23 MINERALS AND AGGREGATES

23.1 Approach

The mineral and aggregate industry includes the exploration for, development of, and extraction of subsurface mineral resources. The Project's use of land would overlap with areas where potential exists for mineral and aggregate production, or where there are existing quarries or pits. The Project's effects on the valued component (VC) of minerals and aggregate has been assessed in consideration of the interaction of the Project to land use; resource use; access as related to industrial mineral and aggregate utilization; the Project's consumption of local aggregate deposits for construction activities; and any new or improved access to aggregate sources created by the Project.

23.1.1 Regulatory and Policy Setting

The assessment was prepared in accordance with Section 16.5 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).

Minerals are defined in the *Mines Act* and the *Coal Act*, which set out the regulatory framework for developing the respective subsurface resources. Aggregate material (i.e., construction material such as sand and gravel) is tenured under the *Land Act* except where the right has been granted to the surface landowner.

Unless the right has been granted, the Province owns the resource beneath Crown and private land. Rights to enter land and explore for subsurface resources is conveyed by the *Mineral Tenure Act* for metallic and industrial minerals and placer deposits, and under the *Coal Act* for coal resources. Work on mineral tenures and aggregate pits that involves land disturbance are regulated under various acts, including the *Mines Act* and the *Land Act*.

Government may also place a "reserve" on land to constrain certain uses or maintain land use options as set out in the conditions of the reserve, which depend on the reserve's purpose. For instance, a "no registration reserve" (formerly termed a "no staking reserve") precludes the issuance of a mineral tenure because mineral development may not be a compatible land use (e.g., reserving the land for designation under the *Park Act*). The province may register a reserve on land earmarked for future development. The B.C. Ministry of Transportation and Infrastructure (BCMoTI) has many reserves on land with known sand and gravel deposits. A reserve may be established under various acts (e.g., *Land Act*, *Mineral Act*, *Coal Act*). Reserves with these types of conditions exist in the Project activity zone.

23.1.2 Key Issues and Identification of Project Effects

In consultation with stakeholders, a concern was expressed in public and property owner consultations about the availability of gravel, and how the Project may deplete local supplies. In addition, mineral exploration and development, particularly coal development, is an important industry in northeast B.C. Growth in the region's economy fuels a broad range of construction projects that require aggregate material. Given the

strategic role of Minerals and Aggregates in the region's development, it is important to assess whether the Project's use of land, or use in meeting its construction requirements, may impinge upon these aspects.

In accordance with Section 16.5 of the EIS Guidelines, the potential to adversely affect the mineral and aggregate VC has been assessed by taking into account the potential for the Project to result in changes to the following key aspects:

- Land use, resource use, access, and activities related to industrial mineral and aggregate utilization within the Project activity zone
- The Project's consumption of local aggregate deposits for construction activities
- Any new or improved access to aggregate sources created by the Project

Project interactions with VCs are ranked in Volume 2 Appendix A Project Interactions Matrix, Table 2, 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" are summarized in Table 23.1. The key issues for Minerals and Aggregates are project construction activities that would result in a change in minerals and aggregates available for industry activity and development. For those Project components that would occupy land, or restrict access to it, there is potential interaction with mineral development activities. The Project's consumption of local aggregate resources is related to those Project components that will require aggregate materials in their construction, as well as the development of pits/quarries to meet the construction requirement. The potential for new and improved access to aggregate sources would be associated with the Project's quarry development activities. The nature of project effects would be similar for all project components; therefore, the assessment of effects is discussed for all activities as a whole during construction, with reference made to key activities where relevant.

Table 23.1 Interactions of the Project With Minerals and Aggregates

Project Activities and Physical Works	Key Aspects		
	Changes in land use, resource use, access and activities related to industrial mineral and aggregate utilization	Project's consumption of local aggregate deposits for construction activities	New or improved access to aggregate sources created
Construction			
Dam Site and Generating Station Construction	✓	✓	
Reservoir Preparation and Filling	✓		
Transmission System	✓		
Quarried and Excavated Material Source Development	✓	✓	✓
Highway 29 Realignment	✓	✓	
Construction Access Roads	✓		

23.1.3 Standard Mitigation Measures and Effects Addressed

A ranking of "0" in Volume 2 Appendix A Project Interactions Matrix, Table 2, indicates that there is no potential interaction between the Project activity and the VC. For Project Operations phase, new or incremental effects are not anticipated and a "0" is assigned to the interaction.

