectares based on a maximum normal operating level of 461.8 metres. The water depth at the dam would increase by 52 metres.

Table 4-1 **Comparison of Site C with Other BC Hydro Facilities**

FACILITY	*YEAR*	*CAPACITY (MW)*	*ENERGY GWh/yr (avg)*	*CAPACITY FACTOR (%)*	*RESERVOIR AREA (ha)*	*RESERVOIR AREA (ha/Gwh)*
GMS	*1968-80*	*2,730*	*14,179*	*55%*	*177,300*	*12.50*
REVELSTOKE	*1984*	*1,980*	*7,476*	*48%*	*11,500*	*1.54*
MICA	*1976*	*1,805*	*7,450*	*47%*	*42,500*	*5.70*
SITE C		*900*	*4,600*	*58%*	*9,310*	*2.02*
SEVEN MILE	*1979*	*790*	*2,919*	*50%*	*410*	*0.14*
PEACE CANYON	*1980*	*694*	*3,263*	*56%*	*890*	*0.27*
KOOTENAY CANAL	*1976*	*580*	*2,467*	*64%*	*–*	*–*

Historically, BC Hydro studies have typically assumed a reservoir fluctuation of approximately 0.6 metres. However, the degree of reservoir fluctuation during normal operating conditions is a decision that would be made based on consultation with communities and First Nations, as well as further studies to examine environmental and recreational impacts and opportunities.

In exceptional circumstances, the Site C reservoir could rise above the normal maximum reservoir level due to unexpected rainfall runoff from the local watershed. Further, the reservoir could also be drawn down to the Emergency Operating Level of 450.0 metres for system emergencies.

Figure 4-1 **The Peace River Hydroelectric System**

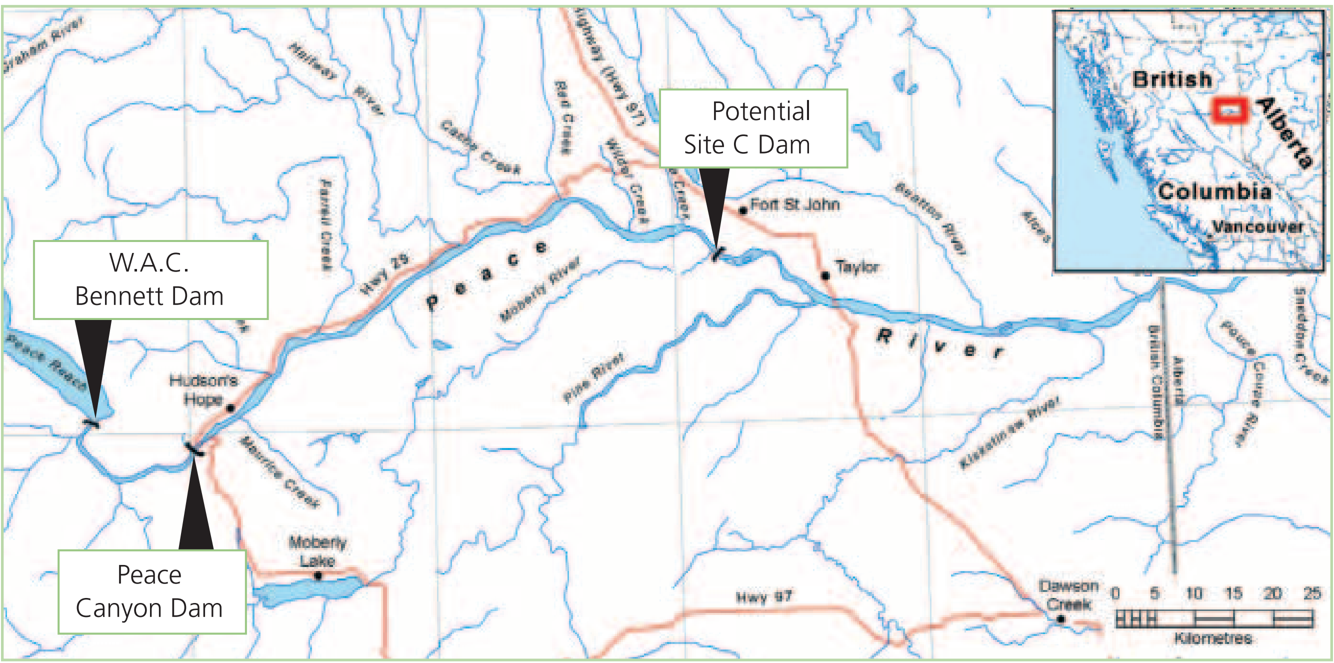
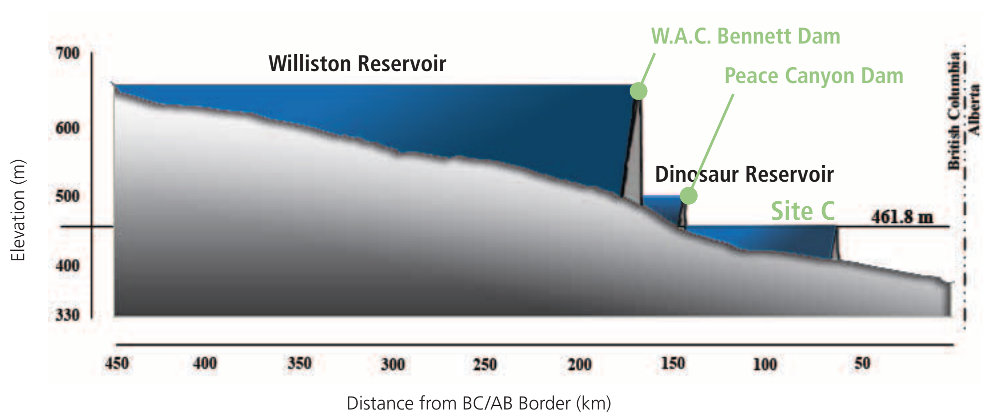


Figure 4-2 **The Peace River Reservoir Profile**



4.3.1.3 Left Bank Excavation

A major excavation would be required on the left bank slope above the dam to stabilize the slope. It would involve removing between 10 and 15 million cubic metres of material (between approximately 400,000 and 600,000 truck loads).

4.3.1.4 Spillway

The spillway would be adjacent to the dam on the right abutment. It would have gated headworks with a concrete-lined chute leading to a submerged energy dissipater near the downstream base of the dam. The dissipater would absorb sufficient energy from the spillway discharge to ensure that downstream erosion would not endanger the dam or power station. The spillway, with gate sills at an elevation of 46.5 metres, would be fitted with six gates. Due to the control exercised by the W.A.C. Bennett Dam on the Peace River and the adoption of flood forecasting procedures, the Site C spillway would be expected to operate rarely, apart from maintenance exercises and testing.

4.3.1.5 Water Intakes, Powerhouse and Switching Facilities

The intake structure takes in water from the reservoir for the turbines. As currently conceived, the intake structure would be adjacent to the spillway structure and approximately 400 metres long and 45 metres high. It would have six separately gated openings. Each would be connected by a steel penstock to the turbines in the powerhouse. The 9.35-metre-diameter penstocks would be encased in concrete and partly buried in granular backfill behind the intake structure. In the current design, the powerhouse was originally conceived to contain six Francis turbines and associated generators rated at approximately 150 MW each (total 900 MW) under a net head of 48.4 metres.

Following transformation to 138 kV, power from the generators would be delivered by cable to the switchgear building located above and to the south of the power station.

Table 4-2 provides a summary of the proposed design features of the proposed Site C dam.

4.3.2.1 Cofferdams and Diversion Tunnels

During construction of the dam, spillway and power installations, cofferdams would be installed to temporarily divert the river into the diversion tunnels and around the construction area. Cofferdams are constructed to divert the river flow, allowing construction to take place on the river bed. Eventually the cofferdams would be incorporated into the upstream and downstream parts of the main dam. As originally conceived, the river would be diverted through two 9.8-metre-diameter concrete-lined diversion tunnels in the north bank. The tunnels would be 688 metres and 790 metres long, respectively, although the length could be increased by approximately 100 metres based on recent design revisions. Each would have a gated concrete intake structure at the upstream end. During filling of the reservoir, one tunnel would be closed using the intake gate and permanently blocked with a concrete plug. Until the reservoir reached the spillway crest level, water would be released through the second tunnel to satisfy downstream requirements. This tunnel would then also be closed and plugged.

The diversion works would be capable of passing a flood with a probability of occurrence of once every 50 years.[3] This is of particular importance during the two-year period between when the river has been diverted using the cofferdams and when the height of the new dam reaches that of the cofferdams.

4.3.2.2 Borrow and Spoil Areas

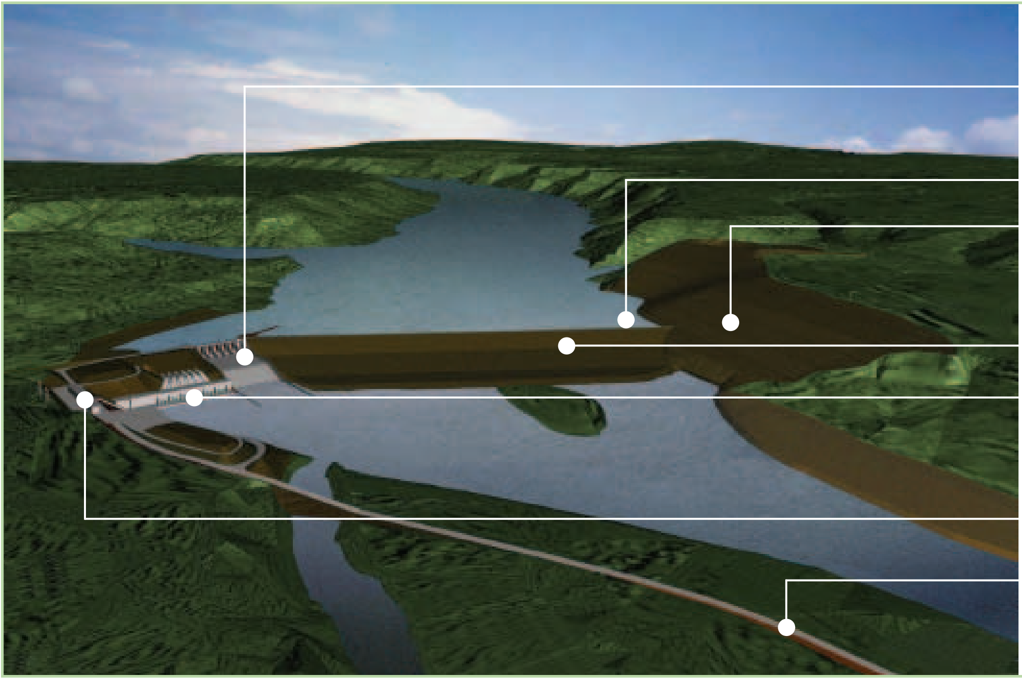
The dam, including the cofferdams, would be constructed of materials obtained from excavations required for the works and from selected borrow areas.

4.3.2.3 Road Access

As envisaged in previous design work, a project road from the left bank would cross the river by bridge four kilometres downstream from the dam, and would provide construction access and permanent access to the powerhouse, switchgear building and spillway. Another

[3] Common industry practice is to design for 25 years of risk for every year of exposure.

Figure 4-3 **Major Components of the Dam Site**



road would connect the facilities on the right bank to a nearby BC Rail line. Access roads are illustrated in Figure 4-4.

4.3.2.4 Highway Relocation

Sections of Highway 29 would need to be relocated to avoid the area flooded by the reservoir. Several realignments were considered by BC Hydro and the Ministry of Transportation in 1982. The recommended alignment consisted of the relocation of approximately 23 kilometres of Highway 29, and the installation of four bridges at Halfway River, Cache Creek, Lynx Creek and Farrell Creek and one culvert crossing at Dry Creek. This work would need to be thoroughly updated and reviewed during Stage 2, incorporating public input.

4.4 Transmission

4.4.1 Transmission to Peace Canyon

As currently conceived, the Site C project would be connected to the existing provincial transmission system by two 500 kV transmission lines that would run from Site C to the existing Peace Canyon Generating Station via an existing 76 km transmission corridor presently used by two 138 kV lines.

The existing 76 km, 118-metre-wide right-of-way that runs from the Site C area to Peace Canyon could accommodate both 500 kV lines. Trees within 11 metres of the existing right-of-way could require clearing to safeguard the new lines. Line terminations and associated switching facilities would be installed at both Site C and Peace Canyon. This equipment could be accommodated within the existing substation boundaries at Peace Canyon and within the development area at Site C.

Early cost estimates for these upgrades are included in the interim project cost estimate for the Site C.

4.4.2 Network Transmission

BCTC is responsible for planning, operating and managing BC Hydro's transmission system. BC Hydro retains ownership. BC Hydro secures transmission capacity to serve its customers by applying to the BCTC for Network Integration Transmission Service (NITS) under the BCTC's Open-Access Transmission Tariff

(OATT). To arrange for network transmission capacity to accommodate Site C, BC Hydro would submit a NITS Application or data update to BCTC with the Site C plant included in the 20-year generation resource plan. BCTC would then determine the transmission reinforcements needed to provide the required service, as well as the estimated costs and construction schedules. BC Hydro would secure the necessary transmission capacity rights by executing a NITS with BCTC or, in the case of a NITS data update, by executing an Addendum to an existing NITS Agreement.

Existing transmission lines between Peace Canyon and Kelly Lake substation are generally sufficient to accommodate the proposed Site C project, but upgrades would be required. A previous study of a resource portfolio that included the proposed Site C project and a 700 MW wind project in northwestern B.C. indicated that thermal upgrades to three lines between G.M. Shrum/Peace Canyon and Williston substation, and two lines from Williston substation to Kelly Lake would be required. Upgrades to series capacitor stations and additions of static var compensators (SVCs) would also be required. No new transmission lines would be required between Peace Canyon and Kelly Lake. Costs associated with upgrades are not included in the capital cost estimate for the project at this time, and this analysis will be thoroughly reviewed and updated in Stage 2.

In virtually all resource option portfolios, additional Interior-to-Lower-Mainland (ILM) transmission is required to meet growing loads in the southwest corner of the province. According to the 2006 Integrated Electricity Plan, the first ILM transmission line (5L83 between Nicola and Meridian substations) is required in most resource option portfolios in Fiscal 2014. This includes portfolios that contain the proposed Site C project as well as those that do not.

The next ILM transmission line (5L46 between Kelly Lake and Cheekeye substations) is not required before 2019 and then in only four of 17 portfolios. In the remaining 13 portfolios, a second ILM transmission line is not required within the planning horizon. Two of the four portfolios that require the second additional ILM line (5L46) include the proposed Site C project and the other two do not include Site C.

The requirement for additional ILM transmission is dependent on load growth in the Lower Mainland and Vancouver Island, the location and timing of resource additions, the timing of the retirement of Burrard Generating Station and the amount of coastal generation designated as being available to support the transmission system. This requirement would be updated in future stages based on current information.

4.5 Site C Construction

A seven-year construction period is envisaged for Site C, requiring approximately 7,650 person-years to complete.

The approximate seven-year construction period would consist of four main activity periods: pre-diversion work; work undertaken during river diversion; reservoir filling; and the commissioning of the generating units, including final detail work such as landscaping and paving.

- *The pre-diversion work would take approximately 21 months. The first step would include the creation of access to the Site C dam site and associated facilities. The bridge and roads would be permanent, except for those roads to the construction camps and borrow and spoil sites. This period would include the completion of the diversion tunnels and cofferdams in order to divert the Peace River during construction. Pre-diversion work also includes the removal of the bulk of the overburden and rock excavation on both banks.*
- *The Peace River would be diverted for a period of approximately 46 months. During this period, the bank excavation would be completed, the cofferdams would be closed, and the main structures on the right bank would be completed. In addition, the mechanical aspects of the first two generating units would be completed.*
- *The next activity would be the filling of the reservoir, which would take approximately one month. The first two generating units would undergo testing after reservoir filling.*
- *The approximate on-time final 15-month period would involve the commissioning of all generating units, the completion of diversion plugs, and final paving and landscaping.*

Table 4-2 **Summary of Design Features of the Site C Dam and Related Facilities as Historically Conceived**

DAM	*Type:* *Height from Riverbed:* *Crest Length:* *Dam Freeboard:*	*Zoned Earth Embankment* *60 m* *1,120 m* *8.2 m*
RESERVOIR (based on 461.8 m)	*Type:* *Max Normal Op. Level:* *Length:* *Width:* *Reservoir Surface:* *Water Depth at Dam Face:* *Storage Volume:* *Normal Operation:*	*Run-of-River* *461.8 m* *83 km* *1-2 km* *9310 ha* *52 m* *2310 million* m^3 *0.6 m (0 to 1.3 m)*
POWER PLANT	*Turbine Number:* *Turbine Type:* *Hydraulic Head:* *Total Discharge at Rated Head:*	*Six* *Francis - 150 MW each* *48.4 m* *2,118* m^3/s
DIVERSION TUNNELS	*Number of Tunnels* *Tunnel Diameter:* *Length between portal structures:* *Tunnel #1:* *Tunnel #2:* *Discharge Capacity:*	*2* *9.8 m* *688 m* *790 m* *2570* m^3/s
SPILLWAY	*Type:* *Bays:* *Elevation of Gate Sills:* *Spillway Design Flood (SDF):* *Probable Maximum Flood (PMF):*	*Gated chute with stilling basin* *Six* *446.5 m* *11,700* m^3/s *at el. 461.5 m* *20,810* m^3/s *inflow; 17,500* m^3/s *outflow*
TRANSMISSION FACILITIES	*Type:*	*Two 500 kV lines from Site C to Peace Canyon south of the Peace River in place of two existing 138 kV lines*

4.6 Engineering Design

Engineering work has been undertaken on the Site C project several times throughout its history. Feasibility studies and preliminary design work by BC Hydro prior to 1981 resulted in the 1981 project design (1981 Design), which established the layout of the facilities for Site C.

Preparatory engineering activities commenced in 1989 by a team of engineers from KCBL, SNCI and BC Hydro. However, this engineering work was terminated in 1991 and a number of significant design issues remained unresolved, as described below.

