22 OIL, GAS, AND ENERGY

22.1 Approach

The Project would physically overlap areas where oil and gas exploration and development occurs. The Project's use of land was assessed on the valued component (VC) of oil, gas, and energy, considering the Project's interactions with the land base and with the oil, gas, and energy industry activity.

22.1.1 Regulatory and Policy Setting

The assessment was prepared in accordance with Section 16.4 of the Site C Clean Energy Project Environmental Impact Statement Guidelines (the Minister of Environment of Canada and the Executive Director of the BCEAO 2012) (EIS Guidelines).

Oil, gas and energy activity in the province is the responsibility of the B.C. Ministry of Energy, Mines and Natural Gas and the B.C. Oil and Gas Commission (BCOGC), and is regulated through the following primary legislation:

- *The Petroleum and Natural Gas Act* – provides the framework for the administration of Crown-owned subsurface petroleum and natural gas rights. The Act deals with most aspects of entry, geophysical exploration (including permits), leases, tenures, taxation, royalties, and conservation.
- *The Oil and Gas Activities Act* – consolidates the powers and duties of the BCOGC as well as the rules regulating persons carrying out an oil and gas activity in the province. The BCOGC was established as a Crown corporation to regulate upstream oil and gas activity in B.C., including exploration, development, pipeline transportation to facilities, and reclamation activities. Regulatory authority is derived from numerous other acts and legislation. While petroleum and natural gas rights provide the right to the subsurface petroleum and natural gas resources, all exploration and development activities conducted on petroleum and natural gas tenures, including well drilling, pipeline, and facility or road construction, are authorized and regulated by the *Oil and Gas Activities Act.*
- *Clean Energy Act* – guides government, BC Hydro and the British Columbia Utilities Commission in advancing the province's sustainable energy vision. Key objectives include electricity self-sufficiency, promoting economic development, reducing greenhouse gas emissions, and investing in new clean and renewable energy.

B.C. has jurisdiction over the generation, transmission, and distribution of electricity within its provincial boundaries. Primary legislative authority over these activities in B.C. is provided through the:

- *Hydro and Power Authority Act*
- *Transmission Corporation Act*
- *BC Hydro Public Power Legacy* and *Heritage Contract Act*
- *Utilities Commission Act*

The undertaking of oil, gas, and energy projects is also subject to other legislation, depending on the nature of the activity.

The federal National Energy Board (NEB) regulates the international and interprovincial aspects of the oil, gas, and electric utility industries. The purpose of the NEB is to regulate pipelines, energy development, and trade in the Canadian public interest.

22.1.2 Key Issues and Identification of Project Effects

A review of public consultation materials and information requests to BC Hydro from regulatory agencies, the public, and Aboriginal groups regarding the draft EIS Guidelines did not identify potential adverse effects on oil, gas, and energy as a result of the Project. BC Hydro's technical engagement process with local government also did not identify any potential effects of the Project on the industry (See Volume 1 Section 9 Information Distribution and Consultation).

Nevertheless, the industry does actively use the proposed Project activity zone for exploration and development, and infrastructure is in place. Discussions with government and industry indicated that there are oil, gas, and energy interests in the Project activity zone and that overlaps exist.

The key issues for industry, as identified in Table 22.1, are project construction activities that would result in a physical loss of land, and change in access to or use of the land base for oil, gas, and energy industry activity and development.

Industry also identified the potential for traffic conflicts resulting from the Highway 29 realignment, and the development and use of construction access roads on the north banks. Both potential effects are considered in other sections of the EIS. Regarding north and south bank activity, any overlap or conflict between existing third-party tenure holders and BC Hydro's proposed activities, or BC Hydro's required tenure over Crown land, would be addressed through discussions and, where appropriate, agreements with the tenure holders to address any potential project effects noted in Table 22.2. Further information about third-party Crown land tenures is available in Volume 2 Section 11.3 Land Status, Tenure, and Project Requirements.

Table 22.1 Key Issues: Oil, Gas, and Energy

Key Issues	Approach to Addressing Key Issues
The Project would inundate or otherwise physically displace infrastructure, including wells and pipelines in the Project activity zone.	▪ A geographic information systems analysis of government tenures and resource estimates was undertaken to identify spatial overlaps, as well as tenure status, type, and ownership. ▪ Discussions were conducted with government and industry to identify potential effects and mitigation options. ▪ Addressed as one of two potential effects in this assessment. ▪ As further outlined in Volume 2 Section 11.3, Land Status, Tenure, and Project Requirements, BC Hydro would address any overlap on Crown land between third-party tenures and BC Hydro's proposed tenure through discussions and, where appropriate, agreements with the tenure holders.
Project could affect access to subsurface resources and future development potential in the Project activity zone.	▪ A geographic information systems analysis of government tenures and resource estimates was undertaken to identify spatial overlaps, as well as tenure status, type, and ownership. ▪ Discussions were conducted with government and industry to identify potential effects and the need for mitigation, with a focus on how the Project might affect current and future production activity. ▪ Addressed as one of two potential effects in this assessment.
Project activities could interrupt industry activities on the north bank of the Peace River due to use of petroleum development roads that increase traffic risk and the development of temporary access roads that cross pipelines and other infrastructure.	▪ As indicated in Volume 2 Section 11.3, Land Status, Tenure, and Project Requirements, BC Hydro would address any overlap on Crown land between third-party tenures and BC Hydro's proposed tenure through discussions and, where appropriate, agreements with the tenure holders. ▪ Traffic-related issues would be addressed by BC Hydro by entering into road use agreements with the oil and gas industry (also outlined in Volume 2 Section 11.3 Land Status, Tenure, and Project Requirements) and through implementation of the Transportation Management Plan (Volume 5 Section 35 Summary of Environmental Management Plans).
Highway 29 realignment would interact with the transport of oil and gas industry workers.	▪ Transportation and traffic issues are assessed in Volume 4 Section 31 Transportation, and mitigation will be implemented through implementation of the Transportation Management Plan (Volume 5 Section 35 Summary of Environmental Management Plans).
Project would limit fracking activity in the vicinity of the Site C dam site due to seismic concerns.	▪ BC Hydro will not be requesting restrictions on fracking activity in the Site C reservoir or Site C dam site area.