Table 23.1 indicates that some project components may potentially interact with some aspects of Mineral and Aggregates, but not others. For instance, the Project's consumption of aggregate deposits is limited to construction of the Site C dam site and generating station, and Highway 29 realignment project components, as well as the pits/quarries expected to be used by the Project for sourcing the aggregate material. The Site C reservoir filling activity, constructing the transmission system, and worker accommodation do not involve consumption of aggregate deposits.

A "1" ranking was applied to the southern and northern regional temporary accommodation activities of worker accommodation because, while there may be spatial overlaps with mineral and aggregates, 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.

Mineral and aggregate development activities that may be proposed for lands adjacent to the reservoir have the potential to be affected by the Project. These lands are discussed in Volume 2 Appendix B Geology, Terrain Stability, and Soil Reports, Part 2 Preliminary Reservoir Impact Lines and defined spatially as the 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 mineral tenure holder of the nature of the particular effect when contacted through the notice of work referral process, an established process managed by the B.C. Ministry of Energy, Mines and Natural Gas.

The potential beneficial effect of improved new or improved access to aggregate sources would be related to the Project's quarry development activities. The specific quarries are identified in the assessment. For the other Project components, there is no overlap in time or space with this aspect of minerals and aggregates.

As referenced in Volume 2 Section 11.3 Land Status, Tenure, and Project Requirements, BC Hydro will consult with affected third-party tenure holders and, where appropriate, enter into agreements to mitigate any potential project effects.

For market interactions, such as the Project purchasing aggregate material on the local market in competition with other buyers, the price mechanism serves to allocate aggregate products to highest valued uses and is considered a standard mitigation measure.

23.1.4 Selection of Key Indicators

Key indicators for the minerals and aggregate VC are standard measures that indicate potential effects on industry activity. The indicators include descriptors of the resources within the Project area – including potential, production, tenures, and activity – which collectively provide a view of the existence or probability of certain types of deposits. The indicators also include descriptors of the market in consideration of the Project's material requirements for construction, identified material sources, and market pricing and

demand factors. Employment associated with the Project extraction activities is included in the Project's employment forecast (Volume 3 Section 17 Labour Market). Mineral reserve is included as an indicator because it is a mechanism for regulating where mineral development activities occur.

The key indicators for assessing potential project effects on mineral and aggregate resource developments are summarized in Table 23.2.

Table 23.2 Key Indicators for Minerals and Aggregates

Key Aspects	Key Indicators	Rationale for Selection of the Key Indicators
Changes in land use, resource use, access, and activities related to aggregate utilization	Metal, industrial mineral and aggregate potential Record of exploration and development Historic production record Remaining mine or pit life Existing mineral and aggregate tenures Mineral reserves	Known and potential mineral resources that could be developed in the future but would not be, if the Project proceeded.
Project's consumption of local aggregate deposits for construction activities	Volume of aggregate material expected to be purchased by the Project relative to local market conditions Local and regional aggregate pricing and current and forecast consumption profile	Project requirements relative to the local supply and demand for aggregate.
New or improved access to aggregate sources created	Remaining mine, quarry, or pit life	Identifies the Volume of aggregate that may be for other applications

23.1.5 Spatial and Temporal Boundaries

23.1.6 Spatial Boundaries

The Local Assessment Area (LAA) in the EIS Guidelines for the assessment of the VC of minerals and aggregates is the Project activity zone. The Regional Assessment Area (RAA) in the EIS Guidelines is the north Peace area, consisting of the City of Fort St. John, the districts of Taylor and Hudson's Hope, and Area C of the Peace River Regional District.

The area used for reporting in this assessment was updated from the originally proposed spatial boundaries in the EIS Guidelines. The spatial boundary selected for the LAA is the Project activity Zone plus the area within the Five-Year Beach Line, which is the area where the Project occupation of the land base would interact with the exploration or development of minerals and aggregates. The Five-Year Beach Line is adopted, as it is the extent of reservoir clearing and 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 RAA is defined as the north Peace area, consisting of the City of Fort St. John, the districts of Taylor and Hudson's Hope, and Area C of the Peace River Regional District. The RAA captures the spatial extent of the aggregate market, as constrained by the low value of the product relative to transportation costs, and where minerals and aggregate activities may act cumulatively with project residual effects.