4.7 Engineering Design Review

In 2005, the BC Hydro Board of Directors identified the need to review the design and cost estimate for Site C. KCBL and SNCI were engaged to provide an assessment of design issues that could affect project cost. These include:

- *design issues outstanding since the 1991 design work;*
- *design standards that have changed since the 1991 design work; and,*
- *design issues that have arisen since the 1991 design work.*

The findings of the 2005 design review are summarized below. BC Hydro has included an assessment of the contingencies and allowances recommended by KCBL and SNCI in the updated range of interim project cost estimates, as outlined in Chapter 5, Table 5-4.

4.7.1 Seismic Design Criteria

Understanding of seismicity has changed since the 1991 Design. This is likely to increase the Maximum Design Earthquake, a fundamental design parameter.[4] Changes to the project seismic parameters would be expected to have impacts on the design of various components of the project and could result in design changes with cost and schedule impacts. Implications for the left bank permanent excavations, the dam embankment and the reservoir slopes would need to be assessed in detail to adequately quantify the cost and schedule impacts due to revisions of seismic parameters.

KCBL/SNCI recommended that a seismic study be undertaken to establish the Maximum Design Earthquake. Until further assessment is done, KCBL/SNCI recommended that a special contingency be added to the cost estimate to include the cost and schedule implications of having to revert to the more conservative left bank excavation design developed in the 1981 Design and modified in the 1991 Design.

[4] The Maximum Design Earthquake is the level of earthquake ground motion for which a dam structure is designed.

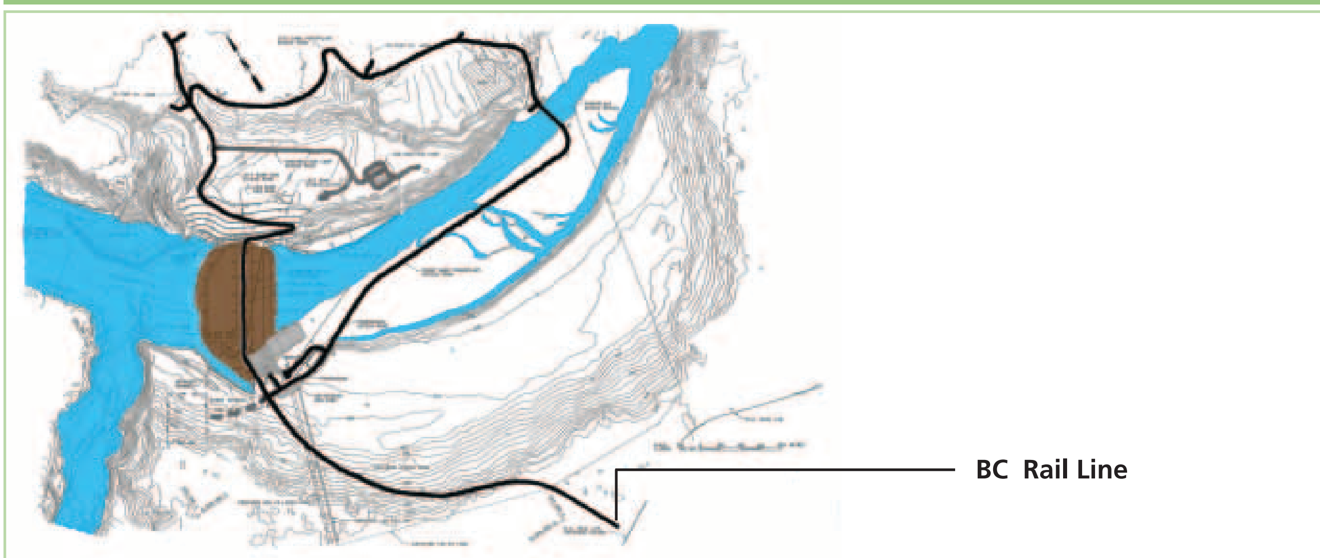
4.7.2 Probable Maximum Flood

The spillway at the Site C dam would be designed for the Probable Maximum Flood in accordance with the Canadian Dam Association Dam Safety Guidelines.[5] With allowance for the regulation of the Williston Reservoir, the Probable Maximum Flood inflow at Site C was calculated to be 20,810 m^3/s and outflow to be 17,500 m^3/s (at reservoir elevation 466.3 m.). The Spillway Design Flood, which is the discharge with all gates open at reservoir level 461.8 metres, is 11,700 m^3/s. The reservoir and discharge facilities have been designed to accommodate both the Probable Maximum Flood and Spillway Design Flood.

While KCBL and SNCI do not expect any material changes to the 1991 Design assumptions, new standards for antecedent or extreme conditions have been established for the Probable Maximum Flood which could affect Site C's final design.

[5] The Probable Maximum Flood is the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area.

Figure 4-4 **Potential Road and Bridge Access to Site C Dam Site**



4.7.3 Rebound of the Foundations of the Right Bank Structures

Excavations of up to 65 metres in depth are required for the construction of the right bank structures. Typically the load applied by the structures themselves would be less than the weight of the overburden and rock removed from the site, resulting in a net stress relief over much of the foundation area. This would cause the shale bedrock at the site to expand or rebound. Because of the importance of rebound for the design of the structures, a series of laboratory studies were conducted to determine the maximum amount and rate of rebound. The results of the studies were not incorporated into the 1991 Design of the right bank structures. The right bank structures would have to be designed to accommodate the predicted amounts and rates of rebound.

KCBL/SNCI recommended a special contingency to cover the cost and schedule implications of the design changes that would be required to accommodate the potential rebound of the right bank structures. This contingency is included in the initial project cost estimate.

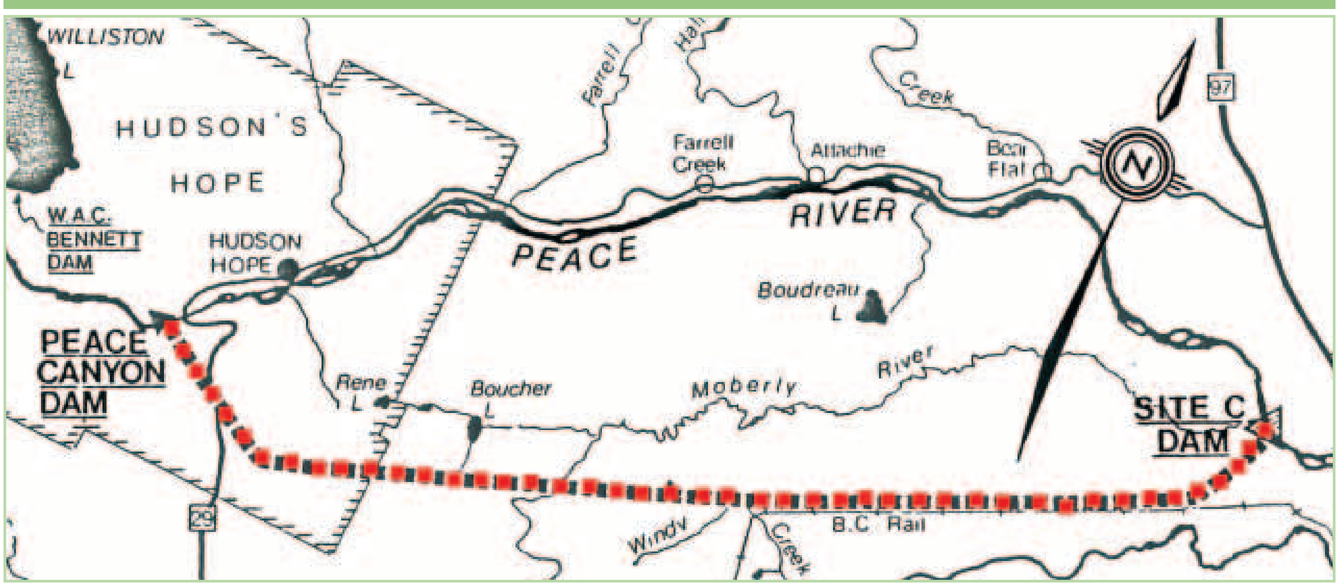
4.7.4 Shear Strength of Bedding Planes

Throughout the shale bedrock at Site C there are numerous weak horizontal layers known as bedding planes that influence the design of the dam. The bedding planes can weaken under the weight of an earthfill dam as increased pressure on the pores of the bedding planes causes a reduction in sliding resistance. This response to the weight of the dam is known as the pore pressure response.

The pore pressure response of the bedding planes was investigated for the 1991 Design and the pore pressure assumption was modified. In order to confirm the pore pressure assumption, and to optimize the design for the cofferdam and dam embankment, KCBC/SNCI recommended that additional field investigations be undertaken, including the construction and monitoring of a test embankment. Due to the suspension of engineering activities in 1991, the test embankment was not built.

KCBL/SNCI recommended that the test embankment be built as originally planned and that, until it is, a special contingency be included in case the pore pressure assumption is found to be different than that assumed in the 1991 Design, requiring the reversion to the 1981 Design.

Figure 4-5 **Potential Route for 500 kV Transmission**



4.7.5 Affect of Test Chamber on Diversion Tunnel Excavation

In 1981, the bedrock of the left abutment was investigated to confirm the feasibility of excavating and adequately supporting the two diversion tunnels. An access tunnel was driven into the left abutment leading to an exploratory test chamber. It is unlikely that the access tunnel and test chamber remain in a condition that would allow them to be safely and economically rehabilitated. KCBL/SNCI recommended that the test chamber and access tunnel be backfilled with concrete as they are likely to be unsafe, and that the diversion tunnels be realigned further into the left bank.

4.7.6 River Diversion Design Flood

The diversion design flood is a key parameter affecting the cost and schedule of Site C. In order to allow construction of the dam, the Peace River would be temporarily diverted through two tunnels in the left abutment. The 1991 design used the 50-year return period flood for sizing the diversion tunnels and the cofferdams. Recent data suggests that an increase in the 50-year flood estimate is possible. KCBL/SNCI recommended further study to confirm the previous assumptions.

4.7.7 Potential Sources of Construction Materials

Construction of the temporary and permanent dam facilities would require a considerable volume of construction materials. The source, quantity and suitability of the materials have not been definitively identified. The ease with which suitable construction material may be obtained could affect the capital cost of the project. The location and extent of the borrow sites must be identified to evaluate the cost, schedule and environmental impacts of the project.

KCBL/SNCI recommended that detailed field and laboratory investigation programs be undertaken to define the most favourable borrow sources for impervious material, and that studies be undertaken to determine the most economic source of permanent erosion protection material. Given the source assumptions, revisions are not expected to have a major impact on cost, schedule or environmental feasibility.

4.7.8 Design of the Spillway to Mitigate Dissolved Gas Supersaturation

Since the 1991 design, the level of total dissolved gas, a measure of the additional air that is forced into water, has emerged as an environmental issue in the hydroelectric industry, particularly on the Columbia River. Discharge through some spillways has been found to result in high levels of total dissolved gas. Based on the preliminary design of the Site C spillway, the spillway could produce saturation levels significantly greater than water quality guidelines. High total dissolved gas pressures are a significant water quality issue. KCBL/SNCI recommended the addition of dividing walls in the spillway and jet deflectors, which are expected to reduce total dissolved gas to currently acceptable levels.

4.7.9 Options for Fish Passage

To date, provisions for fish passage have not been incorporated into the design of proposed Site C project and options for the inclusion of fish passage facilities have not been evaluated. There are potential requirements for the provision of fish passage, though none has ever been prescribed for a dam of the potential height of Site C on a river with non-anadromous fish. Stage 2 will look at opportunities for incorporating provisions for fish passages.

4.8 Potential Effects of Global Warming

Global climate change could have a significant effect on BC Hydro's overall hydroelectric operations due to the potential for changes in the timing and quantity of water flows throughout the system. BC Hydro is involved in two studies to better understand the potential effect of climate change on water supply and glaciers. The first is a four-year study being undertaken in conjunction with the Pacific Climate Impacts Consortium housed at the University of Victoria and launched in 2006. The first phase of the study will assess regional impacts of climate change based on existing climate modelling output and assess the uncertainty around those estimates. The second phase of the study will look more specifically at the impact of water resource changes on reservoirs. Preliminary work in this area suggests that a 10 per cent increase or decrease in flows is possible depending on the time of year and the region of the province.

The second study is being led by researchers at the University of Northern British Columbia (UNBC) in Prince George. It is a five-year study evaluating the potential changes to glaciers as a result of climate change. There are few glaciers in the Peace Watershed, so it would be unlikely that Peace River water flows in B.C. would be significantly affected by any change to glacier size and runoff. The study, called the Western Canadian Cryospheric Network, was launched in May 2006. Participating institutions include six universities, the federal and provincial governments, BC Hydro and the Columbia Basin Trust.

4.9 Alternate Configurations

4.9.1 Alternate Sites for Dam Location

Downstream of Peace Canyon, the Peace River has eroded a broad, flat-bottomed valley a few kilometres wide and about 230 metres deep into the softer rocks of the Alberta Plateau. This is in contrast to the G.M. Shrum and Peace Canyon facilities, which are located where the Peace River has eroded a canyon in the relatively hard rocks of the Rocky Mountains. The topography and geology in the river valley near Fort St. John are more challenging than at the upstream W.A.C. Bennett and Peace Canyon sites.

Two alternate configurations for developing the hydroelectric potential between Peace Canyon Dam and Fort St. John have been reviewed at various times. The first related to the actual location of the proposed Site C project among the three potential sites identified. The second related to developing a series of hydroelectric projects between Peace Canyon and Fort St. John in lieu of the proposed Site C project known as Peace Cascade.

Studies supporting the selection of Site C among a series of alternative sites along the Peace River downstream from Peace Canyon have been extensive. Studies undertaken in 1958 identified five potential new dam sites (A, B, C or D in addition to E) between Peace Canyon and the Alberta border (Figure 4-7).

Geological reconnaissance in 1967 determined that Sites B and D were unattractive due to landslides on the left abutments. Site C was selected over Site A because there was less overburden in the riverbed and on the right bank that would need to be excavated. The Site E flood reserve was cancelled in 1985.

Three alternate locations for the Site C dam were investigated: Site C-1, located about four kilometres upstream of the Moberly River near Tea Creek; Site C-2, located about two kilometres upstream of the Moberly River; and Site C-3 (Site C), located one kilometre downstream of the Moberly River. These alternate locations are shown in Figure 4-8.

Based on an analysis of site topography and geology, Site C-3 was recommended for the current proposed site.

Topography was a key factor in the selection of Site C-3 over the two other options. At Site C-3, the left bank rises steeply to about 100 metres above the crest of the dam and then rises relatively gently to the plateau. The right bank rises steeply to a broad terrace at the dam crest level, and then rises gently to the plateau. The natural terraces at Site C-3 would accommodate the high level concrete structures required, with much less excavation than alternative locations. In contrast, the valley walls are up to 170 metres higher and steeper at Site C-1 and C-2. These sites have no natural terrace on the right bank. The contrasting topography is illustrated in Figure 4-6.

Site C-3 was also found to be geologically more attractive. Feasibility studies undertaken in 1976 found that the left and right banks at Site C-1 were potentially unstable high above the dam crest level, requiring significant amounts of excavation to stabilize them. In addition, Site C-3 was found to have less overburden thickness than Site C-2, more stable dam abutments, and protection by the terraces of both abutments from potential slides originating high above the crest of the dam. A minor benefit of the Site C-3 location was that it would have slightly greater power flows and avoid the deposition of significant quantities of gravel from the Moberly River into the tailrace channel. The 1978 preliminary design work by BC Hydro reconfirmed Site C-3 as topographically and geologically superior to alternate Sites C-1 and C-2.

In 2005, a conceptual level review was undertaken by KCBL/SNCI to consider the cost and schedule implications of moving the dam site upstream of the Moberly to Site C-1 or C-2. The reasons for selecting Site C-3 were again reconfirmed. Conceptual level estimates indicated the direct real cost of locating the project at Site C-2 would be approximately double that at Site C-3 and the construction schedule would be considerably longer, due largely to increased excavation requirements. The environmental implications of disposing of the additional volumes of material were not reviewed, but are expected to be significant.

From a financial and engineering perspective, the present location identified for Site C is considered to be the optimal location between Peace Canyon and Fort St. John.

4.9.2 Peace Cascade

As an alternative to the proposed Site C project, BC Hydro also evaluated a cascade of smaller dams to develop the head between Peace Canyon Dam and the vicinity of the proposed Site C development. KCBL/SNCI undertook a conceptual study of this potential development in 2003. They concluded that a cascade of seven dams could be constructed with each capturing between 5.0 metres and 7.6 metres of gross head (full supply level to tailwater elevation) with installed capacities between 77 MW and 130 MW. Total installed capacity would be 748 MW, with an average annual energy output of 4,000 GWh.

The cascade option would have a smaller reservoir inundation area and slightly less adverse socio-economic impacts than the Site C development, including a lesser impact on fish and wildlife and less flooding of farm land. However, there would be other adverse environmental impacts associated with the greater number of facilities. Also, the cascade option would produce 14 per cent less energy than the proposed Site C development on an annual basis while the total direct cost would be 80 per cent higher. Project risks imposed by the cascade option are also considerable due to the challenging and varied geology. As a result of these factors, the cascade configuration is significantly less attractive.