The potential to adversely affect the oil, gas, and energy sectors is assessed by taking into account the potential for the Project to result in changes to the following key aspects:

- Land use and resource use

- Access and activities for the oil, gas, and energy sectors

Potential project interactions with oil, gas and energy are summarized in Volume 2 Appendix A Project Interactions Matrix, Table 2. As defined in Volume 2 Section 10 Effects Assessment Methodology, a rank of "2" was given where interactions may result in an adverse effect and the nature of the effect and/or the effectiveness of mitigation measures is uncertain. These interactions were taken forward through the effects assessment.

Project interactions that were ranked as "2" for oil, gas, and energy are summarized in Table 22.2.

Table 22.2 Interactions of the Project with Oil, Gas, and Energy

Project Activities and Physical Works	Key Aspects	
	Land and resource use	Access and activities for the oil, gas, and energy sectors
Construction		
Dam and Generating Station Construction	✓	✓
Reservoir Preparation and Filling	✓	✓
Transmission System	✓	✓
Quarried and Excavated Material Source Development	✓	✓
Highway 29 Realignment	✓	✓
Construction Access Road Development	✓	✓
Operations		
Operation of the powerhouse, substation, and Site C reservoir; includes downstream water management	✓	

22.1.3 Standard Mitigation Measures and Effects Addressed

A "0" ranking in Table 2 in Volume 2 Appendix A Project Interactions Matrix means that there is no predicted interaction between a Project component and the VC. A "0" ranking was given to the following construction activities:

- Supply and transportation of goods and services for camp
- In-community accommodation
- Temporary accommodation – Site C dam site
- RV parks

A "0" ranking was also assigned to all but one of the operating activities or components. However, water temperature and sediment conditions may interact with the Spectra water intake downstream of the Site C dam at Taylor. This interaction is further evaluated in this assessment.

A "1" ranking was given where an adverse effect may result from an interaction, but standard mitigation measures to avoid or minimize the potential effects are available and well understood to be effective, and any residual effect is negligible. These interactions were not carried forward through the effects assessment.

A "1" ranking was applied to the southern and northern regional temporary accommodation activities because, while there is expected to be spatial overlaps with oil, gas, and energy, the tenures necessary to construct and operate them will be part of the Project's overall tenuring processing and related mitigation, as outlined in Volume 2 Section 11.3 Land Status, Tenure, and Project Requirements.

Oil, gas, and energy development activities that may be proposed for lands adjacent to the reservoir have the potential to be affected by the Project. These lands, defined spatially as the reservoir impact lines, are discussed in Volume 2 Appendix B Geology, Terrain Stability, and Soil Reports, Part 2 Preliminary Reservoir Impact Lines.

There may be potential effects related to flooding, erosion, instability, and landslide-generated waves on these lands. BC Hydro would notify the tenure holder of the nature of the particular effect when contacted through the established referral process managed by the B.C. Ministry of Energy, Mines and Natural Gas, and the B.C. Oil and Gas Commission.

Any overlap or conflict between existing third-party tenure holders and BC Hydro's proposed activities, or BC Hydro's required tenure over Crown land, will be addressed through discussions, and where appropriate, agreements with the tenure holders as described in Volume 2 Section 11.3 Land Status, Tenure, and Project Requirements.

22.1.4 Selection of Key Indicators

Key indicators for the oil, gas, and energy VC include measures relevant to potential changes to land and resource use and to industry activity. Existing Crown tenures that allow industry to explore and place infrastructure on the land base are used to characterize land and resource use. Measures of industry exploration and development activity, and estimates of future resource potential are indicators that demonstrate change in access and industry activity. In this assessment, access is defined in the broad sense to mean the ability to develop resources as allowed by the terms of petroleum and natural gas tenures issued by government.

The key indicators used in the assessment of potential effects on the oil and gas industry are listed in Table 22.3.

Table 22.3 Key Indicators for Oil, Gas, and Energy

Key Aspects	Key Indicators	Rationale for Selection of the Key Indicators
Land and resource use	Tenured oil, gas, and energy activities, operations, and facilities	Tenured activities identify spatial areas of current or anticipated industry activity
Access and activities for the oil, gas, and energy sectors	Production activity Industry characteristics, including new extraction technologies	Development activity and potential could be adversely affected in the future if access to the resources is impaired

22.1.5 Spatial and Temporal Boundaries

22.1.5.1 Spatial Boundaries

The Local Assessment Area (LAA) and Regional Assessment Area (RAA) in the EIS Guidelines for the assessment of the VC of oil, gas and energy is the Project activity zone.

The areas used for reporting in this assessment were updated from the originally proposed spatial boundaries in the EIS Guidelines. The LAA, which consists of the Project activity zone, the area within the Five-Year Beach Line, and Spectra Energy's water intake in the Peace River just south of Taylor, is the area where physical changes to the land base or changes to land use would interact with oil, gas, and energy activity. The Five-Year Beach Line is the extent of reservoir clearing and the predicted extent of shoreline retreat at the maximum normal reservoir level five years after impoundment of the proposed reservoir, as defined in Volume 2 Appendix B Geology, Terrain Stability, and Soil Reports, Part 2 Preliminary Reservoir Impact Lines.