Spatial boundaries are shown in Table 23.3 and illustrated in Figure 23.1.

Table 23.3 Spatial Assessment Area for Minerals and Aggregates

Local Assessment Area	Regional Assessment Area
Project activity Zone and area within Five-Year Beach Line	Fort St. John, Taylor, Hudson's Hope, Area C of the Peace River Regional District

23.1.7 Temporal Boundaries

Project interactions for the three key aspects would occur during the full eight-Year construction period. With respect to the changes in land use, resource use, access, and activities related to aggregate utilization, the interaction would commence during the early years of construction and continue indefinitely, as the Project is assumed to operate in perpetuity.

New or incremental effects of potential aggregate consumption during the operations phase is not anticipated in consideration of Draft Construction Materials Development Plans as described in Volume 1 Appendix C.

The new or improved access to aggregate sources created by the Project would commence at the conclusion of the construction phase and continue until the deposits were exhausted.

23.2 Information Sources and Methods

23.2.1 Review of Existing Information

The profile of mineral and aggregate resource and the mineral development history and potential was compiled from the MINFILE database, maintained by the B.C. Ministry of Energy, Mines and Natural Gas. The Ministry's regional overview provided the most up-to-date review of the exploration and development prospects located in the region. Assessment reports of exploration activity in or near the Project activity Zone were also reviewed and the pertinent findings presented in the baseline.

23.2.2 Interviews

The Manager of Regional Aggregate Resources of the B.C. Ministry of Transportation and Infrastructure was interviewed to obtain information on baseline conditions, and perspectives on key issues and project interactions. Volume 3 Appendix C Land and Resource Use Assessment, Part 1 Land and Resource Use Assessment Interview Methodology details the interview methodology.

23.2.3 Field Investigations

BC Hydro undertook field investigations to identify the location, quality, and quantity of construction material within the Project activity zone, except where access was restricted (e.g., private land) (BC Hydro 2012a).

23.2.4 Data Management, Mapping, and Modelling

GIS analysis was undertaken to provide quantitative estimates of the overlap of the Project activity Zone including the area within the Five-Year Beach Line with certain mineral and aggregate indicators (Hillcrest Geographics 2012). The source of data was the B.C. government land and resource data warehouse, and the Project activity Zone (BC Hydro 2012b).

23.2.5 Aboriginal Community and Traditional Knowledge

Aboriginal community and traditional knowledge related to the minerals and aggregates 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 the RAA, BC Hydro had not received community baseline information from them at the time of writing.

Baseline information and data as well as concerns and interests of Aboriginal groups relevant to minerals and aggregates are incorporated into the baseline and effects assessment sections below. 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.

23.3 Baseline Conditions

23.3.1 History of Mineral Development Activities and Mineral Potential

The Peace River Regional District has an established mineral development history, most notably coal. Eighteen past producing mines, 37 developed prospects (i.e., advanced exploration stage), three prospects, and over 100 showings (i.e., initial evidence of mineral occurrence) are on record. Most of the past producing mines and the developed prospects were metal or coal sites. In 2011, three coal mines were in operation, all in the vicinity of Tumbler Ridge and Chetwynd (Brule, Trend, Perry Creek, and Willow Creek) (DeGrace 2011).

The LAA's mineral development record shows one past producer and two showings (Table 23.4). The past producer is a coal property on Portage Mountain adjacent to potential Project source of riprap material for use in the realignment of Highway 29 and for the Hudson's Hope Shoreline Protection. The two recorded showings are over

50 years old. One is near Hudson's Hope, which is a showing of travertine (typically used in floor tiles) recorded in 1957. The other, near the confluence of the Peace River and the Moberly River, was recorded in 1949 and identified the presence of sulphur and iron.