Figure 4-6 **Topographical Differences between Site C-3 and Sites C-1 & C-2**

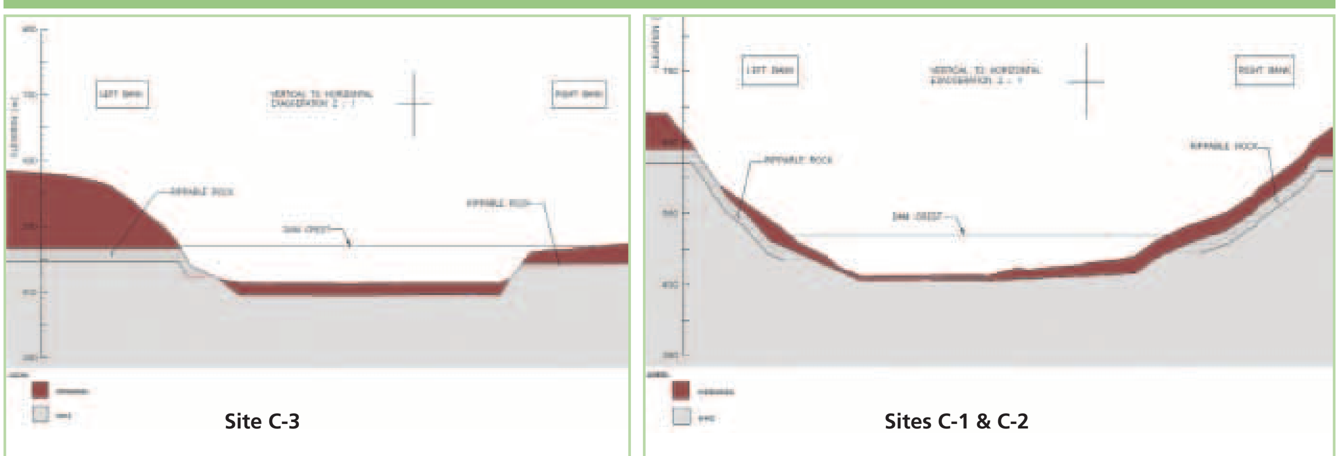


Figure 4-7 **Potential Dam Sites along the Peace River**

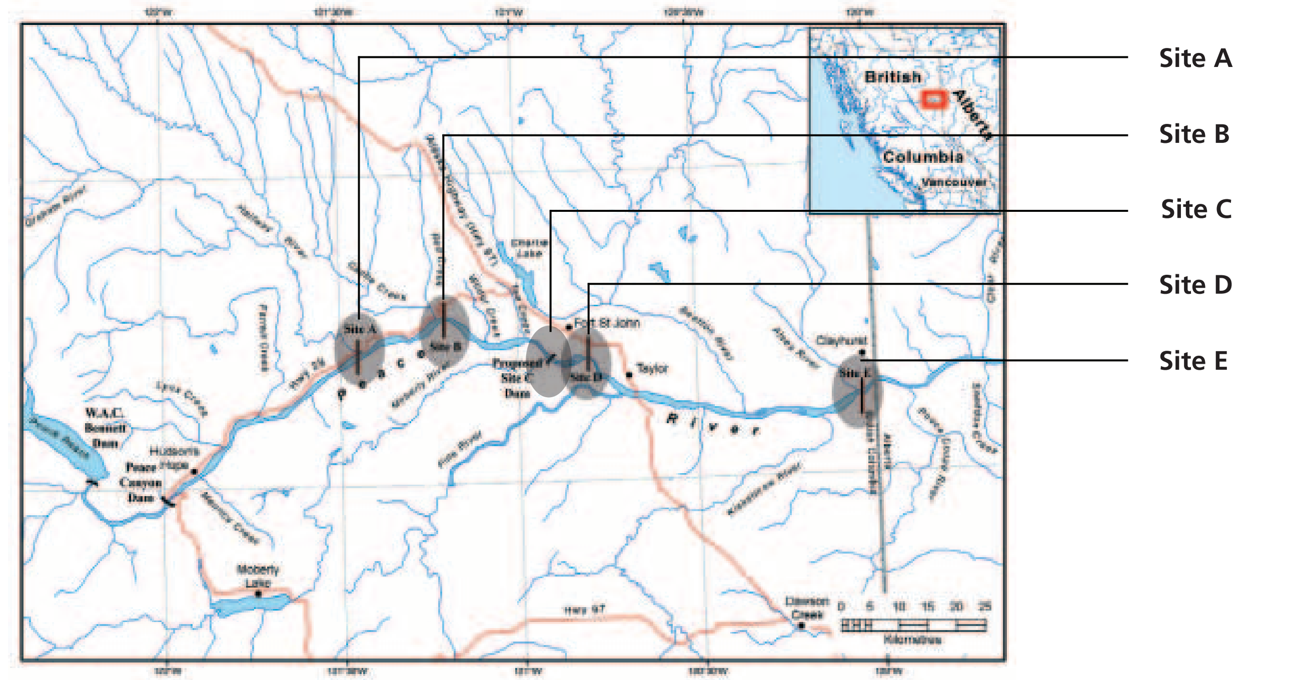
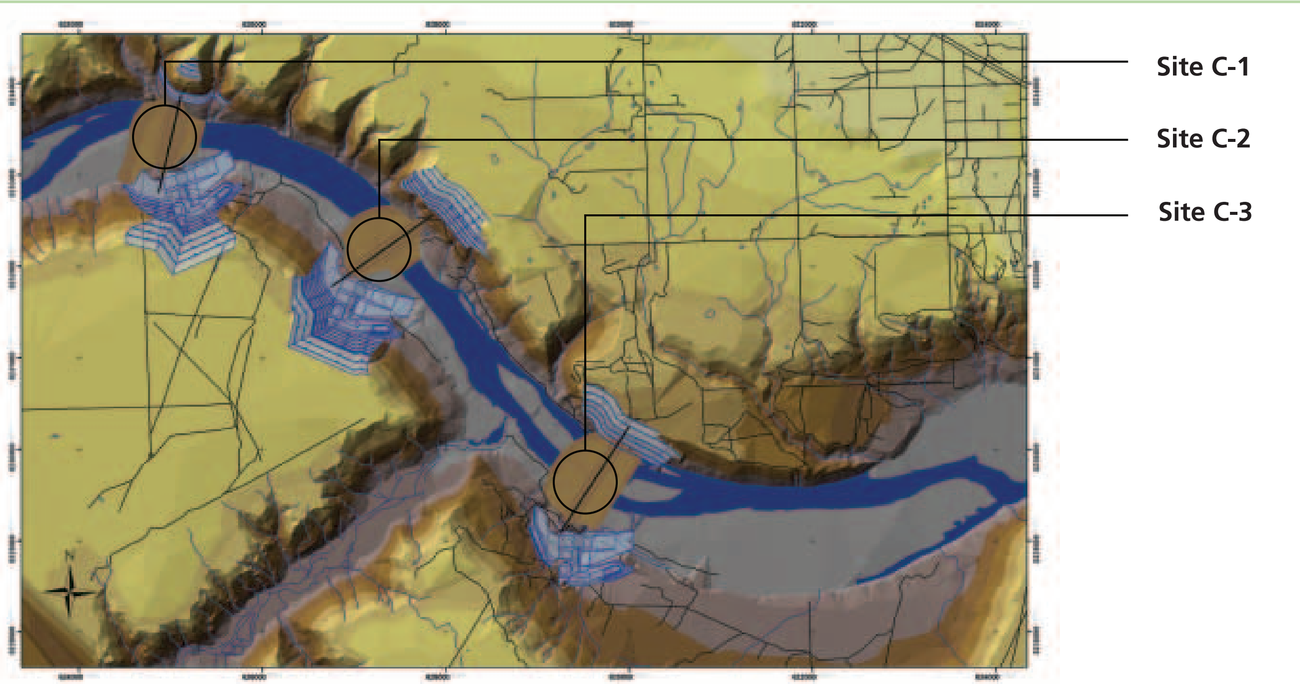


Figure 4-8 **Potential Dam Sites near Fort St. John**



Interim Project Cost Estimates

Chapter 5

5.1 Interim Project Cost Estimates

As with any large capital project, the interim project cost estimates are estimates only and are subject to updating and change due to further project definition, inflation, and labour market changes, among other factors. The Site C project, in particular, is at an early stage of project development as it enters the second stage of a five-stage development process. As a large hydroelectric facility, Site C has one of the longest lead times of any other public sector capital project. Should the project be approved to proceed through all stages as per the current schedule, construction would not be expected to begin until at least 2012, a full five years from the publishing of this report.

In keeping with best practices for large capital projects, BC Hydro has adopted a staged decision-making process for Site C. Interim project cost estimates will be updated at each stage of the project to incorporate changes in project definition, as well as inflation and other changes. In Stage 2, for example, interim project cost estimates are expected to be updated at the end of the stage with information gained from community, First Nations and stakeholder consultation, as well as updated environmental, engineering and socio-economic studies. Interim project cost estimates will also be updated during Stage 3, which focuses on environmental assessment and the regulatory process, and Stage 4, which focuses on detailed design engineering, should the project proceed to those stages.

A key benefit of the staged decision-making process is to ensure that decisions are being made with current information that includes not only updated information about the project and its costs, but also its benefits and impacts as they relate to other resource options at that time. At the conclusion of each stage, BC Hydro will evaluate the project, including updated interim project cost estimates, and make a recommendation to the province as to whether or not to proceed to the next stage of project development.

As with other capital projects, the final cost estimate will be fully known only after a competitive procurement process is complete and final bids are accepted. This occurs just prior to construction. As a decision on whether to proceed to build Site C is still a few years away, any project cost estimates right now are only interim.

As an example, if a contractor were asked for an estimate to build a home today, it would be possible to receive a cost estimate within a certain margin of error. But if the contractor was asked for an estimate to build a house in 2012, it's unlikely that a contractor would be willing to take the risk of providing a firm estimate because of potential future changes in interest rates and inflation, for example.

It's clear that there is uncertainty and risk with the Site C interim cost estimates at this stage. However, interim cost estimates are useful in comparing the project with alternatives under consideration today and making a decision on whether or not it is prudent to investigate this project further.

The interim project cost estimates presented in this chapter reflect initial, early cost estimates from Stage 1 of the five-stage process of project development.

5.2 Site C Interim Cost Estimate

As of May 2007, the early-stage conceptual estimate for Site C is between \$5.0 billion and \$6.6 billion in nominal dollars (see Appendix 2 for key assumptions relating to this initial cost estimate). The corresponding levelized unit cost would range from \$46/MWh and \$97/MWh in Fiscal 2008 dollars. As described below, this is an early stage order of magnitude estimate that would be updated as the project develops.

The cost estimate for the Site C project is built up as follows:

The *Direct Estimate* is the estimate of the unescalated direct costs to complete the known scope of work given the project phase and the level of engineering completed. The Direct Estimate is quoted in constant ("real") dollars, typically as of the date of the estimate.

DIRECT ESTIMATE
+ CONTINGENCY / ALLOWANCE
= Real Risk Adjusted Direct Cost Estimate

+ INFLATION
+ ESCALATION
= Nominal Risk Adjusted Direct Cost Estimate

+ CAPITAL OVERHEAD
+ INTEREST DURING CONSTRUCTION
= Expected Total Cost

+ RISK RESERVE (as applicable)
= Expect Total Cost + Risk Reserve

Contingencies are added based on a probabilistic review of the risks of construction within a relatively narrow range of expected outcomes. In many circumstances, particularly for projects whose construction starts many years in the future like Site C, contingencies do not fully address all the risks. Contingencies are generally added to address the following risks:

- Schedule (productivity, weather);
- Unforeseen Conditions (ground conditions, foundation design);
- Resources (due to material and labour or other unexpected market conditions);
- Regulatory and Permitting (not accounted for in the Direct Estimate);
- Tender (associated with shortage of contractors);
- Construction (change in quantities, contractual claims, construction reserves); and,
- Design (minor changes in design, layout, material or scope).

Allowances are also added for known conditions for which detailed estimates have not been developed. In the case of Site C, allowances have been included to address the following issues as further described in Section 4.7:

- Rebound effects;
- Total Dissolved Gas;
- Left bank stabilization;
- Tunnel construction; and,
- Pore Pressure Contingency.

Inflation and escalation are added to reflect the cost increases that are anticipated to occur between the time of the estimate and the time at which the costs would actually be incurred. To the extent that certain costs are anticipated to increase at rates higher than the general rate of inflation, additional adjustments are made by adding escalation.

Overhead is then added to cover indirect corporate costs.

Interest During Construction is added to reflect the carrying cost of capital between the time at which costs are incurred and completion of the asset.

A *Risk Reserve* is added in certain circumstances, when the cost estimate does not fully reflect possible cost increases beyond those that have been included in the contingencies. In the case of Site C, a significant Risk Reserve is included to reflect risks not considered adequately covered by normal project contingencies.

5.3 Direct Costs Used to Develop the Current Range of Estimates

The direct cost estimates are based on the design work that was done in 2002 by KCBL/SNCI. This estimate was further escalated by 35.3 per cent using the Statistics Canada non-Residential Price Index (Oct. 2001 to Dec. 2006) and an MMK consultant report recommendation for the period to reflect the increase in cost of construction in B.C. over the past few years. BC Hydro's Direct Cost (Table 5-1) is used in the development of the range of Site C estimates.

Table 5-1 **Direct Cost ($million, F2008 dollars)**

Land & Rights, Flowage, Site Access & Clearing	195	
Cofferdams & Dikes, Left Bank	301	
Stabilization, Diversion Tunnels Earthfill Dam	265	
Approach Channel & Gravity Walls, Spillway, Intakes and Penstock	580	
Powerhouse	543	
Switchgear Building	73	
Construction Services	65	
Construction Management	93	
Total Direct Construction Cost (Generation)		**2,115**
Management & Engineering	169	
Mitigation & Comp. Regulatory/Def. Phase, Insurance	213	
Indirect Construction Cost (Generation)		**382**
Total Construction Cost (Generation)		**2,497**
Total Construction Cost (Interconnection)		**99**
Base Estimate		**2,596**

Table 5-2 **Contingencies and Allowances ($million, F2008 dollars)**

CONSTRUCTION CONTINGENCY		
Civil - General (15%)	237	
Electrical (7.5%)	17	
Mechanical (7.5%)	17	
Lands (10%)	1	
Total Construction Contingency		272
OTHER CONTINGENCIES & ALLOWANCES		
Rebound (allowance)	18	
Reduce TDG (allowance)	2	
Left Bank Seismic (allowance)	50	
Tunnel Contingency (allowance)	8	
Pore Pressure (contingency)	67	
Total		145
TOTAL CONTINGENCIES & ALLOWANCES *Excluding Risk Reserves*		**417**

5.4 Range of Capital Cost Estimates

Table 5-3 reflects discrete points within the range of estimates (in nominal dollars) and the resulting levelized unit cost (in Fiscal 2008 dollars).

BC Hydro's current range of estimates for Site C reflects inflation and escalation of six per cent in 2007, five per cent in 2008 and 2009, four per cent in 2010 and three per cent thereafter. Overhead of two per cent was also included. BC Hydro has also included contingencies and allowances in the estimate as outlined in Table 5-2.

There is considerable uncertainty on a number of factors that can have a significant impact on the translation of direct construction costs expressed in real (constant) dollars into expected (nominal) dollars expended given an assumed schedule. This is particularly true of a project such as Site C where the interim project cost estimate is being made many years before the costs would be incurred. In addition to escalation, changes in interest rates and exchange rates have significant effects. While these factors impact most resource alternatives, each alternative can be affected to a greater or lesser degree depending upon the cost structure of the alternative.

To reflect the uncertainties inherent in the Site C project interim cost estimate, BC Hydro has included a range of Risk Reserves that reach to just over $1 billion and a +/- two per cent change in interest rates.

5.5 Comparison with Previous Estimates

A comparison of a representative sample of BC Hydro's current estimates with previous estimates for the Site C project is provided in Table 5-4.

5.6 Peer Review

To test the robustness of the interim direct cost estimate, BC Hydro engaged the services of the Washington Group in August of 2005 to:

- Examine and comment on unit prices, construction methods, crew makeup, equipment, materials, and subcontracts;
- Review productivity factors, prime equipment selection, production rates, and labour crafts;

Table 5-3 **Interim Capital Cost Estimates Based on Various Risk Reserve Assumptions and Discount and Interest Rates**

Change in Discount and Interest Rates		Risk Reserve ($million)						
		150	**300**	**450**	**600**	**750**	**900**	**1050**
	-2%	**A** $5.0billion $46/MWh	$5.2billion $47/MWh	$5.3billion $48/MWh	$5.5billion $49/MWh	$5.6billion $50/MWh	$5.8billion $51/MWh	$5.9billion $52/MWh
	-1%	$5.2billion $54/MWh	**B** $5.3billion $56/MWh	$5.5billion $57/MWh	$5.6billion $58/MWh	$5.8billion $60/MWh	$5.9billion $61/MWh	$6.1billion $62/MWh
	0%	$5.3billion $64/MWh	$5.5billion $65/MWh	**C** $5.6billion $67/MWh	$5.8billion $68/MWh	$6.0billion $70/MWh	$6.1billion $71/MWh	$6.3billion $73/MWh
	+1%	$5.5billion $74/MWh	$5.6billion $76/MWh	$5.8billion $77/MWh	**D** $5.9billion $79/MWh	$6.1billion $81/MWh	$6.2billion $83/MWh	$6.4billion $85/MWh
	+2%	$5.7billion $85/MWh	$5.8billion $87/MWh	$6.0billion $89/MWh	$6.1billion $91/MWh	**E** $6.3billion $93/MWh	**F** $6.4billion $95/MWh	**G** $6.6billion $97/MWh

Project Cost (nominal)
Unit Cost (cash) (F2008 $)

Table 5-4 **Comparison of BC Hydro's May 2007 Interim Cost Estimates with Previous Estimates for Site C**

$million except as noted	1981 Site C Application	1981 Site C Application inflated to 2004	2005 Resource Options Report (as of Oct 2004)	Estimates as of May 29, 2007						
				A	B	C	D	E	F	G
Real $	$1980	$2004	$F2005	$F2008						
In-Service Dates	All units 12/1987		First 2 Units 12/2015	First 2 units 12/2018						
Direct Base Estimate (Site C and interconnection) Construction Contingency other Contingencies and allowance	$998		$2,044	$2,596	$2,596	$2,596	$2,596	$2,596	$2,596	$2,596
Contingency			$220	$272	$272	$272	$272	$272	$272	$272
Design Contingency/ Allowance				$145	$145	$145	$145	$145	$145	$145
Real Risk Adjusted Direct Cost	$998	$2,056	$2,264	$3,013	$3,013	$3,013	$3,013	$3,013	$3,013	$3,013
Inflation and Escalation	$574	$383	$422	$1,165	$1,165	$1,165	$1,165	$1,165	$1,165	$1,165
Nominal Risk Adjusted Direct Cost				$4,178	$4,178	$4,178	$4,178	$4,178	$4,178	$4,178
Capital Overhead	$140	$49	$54	$58	$70	$82	$95	$109	$109	$109
IDC	$686	$439	$484	$648	$781	$920	$1,065	$1,217	$1,217	$1,217
Expected Total Cost	$2,398	$2,927	$3,224	$4,884	$5,029	$5,180	$5,338	$5,504	$5,504	$5,504
Risk Reserve				$150	$300	$450	$600	$750	$900	$1,050
Expected Total Cost + Risk Reserve	$2,398	$2,927	$3,224	$5,034	$5,329	$5,630	$5,938	$6,254	$6,404	$6,554
Unit Cost (Cash Basis) (Real $/MWh)			$47	$46	$56	$67	$79	$93	$95	$97

Please note: The current estimate represents an early-stage interim project cost estimate. These estimates will be updated at every stage of project development and are expected to change at each stage.