The regional RAA is the same as the LAA.

Spatial boundaries are shown in Table 22.4 and illustrated in Figure 22.1.

Table 22.4 Spatial Assessment Areas for Oil, Gas, and Energy

Local Assessment Area	Regional Assessment Area
Project activity zone, area within Five-Year Beach Line and Spectra Energy's Taylor water intake	Project activity zone, area within Five-Year Beach Line and Spectra Energy's Taylor water intake

22.1.5.2 Temporal Boundaries

Project interactions would occur during the full eight-year construction period. They would commence during early years of construction, fully materialize at Site C reservoir filling, and continue indefinitely, as the Site C reservoir and Site C dam are assumed to operate in perpetuity.

New or incremental effects during operations are only anticipated for the Spectra water intake, due to potential changes in water conditions.

22.2 Information Sources and Methodology

22.2.1 Review of Existing Information

The profile of the oil and gas sector in the LAA was compiled based on provincial licence and permit data. The Canadian Association of Petroleum Producers (CAPP) statistical tables were used for describing the regional and provincial industry context. Reports from government and BC Hydro were reviewed for information pertaining to future energy development and issues concerning land use and tenure.

22.2.2 Interviews

Interviews were conducted with representatives of the B.C. Ministry of Energy, Mines and Natural Gas, the BCOGC, local government, and with licensees to obtain information on baseline conditions, perspectives on key issues, and project interactions. Volume 3

Appendix C Land and Resource Use Assessment Supporting Documentation, Part 1 Land and Resource Use Assessment Interview Methodology provides details of the interview methodology. Personal communications are listed in References at the end of this section.

22.2.3 Data Management, Mapping, and Modelling

A spatial analysis was undertaken to identify the overlap between the Project activity zone and the area within the reservoir impact lines and oil, gas, and energy activity. Oil, gas, and energy resource potential; Crown tenures; exploration and development sites; and facilities for the exploration, production, distribution and transmission of oil, gas, and energy resources were identified.

Data were geospatially represented using Geographic Information System (GIS) analysis. The GIS results were also used for figure preparation.

22.2.4 Aboriginal Community and Traditional Knowledge

Aboriginal community and traditional knowledge related to the oil, gas, and energy VC was gained through review of results of BC Hydro's consultation with Aboriginal groups and review of First Nations community baseline studies prepared by the following First Nations:

- Doig River First Nation
- Halfway River First Nation
- Prophet River First Nation
- West Moberly First Nations

While the communities and traditional territories of the Blueberry First Nations and Saulteau First Nations are in or near the boundaries of the LAA (and by extension, the RAA), BC Hydro had not received community baseline information from them at the time of writing.

Baseline information and data, as well as First Nations concerns and interests relevant to oil, gas, and energy, are incorporated in the baseline and effects assessment sections. The First Nations community baseline reports are provided in Volume 3 Appendix B First Nations Community Baseline Reports, Part 7 Community Baseline Report and EIS Integration Summary Table for Doig River First Nation, Halfway River First Nation, Prophet River First Nation, and West Moberly First Nations.

BC Hydro's approach to gathering community-based social and economic data with First Nations is described in Volume 3 Appendix B First Nations Community Baseline Reports, Part 1 Approach to Gathering and Integrating Community Baseline Information.

22.3 Baseline Conditions

Oil, gas and energy includes the oil and gas industry, and other forms of energy production, which, in the northeast region of B.C., includes small-scale hydro, wind power, and biomass energy.

22.3.1 Regional Overview of Production

The province is the second-largest natural gas producer in Canada. The industry in northeast B.C. is primarily focused on the upstream activities of exploration and production of petroleum commodities. A small component of the industry is part of the midstream sector (pipeline transportation, storage, and sulphur extraction). The downstream sector (refining, distribution, and petrochemical production) does not exist in the northeast.

The northeast is the only area of B.C. producing commercial quantities of oil and gas, and it accounts for the majority of exploration and development activity (B.C. Ministry of Energy, Mines and Natural Gas 2012a) in the province. Major gas discoveries in the last decade have consistently increased annual reserve estimates (B.C. Ministry of Energy, Mines and Petroleum Resources 2010a). According to the 2006 Census, over 8,492 jobs were attributable to oil and gas and mining activities in the northeast, while in the Fort St. John area, one-third of all community income was derived from the oil and gas industry (Horne 2009).

Increased gas production is expected in the future, as companies have increased the amount of land they are leasing from the provincial government, and as new discoveries are made (CAPP 2011a). The gas industry invested close to $30 billion in B.C. between 2001 and 2009, resulting in 34,000 direct and indirect jobs (Collyer 2009).

Activity is dominated by Alberta-based companies. The B.C. component is made up of services that support the exploration, drilling, production, and servicing of the thousands of wells across the region. These businesses are generally contractors to the major oil and drilling companies.

Gathering and processing facilities tend to be located as close as possible to producing areas. There are three major gas plants in B.C. located in Taylor, in Fort Nelson, and near Chetwynd. Three main gathering systems deliver crude oil and natural gas liquids to facilities at Taylor. There are no oil refineries in the region, and the majority of the oil is transported by pipeline to Kamloops, and then to Vancouver and Washington area refineries via Kinder Morgan's Trans Mountain Pipeline. A small percentage is processed in Prince George. Further information about the oil and gas industry production activity and characteristics are discussed in Volume 3 Appendix C Land and Resource Use Assessment Supporting Documentation, Part 3 Oil, Gas, and Energy Exploration and Production Activity.