Table 23.4 Summary of Mineral Development Indicators in the LAA

Indicator	LAA
Record of Mineral Development	Number of (or count)
Developed Prospect	0
Past Producer	1
Producer	0
Prospect	0
Showing	2
Tenures (ha)	Total area under respective tenure type (ha)
Coal Application	69.5
Coal Leases	0
Coal Licences	0
Mineral Claim	0
Placer Claim	0
Quarrying (forestry special use permit)	0
Notice of Work (Mineral, Coal, Placer, Sand and Gravel) (count)	0

NOTE:

Source: Hillcrest Geographics (2012)

A province-wide assessment of mineral potential found that three developable gold placer deposits and eight industrial mineral deposits at the 5% confidence level (a low level of confidence) occur in the LAA (Kilby 2004). At the 90% confidence level (a high level of confidence), there are no deposits indicated. Overall, the mineral potential in the LAA is low relative to the mineral potential in the rest of the province (a rank of 186, compared to highest potential track of 794) for metallic potential and 138 for industrial mineral, both considered low potential. The corresponding assessment of aggregate potential was not reported in the province-wide assessment.

Coal is the most likely mineral for future development in the Peace River Regional District. The Peace River corridor is part of the Peace River Coalfield, which is estimated to contain more than 160 billion t of medium- and low-volatile bituminous coal reserves. In the first quarter of 2012, there were four major coal projects in northeast B.C. (all outside the LAA) in the B.C. environmental assessment process: the Roman Coal and Horizon Coal Mine projects near Tumbler Ridge; the Gething Coal Mine project, approximately 25 km west of Hudson's Hope; and a restart of the Quintette coal mine near Tumbler Ridge (BCEAO 2012). The more accessible and commercially viable deposits are south of the LAA.

Within and near the LAA there is a scarcity of natural outcrops of coal. Limited exploratory drilling failed to find thick coal seams, indicating that an economically viable coal resource is not present (Kelman and Hovis 2007). Nevertheless, under economic conditions favourable for coal development, the industry would likely continue to search for viable coal deposits in the LAA.

There is a limited history of drilling for metallic minerals such as gold, silver, copper, and molybdenum in the LAA. Existing mineral reserves restrict tenuring for these minerals in the LAA; however, exploration and development potential is low due to unfavourable geology.

23.3.2 Mineral Tenures

At the time of the records being reviewed (November 2012), there were no mineral tenures in the LAA (Table 23.4). Application for coal exploration covers areas temporally required by the Project to extract aggregate materials. The notice of work indicators reflect the level of activity undertaken on tenures. Most of the notices are associated with mineral and coal tenures in Peace River Regional District. There are no notices of work recorded in the LAA (Hillcrest Geographics 2012).

23.3.3 Aggregate Development Activities

Deposits of aggregate of various dimensions are used directly as an ingredient of concrete and asphalt, road construction, and for road maintenance. Aggregate itself is a relatively low-value product; however, transportation costs are a major factor in the delivery price of aggregate, so deposits tend to be as close as possible to the location of demand.

The majority of aggregate production is alongside major river corridors where water has sorted the clay and sand overburden. There are a number of private and Crown-owned operating pits located along the Peace River. These are located in the Hudson's Hope area, in Beryl Prairie, and in several pits situated downstream of the potential Site C dam site, near Taylor. The Halfway River First Nation and West Moberly First Nations engage in gravel extraction and sales (T8FNs Community Assessment Team and The Firelight Group Research Cooperative 2012 – included as 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).

The Ministry of Transportation and Infrastructure manages pits on Crown lands for use by its contractors for road construction and maintenance work. The ministry manages several pits in the vicinity of the LAA. Approximately 170,000 m^3 are extracted annually from the pits listed in Table 23.5, and about 342,000 m^3 is used by Ministry of Transportation and Infrastructure annually in the Fort St. John area. In recent years, very little has been extracted from the Teko pit because of access constraints (BCMoTI, Manager Regional Aggregate Resources 2012, pers. comm.). Three pits, Peace View, Tompkins, and Riske are adjacent to the Peace River upstream of the proposed dam site (Figure 23.1). The Wuthrich and West Pine quarries are operated by Ministry of Transportation and Infrastructure, producing riprap material, and will be further developed by the Project (Figure 23.1).

In addition to the pits listed in Table 23.5, the Ministry of Transportation and Infrastructure holds reserves over numerous known sand and gravel deposits to meet future road building/maintenance needs.