• The figures presented in this table were developed in May 2007, and should be read in conjunction with the underlying assumptions included as Appendix 2. For example, these assumptions include: An in-service of 12/2018 for the first two units. $250 million should be added to the Project Cost (nominal) for each year that the in-service date occurs later than assumed.

• Capital Overhead rate of 2%. The figures in the purple shaded areas correspond to column A-G in the above table.

• In Directives 25-27 of the 2006 LTAP, the BCUC directed BC Hydro to use the 20-30 year cost of debt as the nominal discount rate in evaluating resource options. However, due to the magnitude of the Site C project there is the possibility that an equity investment may be required. For this reason, this report uses an 8% nominal discount rate to evaluate project economics, which results in a higher, more conservative estimate of the cost per megawatt hour.

- Comment on completeness of estimate and design (as it affects cost); and,
- Provide Value Engineering considerations to save costs.

The Washington Group concluded that the overall work breakdown structure is complete and easy to follow, and it provided clear separation of direct and indirect costs. No significant anomalies were identified and methods and equipment selection were considered appropriate. They also identified a number of areas that could potentially shorten the assumed construction schedule, lower cost or reduce risk.

BC Hydro engaged the services of Washington Group again in October of 2007 to perform additional analysis, including:

- Review of the escalation rates from September 2005 to May 2007;
- Review of the inflation rates used;
- Check of the current fully loaded cost estimates for mathematical errors; and,
- General check on compliance with industry estimating practice.

The Washington Group concluded that the escalation and inflation rates used are reasonable. No flaws were found with the approach and results of BC Hydro's calculations to estimate interim project costs.

5.7 Financial Analysis

BC Hydro has developed a financial model to aid in the analysis of the expected cost of energy from Site C. The financial model includes consideration of the assumed capital cost (in real dollars), escalation, various operating costs, financial assumptions, ongoing investments in sustaining capital, and operating performance.

BC Hydro engaged KPMG in 2005 to review the logical integrity of the arithmetical operations, formulae and calculations under explicitly stated assumptions and input. KPMG did not review the assumptions of the model.

KPMG offered some suggestions that were incorporated and concluded that the model was well constructed and had a logical architecture, noting no substantive findings that were not subsequently resolved.

Select key assumptions included in the Site C Financial Model are outlined in Appendix 2.

5.8 Financial Benefits to Government

The province, regional districts and municipalities would receive specific monies from BC Hydro as shown in Table 5-5.[6]

The province would receive a return on equity associated with Site C, as well as water rental payments based on the energy and capacity generated at Site C. BC Hydro would also pay school taxes to the province based on the assessed value of the Site C switchyard assets and the size of the transmission system. The regional districts and municipalities would be expected to receive grants-in-lieu of property taxes based largely on the generating capacity of Site C.

[6] Return on equity is calculated in accordance with Heritage Special Direction No. HC2 to the BCUC. Water rentals are charged by the Province, pursuant to the *Water Act* in the generation of electricity. The rates are determined by the Ministry of the Environment. Regional district and municipal payments from BC Hydro. BC Hydro 2005 Net Property Tax and Grant Payments as at 28 June 2005. Unpublished BC Hydro report. 2005.

Table 5-5 **Financial Benefits to Government from Site C**

	Returns to Government in Fiscal 2019 ($ nominal)
Equity Returns to Province[1]	150 million
Water Rentals to Province[2]	35 million
Grants-in-lieu of general, regional district and local improvement taxes, and school taxes to Regional District and Municipalities[3]	2 million
Total	187 million

Assumptions: 1) In-service cost is $5.0 - 6.0 billion, 20% equity financing, 13.51% return on equity; 2) 2005 rates, adjusted for rate increases assumed to equal forecast CPI; 3) Capacity and general grants increase with rate increase assumed to equal forecast CPI: school taxes remain constant using current rates of assessment on assessable property.

Land and Environment

6.1 Introduction

Considerable analysis of the environmental consideration and impacts associated with the potential development of Site C has been conducted in the past, particularly in the late 1970s to early 1980s, and in the early 1990s. Many studies provide a good description of the physical and biological conditions at the time they were undertaken. Several studies would need to be updated in conjunction with stakeholder and community engagement and First Nations consultation to ensure that the assessment of the benefits, costs and risks of the project relative to the alternatives are based on accurate and current information. An environmental and social gap analysis review conducted for BC Hydro in 2005 estimated that up to two years would be required to conduct the necessary studies. Some fish and wildlife preliminary baseline studies are currently underway.

This section of the report provides an overview of the expected impacts of the Site C project, with an assessment that further studies, combined with consultation with communities and First Nations, will inform the opportunities to avoid or mitigate these impacts where possible.

6.2 Environmental Changes

The creation of the reservoir, the physical interruption of the Peace River and the construction of the physical works would all cause changes to the local environment. The following paragraphs provide detail on the anticipated environmental changes.

6.2.1 Changes Resulting from the Creation of the Reservoir

6.2.1.1 Flooding of River, Tributaries and Land

The inundation or flooding of the river, tributaries and land is expected to be the most significant impact of the creation of the reservoir. As currently conceived, the reservoir created by a dam at Site C is expected to flood approximately 5,340 hectares of land and about 3,970 hectares of water. The use of additional land would be affected between the reservoir level and a residential safeline, which is a line beyond which the security of habitations can be reasonably assured from landslide activity or beach erosion. The reservoir would increase the water elevation by 52 metres at the dam. The Moberly River would be flooded for 10 kilometres upstream and the Halfway River would be flooded for 14 kilometres upstream, both as measured from their joining together with the Peace River. There would be additional land impacts due to the realignment of Highway 29 away from the flooded area.

6.2.1.2 Erosion Landslides

Approximately 25 per cent of the shoreline has overburden or soil layered over the bedrock in the slopes that would be covered by the proposed reservoir. This material would be more subject to landslides and to wave erosion. Flooding would increase the likelihood of small slides (less than 20,000 cubic metres) along the low bank areas, though the effect on high bank areas would be minimal. Based on historical estimates, active slides could affect between 230 and 540 hectares. Bank stability downstream of the dam is not expected to be affected. Bank protection would be required at Hudson's Hope to minimize the risk of slumping of reservoir banks in the vicinity of the town.

6.2.1.3 Methylmercury

To ensure the levels of methylmercury are kept to a minimum, mitigation measures in the development of Site C could include clearing the reservoir and disposing any non-merchantable timber and vegetation to reduce the organic matter in the reservoir at the time of flooding. In addition, soil sampling would be performed to test for the presence of mercury in the soil, which is a precursor to methylmercury formation.

Available evidence from other recently formed reservoirs suggest that methylmercury levels in the Site C reservoir could increase during the initial years after impoundment, and decline over time to levels similar to natural lakes. Site C would have a relatively small reservoir and the mean residence time for water would be short (approximately 22 days) compared with that of larger reservoirs (e.g., approximately two years for the Williston Reservoir). As a result, there would not be large volumes of standing water in contact with decaying vegetation to cause the accumulation of methylmercury.

6.2.1.4 Local Climate

The replacement of a river with a reservoir may result in changes in temperature and humidity in the area adjacent to the reservoir, and, as a result, increase the magnitude of fogging and snowfall. Since the Site C reservoir would be relatively small in surface area, any modification to the local climate caused by the reservoir would probably be measurable only within the limits of the valley walls and within approximately 600 metres of the shoreline.

The most pronounced climatic effect of the Site C reservoir would be the greater frequency and density of fog, particularly during cold weather in spring and fall. During the winter when the reservoir could be frozen, the amount of fog would be reduced relative to the current norm. Wind speeds near the reservoir would be expected to increase by about 10 per cent. Evaporation rates and humidity would increase slightly due to the reservoir, but the effects would likely not extend beyond the rim of the Peace Valley. There could be small changes in the temperature around the reservoir.

Further study would be required to improve the understanding of local climate effects and their potential consequences.

6.2.1.5 Greenhouse Gases

The greenhouse gas emissions from the operation of Site C are anticipated to be minimal. Carbon is currently stored in the soil and vegetation of the area and these would be removed during construction leading to a one-time release of greenhouse gas during this phase of the project.

Site C would be a high latitude, cold, deep (low surface area to volume ratio) reservoir with relatively less biological productivity and potential for nutrient inflow. Site C is in the category of reservoir with the lowest potential for greenhouse gas emissions.

For general planning purposes, a conservative estimate for greenhouse gas emission flux from the Site C reservoir could fall in the range of 0.015 to 0.030 tonnes of greenhouse gas emissions per MWh. This is based on published information for some specific reservoirs in Canada. Based on an annual energy production of 4,600 GWh, the Site C reservoir could contribute between 70,000 and 140,000 tonnes of greenhouse gas emissions per year for approximately the first 10 years after the reservoir is created. Thereafter, there would be negligible greenhouse gas emissions. Further study is required to refine these estimates.

By way of comparison, the expected greenhouse gas emissions from other energy sources required to produce a similar amount of energy as Site C would be 1,600,000 tonnes/year for a combined cycle natural gas plant and 3,900,000 tonnes/year for a supercritical coal plant.

6.2.2 Changes Caused by Physical Interruption of the Peace River

6.2.2.1 Barriers to Flow and Passage and Changes to Flows

Site C would create a barrier to the free flow of the Peace River and to free passage upstream and downstream.

Changes in the speed of flow of the surface water in the reservoir upstream of the dam compared with that of the existing river would lead to greater formation of ice at that location. Currently, an ice cover occurs rarely in the Site C area, but with the Site C project, an ice cover would be expected to form on the reservoir in most years.

The flow regime downstream of Site C would not be altered appreciably after the initial reservoir filling period as the operation of Site C would generally be in hydraulic balance (i.e., operated as a run-of-river project) with the upstream plants at G.M. Shrum and Peace Canyon generating stations. It would take approximately one month to fill the reservoir. In comparison, it took 36 months to fill the much larger Williston Reservoir.

6.2.2.2 Changes in Water Temperature

Based on a 1979 study, the average water temperature in the Site C reservoir during the summer months would be two to three degrees Celsius higher than in the river at present, reaching a maximum in July of about 13.5 degrees Celsius at the end of the reservoir nearest the dam.

During the BCUC hearings, the B.C. Ministry of Environment maintained that the water temperature increases could be overstated since greater evaporation might offset the heat gain.

Further modelling of the impact of Site C on summer water temperature would be required as part of the next phase of BC Hydro's analysis of this resource option.

Related to the changes in temperature would be changes to patterns of ice formation downstream of the dam. Considerable attention has been paid to ice formation in the Peace River since regulation by the W.A.C. Bennett Dam, due to the periodic flooding at the Town of Peace River caused by ice jams.[7] In 2002, BC Hydro conducted a thorough study on the effects of Site C on downstream ice formation to determine whether there would be an increase in the risk of ice jam flooding as a result of Site C or the proposed Dunvegan Project (described in Chapter 10). The study found that there are no significant effects by Site C on the ice regime at the town of Peace River and that the ice front would never reach Taylor after Site C is built due to warm water releases from Site C as a result of the thermal stratification of the Williston reservoir and water releases through Peace Canyon compared with the present probability of one in five years of an ice front reaching Taylor. In winter months, release temperatures are expected to remain above zero degrees Celsius even after formation of the ice cover on the reservoir. This could be beneficial as in the past, ice has caused flooding at Taylor.

The 2002 ice study is currently being updated using new and substantially better river ice modelling tools that have since become available.[8]

[7] To reduce the potential for flood damage, BC Hydro and the Alberta-B.C. Joint Task Force on Peace River Ice have agreed on a management strategy that includes restrictions on minimum and maximum flows during November through April. The towns of Taylor and Peace River are the two main communities affected by high water conditions induced by the ice regime on the Peace River.

[8] This study is being undertaken as part of an assessment of the implications of the proposed Dunvegan facility on Peace River ice information.

6.2.2.3 Changes to Water Quality/Gas Content

Any problems associated with high total dissolved gas levels due to use of the spillway would occur infrequently should Site C be developed. Mitigation measures are available to reduce the production of dissolved gases.

Another water quality issue would be sedimentation levels. Suspended sediment levels immediately downstream of the Site C dam would be greatly reduced due to the settling out of sediments in the reservoir. This would be most noticeable between the dam site and the confluence of the Peace River and the Pine River.

6.2.3 Changes Caused by the Construction of Physical Works

The construction of the dam and generating station and of the facilities and roads required for construction would have an impact on land use as well as on air quality. Based on initial plans, the dam site, powerhouse, switchyard, access roads and construction camps would affect 280 hectares of land. The realignment of Highway 29 would affect approximately 142 hectares of land. The 500 kV transmission line would affect 179 hectares of Crown land at Peace Canyon and Site C terminations. Additional land would be affected temporarily by borrow and spoil sites (excluding the haul roads), which would be identified following further study.

During the construction period, there would be an impact on air quality as a result of the operation of heavy machinery and burning of debris. Air quality impacts are expected to be temporary and similar to that of any large-scale construction works where the predominant activity is the movement of rock and other materials. The effect of gaseous emissions on local air quality would generally be limited to the construction and commissioning phases of the project.

The large number of workers in the area during construction could put increasing pressure on fish and wildlife populations to the extent they engage in sports hunting and fishing. Improved road access as a result of the project, particularly to the south side of the Peace River, could expand access for recreational hunters and fishers. The issue of whether to permit the public to use the dam access roads would need to be addressed in the next stage of project evaluation.

6.3 Environmental Changes for the Community

The community would be affected through expected displacement of a number of families, impacts on private property holdings, land-based economic activities, the realignment of Highway 29 and increased demands on local infrastructure during construction.

6.3.1 Private Property Holdings and Crown Lands

To date, BC Hydro has acquired 1,389 hectares of privately owned land within the reservoir area. Studies will be conducted in Stage 2 to determine how much privately owned land lies within the reservoir area, as well as land that would lie within a safeline that would be established around the reservoir. In addition, rights of way for flooding or other easements would be required on some Crown land.

6.3.1.1 Private Land Impact

The creation of the reservoir would flood some land owned by others, requiring purchase by BC Hydro. Some of these parcels would be partially flooded or eroded and would require both purchase of the portion flooded by BC Hydro, and a right-of-way for the area below the safeline but above the area flooded. Some parcels situated below the safeline but above the portion flooded would be subject to flooding or erosion and could require the acquisition of the right-of-way. The safeline will be reassessed in Stage 2 to determine specific parcels that would be impacted.

Some private land would also have to be acquired for the realignment of Highway 29. No private land acquisitions are currently contemplated for the transmission line.

6.3.1.2 Crown Land Impact

Some Crown land would be flooded by the project. BC Hydro would be required to apply for Crown land rights for land that would be flooded. No additional land or right-of-way would need to be acquired for the dam site. A right-of-way may need to be acquired for Crown land affected by the final connections of the transmission line.

6.3.1.3 Land Acquisition Program

In the 1970s, BC Hydro published a Land Acquisition Policy pamphlet that explained its "Responsive Program" of land purchase. Some landowners had expressed a desire to sell their property to BC Hydro in advance of a final decision on the project. Negotiations were based on fair market value. Approximately $6.2 million was spent on purchasing properties, largely between 1977 and 1981 when the larger rural parcels were obtained. Many of the smaller, residential properties in Hudson's Hope (Lynx Creek) were purchased in 1990. All property owners who disposed of their property and who continue to lease their property back from BC Hydro have the right to repurchase the property they sold to BC Hydro at the price paid by BC Hydro, if the project is abandoned. The acquisition program remains in effect.

Wherever possible, farmland and ranchland acquired by BC Hydro is being maintained in productive use, either by leasing it back to the original owner or to another tenant where the original owner did not elect to remain. Those who continue to lease the land would be affected by the need to relocate should this project proceed.

Currently, BC Hydro owns 2,691 hectares of which 2,351 has been leased.

6.3.1.4 Site C Safeline

A residential safeline was determined in 1978 as a line beyond which the security of residents and residential improvements can be reasonably assured from landslide activity or beach erosion. The safeline was intended to be applied to residential use of land only. Roads, farming and some industrial facilities may continue below the safeline provided there are no permanent habitations. Since 1978, design codes have been updated, including the National Building Code. The safeline will be thoroughly reassessed to modern criteria during Stage 2.

6.3.2 Land-Based Economic Activities

6.3.2.1 Agriculture

Agriculture is an important local economic activity. Agriculture is primarily focused on grain and forage crop production. Cattle ranching is the prime livestock focus. Farms tend to be larger than elsewhere in the province.

Some agricultural land, of different classes, will be impacted. Studies will be conducted in Stage 2 to determine the amount of agricultural land impacted.