22.3.2 Production in the Peace River Area

The Montney Play region, which is one of northeast's most active exploration and development areas for unconventional gas deposits, includes the area of the Peace River between Fort St. John and Hudson's Hope. A summary of recent industry activity is presented in Figure 22.2. Exploration and development focus on the Upper and Lower Montney using horizontal drilling techniques, but proven production is primarily in the Upper Montney in the Dawson Creek/Fort St. John area (B.C. Ministry of Energy, Mines and Petroleum Resources 2010b).

Wells for conventional and unconventional resources are dispersed throughout the region, and while indicated tenure areas and production zones are mostly east of the proposed Site C dam site, a development cluster is located on the plateau above the south banks of the Peace River in the Monias area, approximately 25 km southwest of Fort St. John. Major

producing areas other than Monias, including Swan, Dawson, and Saturn, are all south of the LAA in the Dawson Creek area.

While conventional production and reserve additions have been on the decline over the past decade, development of B.C.'s unconventional gas deposits has increased and is responsible for the increasing reserve additions. The Montney continues to be the most active natural gas play in B.C., accounting for 26% of the total production within the province (BCOGC 2011).

There is no coalbed methane production in B.C. at this time.

22.3.3 Tenured Oil and Gas Facilities in the LAA

Data in Table 22.5 indicates a total of six wells and eight facilities within the LAA, representing 0.03% and 0.07% of the total Peace River Regional District count, respectively. Most wells have joint ownership licensees, including Terra Energy Corp., Penn West Petroleum Ltd., Arc Resources Ltd., Canada Natural Resources Limited, and Pioneer Natural Resources Inc.

Petroleum rights-of-way totalling 2.9 ha are within the LAA, representing 0.02% of the total area allocated to pipeline rights-of-way in the Peace River Regional District. Ten separate rights of way are affected. The licensees include Spectra Energy, Canadian Natural Resources Ltd., Terra Energy Corp., Petrobakken Energy Ltd., and Penn West Petroleum Ltd.

The locations of these facilities are shown in Figure 22.3.

Table 22.5 Oil and Gas Facilities in the LAA and Peace River Regional District

Facility	LAA	PRRD	LAA as % of PRRD
Oil and gas wells (count)	6	20,918	0.03
Oil and gas facilities (count)	8	10,891	0.07
Oil and gas pipelines (right-of-way) (hectares)	2.9	16,381	0.02

NOTE:

Source: Hillcrest Geographics (2012)

22.3.4 Petroleum and Natural Gas Tenures in the LAA

A list of the top five licensees for petroleum and natural gas titles falling inside the LAA is shown in Table 22.6. The total number of licensees is 24 companies, and they include coalbed methane developers, land companies acting on behalf of producers, large integrated producers, and junior companies. These tenures have been issued from 1955 to the current year and have remained active through a combination of competitive bids (new tenures), conversions, extensions, and renewals. All tenures that fall within the provincial Order-in-Council reserve are advertised as such by government.

Table 22.6 Top Five Oil and Gas Tenure Holders in the LAA, 2012

Tenure Holders	LAA (ha)
Terra Energy Corp.	2,088.3
Penn West Petroleum Ltd.	939.8
O & G Resource Group Ltd.	307.7
Husky Oil Operations Limited	292.5
Aduro Resources Ltd.	289.3
Other Licensees	1,856.7
Total	5,774.3

NOTES:

Only majority owners are listed

Source: Hillcrest Geographics (2012)

22.3.5 Extraction Technologies

The oil and gas sector in B.C. is developing and adopting innovative technologies for extracting energy resources, with a focus on directional drilling as an alternative to conventional vertical drilling methods. Directional drilling can allow companies to tap deposits of oil and gas at almost any depth from drilling sites up to 10 km away from the resource. Directional drilling has proven technically and economically feasible for tight gas and coalbed methane gas resources with high potential in the region. These new technologies have not only proven to substantially increase producible reserves, but they are often more profitable than vertical drilling (Molvar 2003). An illustration of the drilling techniques used in the northeast is presented in Figure 22.4.

In the Montney, companies drill vertical wells and then drill across or horizontally, which allows for higher levels of production. The cost of drilling a horizontal well is roughly double that of a vertical well, but new fracturing techniques have made shale plays profitable (Shale News 2012). Drilling operations are more streamlined than conventional vertical methods, with fit-for-purpose rigs, multi-well drilling pads, and a manufacturing-style approach to all operations (gas factories). This has allowed continuous cost improvements and enhanced competitiveness during a period of low commodity prices (Conrad 2010).

Access to the subsurface resource delineated in the petroleum and natural gas tenure does not necessarily occur within the surface area defined for that tenure, and in some cases surface access is not allowed. Licensees can access the resource by occupying other Crown or private land for drilling activities (B.C. Ministry of Energy, Mines and Natural Gas, Director of Resource Development 2012, pers. comm.).

In North Dakota, oil companies have begun tapping crude oil and gas underneath Lake Sakakawea (the state's biggest lake) using advanced horizontal drill techniques. The federal government created the 180-mi.-long reservoir when the Garrison Dam was built on the Missouri River in the 1950s. The lake flooded more than 60,703 ha and has more than 2,736 km of shoreline. With the new technologies, wells can be situated at an environmentally safe distance from shore, drilled vertically to about 3,048 m, and then pushed an equal distance horizontally to reach the resource (MacPherson 2008).

