5. ASSESSMENT METHODOLOGY

5.1 INTRODUCTION

This chapter of the Application/EIS describes the effects assessment methodology that was used to identify and assess potential effects of the Murray River Coal Project (the Project). The methodology described in this chapter is consistent with the requirements of the Application Information Requirements (AIR; BC EAO 2013b), and the Environmental Impact Statement Guidelines (the Guidelines; CEA Agency 2013b) for the Project.

An EA has the following objectives:

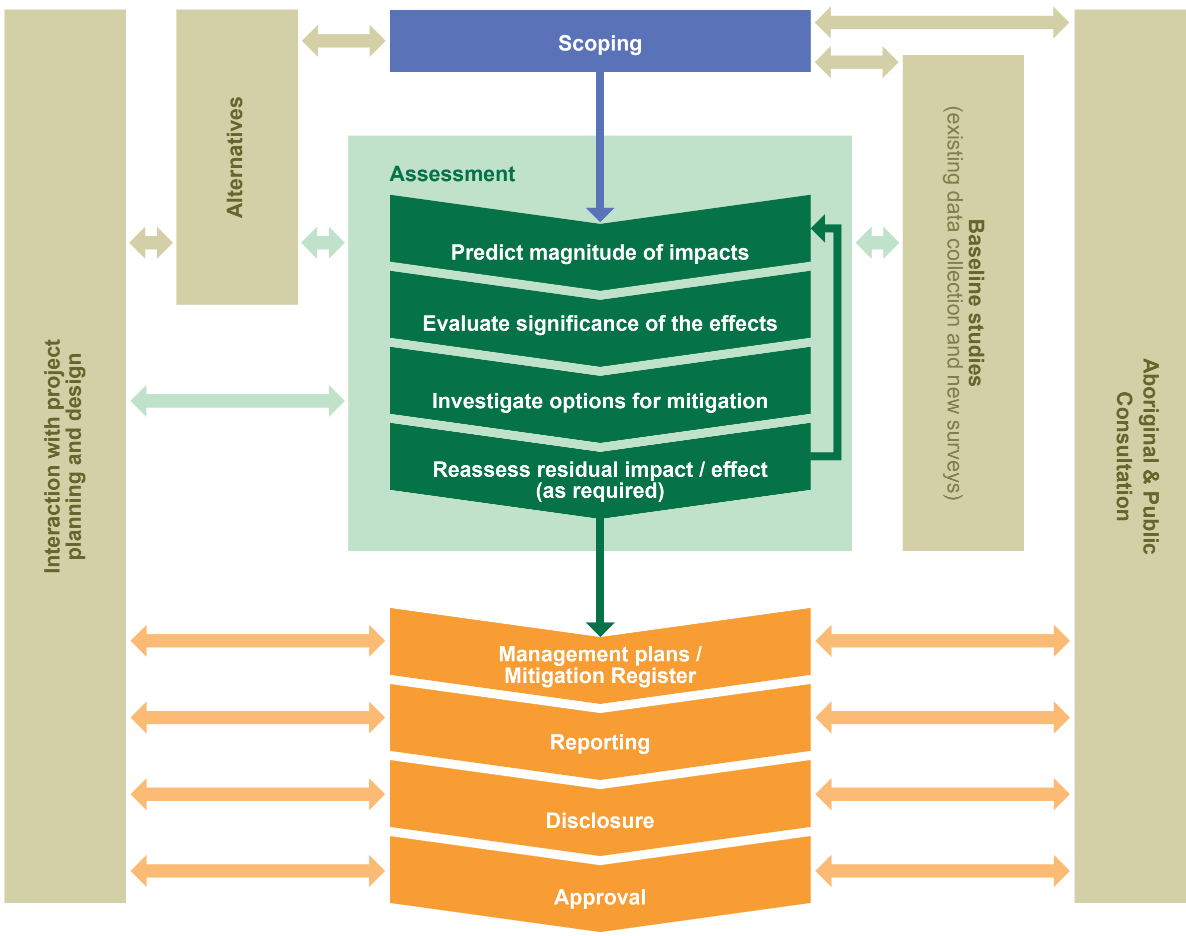
- to identify potential interactions among Project components and the surrounding biophysical and socio-economic environments;
- to identify any potential effects on Valued Components (VCs) resulting from the Project;
- to propose mitigation measures to minimize adverse potential effects;
- to identify any residual effects which cannot be mitigated;
- to determine the significance of residual effects, their likelihood of occurrence, and level of confidence;
- to assess potential cumulative effects that could result from interaction between the Project and other past, present, or reasonably foreseeable projects and human activities;
- to identify mitigation measures for potential cumulative effects and identify cumulative residual effects that cannot be mitigated; and
- to determine both the significance of these cumulative residual cumulative effects and their likelihood of occurrence.