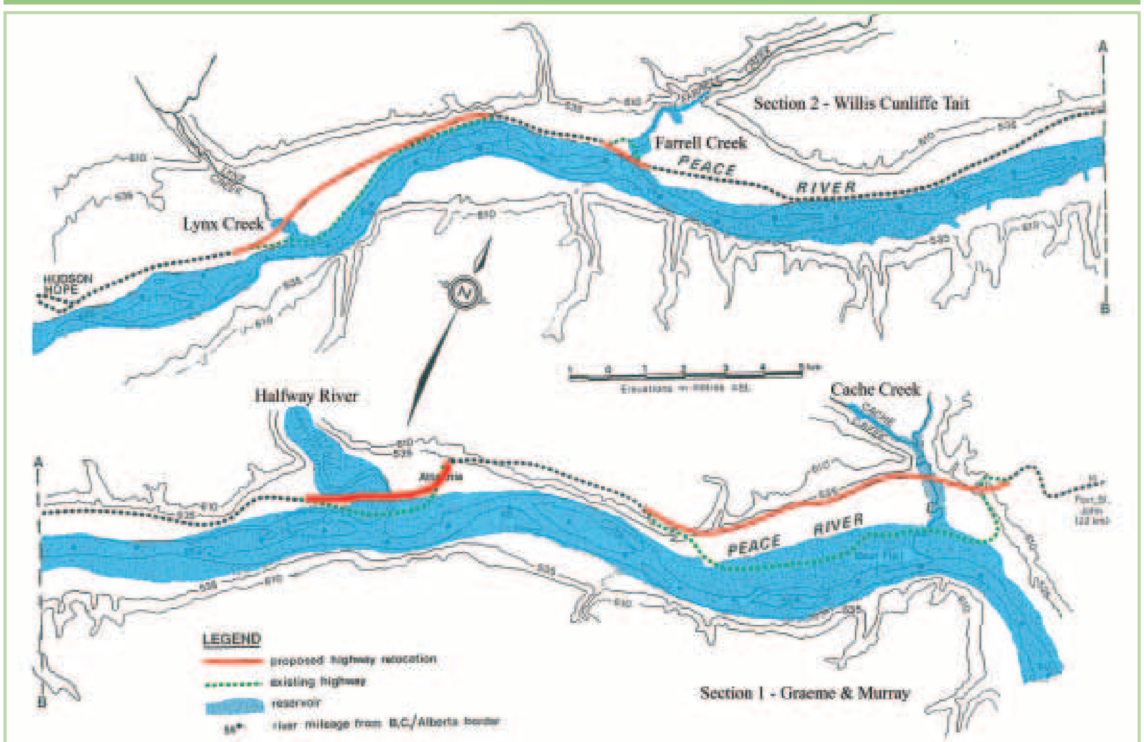
Farming operations adjacent to the reservoir could be directly affected through the flooding of land; inclusion of land within the reservoir safeline; fragmentation of agricultural land parcels; disruption of access routes; the loss of land associated with the relocation of Highway 29, and potentially by local climatic effects on crop drying and growing period; as well as impacts from construction activities. Studies during Stage 2 will establish which farms would be flooded by the creation of the reservoir or otherwise affected as a result of potentially being within the safeline area.

Some of the potentially affected land falls within the provincial Agricultural Land Reserve, a provincially regulated zone in which agriculture is the priority use, farming is encouraged and non-farm uses are restricted. At the appropriate time, BC Hydro would discuss with the Land Commissioner the applicable process and protocol with respect to lands that would be affected by the Site C development within the Agricultural Land Reserve.

The overall impacts of the project on the actual agricultural production within the Peace River valley and the agricultural region are expected to be small, and most operations in the region would remain economically viable following the development of Site C.

Agricultural land use information would need to be updated prior to further assessment on the potential impacts of the Site C project on agriculture.

Figure 6-1 **Potential Realignment of Highway 29**



6.3.2.2 Forestry

About half of the area flooded by the creation of the reservoir would be forest land. Further study would be required to determine the exact area of productive forest land and to conduct a forest inventory and timber supply analysis.

6.3.2.3 Mineral and Aggregate Mining

The reservoir area is reserved from permanent mineral development as a part of the original reserve for hydroelectric development granted by an Order In Council. There is low metallic mineral potential in the flood area. There are no-mineral claims in the reservoir area or within the three kilometre buffer area. The Peace River reservoir area has approximately 1,560 hectares of land in sand and gravel tenures and 50 placer claims locally. The Order in Council 1722 gives precedence to hydroelectric development over placer claims. The reservoir area and the downstream area are known to have good coal potential, but it is unlikely that coal mining would occur in the reservoir area.

6.3.2.4 Tourism and Recreation

The Peace River is a popular location for many river-based and wildlife-related tourism activities. Tourism and recreation would be affected by both the creation of the reservoir and the construction of physical works.

Boating, camping, hiking, hunting, and wildlife- and nature-viewing are popular activities for residents and tourists. The two main attributes of the Peace River Valley are its scenic views and the variety of activities made available by the river and its surrounding shoreline.

Although a net loss of attractive shoreline is expected as a result of reservoir creation, there would continue to be substantial shoreline suitable for existing activities, such as beaching, boating and picnicking. Areas of exception would be along the Moberly and Halfway arms of the reservoir, due to flooding. Overall, creation of the reservoir would result in a decrease in river-based activities, although this could be offset by new opportunities for reservoir-based recreation.

The creation of the reservoir would change the present river-based fishing experience to a reservoir fishing experience. A study in 1979 predicted that recreational hunting in the vicinity of the Site C reservoir would become less popular because of decreases in big game populations. This study will be reviewed in Stage 2.

Tourism and recreation information would require updating prior to further analysis of the potential impact of the Site C project.

6.3.3 Highway Realignment

As a result of the creation of the reservoir, sections of Highway 29 would need to be relocated. The route realignment based on initial design plans is illustrated in Figure 6-1.

A comprehensive review of alternate highway realignment routes would be undertaken in the next stage of evaluation to update right-of-way requirements to current Ministry of Transportation standards, to develop detailed maps and to engage in community consultation.

6.3.4 River Navigation

The *Navigable Waters Protection Act* attempts to balance the public's right to travel on navigable waters and the need to build infrastructure and facilities that may affect navigability. Navigable waters are defined as including any body of water capable of being navigated by any type of floating vessel for the purpose of transportation, recreation or commerce. The Peace River is a navigable water way.

The Peace River is not believed to support significant amounts of commercial navigation, but there may be affects on recreational uses. This issue requires further study.

6.3.5 Demands on Local Infrastructure

Local community infrastructure would experience increased use during the construction period as a result of increased employment. The greatest community impacts would be experienced in Fort St. John, though other communities in the immediate vicinity of Site C (Taylor, Hudson's Hope, Chetwynd and Dawson Creek) could also be affected.

The influx of temporary and permanent workers and their families into these communities for dam and facilities construction, reservoir preparation, Highway 29 relocation, transmission line construction and support services would affect housing, transportation, community services, public programs, infrastructure and municipal finances. According to previous estimates, approximately 7,650 person-years of work would be required to complete the project, with the labour force peaking at approximately 2,015 in year four of construction. The increased construction labour force could cause an increased demand for housing, higher rents and real estate prices and possible housing shortfalls. Planned construction camps for the construction crew would minimize this impact.

Impacts on the road and highway system due to the increased movement of workforce and goods during construction would be significant.

An updated population forecast would inform further analysis of impacts on infrastructure, service levels and other community considerations.

6.4 Environmental Changes in Heritage and Culture

Heritage and cultural resources would be affected by the flooding of river, tributaries and land, ongoing erosion of the reservoir banks, and by construction and road-building activities. The *Heritage Conservation Act* provides protection for British Columbia's archaeological resources. The *Act* applies to archaeological sites predating 1846, whether they are located on public or private land. In accordance with the *Act* (Section 13(2)), archaeological sites may not be destroyed, excavated, or altered without a permit.

The majority of heritage impact assessment field work in the Peace River area was conducted in 1978, 1980 and 1981. A comprehensive inventory near the dam site identified 16 historic sites, while a sampling program identified an additional 241 heritage sites in or near the proposed reservoir, 30 per cent of which were previously disturbed by agricultural operations, road construction or natural erosion.

Four kinds of heritage resources were identified in the Site C impact zone:

- *Historic sites, including forts and other log structures from the early fur trading and gold rush eras;*
- *Prehistoric sites, some dating back as far as 10,500 years;*
- *Paleontologic or fossil bearing sites; and,*
- *Ethnographic or traditional social and religious sites, which do not qualify as heritage sites because they do not contain any physical remains. These sites and their contemporary use are often the main focus of the heritage concerns of First Nations during consultations for projects such as Site C.*

While some sites have already been disturbed or destroyed by previous activity (agriculture, road construction and maintenance, gravel quarrying or natural erosion), the effects of flooding would further affect these sites and require further investigation. The surface of these sites could also be disturbed during reservoir forestry clearing, construction and road building activities.

Studies in the 1970s estimated that 177 known heritage sites could be affected by the project. Sixty-four known heritage sites would be inundated by the Site C reservoir (of which 16 are historic in origin).

Forty-nine sites would be near full pool (461.8 metres) where beaching, water erosion and minor sloughing would be greatest; 41 sites would be above the full pool level but at potential risk; and 23 sites would be affected due to the relocation of Highway 29. Further study would be required to update the heritage resource impact assessment for Site C.

6.5 Environmental Changes in Flora and Fauna

The construction of the Site C project and the filling of the reservoir would affect the flora and fauna in the Peace River valley between Peace Canyon and Site C. Most important among these changes would be the flooding of the valley bottom, including in-stream islands and the vegetation situated along or near the bank of the Peace River.

6.5.1 Legal Framework for Assessing Consequences for Flora and Fauna

The key federal Acts are the *Species at Risk Act* (SARA) and the *Federal Migratory Birds Convention Act* as well as the *Fisheries Act,* which is discussed in Chapter 9. The provincial Acts and processes that protect species at risk are the *BC Wildlife Act* and the *BC Forest and Range Practices Act.* Pursuant to the *Hydro and Power Authority Act*, BC Hydro is exempt from the application of these provincial Acts. Nevertheless, BC Hydro tends to work to achieve the outcomes targeted under such legislation. In addition to the provincial legislation, the BC Conservation Data Centre manages the process of identifying species at risk in the province.

Other legislation pertaining to environmental protection and assessment is reviewed in Chapter 9 and Appendix 3.

6.5.2 Wildlife

Wildlife is abundant in the Peace River valley and the surrounding area, though constrained somewhat by land uses such as agriculture, highways and oil and gas development. A variety of wildlife species (aquatic, terrestrial and avian) have been identified. Flooding would lead to the loss of some habitat for hoofed mammals such as elk, deer and moose and for fur-bearing animals such as fisher, lynx, beaver and marten. Key uses of the habitat that would be flooded include overwintering and refuge habitat on the islands, of particular importance to elk, deer and moose during the spring calving season.

Many issues with respect to impacts on wildlife have been studied in the past and canvassed in the previous regulatory hearings for Site C. This information requires updating, particularly with respect to inventory of species, survey work and habitat analysis. Some of these studies are underway as a result of the work for the Stage 1 report as data over multiple years is required. Further studies are planned in Stage 2 in order to better understand the potential impacts of Site C and mitigative measures that could be considered.

6.5.3 Fish

Fourteen principal species of fish have been observed in the Peace River main stem in the vicinity of Site C.[9] The most abundant species is the mountain whitefish (87%) followed by long nose sucker (7%), the Arctic grayling (2%) and the bull trout (2%).[10] The bull trout is identified as a species at risk under The *Forest and Range Practices Act.* There are no SARA-listed fish in the potentially affected area.

The development of the dam and reservoir would have an impact on both the fish habitat and fish populations. The creation of the reservoir would change existing river habitat to reservoir habitat. Changes to the aquatic habitat could potentially cause a shift in species composition and a reduction in same species . Changes to the habitat would result in the loss of some spawning habitat in the main stem and part of the lower tributaries. The change in habitat could also benefit some fish, by improving overwintering conditions for rainbow trout, bull trout, mountain whitefish and Arctic grayling, and creating a region of shallow water in the reservoir where the light reaches the bottom, which is important for fish production. The reduced turbidity of the water downstream of Site C would likely result in an increase in the populations of rainbow trout and mountain whitefish.

The operation of the proposed Site C dam would result in the loss of fish from the reservoir over the spillway or through the turbines. Periods of spillway discharge could result in elevated levels of total dissolved gas and affect fish downstream of Site C, but spills are expected to occur infrequently and the risk could be mitigated through spillway design.

The existing design for Site C does not incorporate fish passage facilities. Bull trout would be among the fish affected by the lack of fish passage facilities as downstream populations would no longer be able to move past the dam and into the upper Halfway River system to spawn in the fall.

[9] There are up to an additional 13 fish species found in the Peace River mainstem, but in low numbers.

[10] Data is based on indexing work of 12,540 fish by BC Hydro in 2005.

Further studies would concentrate on species movements through radio tagging, migration to critical spawning habitats and seasonal use of the main stem and tributaries, and review opportunities for fish passage.

6.5.4 Plants

Vegetation resources of concern in the Site C area include rare higher order plants including flowers, trees and shrubs. Vegetation would be affected by flooding, climate effects and the loss of land to physical works. Field surveys during 2005 found 21 Red or Blue-listed plants, six of which were not previously known in the Peace River area. There are Conservation Data Centre records for 36 additional plants within the Peace study area that were not recorded during the field surveys in 2005. There are two Red-listed plant communities and three Blue-listed plant communities that may be present. Studies to date have not found any SARA-listed plants in the potentially affected area. Additional surveys may be required to cover a wider range of habitats.

6.6 Reconciling Among Land Use Preferences

Certain types of land use are simultaneously compatible for multiple uses while other types of uses are mutually exclusive, such as agriculture and forestry. To properly evaluate the consequences of the Site C project, it is necessary to determine what is likely to be the best use of the land in the absence of the project.

The provincial Land and Resource Management Plans for the region provide overall recommendations and direction for land use, including protected area designation. The Dawson Creek Land and Resource Management Plan (covering the south bank to the centre line of the river) respected the Site C flood reserve as well as oil and gas activity. In so doing, it did not recommend full protected area designation. The Dawson Creek Land and Resource Management Plan recommended the following with respect to the south bank lands:

- *Designate Crown lands within the Peace River Boudreau Lake Protected Area under The Environmental and Land Use Act to accommodate the Site C flood reserve and opportunities for directional drilling;*
- *Consider timber harvesting within the flood reserve adjacent to the Peace River if government endorses the Site C project;*
- *Consider having BC Hydro re-evaluate its hydroelectric development proposals on the Peace River prior to the onset of a future Land and Resource Management Plan process within an eight-year time frame.*

The Fort St. John Land and Resource Management Plan, October 1997 (covering the north bank to the centre line of the river) went further towards recommending full protection status for all islands upstream of the potential dam site, and added that:

- *Any portion of these islands that are outside of the flood reserve be designated as Protected Areas;*
- *Areas within the flood reserve be designated under The Environment and Land Use Act such that resource development activities or tenures are precluded until such time as a decision is made on the Site C proposal;*
- *If the Site C flood reserve is cancelled, the areas designated under The Environment and Land Use Act be upgraded to full protection status.*

The current Site C flood reserve causes uncertainty in land use planning within the Fort St. John planning area. The Fort St. John Land and Resource Management Plan therefore recommends that BC Hydro review its plans for Site C prior to any subsequent land use planning exercise, no later than 10 years from approval date of the Plan.

6.7 Issues & Recommendations

As previously mentioned in this report, Stage 1 work was predominantly a desk-based exercise summarizing existing studies and historical information about the project, with a view to determining if there is enough potential to address key issues to move to the next stage of project development. The conclusion from this initial analysis is that there is potential to address key concerns and legislative requirements, and that many of the issues relating to individuals, community, land impacts and environmental impacts require further study and engagement to determine benefits, impact and potential mitigation.

It is recommended that the communities, First Nations and stakeholders have an opportunity to participate in determining which studies and key issues should be addressed.

Key areas for further study include, but are not limited to, the following:

- *Environmental changes;*
- *Community impacts including families living within the reservoir or safeline area, realignment of Highway 29, demands on infrastructure and other land impacts;*
- *Impacts on agriculture, forestry, mining, tourism and recreation; and,*
- *Species at Risk, fish and wildife.*

Public and Community Consultation

Chapter 7

7.1 History of Site C Consultation

BC Hydro first seriously considered Site C in the 1970s. Public meetings specific to a Site C regulatory application started in 1977, a Site C information centre was opened in Fort St. John in 1980, and additional public meetings and open houses were held prior to initiating an Energy Project Certification (EPC) process with the BCUC. The resulting 1982 year-long hearing process included extensive input from First Nations communities, local residents and regulatory agencies. The BCUC ultimately denied the project based on the demand forecast and comparison of alternative supply options.

BC Hydro took no further public action on Site C until 1989. BC Hydro began Site C consultation, including a regional public consultation committee, focus groups, open houses and newsletters. In 1991, due to a change in the forecast electricity demand, BC Hydro put the project on hold.

Most recently, through the BC Hydro Integrated Electricity Planning (IEP) processes (2004 and 2006), Site C was again raised in the context of available future supply options. The 2006 IEP process included extensive regional and provincial level consultation. Site C was considered within a range of all possible supply-demand option portfolios over a 20-year period. From the 1982 BCUC hearings to the more recent IEP consultations, key themes from consultative programs on Site C have included:

- *Communities and stakeholders want a fair and transparent consultation and environmental review process; and,*
- *Communities and stakeholders want a comprehensive review of the distribution of project impacts and benefits.*

7.1.1 1982 BCUC Site C Hearings

The following provides a brief overview of the concerns and issues raised by public and intervenor speakers during the 1982 BCUC Site C hearings, conducted 25 years ago.

- **Project-Related Topics:** *During the hearings, speakers raised questions around a diverse range of BC Hydro electricity planning topics including: the forecast need for energy; evaluation and consideration of supply alternatives; and implementation of energy conservation initiatives to offset future demand. A number of speakers raised questions about the project's design (its affect on socio-economic or environmental factors), financial impacts and the short- and long-term rate impacts.*
- **Environmental and Socio-economic Topics:** *The frequent topics raised by the public hearings were environmental and socio-economic concerns. Agricultural and recreational impacts were mentioned most frequently. Agricultural concerns hinged around the net land impacts and provincial food supply. Recreation concerns focused on access to, and quality of, recreation experiences and consumptive recreation uses (hunting and fishing). Speakers were also concerned about damage to, or destruction of, heritage resources (both paleontological and historical resources). Changes to, and loss of, fish and wildlife habitat and populations were raised by several speakers, most often in the context of hunting and fishing impacts. Finally, local climate change (increased wind and fog) was raised in the context of impacts on growing season, air navigation and local climatic conditions.*
- **Social and Cultural Topics:** *Many speakers raised community-based concerns about direct local benefits and impacts, such as opportunities for employment and training. Some individuals felt that the local residents should receive discounted power rates as compensation for bearing the project impacts. Community leaders and local residents were concerned about the short-term pressure on local services, such as hospitals and schools, as a result of increased labour during construction.*
- **First Nations:** *First Nations were concerned about permanent disruption and change to their resource-based economy, culture and way of life. Similarly to non-aboriginal communities, First Nations were concerned about the population increase and its impact on social service levels, hunting and fishing pressure and increased wilderness access. Members of Treaty 8 were specifically concerned about how Site C might affect their Treaty rights to hunt, fish and trap.*

- **Remote Communities:** *Some communities in the region were not, and still are not, connected to the BC Hydro grid. Speakers from these communities felt that BC Hydro should connect communities that bear the impact of BC Hydro facilities. Currently, work is underway to provide a number of remote communities from around the province with electric service under the BC Hydro's Remote Community Electrification Program and through direct negotiations with First Nations in some cases.*

As stated earlier in the report, those voicing support for the project at the time included some associations representing province-wide stakeholders who favoured adding reliable electricity supply. There were also regional stakeholders who spoke in favour of development because they preferred hydroelectricity over coal and other resource options. Some others also supported the project as a means of economic development in the region.