In northeast B.C., new oil and gas tenures are available in protected areas designated as candidates for directional drilling, although tenures are only issued with a condition of no

surface disturbance. Directional drilling is a requirement for all drilling taking place near the proposed Peace River Boudreau Lake proposed protected area (B.C. Ministry of Forests, Lands and Natural Resource Operations 1999). It is also increasingly used to access the unconventional resources in the Montney play. The majority of drilling is now using directional methods (BCOGC, Area Director 2011 pers. comm.). However, directional drilling techniques are not being used by the licensee exploring for coalbed methane in the LAA (Jones 2012, pers. comm.).

22.3.6 Other Energy Developments in the Peace Region

The renewable energy potential of the Peace region is among the highest of the province's development regions, due to wind power resource and small and large hydro-electric resources. The B.C. Ministry of Energy, Mines and Natural Gas estimates the Peace River Development Region's potential for small hydro at 258 MW and the potential for wind power at 6,256 MW (B.C. Ministry of Energy, Mines and Natural Gas 2012b).

BC Hydro classifies micro hydro developments as those with an installed capacity of less than 2 MW (2,000 kW) and small hydro developments as those with an installed capacity of between 2 and 50 MW. BC Hydro has signed electricity purchase agreements for 19 small hydro projects to be owned, built, and operated by independent power producers (BC Hydro 2012). None are situated in northeast B.C. and no water licences for power purposes exist in the LAA (Table 22.7).

Table 22.7 Water and Wind Licences in the LAA

Licence	Five-Year Beach Line[a]	Site C Dam Site Area[b]	Transmission Line[c]	Construction Access Roads[d]	Quarried & Excavated Materials[e]	Total
Water Licences, points of diversion (count)						
Power-commercial	0	0	0	0	0	0
Other	8	0	0	3	0	11
Wind Power (count)	0	0	0	0	0	0

NOTES:

[a] Five-Year Beach Line is the predicted position of the toe of the bluff at the maximum normal reservoir level five years after impoundment of the proposed reservoir as defined in Volume 2 Appendix B Geology, Terrain Stability, and Soil Reports, Part 2 Preliminary Reservoir Impact Lines

[b] Site C dam site and substation construction areas and restricted access zones as described in Volume 1 Section 4 Project Description

[c] Transmission line corridor and one-time clearing areas as described in Volume 1 Section 4 Project Description

[d] Permanent and temporary roads, and Highway 29 realignment as described in Volume 1 Section 4 Project Description

[e] Off-site construction material sources as described in Volume 1 Section 4 Project Description

Source: Hillcrest Geographics (2012)

In 2008, the wind energy potential, including investigative sites, wind energy regime, and total energy capacity, was assessed for all B.C. regions. Development potential was favorable and attributable to high wind speeds and the unidirectional nature of the wind regimes, which are able to deliver an overall lower cost of energy. A total of 96 investigative sites were identified for the Peace region, the large majority of which were located in elevated areas to maximize terrain speedup (Garrad Hassan Canada Inc. 2008). The nearest sites identified were approximately 20 km north of Hudson's Hope.

BC Hydro has signed Electricity Purchase Agreements with several existing and proposed wind farms in B.C., most of which are in the Peace River region. The Bear Mountain Wind Park near Dawson Creek was commissioned in 2009, and the Dokie Wind Project near Chetwynd began operating in 2011. The Dokie Wind Project is owned by a partnership of Alterra Power and Halfway River First Nation, McLeod Lake Indian Band, Saulteau First Nations, and West Moberly First Nations. Quality Wind Project (Tumbler Ridge) is a 142 MW wind farm under construction that is due to begin commercial operation late in 2012. Another eight proposed wind farms are in various stages of pre-development planning. Most are located near Tumbler Ridge or Chetwynd. The nearest development, the Hackney Hills Wind Project, is located 50 km northwest of Hudson's Hope. There are no wind power licences in the LAA (Table 22.7).

The First Nations Clean Energy Business Fund was created in 2010 to support First Nations and new power projects. The provincial government contributed an initial $5 million to the Fund and will contribute a percentage of land and water rentals generated by eligible projects until the fund becomes self-supporting in the future. To date, the fund has provided $1.97 million to 41 Aboriginal communities in B.C. to support First Nations participation in the clean energy sector (BCMARR 2012). In the third round of funding from the fund, the Treaty 8 Tribal Council in Fort St. John received $40,000 to determine the engineering, preliminary construction, and economic feasibility of moving the Mt. Lavitah Wind Farm project to the next phase. Mt. Lavitah is in the Fraser–Fort George Regional District, adjacent to Highway 97, approximately 18 km northeast of the Mackenzie junction. There are no proposed developments in the LAA.

A 2010 assessment of wood-based biomass energy potential indicated that there is supply potential in the Peace River region to support an electrical generating facility in Chetwynd in the future (IFS 2010). No potential for facility development was identified for the LAA.

22.3.7 Oil, Gas, and Energy Outlook

As discussed above, there is little or no potential for future development of micro and small hydro, wind power, and biomass in and near the LAA.

The Peace River corridor has oil, gas, and energy potential that will support the ongoing growth of the industry. Estimates of marketable oil and gas reserves in B.C. as of 2009 are shown in Table 22.8. The majority of these resources are located in northeast B.C., where current industry activity, investment, and future production plans are focused.

Table 22.8 Oil and Gas Reserves in B.C., 2009–2010

Resource	Category	Unit	Number
Natural gas (2010)	Remaining established reserves	Million m^3	931,971
Crude oil (2010)	Remaining established reserves	Thousand m^3	18,653
Natural gas liquids (2009)	Remaining established reserves	Thousand m^3	25,863
Pentanes plus (2009)	Remaining established reserves	Thousand m^3	9,959

NOTE:
Remaining established reserves are those recoverable under current technology and present and anticipated economic conditions
Source: CAPP (2011b); BCOGC (2011)

Unconventional gas holds the highest potential for remaining technically recoverable natural gas resources in the northeast (CAPP 2011b). Advances in drilling and fracturing technology have turned worldwide attention to several B.C. areas, including the Montney play.