Table 23.5 Summary of B.C. Ministry of Transportation and Infrastructure Aggregate Pits

Pit Name	Est. Proven Reserves (m^3)	Quality of Pit[a]	Importance to BCMoTI Operations in District	BCMoTI Comments
Pits located in the LAA				
Del Rio	Unknown	Unknown	Medium	Important for future use
Peace View	1.5 million	High	High	NA
Tompkins	135,000	High	High	Approximately 40 ha of reserve still remains to be assessed for Volume potential
Riske Pit	100,000	High	High	NA
Bear Flats	Unknown	Low	Low	Poor durability characteristics of the bedrock
Other ministry pits located in the region				
Beryl Prairie	2.6 million	High	High	NA
Benard	500,000	High	High	Potential for more volumes; only a portion has been assessed
Ardill	NA	High	Low	Close to depletion
Johnson pit	NA	NA	NA	Close to depletion
Teko	6.0 million	High	High	Source very important to BCMoTI, even though there are challenges with access
Reserves	NA	High	High	NA
Southwick Hudson's Hope	960,000	High	High	NA
Southwick Notation	500,000	High	High	Tenure issues exist with District of Hudson's Hope

Notes:

BCMoTI – B.C. Ministry of Transportation and Infrastructure

NA – data not available

[a] This relates to how well the physical quality of the deposit meets BCMoTI requirements

[b] This includes consideration of the quality of the deposit, its location, cost of extraction, size, and other factors that make it more or less important to the BCMoTI

Source: BCMoTI, Manager Regional Aggregate Resources (2012, pers. comm.)

23.3.4 Local and Regional Aggregate Pricing and Current and Forecast Consumption Profile

Some gravel sizes are relatively scarce in the northeast. The Ministry of Transportation and Infrastructure pays the highest price for crushed gravel in the northeast and central region as compared to the rest of the province, a reflection of local scarcity (BCMoTI, Manager Regional Aggregate Resources 2012 pers. comm.).

Granular materials from private pits supply the Fort St. John area's construction, paving, and oil and gas industry requirements. Industry may also excavate nearby pockets of granular material for immediate and short-term needs, such as local road building and drilling pad development. The larger commercial pits near Taylor have been operating for at least two decades and have known reserves to continue current production for at least 20 years.

Total aggregate consumption is the sum of private sector projects and road work proceeding in any given year. In recent years, total annual consumption has been in the range of 590,000 m^3 (1 million t). Future demand will grow to supply new construction

and to maintain an expanded and upgraded road network. The gravel requirements will be met from existing private and government-managed pits, and the development of new pits.

Future pit development over the next two decades would continue to focus on the Taylor area. The Teko pit and surrounding area has large aggregate reserves, but road access is required to fully develop the property. The proximity of Teko pit to the area of demand would concentrate effort to provide access to this site. There are other potential sources similar to the Teko Pit concentrated along the Peace River basin that may prove viable.

23.3.5 Mineral Reserves

A “mineral reserve” may be attached to Crown land to restrict or prohibit the establishment of mineral tenures, because such activities would not be compatible with the preferred land use. A reserve may apply individually to minerals, placer activity or coal, and mineral reserves may overlap on the land base. The mineral reserves in the LAA, rationale for their issuance, and their conditions are summarized in Table 23.6. The total size of the reserve is reported in the table. The overlaps of the various reserves in the LAA were removed by allocating land to the most restrictive reserve first (i.e., Peace River Boudreau Lake proposed protected area), moving down the list of reserves in Table 23.6 from top to bottom.

The most restrictive condition is a “no registration reserve”, in which no mineral, placer, or coal tenure may be issued after the effective date of the reserve. The Peace River Boudreau Lake proposed protected area and the Peace Moberly reserves have these restrictions and cover a total of about 7,371 ha within the LAA. Four mineral reserves are related to hydro developments and cover about 4,800 ha in the LAA (excluding overlaps) Note that these reserves do not restrict staking for coal. That is, if these reserves were removed, the incremental change is that tenuring for mineral and placer would be allowed. But, as discussed earlier, the potential for discovering these minerals in the LAA is considered low.

The B.C. Ministry of Transportation and Infrastructure also puts a reserve over known deposits of material (e.g., sand and gravel deposits) that it may require for future road construction or maintenance. Several of these reserves are present in the LAA and will be discussed in the next section.