In 1983, the BCUC released its report and recommendations stating:

> *[While] the Commission recognizes that major impacts will result from the Site C project, the Commission concludes that they are not so large as to make them unacceptable. Provided that appropriate conditions are placed on Hydro and the government responds to the special needs created in the region, the impacts can be successfully and acceptably managed.*

However, the BCUC nonetheless concluded that:

> *An Energy Project Certificate for Site C should not be issued until (1) an acceptable forecast demonstrates that construction must begin immediately in order to avoid supply deficiencies and (2) a comparison of alternative feasible system plans demonstrates that Site C is the best project to meet the anticipated supply deficiency.*

7.1.2 Views Expressed by a Broad Cross-Section of British Columbians on Site C

Although no comprehensive, province-wide consultation specific to Site C has been done to date, the 2006 IEP process did engage stakeholders province-wide on all resource options. In the past, most project consultation focused on local stakeholders. BC Hydro has conducted some public opinion research that included Site C in the context of long-term resource planning. One focus group study was undertaken in 2003 and two polls were conducted in 2005, with the purpose of understanding how citizens evaluated various resource options by exploring their economic, social and environmental implications. In addition, the 2003 focus group study offered an opportunity to understand which options were preferred and why.

In evaluating Site C relative to other resource options, the 2003 focus group research concluded that:

- *Support was based on the planned Site C location and its large and dependable electricity output. Site C is in a remote location, it is a proven site and environmental damage may be minimized through prior experience in the area;*
- *Key concerns were related to the potential environmental impact of creating a new reservoir. An independent environmental review would be important in securing public support;*
- *Further consultation with all British Columbians would be necessary to determine their views on the project as more information related to project impacts and benefits is gathered.*

In 2005, opinion polling showed that support for building Site C was not markedly different between the northern region and the province as a whole (54 and 57 per cent, respectively). However, the level of opposition to the project was greater in the north than across the province (37 per cent and 28 per cent, respectively).

7.2 BC Hydro's Commitment to Comprehensive Consultation

Consistent with BC Hydro's commitment to consultation and with the *BC Energy Plan*, the public and stakeholder consultation activities for the Site C project are expected to be comprehensive, multi-phased and create levels of public involvement through a variety of methods. The consultation program will seek feedback into project design and plans, benefits arising out of the project, and how project impacts may be avoided, mitigated or compensated. Consultation methods are expected to include:

- *Fact-based information (website, presentations, display boards, advertising, scale models, etc.);*
- *Thorough public and stakeholder notification;*
- *Open houses, one-on-one meetings, focus groups and public opinion surveys; and,*
- *Online mechanisms to encourage broader participation by those with location or schedule constraints.*

In addition, BC Hydro proposes to establish multi-party consultative committees to inform project definition. These committees would include First Nations and interested stakeholders, as well as government representatives, consultants and experts. The committees would involve issues such as fish, recreation and transportation among others.

Further, pre-consultation will be conducted to gain information on how British Columbians want to be consulted during consultation, and what topics they would like to discuss.

7.2.1 BC Hydro Recent Stakeholder and Community Engagement Projects

BC Hydro has successfully engaged with stakeholders in a variety of operational, planning and regulatory decisions as outlined below.

Revelstoke Unit 5 (2006): BC Hydro collaborated with regulators, agency staff and stakeholders in the development of a process for determining acceptable environmental, social and operational provisions for the proposed installation of a fifth unit at Revelstoke Dam.

Integrated Electricity Plan (2006): BC Hydro simultaneously engaged stakeholders at different levels, developing in parallel a deep dialogue with a few stakeholders while listening to a broader community across British Columbia. Creating opportunities for the broad public, not just the most interested stakeholders, is an important component to thorough consultation.

Water Use Planning (1998 – 2004): BC Hydro collaborated with regulators, agency staff and stakeholders toward a renewed operating decision on 23 projects, despite conflicting values, data uncertainty, and legal and regulatory alternatives to the collaborative process. There was strong First Nations, regulator and public participation and high satisfaction in the multi-party committee process.

Negotiated Settlements (2005): BC Hydro and intervenors reached negotiated settlements on BCUC filings due to a shared motivation to increase the certainty and reduce the burden of reaching agreements.

Regulatory Relations: Through various programs, BC Hydro is building constructive relationships with environmental and water regulators, who in turn are promoting BC Hydro's approach to multi-party decision-making as a model for others to follow (e.g., Water Use Plans, Sturgeon Recovery).

7.2.2 BC Hydro's Historical Relationship with Peace Region Stakeholders

BC Hydro has a significant profile in the upper Peace River corridor. This presence has developed over nearly four decades of hydroelectric development and operation on the Peace River, environmental footprint mitigation efforts through the Peace-Williston compensation and restoration program and from property management along the river. Local residents are familiar with the Site C project, including the previous BCUC regulatory application.

The strength and nature of BC Hydro's relationships with stakeholders in the Peace corridor are variable. BC Hydro's facilities in the Peace River region have provided benefits to local communities in the form of employment and grants-in-lieu of taxes[11] based on operation of the G.M. Shrum and Peace Canyon generating stations, as identified in Table 7-1. Based on proximity to BC Hydro facilities, the District of Hudson's Hope received significantly more in both school taxes and grants than Fort St. John, despite having a much smaller population. A 2002 study reported that in the prior 10 years, BC Hydro's payments to Hudson's Hope accounted for more than half of total tax receipts.

[11] BC Hydro pays three types of grants-in-lieu of taxes: generation capacity grants, a grant based on revenues, and a general grant paid on fee-owned land and specified buildings including warehouses, offices, substation control buildings, etc.

There are historic issues relating to dam development from the 1950s and 1960s that also affect community perceptions of the current project. Of note are contentious property expropriations for the W.A.C. Bennett Dam, concern about inadequate local employment during construction of both upstream projects and the perception among local stakeholders that BC Hydro has not met the commitments made related to previous hydroelectric projects. Further, there is also a public misperception that the rejection of Site C by the BCUC in 1983 was based on unacceptable environmental impacts. More recently, there has been support for current BC Hydro projects in the region, such as Peace Water Use Planning and the Peace Williston Advisory Committee.

BC Hydro's most recent dialogue with stakeholders about Site C was limited within the broader context of the 2006 IEP, though public meetings held in the northeast attracted considerable local interest and attendance.

7.3 Issues & Recommendations

Much of the information relating to community, stakeholder and public involvement in Site C is almost 25 years old. The current staged development approach for Site C allows BC Hydro to conduct a thorough, province-wide public consultation program for Site C for the first time. Input gained during the consultation program would be considered and help inform the project definition. The results of this consultation program would serve to better inform the province, BC Hydro and the public of project benefits, impacts and issues, prior to deciding whether to move to the third stage of project development, involving regulatory filings. Consultation discussions will also focus on seeking feedback to identify opportunities to benefit First Nations, residents and communities directly affected by the Site C project.

Table 7-1 **BC Hydro 2005 Net Property Tax & Grant Payments to Municipalities and Districts**

Municipality/ District	***2005 School Taxes (paid to the Province)***	***2005 Grants***	***2005 Other Taxes***	***2005 Total Payments***
District of Hudson's Hope	$1,432,100	$787,610	$5,149	$2,224,860
Peace River Regional District	$0.00	$444,643	$0.00	$444,643
City of Fort St. John	$52,469	$118,070	$1,221	$171,760
District of Taylor	$20,398	$231,141	$0.00	$251,539
TOTAL	$1,504,967	$1,581,464	$6,370	$3,092,802

First Nations

Chapter 8

8.1 Introduction

The rights of the different First Nations and Métis groups in the region may be impacted by the Site C project. First Nations issues are, therefore, a central component for consideration in any plan for Site C.

8.2 BC Hydro's Relations with First Nations in the Peace River Area

BC Hydro and First Nations groups have had few discussions to date about the potential Site C project, other than limited discussions as part of the 1982 British Columbia Utilities Commission (BCUC) hearings, in 1989 consultations, and the 2006 Integrated Electricity Plan (2006 IEP). As a result, there is a general lack of specific information on the part of First Nations regarding the project. BC Hydro's current understanding of the perspectives of First Nations is based on evidence submitted during the BCUC hearings, and public statements made in the media and through the 2006 IEP engagement process. Insights have also been gained from brief conversations about the Site C project that have occurred as part of meetings on other subjects between BC Hydro and individual First Nations bands. Based on these interactions, BC Hydro knows that First Nations have concerns about the Site C project and its potential impacts, and have expressed general opposition to it at times. First Nations are also interested more broadly in understanding the energy options that are being considered by the government and how the Site C project might meet future energy requirements. Only by engaging in dialogue with First Nations will BC Hydro fully understand the potential impacts of the proposed Site C project on First Nations and be in a position to respond appropriately to concerns and interests.

BC Hydro's relationships with First Nations in the Peace Region are limited. BC Hydro, in partnership with the province, has work to do to further develop and maintain effective relationships with First Nations in the region. BC Hydro has made significant progress towards a resolution of the Williston Reservoir claims with the negotiation of an Agreement in Principle. BC Hydro has addressed historical grievances associated with G.M. Shrum and Peace Canyon with two bands within B.C., but some historical grievances of other bands in B.C. and Alberta related to perceived ongoing adverse impacts due to regulation of the Peace River downstream of G.M. Shrum and on the Peace-Athabasca Delta remain unresolved. Further detail on historical grievances is provided in Chapter 10.

BC Hydro is at varying stages of consultation for three other initiatives in the Peace River area: the planned construction of a 57-kilometre 138 kV transmission line near Fort St. John with the BCTC; a proposed 90 MW expansion project at G.M. Shrum; and the Peace Water Use Plan. Consultation for the transmission line and the associated agreements with the Blueberry First Nation are complete. Consultation for the G.M. Shrum expansion project has been completed and an exemption of the Environment Assessment Office certificate process has been given. The Peace Water Use Plan has been finalized and recently received Cabinet approval and is now subject to final statutory approval by the provincial Water Comptroller. Several First Nations participated fully in the Peace Water Use Plan process and perceived benefits from the initiative, while others chose not to participate on the grounds that the process did not address historical grievances related to the impact of W.A.C. Bennett Dam and the perceived impact on Treaty rights.

8.3 Overview of Aboriginal People in the Surrounding Area

There are numerous First Nations and Métis communities in the Peace River area with tremendous cultural and linguistic diversity. They have quite different histories and currently experience a broad range of socio-economic conditions. BC Hydro's specific understanding of the individual First Nation bands living in the region is varied, but generally limited.

The area is relatively unique within B.C. as many of the First Nations are parties to the 1899 Treaty 8. The six Treaty 8 bands closest to the proposed dam site, along with Kwadacha and Tsay Keh Dene, have a combined population of approximately 3,000 people. Table 8-1 lists the Treaty and non-Treaty First Nations and Métis bands in B.C., Alberta and the Northwest Territories.

8.3.1 Treaty 8

Treaty 8 covers approximately 840,000 square kilometres of northern Alberta, northwestern Saskatchewan, northeastern British Columbia, and the southwest portion of the Northwest Territories. Figure 8-1 outlines the boundaries of Treaty 8 and other pre-modern treaties in Canada. Of the First Nations communities that are signatories to Treaty 8, 22 are located in Alberta, eight are in British Columbia, and six are in the Northwest Territories. Although some bands have historical and contemporary ties with one another, they represent several different cultures and traditions. The key political organizations representing Treaty 8 First Nations are the B.C. Treaty 8 Tribal Association and the Treaty 8 First Nations of Alberta.

The Site C project would fall within the territory defined in the Treaty 8 agreement. Treaty 8 provides that the First Nations surrender the land to the Crown in return for "the right to pursue their usual vocations of hunting, trapping and fishing throughout the tract surrendered." It also "lay[s] aside reserves for such bands as desire reserves." The Crown benefits from "such tracts as may be required or taken up from time to time for settlement, mining, lumbering, trading or other purposes." In BC Hydro's view, "other purposes" includes hydroelectric generation.

In 2000, the Treaty 8 Adhesion Agreement was executed by B.C., Canada and the McLeod Lake Indian Band (McLeod Lake) to bring the McLeod Lake into Treaty 8. The Agreement affirms the rights of McLeod Lake to hunt, fish and trap throughout the Treaty 8 lands and additional claimed territory – a tract of land along the south bank of the Peace River from the Alberta border westward and including the south end of the Williston Reservoir, as specified in Schedule A of the Treaty 8 Adhesion Agreement. The Agreement recognizes a dispute over the western boundary of Treaty 8 lands. Notwithstanding this dispute, much of the physical works for Site C and part of the reservoir flooding would fall within McLeod Lake's claimed land.

8.3.2 Non-Treaty First Nations

The key non-Treaty First Nations who may perceive themselves to be affected by Site C are the Tsay Keh Dene Band and Kwadacha First Nation. BC Hydro has reached an Agreement in Principle towards the resolution of historical grievances with these two First Nations that relates to the construction of the original Peace River power projects.

8.3.3 Métis

There are four Métis communities located in the region, including Kelly Lake, B.C. There is also a significant Métis population in the town of Fort Chipewyan, Alberta. Kelly Lake is the closest Métis community to the Site C project. It is located approximately 80 kilometres southeast of Dawson Creek, just inside the B.C.-Alberta border. The community is a mix of Métis and Saulteau Band (a Treaty 8 First Nation) members.

The political configuration of Kelly Lake is complex, with three organizations – none of which are recognized under the federal *Indian Act* – representing subgroups of the community.[12]

8.4 Potential Impact of the Site C Project on First Nations

In addition to the incremental impact of a third dam on the Peace River, First Nations are likely to be concerned about the cumulative impacts from the construction of G.M. Shrum and Peace Canyon, ongoing oil and gas exploration and agricultural development.

8.4.1 Impacts Due to Reservoir Flooding and Construction of the Dam

The potential impacts of the Site C project on wildlife and fish are documented in Chapter 6. First Nations may be particularly concerned about potential impacts on moose populations, fur-bearing animals and fish. During the 2006 IEP consultation process, First Nations groups expressed concern about increased pressure on the fishing and hunting resources during construction and as a result of increased access to the south side of the river.

[12] The *Indian Act* is the principal federal statute dealing with Indian status, local government and the management of reserve land and communal monies. It defines an Indian as "a person who, pursuant to this act, is registered as an Indian or is entitled to be registered as an Indian." The present act was passed in 1951, but its provisions are rooted in colonial ordinances and Royal Proclamations.

In addition to impacts on habitat, flooding of the reservoir area and the associated relocation of Highway 29 would likely result in damage to cultural and heritage sites. Such sites are typically important to First Nations because of their cultural significance and because they are often the source of evidence of traditional use and occupation by First Nations. In addition to formally recognized heritage sites, First Nations would likely identify traditional use areas, spiritual sites and community use sites as being of importance to them.

The impact of the project on activities on the Williston Reservoir above G.M. Shrum appears to be relatively modest.

8.4.2 Downstream Impacts

Some First Nations are likely to believe that the Site C project will cause significant downstream impacts. Certain First Nations believe that the construction of the W.A.C. Bennett Dam and the change in the annual pattern of flows damaged the Peace-Athabasca Delta.

The Mikisew Cree First Nation (Mikisew Cree), the Athabasca Chipewyan First Nation (Athabasca Chipewyan) and the Métis of Fort Chipewyan have long asserted that BC Hydro's regulation of the Peace River has resulted in less frequent flooding of the Peace-Athabasca Delta. They assert this has caused drying of the delta, which, in turn, has affected the way of life of the inhabitants. This perception was exacerbated by the filling of Williston during a dry period and the drawdown of Williston for a sinkhole during a wet period in 1996. The period since the dam was constructed also coincided with a period of steep decline in the markets for furs from the region that adversely affected First Nations' way of life. Scientific studies undertaken by BC Hydro demonstrate that there would be no downstream effects of the Site C project on the Peace-Athabasca Delta. Although some First Nations do not accept this evidence, the studies also demonstrate that there were no damaging effects resulting downstream from the construction of W.A.C. Bennett Dam and regulation of the Peace River. The issue of the Peace-Athabasca Delta is outlined in more detail in Chapter 10.

The construction of a third dam on the Peace River may be perceived to exacerbate this alleged damage, entrench the existing pattern of flow on the Peace River and reduce the likelihood of it ultimately being reversed.

In the late 1990s, the Mikisew Cree and Athabasca Chipewyan sued BC Hydro, seeking compensation for damages ($10 billion in the case of the Mikisew Cree First Nation), cessation of regulation and injunction against the Site C project and, in the Mikisew Cree's case, a share of profits from the facilities. BC Hydro and the Athabasca Chipewyan reached a settlement in 2002. BC Hydro and the Mikisew Cree began negotiations in 2001. Negotiations have subsequently been deferred several times and are currently inactive.

8.5 Issues & Recommendations

At this stage in project development, BC Hydro has limited knowledge to fully assess First Nations issues related to the Site C project. Further engagement and consultation would permit a much more informed understanding of the issues. Consultation for the Site C project would be a substantial effort that will require significant capacity and resources from BC Hydro, the ministries of Aboriginal Affairs and Reconciliation, and Energy, Mines and Petroleum Resources, First Nations and provincial and federal agencies. Although BC Hydro has substantially enhanced its capabilities to consult with First Nations, the Site C project consultation project would require significant bolstering of these resources and capabilities as well as support from other parties.

In entering the next stage of project development, it is recommended that initial discussions take place with First Nations to gain input into the engagement process, and that protocol agreements establishing the framework for negotiations would be a good starting point in this process.