Persistent low natural gas prices and excess supply in North America have curtailed development activity in the Montney in 2012 as major producers implement production cuts. The decline is reflected in lower proceeds for petroleum and natural gas rights, and royalty payments to government.

Industry and government continue to investigate new and expanded targets for the province's gas productions, with a focus on higher-priced markets in Asia. Planned Liquefied Natural Gas plants on the west coast would provide new market opportunities for producers in northeast B.C. New Asian investment in the industry and the revenue potential of the Montney's wet gas resource are other factors that are expected to keep investment and production buoyant in the regional oil and gas sector (Hamilton 2012).

Land use constraints on the oil, gas, and energy sector in the vicinity of the LAA would change if the Peace River Boudreau Lake proposed protected area were to be designated a park. The protected area designation was established in the Dawson Creek land and resource management plan and, although the area is managed as a protected area, it has yet to be officially designated. The land and resource management plan Working Group recommended that oil and gas tenures be grand-parented under existing normal rules, voluntarily surrendered, expropriated by government, or otherwise resolved. Existing tenures could be developed subject to environmental guidelines, and directional drilling methods from outside the park would be encouraged to access subsurface resources. Tenures would only be reissued with a no surface access condition attached to the tenure (B.C. Ministry of Forests, Lands and Natural Resource Operations 1999).

22.4 Effects Assessment

The potential to adversely affect the oil, gas, and energy sectors is assessed by taking into account the potential for the Project to result in changes to the following key aspects:

- Land use and resource use
- Access and activities for the oil, gas, and energy sectors

22.4.1 Effects Assessment – Construction – Change in Land and Resource Use

The Project would change land and resource use conditions for the oil, gas, and energy industry by occupying or inundating surface lands that have existing infrastructure, including pipelines, wells, and other facilities on Crown land.

The spatial analysis of *Land Act* tenures did not identify energy infrastructure or tenures other than that of the oil and gas industry in the LAA.

The Project would create new, and use existing, transportation routes, including petroleum development roads, to transport materials, equipment, and worker vehicles to work areas in the LAA. Conflicts with the oil and gas infrastructure could occur if a Project component or activity were to directly cross a gas pipeline, be within a prescribed distance of a pipeline, or encroach on the site of an oil and gas company (referred to as pipeline permit holder), such as a well site or a right-of-way. These conflicts would be primarily due to loading or

proximity concerns associated with the transport of materials, equipment, labour, and initial road construction.

Oil and gas industry infrastructure would be flooded in the Site C reservoir or affected (e.g., the Project crosses a pipeline, comes within a prescribed distance, or encroaches on well site or right-of-way) in other project components such as the Site C dam site and the transmission line. Temporary components related to construction, including temporary access roads and off-site material sources, would generate similar effects during the construction period only, after which there would be a return to baseline conditions. As noted previously in Table 22.5, six wells, eight facilities, and 2.9 ha of pipeline right-of-way are thus affected, with one well, four facilities and 1.65 ha of pipeline in the reservoir.

The Spectra Energy water intake in the Peace River just south of Taylor could be affected by the predicted physical changes in suspended sediment during construction, or by event driven sediment discharges during construction. The main concerns related to the construction phase raised by Spectra Energy to BC Hydro relate to the potential for increased suspended sediment that could affect their operations, as follows:

- Increased suspended sediment in the water (i.e., higher turbidity) could lead to an increase in the required frequency of maintenance.

Expected changes with Site C during construction, in the vicinity of the Spectra intake are described in Volume 2 Section 11.8 Fluvial Geomorphology and Sediment Transport. In summary, expected changes with Site C related to the concerns of Spectra include:

- It is expected that there would be periods of increased suspended sediment / turbidity during construction.

While the physical changes can be characterized, it is not clear based on what is known today that these physical changes expected due to Site C would lead to an actual adverse effect on Spectra Energy's operations. The modelling of predicted changes in water temperature and sediment transport expected during construction, along with specific information from Spectra on the relationship between these variables and its operations, can be used to inform and develop an appropriate construction monitoring program with Spectra.

22.4.2 Effects Assessment – Operations – Change in Land and Resource Use

During operations, the Spectra Energy water intake could be affected by changes in water temperature as well as suspended sediments.

- If river water temperature downstream of Site C increases, more water would have to be pumped from the river to achieve the same amount of cooling. When water temperature approaches 15 – 17°C, Spectra may need to cut back production. This typically happens, currently, on hot summer days, during daylight hours.
- Increased suspended sediment in the water (i.e. higher turbidity) could lead to an increase in the required frequency of maintenance.

Expected changes with Site C during operations, in the vicinity of the Spectra intake are described in Volume 2 Section 11.4 Surface Water Regime, Volume 2 Section 11.7 Thermal and Ice Regime, and in Volume 2 Section 11.8 Fluvial Geomorphology and

Sediment Transport. In summary, expected changes with Site C related to the concerns of Spectra include:

- Modelled temperatures at the Site C outlet were warmer than observed temperatures at the same location between July and January, ranging from 0.3°C in July to 1.5°C higher than existing conditions in October. The monthly modelled outlet temperatures were between 0.4 and 0.9 °C cooler from March to June, and in all months had a smaller daily range than the existing river.
- During operation, the turbidity during the spring freshet would be substantially reduced. At other times of the year (during the first 10 years of operation) there would be a slight increase in the suspended sediment due to additional inputs to the reservoir from the erosion of shorelines. After the first 10 years the sediment input from the shorelines is expected to decrease.