Table 23.6 Mineral Reserves in the Local Assessment Area

Name	Reserved			Reason	Date Created	Restriction	Total size (ha)	Non-Overlapped area in LAA (ha)
	C	M	P					
Peace River Boudreau Lake	✓	✓	✓	Proposed protected area	29/01/2009	No staking	42,483	6,668.9
Fort St. John	N/A	✓	✓	Trans. line & hydro project	01/01/2006	Conditional	26,489	2,021.6
Peace Moberly	X	✓	✓	Study area	15/03/2005	No staking	109,014	702.0
G.M. Shrum Generating Site	N/A	✓	✓	Transmission Line	16/12/1976	Release required	25,691	39.4
Hudson Hope	N/A	✓	✓	Hydro project	07/08/1959	No staking	48,243	190.7
Wennergren Reserve	N/A	✓	✓	Flooding	11/10/1957	No staking	243,747	2,559.4

NOTES:
C – Coal
M – Mineral
P – Placer
N/A – not applicable
Source: Hillcrest Geographics (2012)

23.4 Effects Assessment

The potential to affect minerals and aggregates is assessed by taking into account the potential for the Project to result in changes to the following key aspects:

- Land use, resource use, access, and activities related to industrial mineral and aggregate utilization within the LAA
- Any new or improved access to aggregate sources created by the Project
- The Project's consumption of local aggregate deposits for construction activities

The first and third~~two~~ aspects could give rise to adverse effects after the application of standard mitigation measures, and are addressed in the following effects assessment. The ~~third~~ second aspect is a potential beneficial effect.

23.4.1 Effects Assessment – Construction – Land Use, Resource Use, Access, and Activities Related to Industrial Mineral and Aggregate Utilization

Changes in industrial mineral and aggregate utilization were assessed considering changes to land use, resource use, access, and activities. The effect mechanism was the Project's use or occupation of surface lands that would preclude or restrict mineral or aggregate development. The Project would obtain its construction material requirements from a number of sources as shown in Figure 23.1.

23.4.2 Access to Mineral and Coal Development

During Project construction, mineral exploration activities could be limited in temporary Project areas, and the Site C reservoir filling would permanently preclude existing and potential mineral and aggregate use. Nevertheless, the record of exploration in the LAA shows no sustained industry exploration effort, and the LAA's geological characteristics are not favourable for most valuable minerals, except for coal. The record of mineral exploration shows limited evidence of valuable deposits; consequently, the mineral potential land is low (Table 23.4). Furthermore, the 4,800 ha in the LAA exclusively subject to mineral reserve for a hydro development purpose allows for coal tenuring, which appears to be relatively greater potential for future development (Table 23.6). Based on these observations, the probability of reduced access to undiscovered mineral potential as a result of the Project is low.

23.4.3 Access to Aggregate Deposits

Three Ministry of Transportation and Infrastructure pits would be affected by the Project. The Peace View pit would be alienated from future use, as it would become an island after Site C reservoir filling, while the Tompkins and Riske pits would be within the reservoir impact lines, and future use would be technically assessed (Figure 23.1).

The Ministry of Transportation and Infrastructure's Del Rio Pit is located in the transmission line corridor. It would remain a gravel source to the ministry after the Project was completed.

The Portage Mountain quarry would remain a BC Hydro quarry for future use in maintenance of Hudson's Hope Shoreline Protection and the W.A.C. Bennett Dam as required, and would be potentially available to Ministry of Transportation and Infrastructure.

The 85th Avenue Industrial Lands would be remediated based on post-construction use of the site to be considered in relation to the Official Community Plans of both the regional and local governments.

The B.C. Ministry of Transportation and Infrastructure also holds seven sand and gravel reserves that overlap the LAA. The area of overlap of the reserves by project component is summarized in Table 23.7. Except for the overlap with the reservoir component (i.e., Five-Year Beach Line), the Project will have minimal effect on B.C. Ministry of Transportation and Infrastructure's access to the reserved deposit. Material extracted from the reserves for the Project will be addressed under the terms of a memorandum of understanding with the B.C. Ministry of Transportation and Infrastructure.