Figure 8-1 **Map of Pre-Modern Treaties in Canada**

Table 8-1 **Treaty and Non-Treaty First Nations and Métis Bands in B.C., Alberta and Northwest Territories**

	BRITISH COLUMBIA	ALBERTA		NORTHWEST TERRITORIES
TREATY 8	*McLeod Lake West Moberly Saulteau Halfway River Doig River Blueberry River Prophet River Fort Nelson*	*Horse Lake Dene Tha Beaver Sturgeon Lake Cree Woodland Cree Lubicon Lake Tall Cree Fort McKay Fort MacMurray #468 Driftpile Sucker Creek Swan River*	*Whitefish Lake Athabasca Chipewyan Little Red River Cree Loon River Duncan's Mikisew Cree Chipewyan Prairie Bigstone Cree Nation Kapawe'No Sawridge*	*Deninu K'ue Salt River Smith's Landing Lutsel's K'e Dene Band Yellowknives Dene First Nation (Dettah) Yellowknives Dene First Nation (N'dilo)*
B.C. NON-TREATY	*Tsay Keh Dene Kwadacha*			
MÉTIS	*Kelly Lake*	*Paddle River*	*Red River*	*Fort Resolution*

Regulatory Requirements

Chapter 9

9.1 Major Regulatory Requirements

There are several federal and provincial regulations and processes that could apply to the Site C project. Chief among these are the *Canadian Environmental Assessment Act* (CEAA), the *BC Environmental Assessment Act* (BCEAA), the *British Columbia Utilities Commission Act* and the *Fisheries Act.*

9.2 CEAA and BCEAA and the Environmental Impact Assessment

9.2.1 Applicability of CEAA and BCEAA

The CEAA and the BCEAA and related regulations require that certain categories of projects undergo a comprehensive, integrated, coordinated and timely environmental impact assessment. These assessments provide the framework to address a broad range of issues prior to determining whether a project should proceed.

The Site C project would require review under both provincial and federal environmental assessment legislation. A CEAA assessment would be applicable because the Site C project would require certain CEAA-triggering approvals by federal agencies under the *Fisheries Act* and the *Navigable Waters Protection Act.* Applications for issuance of these authorizations are a trigger for the requirement of a CEAA assessment. Under the *Fisheries Act*, the Site C project would require an authorization for harmful alteration, disruption or destruction of fish habitat under Section 35, and the consideration of flow of water for fish under Section 22. The Site C project would also require a permit to construct a work in navigable waters under Section 5 of the *Navigable Waters Protection Act*.

As a project of greater than 200 MW or 1,500 hectares of flooding, the Site C project would require a comprehensive study under CEAA.[13]

[13] The CEAA can be applied to a project through three types of assessments: a screening process for those projects not listed in the Comprehensive Study List Regulations; a Comprehensive Study Process for listed projects, including hydroelectric generation stations of 200 MW or more and construction of a dam that creates a reservoir inundating 1,500 hectares or more over the annual mean surface area of a natural body of water; and a Panel Review process for a project listed in the Comprehensive Study List Regulations, when public concerns regarding the project, the potential of the project to cause adverse environmental effects, and the ability of the comprehensive study to address the project issues warrant referral to a review panel. The CEAA also provides for a referral to mediation.

Site C would also require a BCEAA assessment because, as an energy project larger than 50 MW, it would fall within the prescribed thresholds of the provincial Reviewable Projects Regulation.

BCEAA assessments are made within the context of prevailing policy and with the involvement of First Nations, the public and the proponent, and provide the framework to address a broad range of environmental, health, safety, socioeconomic, community and First Nations issues prior to determining whether a project should proceed.

The environmental assessment process provides opportunities for the involvement of all interested parties; technical studies of relevant environmental, social, economic, heritage and/or health effects of the proposed project; the identification of ways to mitigate or compensate for undesirable project effects and to enhance desirable effects; and input from all parties in compiling and assessing findings and making decisions with regard to the project.

9.2.2 The Environmental Assessment Process

Both the federal and provincial environmental assessment processes provide mechanisms for reviewing proposed projects and assessing their potential effects and possible mitigative measures, and ultimately for determining project acceptability. These processes are delivered by the B.C. Environmental Assessment Office (BCEAO) and the Canadian Environmental Assessment Agency (CEAA). Under the 2004 Canada-British Columbia Agreement on Environmental Assessment Cooperation, the BCEAO and the CEAA may consider harmonizing their reviews to the extent possible.

Both processes are made up of a number of steps that can be summarized broadly into a *pre-application*, and an *application and review* phase. Both processes also require consultation with First Nations, other government agencies, and the public throughout both the *pre-application* and the *application and review* phases, by both the proponent and by the BCEAO and the CEAA themselves.

The *pre-application* phase starts when the proponent presents a project description to the BCEAO and to the CEAA. Each agency independently decides if an environmental assessment review is required, who is involved, and the process and timelines for the specific project. The BCEAO leads the provincial process, and under the CEAA a Responsible Authority (RA) is identified to lead the federal assessment.

The next major *pre-application* activity is to define the scope of the project, information requirements and factors to be considered during the environmental assessment. The proponent develops a draft Terms of Reference and then works with the BCEAO and the CEAA and other parties. The proponent is then responsible for doing the work required by the Terms of Reference.

The *application and review* phase starts when the proponent submits their Environmental Assessment Application and Report to the BCEAO and to the CEAA for review. The agencies may request revisions from the proponent. Once the agencies accept the Application for review the agencies will follow their respective review processes with recommendations to Ministers and Ministerial decisions to issue or not issue a Certificate.

9.3 *Utilities Commission Act* and the British Columbia Utilities Commission (BCUC) Review Process

The second major regulatory requirement would be the application to the BCUC for a Certificate of Public Convenience and Necessity (CPCN).

Section 45 (1) of the *Utilities Commission Act* states:

> *Except as otherwise provided, after September 11, 1980, a person must not begin the construction or operation of a public utility plant or system, or an extension of either, without first obtaining from the commission a certificate that public convenience and necessity require or will require the construction or operation.*

The BCUC has the discretion to require an application for a CPCN before a utility constructs or operates an extension to its existing system. For an approval, the BCUC needs to be satisfied that the new system or extension is in the public interest and necessary for the public's convenience.

9.3.1 CPCN Process

Section 46 (1) of the *Utilities Commission Act* states:

> *An applicant for a certificate of public convenience and necessity must file with the commission information, material, evidence and documents that the commission prescribes.*

The scope of the information requirement for a specific application will depend on the nature of the project and the issues that it raises. Project proponents are encouraged to initiate discussions with appropriate government agencies and the public early in the project planning stage to obtain an appreciation of the issues to be addressed.

Typically, the BCUC requires a project description, including its purpose and cost, engineering design, capacity, location options and preference, a detailed project schedule for constructing and operating the project, and identification of critical milestones and dates that must be achieved for the project to continue to be a feasible proposal. Any additional public infrastructure that would be required by the project, including cost estimates and required completion dates, should be provided. Project justification is a key element of a CPCN application. Analysis must be provided that demonstrates the need for the project, confirms the technical, economic and financial feasibility of the project, compares the costs, benefits and risks of the project with alternatives, and quantifies the impact of the project on customers' rates.

CPCN applications may be supported by resource plans, which, in BC Hydro's case, are the Integrated Electricity Plan and the Long-Term Acquisition Plan. Significant aspects of project justification, particularly the need for the project and the assessment of the costs and benefits of the project and alternatives, are described in these documents.

The BCUC initially reviews the filed application for possible deficiencies which normally generates an Information Request for response by the applicant. Once the additional information is received, the application is reviewed by the BCUC in the context of project justification, issues and concerns raised, as well as general project suitability. When necessary, the BCUC may establish a Regulatory Agenda if further review of the application is required. Section 46 (2) of the *Utilities Commission Act* states that at the discretion of the BCUC a hearing on the application can be held.

In the case of the Site C project, the BCUC is likely to determine that a comprehensive review of the application would be required. Such a process would include several rounds of information requests to BC Hydro and an oral public hearing to test the veracity of BC Hydro's evidence.

The BCUC issues CPCNs with conditions attached. These conditions specify the scope of the project, its schedule and its expected costs. If these and other relevant conditions are met, the utility will generally be allowed to recover the project costs in rates after the project comes into service. If, for reasons within the control of the utility, the conditions are not met, the BCUC may deny cost recovery of all or part of the costs. In the past, the BCUC has imposed a risk-sharing mechanism on big projects to provide an incentive to the utility to contain costs and to protect ratepayers from cost overruns.

9.4 The *Fisheries Act*

The *Fisheries Act*, administered by Fisheries and Oceans Canada (DFO), is the primary federal legislation used to regulate activities that potentially affect fish and fish habitat in Canada. The scope of the *Fisheries Act* is wide as it applies to Canada's marine and inland waters and to the conservation and protection of fish, shellfish, marine mammals, marine plants, as well as to the habitat that sustains them. Since electrical generation facilities have the potential to affect both fish and habitat directly, it is important to understand the intent and use of the various sections of the *Fisheries Act* that pertain to hydroelectric development. Following are summaries of the pertinent sections of the *Act*.

Inclusion of Section 20 and its subsections in the original version of the *Fisheries Act* was recognition of the importance of maintaining unobstructed fish passage. Section 20 (1) gives the minister of DFO the power to require the owner or occupier of an obstruction to provide for the free passage of fish by constructing a "…durable and efficient fish-way or canal around the obstruction…". As contained in subsection 20 (3), this fish-way or canal is to be approved in advance of construction and must be modified, if necessary, to ensure that it passes fish effectively.

Section 22 gives the minister the discretionary power to order the release of water at an obstruction in sufficient quantities to provide for the safe and unimpeded descent of fish, the free passage of both ascending and descending migratory fish during the period of construction, the safety of fish below the obstruction and the safety of the ova deposited in spawning grounds.

Section 30 is a discretionary power to ensure the screening of intakes, ditches, channels or canals that conduct water away from any fisheries water. The intent of this section is to protect fish from injury or death and to ensure migrating fish are afforded safe passage elsewhere.

Section 32 prohibits the destruction of fish by any means other than fishing unless authorized by the minister. Within the context of hydroelectric facility operations, mortalities can occur through impingement at fish screens, turbine entrainment, gas supersaturation, stranding through abrupt changes in river elevation, or the discharge of anoxic reservoir water.

Section 35 is a relatively recent addition to the *Fisheries Act* that recognizes the inherent value of habitat to fish population health. This section prohibits the harmful alteration, disruption, or destruction (HADD) of fish habitat, which, in Section 34, is defined as "…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." Subsection 35 (2) gives the minister discretionary powers to authorize a HADD. Authorizations are usually only issued where the HADD is unavoidable, where the habitat is not deemed to be critical, and provided that the proponent agrees to compensate for lost habitat in a manner acceptable to the minister.

Section 35 is prescriptive in its application, which means that works or undertakings need to be authorized in advance of committing a HADD. Authorizations are not issued retroactively for HADDs that have already occurred. Because of the broad definition of habitat, Section 35 can be used to address hydroelectric operation effects on flows and fish passage, as well as direct physical HADDs. From the perspective of reviewing and permitting a new development proposal, it is often more efficient to consider all the habitat protection provisions during the review, and address concerns through the issuance of a subsection 35(2) authorization or letter of advice. As such, the powers established under section 20 and 22 are generally reserved for dealing with situations involving ongoing effects that can no longer be addressed through section 35. This would be the case, for example, where impacts to fish habitat are the result of existing hydroelectric operations. Even in such situations, orders would normally be used only where the proponent was unwilling to work toward a more cooperative solution.

The 1986 DFO Policy for the Management of Fish Habitat sets out strategies, goals, and objectives for the conservation, restoration and development of fish habitat. In particular, it establishes a guiding principle that there be no net loss of productive capacity of habitats, which is defined as the maximum capability of habitat to produce and sustain fish populations, whether they be naturally occurring or identified within fisheries management objectives. It is this principle that DFO habitat managers consider in the assessment of hydroelectric project proposals, the potential effectiveness of mitigation measures, and the biological (habitat) value of compensation options.

Due to the specific reference of Section 35 to fish habitat, rather than fish populations, and the focus of the Habitat Policy on productive capacity, hydroelectric projects are mainly evaluated on their potential to diminish the capacity of habitats to sustain all parts of the life cycle, rather than on fish population effects. The size and distribution of fish populations can vary considerably based on numerous natural and anthropogenic factors and are therefore not necessarily reliable for the assessment of development impacts. However, fish population data are used as indicators of habitat quality and availability, and to categorize and map fish community structure within a river system. These data are therefore valuable and necessary components of environmental impact studies.

Section 36 of the *Fisheries Act* prohibits the deposit of deleterious substances in waters frequented by fish. No permit or authorization can be issued to overcome this requirement.

While not directly applicable to the management or regulation of fish and fish habitat, the *Species at Risk Act* [SARA] could result in requirements additional to those imposed by the *Fisheries Act*, if species named within SARA schedules are found within a system proposed for development.

9.5 Applicability of Other Acts and Regulations

The Site C project would require authorizations and permits under several federal and provincial acts and regulations that are not superseded by or encompassed by the corresponding federal and provincial Environmental Assessment Certificates. To varying extents, some of the work to obtain the authorizations and permits listed below would be covered by the environmental review process, but additional work would be required for permit and licence applications. In particular, Site C would require storage and diversion licences under the provincial *Water Act.* Tenures under the *Land Act* could be needed for use or occupation of Crown lands during Site C construction or operation of Site C and related facilities. The *Significant Project Streamlining Act* could also apply to Site C. If the project is declared a provincially significant project, some or all provincial legislative and regulatory requirements could be expedited or replaced by the responsible minister if they were determined to be constraints on the project's timely completion.

A number of provincial statutes are not applicable to BC Hydro. However, BC Hydro tends to work to achieve the outcomes targeted under those pieces of legislation to minimize environmental impacts. BC Hydro would typically consult with all relevant government organizations to determine all additional regulatory requirements and pursue them at the same time as the environmental assessment certificate. These additional authorizations and permits are outlined in Appendix 3.

9.6 Issues & Recommendations

Because Site C would be a major undertaking, the regulatory process is expected to be comprehensive and exhaustive, particularly with potential requests for further information flowing from the public review process. Environmental studies in particular often require data analysis over a two-year period on account of seasonal and biological factors.

Active stakeholder consultation and participation of First Nations and key regulators is strongly recommended prior to regulatory filings. An important element of the project definition activities to take place in Stage 2 is to involve communities, First Nations and stakeholders in identifying a common understanding of which studies to undertake and key issues that require resolution.

Other Issues

Chapter 10

10.1 Introduction

There are three other initiatives currently underway with potential implications for BC Hydro's operations in the Peace River area. These are the B.C.-Alberta Transboundary Water Management Negotiations, issues related to the Peace-Athabasca Delta and the potential Dunvegan Hydroelectric project in Alberta. The following sections provide detailed information on these three initiatives.

10.2 B.C.-Alberta Transboundary Water Management Negotiations

10.2.1 Process of Bilateral Water Management Agreement Negotiations

The governments of British Columbia and Alberta signed a Memorandum of Understanding to negotiate a Bilateral Water Management Agreement in March 2005.[14] The bilateral negotiation process has four phases, with a targeted completion date of March 2008. The phases are:

1. Information gathering and sharing;
2. Negotiating and drafting agreement document;
3. Consultation on the draft agreement; and,
4. Approval and signing of a formal agreement.

The Peace River is the most significant transboundary river subject to these negotiations. BC Hydro was asked by the provincial government for support in the negotiations. BC Hydro is currently represented on several Technical Working Groups and has made presentations on various issues including the importance of the Peace River operations to BC Hydro. BC Hydro has also provided the provincial government with information related to the Site C project, including preliminary information regarding reservoir filling, flow changes downstream from Site C, effects of any flow changes on the ice regime and possible effects of flow changes on the Peace-Athabasca Delta.

[14] The bilateral negotiations follow from commitments made in the Mackenzie River Basin Transboundary Waters Master Agreement, signed in 1997 by the governments of Canada, B.C., Alberta, Saskatchewan, the Northwest Territories and Yukon, and the Alberta British Columbia Memorandum of Understanding on Environmental Cooperation and Harmonization in 2004.

10.2.2 Potential Impact of Site C on the Peace River Transboundary Flows

Site C is not expected to result in any discernible changes to existing downstream flows. Site C would not have a highly variable storage reservoir, so it would not re-regulate flows. The impact of filling the Site C reservoir would also be negligible as the water volume – only 3.6 per cent of the average annual transboundary flow – could be drawn from the Williston Reservoir. Filling the reservoir would be a one-time occurrence that would take about one month, during which normal flows downstream of Site C could be maintained.

Figure 10-1 **Map of the Peace-Athabasca Delta**

10.3 Peace-Athabasca Delta (PAD)

10.3.1 Peace River and the Peace-Athabasca Delta

The Peace-Athabasca Delta is located 1,200 kilometres downstream of the W.A.C. Bennett Dam in northern Alberta, largely within Wood Buffalo National Park. The Peace-Athabasca Delta is one of North America's largest freshwater deltas (approximately 6,000 square kilometres) and an internationally recognized environmental area. The Wood Buffalo National Park has been designated as a United Nations Educational, Scientific and Cultural Organization (UNESCO) world heritage site and the Peace-Athabasca Delta was named a Ramsar Wetland of international significance.[15] It is a junction for five major North American bird flyways and provides habitat for many species, including the largest free-ranging bison herd in North America.

Figure 10-1 shows a map of the Peace-Athabasca Delta.

The Peace River represents the northern boundary of the Peace-Athabasca Delta and does not normally flow through the delta. Water from the Peace River does flood back into the Peace-Athabasca Delta during periodic spring ice jams, which causes tributaries of the Peace River from the Peace-Athabasca Delta to change direction. The effect of this reversal of flows is to flood the so-called "perched basins," which would otherwise receive no inflows from the river and would tend to dry out over time. The perched basins provide important habitat for fur-bearing animals, particularly muskrat.

10.3.2 Historical Grievances

There remain long-standing, unresolved historical grievances dating from the construction of the W.A.C. Bennett Dam and its perceived impact on the Peace-Athabasca Delta. Some First Nations believe that BC Hydro's regulation of the Peace River has resulted in less frequent flooding of the Peace-Athabasca Delta. They believe this has caused drying of the delta, which has affected the way of life of the local inhabitants in Fort Chipewyan. This view was reinforced by the filling of Williston during a dry period and the drawdown of Williston for the sinkhole during a wet period in 1996. Scientific studies done shortly after the W.A.C. Bennett Dam was completed supported some First Nations' view that BC Hydro's regulation of the Peace River caused significant damage to the delta.