As during the construction phase, while the physical changes can be characterized, it is not clear based on what is known today that these physical changes expected due to Site C would lead to an actual adverse effect on Spectra Energy's operations. The modelling of predicted changes in water temperature and sediment transport expected during operations, along with specific information from Spectra on the relationship between these variables and its operations, can be used to inform and develop an appropriate construction monitoring program with Spectra.

22.4.3 Mitigation Measures – Construction – Change in Land and Resource Use

Standard mitigation of effects on tenure holders would apply for existing oil, gas, and energy structures affected by the Project (Section 22.1.3).

22.4.4 Effects Assessment – Construction – Change in Access and Industry Activities

The Project would occupy or flood surface lands that are, or could be, used by oil, gas, and energy companies to exploit the energy resources of the region. This could directly affect the access to, and the commercial viability of, surface and subsurface energy resources by industry.

22.4.4.1 Oil and Gas

The LAA has been actively explored and developed for oil and gas. Petroleum and natural gas leases and licences overlap most of the proposed project components. Just over half of the LAA is covered by active petroleum and natural gas tenures, comparable to the coverage for the Peace River Regional District, which is approximately 46%.

In the future, the conventional and unconventional oil and gas fields that underlie the Peace River would generate currently unknown land sales, exploration, and development and production activity. Tenures would be newly issued and renewed so industry could continue to exploit reserve potential. The LAA overlays 0.07% of regional district oil fields, 0.08% of conventional gas fields, and 0.51% of the Montney Basin.

Table 22.9 Comparison of Petroleum and Natural Gas Tenures and Resource Areas in the LAA and the Peace River Regional District

Tenure/Resource Area	LAA	PRRD	LAA as % of PRRD
PNG Tenures			
Active Petroleum and Natural Gas Tenures (ha)	5,774	5,477,363	0.11
Resource Areas			
Gas fields (ha)	2,139	2,713,745	0.08
Percent of total area (%)	15.6	22.7	N/A
Oil fields (ha)	530	801,150	0.07
Percent of total area (%)	3.9	6.7	N/A
Coal Bed Methane Potential (ha)	13,598	1,935,190	0.70
Percent of total area (%)	99.2	16.2	N/A
Unconventional Play Trends – Montney Basin (ha)	13,254	2,594,685	0.51
Percent of total area (%)	96.7	21.7	N/A

NOTES:
N/A – not applicable
Source: Hillcrest Geographics (2012)

Petroleum and natural gas tenure areas within the LAA are shown in Table 22.10. The area of tenures directly affected by Project construction include:

- 1,270 ha of drilling licences and 2,633 ha of oil and gas leases in areas that would be permanently occupied by the Project
- 1,073 ha of drilling licences, 18 ha of natural gas leases, and 881 ha of petroleum and natural gas leases in temporary components

Major licensees were previously identified in Table 22.6.

As noted in Table 22.9, the sum area of these tenures account for 0.23% of the more than 5,000,000 ha of tenures issued in the PRRD. However, even if the Project proceeds, the status of all tenures within the LAA would remain largely unaffected and licensees would continue to have access to subsurface resources through deployment of horizontal drilling methods, the predominant form of drilling in the Montney.

The licensee with coalbed methane tenure in the Project activity zone (near Farrell Creek) has indicated that the Project would affect only a small part of their concessions and would neither limit future resource potential nor increase development and production costs (Jones 2012, pers. comm.).

While there is no coalbed methane production currently in the LAA at this time, the resource still exists beneath virtually the entire Project activity zone, and might be commercially developable in the future if higher gas prices were to occur. The predominant means of accessing this resource is through vertical drilling, which places a premium on surface access above the resource. Unlike shale gas, coalbed methane resources beneath the Project activity zone would be more difficult and expensive to access and develop in the future. The context of this potential opportunity includes the following two important factors:

- With or without the Project, the current intention of government is to create the Peace River Boudreau Lake proposed protected area, which would exclude all surface access

for new drilling activity. This essentially eliminates access to the south bank of the Peace River for coalbed methane development. The Project would therefore have no incremental effect on south bank coalbed methane activity.

- As noted in Section 22.3.5, directional drilling techniques are being developed to access coalbed methane in North America, even though vertical drilling is still the predominant form of access. In considering the advancements in drilling technology in the last five years, which have unlocked shale and deep gas potential in the province, and considering that the surface area on the north bank that would be lost to vertical drilling access, the Project would not limit access to the coalbed methane resource in the LAA.

In consideration of the foregoing, adverse effects on the access to resources by the oil and gas industry are therefore not anticipated.