Table 23.7 B.C. Ministry of Transportation and Infrastructure Sand Gravel Map Reserves in LAA (ha)

Five-Year Beach Line [a]	Site C Dam Site Area [b]	Transmission Line [c]	Construction Access Roads [d]	Quarried & Excavated Materials [e]
57.1	0.0	19.2	14.3	199.5

NOTES:

[a] Five-Year Beach Line is 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

[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 Section 4 Project Description

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

[e] Off-Site Construction material sources as described in Section 4 Project Description

Source: Hillcrest Geographics (2012)

The B.C. Ministry of Transportation and Infrastructure would continue to have access to the Wuthrich and West Pine quarries during construction. Following Project construction, the surplus quarry materials in the two quarries would be available to Ministry of Transportation and Infrastructure for further development. In summary, the low mineral potential of the LAA, as implied by past exploration efforts, indicates that the Project's restrictions on access and land use would not constrain mining industry's activity. The Project would utilize and/or inundate developed and undeveloped aggregate pits used by B.C. Ministry of Transportation and Infrastructure.

The West Pine and Wuthrich quarries would be expanded and the Portage Mountain quarry developed specifically for the Project. The three quarries would provide riprap and bedding material for the Project, and they would be available for further production after Project construction. The surplus material is an estimated 2.9 million m^3 from the three quarries for use by Ministry of Transportation and Infrastructure (Volume 1 Section 4 Project Description), which is a beneficial effect.

23.4.4 Effects Assessment – Construction – Consumption of Local Aggregate Deposits

The Project would require an estimated 40 million m^3 of construction material (Volume 1 Section 4 Project Description, Section 4.3.5, Tables 4.6 to 4.7), the majority of which would be sourced directly by the Project from new sources, or as agreed with Ministry of Transportation and Infrastructure for the use of Ministry sources. The Project may purchase material in the local market for the period of time the material is needed.

Material purchased from private pits is expected to consist mostly of concrete aggregates, which would be used in building bridges for Highway 29. For purchased material, the responsible contractors would negotiate a supply agreement from a local pit. Up to 28,000 m^3 could be purchased from private pits, subject to the bidding process. This would be a small Volume relative to the project's total requirements and in relation to local consumption of about 590,000 m^3.

In summary, the Project would obtain a large proportion of the material from deposits located within the LAA, with a relatively small Volume purchased from the private sector. As the Project would be largely self-sufficient in aggregate use, with little reliance on private sources, it would not disrupt the local aggregate market.

23.4.5 Mitigation Measures

BC Hydro will negotiate a memorandum of understanding with the B.C. Ministry of Transportation and Infrastructure to compensate for material used by the Project and to maintain material availability for Ministry operational needs. The Project will reduce the B.C. Ministry of Transportation and Infrastructure's use of existing pits and future use of undeveloped deposits reserved for their use. With these measures, in addition to the use after construction of the West Pine, Portage Mountain, and Wuthrich quarries by the B.C. Ministry of Transportation and Infrastructure, no adverse effects would be expected.

23.4.6 Summary of Effects Assessment and Mitigation Measures

A summary of potential effects and mitigation measures are shown for minerals and aggregates in Table 23.8. With the implementation of mitigation discussed above there will be no adverse residual effects to minerals and aggregates.

Table 23.8 Project Effects and Mitigation Measures on Minerals and Aggregates

Project Phase	Potential Effects	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction	Land use, resource use, access, and activities related to industrial mineral and aggregate utilization	Negotiate a memorandum of understanding with the BCMoTI to compensate for material used by the Project and to maintain material availability for ministry operational needs. Memorandum of understanding to include: 1) aggregate source strategy to compensate for inundated Ministry aggregate sources 2) BC Hydro commitment to stockpile surplus rock material at the West Pine, Wuthrich, and Portage quarries	Negotiated agreement will address BCMoTI identified needs Residual effects are not anticipated	BC Hydro

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 preliminary reservoir impact lines with affected third-party tenure holders and, where appropriate, enter into agreements regarding potential conflicts with mineral and aggregate tenure holders. This mitigation measure is considered standard mitigation, per Section 23.1.3 Standard Mitigation Measures and Effects Addressed.

23.4.7 Other Mitigation Options Considered

There were no other mitigation measures considered by BC Hydro for effects on minerals and aggregates.

23.5 Residual Effects

No residual effects are anticipated following the proposed mitigation measures.

23.6 Cumulative Effects Assessment

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

23.7 Monitoring and Follow-Up

Monitoring and follow-up is not required for minerals and aggregates.

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