More recent scientific studies, however, conclude that the Peace-Athabasca Delta continues to function as a healthy delta ecosystem, and that BC Hydro's operations have had no significant long-term impact on its ecology.

Ice jams have continued to cause flooding from the Peace River into the Peace-Athabasca Delta since the construction of the W.A.C. Bennett Dam. Post-dam dry periods have been neither as lengthy nor as severe as dry periods in the past. While water levels, vegetation communities, and wildlife populations have fluctuated since construction of the dam, these fluctuations are not unusual and do not exhibit a systemic negative trend. Minor changes in habitat are expected in a healthy, evolving delta. Those changes that have occurred in the Peace-Athabasca Delta are consistent with a naturally evolving delta and with climate change.

10.3.3 Implications for the Site C Project

Issues related to the perceived impact of BC Hydro's Peace River operations on the Peace-Athabasca Delta remain unresolved. These issues may be expressed in the context of Site C development.

10.4 The Proposed Dunvegan Project

10.4.1 Components of the Dunvegan Project

The Dunvegan project is a run-of-river project proposed by Glacier Power that would be located on the Peace River, approximately 189 kilometres downstream of Site C in Alberta.

As currently defined, the Dunvegan project would produce up to 100 megawatts of power and would require a 400-metre wide structure across the Peace River made up of of a 285-metre powerhouse containing 40 2.5-MW turbines, a 110-metre weir and a boat lock to allow boat traffic to continue to move upstream and downstream past the project. The project includes two ramp fishways to allow fish to travel upstream past the project and 10 fish bypasses across the powerhouse and spillway to provide safe and efficient downstream passage for larger fish.

[15] The Ramsar Wetland is a Wetland that is included under the Ramsar Convention, or 'Convention on Wetlands', aimed to promote and protect wetlands throughout the world.

The project would also include a permanent access road along the south bank of the Peace River, and a 144 kV transmission line. Power from the project would be sold into the market.

10.4.2 Dunvegan Environmental Review Process

The original application for approval to construct the Dunvegan project was rejected; however, the proponent submitted a renewed application in 2006 and is awaiting a regulatory decision. While the proposed Dunvegan project would be significantly different in scope and design to the Site C project as currently envisioned, the progress and status of the Dunvegan project provides some insight into the potential issues that could arise should the Site C project progress through phases of development.

Conclusions

11.1 Summary of Stage 1 Findings Regarding the Site C Project

The purpose of the Stage 1 review of project feasibility is a review of existing studies and historical information about the Site C project, with a view to determining whether it is in the best interests of BC Hydro customers to move to the next stage of project planning and development.

11.2 Conclusions and Recommendations

Additional resources are required in order to meet B.C.'s electricity shortage in the second half of the 20-year planning period. While Site C represents a significant resource, it could only bridge a portion of the identified demand-supply gap. Other resource options would be required, in addition to Site C and the planned DSM and Independent Power Producer initiatives. Assessment of clean coal and natural gas as options to supply firm energy and capacity in place of or in addition to the Site C project will continue.

Site C should be evaluated against these other resource options, many of which would also have adverse economic, environmental and social impacts, and also bear a variety of risks.

Specifically, in response to the questions posed, the work on Stage 1 provided the following insights:

1. **Is the anticipated magnitude of the electricity gap significant enough, particularly in the second decade of the 20-year planning horizon, that Site C should continue to be examined as a potential resource option?**

   Yes. BC Hydro has not faced a long-term supply challenge of the magnitude currently anticipated in several decades. Based on the feasibility review, and given the volume of electricity required to meet the growing gap, and further, to meet the goal of becoming energy self-sufficient by 2016 and to have an additional 3,000 gigawatt hours by 2026, it is recommended to preserve all reasonable resource options, including Site C.

2. **Have any project characteristics been identified to date that suggest Site C should not be considered further as a resource option?**

   No. Based on the analysis to date, no characteristics have been identified that would render Site C unfeasible.

3. **Does Site C appear to offer sufficient overall benefits relative to the alternatives to justify further investigation?**

   Yes. Site C offers an attractive electricity option relative to the alternatives, and further investigation into Site C is recommended. Site C would deliver firm electricity with a high degree of flexibility to meet peak periods of demand. Increasing BC Hydro's firm and flexible energy capacity could also further support the development of intermittent energy sources such as wind power. In addition, Site C would have no exposure to natural gas fuel costs and would cause minimal greenhouse gas emissions once operational. At this stage, the estimated range of project costs is wide, but still potentially attractive relative to the cost and characteristics of other resource options.

4. **Will further work on Site C provide information to guide decisions regarding Site C compared with other future resource alternatives?**

   Yes. Further work on Site C, in a staged decision-making and development process, will reduce the knowledge gaps that remain, and better identify the project's benefits and impacts relative to other resource alternatives. Further work is recommended to help define the project, including project benefits and impacts, and associated compensation, mitigation and avoidance options. Stage 2 work on the project would include extensive community and First Nations consultation, as well as ongoing environmental and technical studies.

   The provincial government would be in a better position at the end of the second stage of project evaluation to decide whether or not Site C should be presented to the regulators for their review.

   Given the above recommendations, and as directed by the *BC Energy Plan*, BC Hydro is prepared to move to Stage 2 of the analysis of Site C as a potential resource option. This stage involves extensive community engagement and project definition with five key areas of focus:

- *Pre-Consultation: initial discussions with communities, stakeholders, First Nations and the Province of Alberta to provide input into the design of the consultation and participation process;*
- *Consultation: a comprehensive consultation process that is local, regional and provincial, and that creates levels of involvement through a variety of methods;*
- *First Nations: formal and comprehensive engagement and consultation, based on principles of respect;*
- *Project Definition: environmental, social, land and technical studies that update the originally conceived project and address key issues, in addition to updated project cost estimates; and,*
- *Public Information: develop a website and other collateral materials to provide fact-based information to all interested parties.*

Appendix 1

Appendix 1 – Energy Planning Criteria

BC Hydro utilizes planning criteria to ensure it has an adequate supply of energy and capacity. With respect to generating capacity, BC Hydro uses a criterion to help ensure sufficient installed capacity, which can reliably serve instantaneous demand of the system. In applying this criterion, BC Hydro considers an "adequate" system as one with an annual expectation of being unable to serve daily peak demand less than one day in 10 years, and forecasts its load based on the average coldest day over the past 30 years. BC Hydro also requires that installed, dependable capacity exceed peak load by approximately 14 per cent, which includes 400 MW from neighbouring control areas.

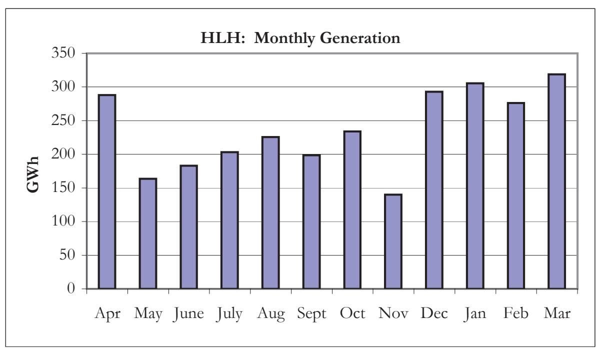
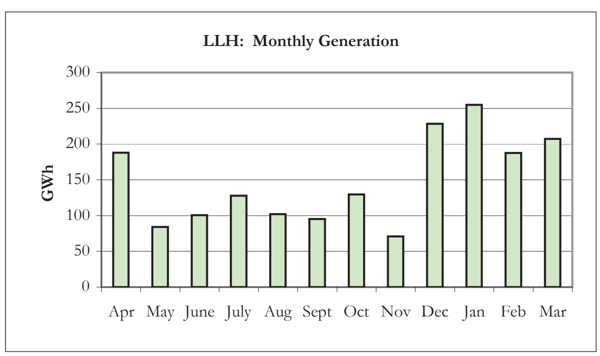
In addition to criteria to ensure sufficient capacity, BC Hydro also applies criteria to the supply of energy. This is intended to ensure sufficient resources are available to satisfy annual energy requirements. BC Hydro's criterion aims to meet energy requirements with "firm" from three categories: (i) its hydroelectric – capability under most adverse sequence stream flows within adopted historical record; (ii) thermal resources – capability-based conservative estimates of plant availability, (iii) contracts with Independent Power Producers – energy that is anticipated to be reliably available under contract.

In addition to the criteria that BC Hydro applies to its supply of energy and capacity, British Columbia Transmission Corporation also utilizes planning criteria for its transmission system. BCTC uses North American Electricity Reliability Council/Western Electricity Coordinating Council Planning Standards plans, and operates its system to meet certain steady state and dynamic performance standards, under various single or multiple failures.

A key requirement is that the system should withstand a severe short-circuit and outage of any single component under any system condition (i.e., one major component out of service) with no loss of customer load or cascading outages of other system elements, and with acceptable variation in voltage or frequency. Increasing demands are being placed on Interior-to-Lower-Mainland transmission due to load growth in urban areas, the potential retirement of the Burrard Generating Station and a lack of resource options in the Lower Mainland or Vancouver Island.

Appendix 2

Appendix 2,Table 1 **Financial Model Assumptions**

Inflation/Escalation	*6% in 2007, 5% in 2008 and 2009, 4% in 2010 and 3% thereafter*
Capital Overhead	*2% of the Project Cost*
Interest During Construction (IDC)	*6.88%*
Debt/Equity	*80/20, Debt @ 6.7%; Equity @ 13.51%*
Discount Rate	*8% Nominal (Scenario C)*
Operation	*Run-of-River*
Water Rentals	*Capacity based on rated 912 MW; Energy based on 4606 GWh/yr*
Taxes and Grants	*Approx $2 million/year (F2008$)*
Unit In-Service Dates	*Unit #1 In-Service Date 1-Dec-18* *Unit #2 In-Service Date 1-Dec-18* *Unit #3 In-Service Date 1-Mar-19* *Unit #4 In-Service Date 1-Jun-19* *Unit #5 In-Service Date 1-Sep-19* *Unit #6 In-Service Date 1-Dec-19*
Sustaining Capital	*Generator Rewind – every 25 years per unit* *Generator Rebuild – every 50 years per unit* *Turbine Refurbish – every 25 years per unit* *Turbine Rebuild/Replace – every 50 years per unit* *Switchyard Electrical – every 35 years* *Governor, Exciter – every 25 years per unit* *Generator Transformer – every 30 years per unit*
Period of Evaluation	*70 years*
Average Generation (Peak Hours)	
Average Generation (Off-Peak Hours)	
Depreciable Life (Years)	*Reservoir Cost (Flowage) 100* *Site Access 100* *Site Clearing 100* *Cofferdams & Spill Dikes 100* *Left Bank Stabilization 100* *Diversion Tunnels 100* *Diversion Tunnel Plugs 100* *Earthfill Dam 100* *Approach Channel & Gravity Walls 100* *Spillway 100* *Power Intakes & Penstocks 100* *Powerhouse - Civil 100* *Switchgear - Civil 40* *Switchgear - Mechanical 40* *Switchgear - Electrical 40* *Mechanical and Electrical 50* *Stations and Transmission 50*

Appendix 3

Appendix 3 – Potential Additional Legal Requirements

Authorizations and permits could be required under several federal and provincial regulations in addition to those reviewed in detail in Chapter 9. These are documented below.

Pursuant to the *Hydro and Power Authority Act*, BC Hydro is exempt from the application of many provincial Acts. Nevertheless, BC Hydro intends to work to achieve the outcomes targeted under such legislation, and as such they are included here. Provincial acts from which BC Hydro is not exempt are indicated with an asterisk. All federal legislation applies. Through the BCEAO, a proponent may request that some provincial approval applications be processed concurrently with the environmental assessment.

Potential Additional Federal Law Requirements

Migratory Birds Convention Act

- *Prohibits disturbance, destruction or taking of a migratory bird, its nest, etc., except under a permit;*
- *It also prohibits deposition of oil and similar substances that are harmful to migratory birds in waters or areas frequented by migratory birds. Fines have been increased substantially by recent amendments to the Act;*
- *Projects need to be planned, rescheduled or designed to avoid disturbance and destruction; mitigation and/or compensation may be possible;*
- *Consult with Canadian Wildlife Service for guidance in dealing with environmental impacts to migratory birds.*

Certificate of Public Convenience and Necessity under the *National Energy Board Act*

- *A CPCN may be required if power is transmitted across national and/or provincial borders;*
- *The National Energy Board approval process may be applicable depending on the project description, operational and contractual arrangements:*
  - *whether transmission line crosses into Alberta (interprovincial trigger);*
  - *whether the project will increase trade in electricity; or*
  - *whether there are traffic, tolls & tariffs for energy transmission.*

Potential Additional Provincial Law Requirements

** Significant Projects Streamlining Act*

- *Cabinet can designate a project as a provincially significant project. Minister's recommendation is a prerequisite;*
- *Designation places an obligation on provincial regulators to expedite matters in connection with the project;*
- *Designation also permits cabinet to authorize the minister to replace provincial regulatory constraints; however, prior to the minister so doing, the proponent must consult with the regulatory agencies as to how the constraint can be satisfied and the project's needs met. If the proponent and the agency can agree, an implementation agreement must follow. If they cannot, the minister can by order replace the constraint.*

Water Licence Revision under the *Water Act*

- *Site C would require storage and diversion licences;*
- *A flood reserve (by cabinet order) or water licence application at an early date would help prevent or mitigate the possibility of "claim jumping" (whether genuine or mischief-making) by competing applicants.*

Land Tenure application process under the *Land Act*

- *Applies to all Crown Land used for linear public and private utilities;*
- *Licence to occupy could also be required;*
- *This process would need to be meshed with the federal and provincial environmental assessment processes (and potentially the NEB process) and the Water Licensing process.*

Land and flooding rights – *Land Act* and *Water Act*

- *For the dam site and related facilities, the transmission line, the construction camp, the borrow and spoil areas, access roads and the flooded lands; various rights (fee simple, rights of way, licences of occupation, permits to occupy Crown land) would be required under the Land Act;*
- *Some rights are available under s. 26 of the Water Act if a water licence is obtained with respect to permits authorizing the flooding of Crown land or the construction, maintenance or operation on land of works authorized under a licence or approval.*

***Wildlife Act* and *Forest and Range Practices Act* (Identified Wildlife Management Strategy)**

- *These two pieces of provincial legislation provide protection to provincially listed species at risk. While the prohibitions are similar to those under SARA, exemptions from the prohibitions are provided for incidental killing and destruction of residences.*
- *Similar to SARA, under these provincial statutes listed species, critical habitat and their residences need to be taken into account in project siting and design, development, operations and maintenance. Harmonization of federal and provincial approaches and requirements to protection and recovery of listed species at risk occur through the Canada-BC Bilateral Agreement on Species at Risk.*

*** Permit under S. 12 *Heritage Conservation Act***

- *If flooding or otherwise damaging heritage sites, whether through construction or operation, a permit would be required if heritage sites are potentially damaged through flooding, construction or generation.*

***Drinking Water Protection Act*, Drinking Water Protection Regulation**

- *Construction permit required for construction, installation, alteration or extension of a water supply system;*
- *Operating permit for domestic water system (operation of a system will include water quality monitoring, emergency response and contingency plans and training of system operators);*
- *Requirements will vary depending on the type of water system provided for workers (disinfection, signage);*
- *Work with ministries of Environment and Health to ensure protection of ground and surface water quality and provision of safe drinking water to employees/ staff;*
- *This would apply to the construction camp and the permanent facility.*

Ecological Reserves Act

- *Consideration of this legislation will depend on the location of the project components and potential interaction with designated Ecological Reserves.*

Groundwater Protection Regulation under the *Water Act*

- *Regulates installation, operation & maintenance of wells that may be constructed;*
- *Permits may be required;*
- *This would apply to both domestic water wells and geotechnical wells.*

Transportation of Dangerous Goods Act

- *For transport of dangerous goods products to and from the work site during construction.*

Environmental Management Act

- *Prohibits pollution unless authorized;*
- *Governs collection and disposal of waste and hazardous waste, sewage holding and disposal, waste water disposal/holding systems, debris management, spills and releases of pollutants including oil and other chemicals;*
- *Oil containment works are necessary to prevent pollution from oil-filled equipment.*

Waste Discharge Regulation under the *Environmental Management Act*

- *Authorization required for air emissions, solid waste disposal or effluents (e.g., burning of vegetative debris, burning of solid waste, discharge of refuse, discharge of sewage effluent).*

Contaminated Sites Regulation under the *Environmental Management Act*

- *Requirements for management of contaminated lands already existing or created during construction;*
- *Prevention of spills to avoid legacy issues.*

Hazardous Waste Regulation under the *Environmental Management Act*

- *Storage, handling and transportation requirements for hazardous waste management (e.g., storage permit, registration, licensed waste contractor and waste manifest requirements).*

Open Burning & Smoke Control Regulation under the *Environmental Management Act*

- *Open burning of vegetative debris from land clearing;*
- *Specific requirements for the duration and frequency of burning activities, depending on the location and air quality index, based on the proximity to local population centres.*

Sewerage System Regulation under the *Health Act*

- *Regulates sewage system design;*
- *Quarry and Borrow Pit permit under the Mines Act for project construction phase.*

Application under s. 28 *Fish Protection Act*

- *Requires submission to Minister of plans for fishways and fish protection devices, etc.;*
- *Statute not applicable to BC Hydro by virtue of Hydro and Power Authority Act but it is advisable to discuss approaches with Ministry of Environment staff.*

Agricultural Land Reserve - application for non-farm use/exclusion from Agricultural land reserve under *Agricultural Land Commission Act* ("ALC Act")

- *Land owned by BC Hydro (whether bought or expropriated) is likely exempt from this Act by virtue of the Hydro and Power Authority Act;*
- *Crown land is likely subject to the ALC Act;*
- *If BC Hydro proposes to use Crown land in the reserve in a manner contrary to ALC Act's requirements, then the ALC Act would likely apply to that extent;*
- *For Crown or private land to be inundated or used for transmission or generation sites, the application may have to be made for exclusion or non-farm use.*

**** Forest Act***

- *Permit required to cut and remove merchantable timber from Crown land;*
- *Permits for burning.*

Highway Act

- *If highways affected or crossed by transmission.*

Health Act

- *Application to drinking water, sewerage/septic systems.*

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