Table 22.10 Petroleum and Natural Gas Tenures in LAA

Tenure	Five-Year Beach Line [a]	Site C Dam Site Area [b]	Transmission Line [c]	Construction Access Roads [d]	Quarried & Excavated Materials [e]	Total
Drilling Licence (ha)	1,043.5	N/A	303.2	42.1	58.3	1,447.1
Natural Gas Lease (ha)	N/A	N/A	N/A	N/A	17.9	17.9
Petroleum and Natural Gas Lease and Agreements (ha)	2,958.2	323.7	754.5	126.0	146.7	4,309.2
Underground Storage Lease (ha)	N/A	N/A	N/A	N/A	N/A	N/A
Total (ha)	4,001.7	323.7	1,057.6	168.2	223.0	5,774.3

NOTES:

[a] Five-Year Beach Line is the predicted position of the toe of the bluff at the maximum normal reservoir level five years after impoundment of the proposed reservoir as defined in Volume 2 Appendix B Geology, Terrain Stability, and Soil Reports, Part 2 Preliminary Reservoir Impact Lines

[b] Site C dam site and substation construction areas and restricted access zones as described in Volume 1 Section 4 Project Description

[c] Transmission line corridor and one-time clearing areas as described in Volume 1 Section 4 Project Description

[d] Permanent and temporary roads, and Highway 29 realignment as described in Volume 1 Section 4 Project Description

[e] Off-site construction material sources as described in Volume 1 Section 4 Project Description

N/A – not applicable

Source: Hillcrest Geographics (2012)

22.4.4.2 Other Energy Sources

The Project could change access to other energy activities other than oil and gas through the same pathways; that is, changes in access to land to develop that potential.

At this time, there are no existing or proposed commercial energy operations in or near the LAA for small-scale hydro, wind power, or biomass energy production. Technical studies do not show commercially viable resource values in the LAA, and Crown tenure activity does not indicate exploration or development activity.

As illustrated in Table 22.7, there are no licences for wind power within or near the LAA. Two investigative permits downstream of the Site C dam site would not be affected by the Project (Hillcrest Geographics 2012).

None of the water licences (points of diversion) in the LAA are for general power production or storage. Similarly, a review of *Land Act* tenures shows no licensing for energy production purposes other than oil and gas facilities (Hillcrest Geographics 2012).

In the absence of reasonably foreseeable interest or investment in small-scale hydro, wind power, or biomass energy production, adverse effects on other energy sources are not anticipated.

22.4.5 Mitigation Measures – Change in Access and Industry Activities

Potentially adverse effects are not anticipated for existing and future potential petroleum and natural gas licensees that require access to subsurface resources below the Project activity zone, or for other potential sources of commercial energy production, including small hydro and wind power. Therefore, mitigation is not proposed.

22.5 Summary of Effects Assessment and Mitigation Measures

A summary of project effects and mitigation measures on oil, gas, and energy is presented in Table 22.11.

Table 22.11 Project Effects and Mitigation Measures on Oil, Gas and Energy

Project Phase	Potential Effects	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction Operations	Project would change land and resource use, and could affect oil and gas infrastructure	Standard mitigation: agreements would be concluded where appropriate with third-party tenure holders. Spectra Energy monitoring: if adverse effects identified, mitigation would be implemented.	Spectra Energy may experience adverse effects if increases in sedimentation during construction, and in sedimentation and water temperature during operations affect its operations. Mitigation measures would be determined once operating effects are defined and monitoring is undertaken. With appropriate mitigation residual adverse effects would not be expected.	BC Hydro
Construction	Project could affect access to oil and gas resources and industry activity	Access to resources would not be restricted. No mitigation required.	Residual effects are not anticipated	N/A

NOTE:
N/A – not applicable

In summary, the Project's use of land inside the LAA would change the conditions of access and use by the oil, gas, and energy industry, and it would inundate, displace, or otherwise affect the existing infrastructure of the oil, gas and energy industry. However, the Project's use of land would not measurably affect the industry's ability to access resources. The

Project activity zone and the Five-Year Beach Line would occupy a negligible area – 0.11% of the total petroleum and natural gas tenure area in the Peace River Regional District. Small-scale hydro, wind power, and biomass energy production potential has not been identified within the LAA.

As referenced in Volume 2 Section 11.3 Land Status, Tenure, and Project Requirements, BC Hydro will discuss any overlap with the Project activity zone and reservoir impact lines with affected third-party tenure holders and, where appropriate, enter into agreements regarding potential conflicts with oil, gas and energy tenure holders. This mitigation measure is considered standard mitigation, per Section 22.1.3 Standard Mitigation Measures and Effects Addressed.

22.5.1 Other Mitigation Options Considered

There were no other mitigation measures considered by BC Hydro for effects on oil, gas and energy.

22.6 Residual Effects

As described above, there is a potential for Spectra Energy to experience adverse effects if increases in sedimentation during construction, and in sedimentation and water temperature during operations affect its operations. As these effects are uncertain monitoring is proposed. Mitigation measures would be determined once operating effects are defined and monitoring is undertaken.

With appropriate mitigation no residual adverse effects are anticipated.

22.7 Cumulative Effects Assessment

No cumulative effects are anticipated, because no residual effects are anticipated following mitigation.

22.8 Monitoring and Follow-Up

While the physical changes can be characterized, it is not clear based on what is known today that these physical changes expected due to Site C would lead to an actual adverse effect on Spectra Energy's operations. The modelling of predicted increases in water temperature and sedimentation expected during construction and operations, along with specific information from Spectra on the relationship between these variables and its operations, will be used to inform and develop an appropriate construction monitoring program with Spectra.

BC Hydro will develop a program with Spectra Energy, focused on monitoring of water temperature and sedimentation, at the Spectra water intake in Taylor, to determine if future mitigation by BC Hydro will be required. The frequency will be determined in consultation with Spectra, while duration would be for construction and the first 10 years of operations.

Table 22.12 Follow-up Program for Oil, Gas, and Energy

Valued Component	Project Phase	Monitoring Program Objective	Monitoring Program Frequency	Monitoring Program Duration
Oil, Gas and Energy	Construction Operations	At Spectra Energy intakes, monitor baseline conditions, and effects of increased sedimentation during construction, and effects of increased water temperature and sedimentation during operations, on Spectra cooling operations.	To be determined in discussion with Spectra	Construction and first 10 years of operations

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