Figure 5.1-1 provides an overview of the EA process that was followed to develop this Application/EIS. The EA process was iterative: analysis of baseline studies, stakeholder feedback (inclusive of Aboriginal groups), and re-evaluation of Project design (including evaluation of alternatives and improved mitigation measures) all contributed to the refinement of EA scoping, as well as the avoidance of effects and design of mitigation measures to reduce the scale of residual effects. The following guidance documents were used in the development of this methodology:

- An Ecological Framework for Environmental Impact Assessment in Canada (Beanlands and Duinker 1983);
- Application Information Requirements (British Columbia Environmental Assessment Office 2013b); and
- Environmental Impact Statement Guidelines (CEA Agency 2013b).

Figure 5.1-1

Overview of the EA Process



The content included in this chapter is intended to:

- identify the objectives of the effects assessment process;
- provide a general description of how baseline information was integrated into the Application/EIS (both through the collection of new baseline data, and a review of existing information);
- describe the scoping process used to identify and categorize valued components (VCs);
- identify the approach used to select assessment boundaries;
- present the method used to predict and assess effects;
- provide an overview of the types of mitigation used to reduce the potential for significant adverse effects;
- identify the criteria and process used to determine the significance of residual effects on VCs; and
- describe the methodology used to assess cumulative effects.

The detailed methods used in the assessments for each selected component are provided in the relevant chapters for each VC within this Application/EIS. Information gleaned from public consultation and Traditional Knowledge/Traditional Use (TK/TU) information is integrated into multiple areas of the overall assessment methodology. Chapter 20 of the Application/EIS outlines how this information has been incorporated.

5.2 REGULATORY AND POLICY FRAMEWORK

The assessment process for a standard EA under federal and provincial law for the Project is described in Chapter 1 (Section 8, Regulatory Framework). Each assessment chapter includes a separate description of the regulatory framework and regulatory requirements for each assessment topic. This includes laws, regulations, decrees, treaties, and other instruments or declarations of relevance. In addition, the chapters discuss other plans and guidelines of relevance to the Project including jurisdictional policies (e.g., land use management plans).

5.3 REGIONAL OVERVIEW

Each assessment chapter provides a regional overview of the relevant environmental, social, economic, heritage, and health conditions surrounding the Project. The regional data was used to determine the framework for the assessment and to characterize Project effects. The regional overview also describes processes relevant to the environmental, social, economic, heritage and health regional settings, and considers current conditions, trends and variability over time. Information described in each assessment chapter includes:

- available scientific studies, supplemented by Aboriginal traditional knowledge and community knowledge (See Chapter 20); and
- references to supporting documents, maps, and engineering and technical reports, which are included in the appendices to the Application/EIS.

5.4 HISTORICAL ACTIVITIES

Each assessment chapter provides a brief description of historical and current activities influencing the Project footprint. These activities include: mineral and coal production, wind power projects, forestry, tourism/recreation and hunting/trapping. Other projects and activities that are currently in the regulatory process (e.g., construction activities have not commenced), or that are planned or proposed but are not yet committed or certain (i.e., they are less advanced than the Murray River Project in the planning cycle) may be considered in the assessment of cumulative effects, although not as part of the baseline.

5.5 BASELINE STUDIES

Each assessment chapter describes any baseline studies undertaken to support each of the effects assessments, including a description of: the information sources that were reviewed to obtain existing data, data collection and analytical methodologies, and a summary of results. Detailed baseline study results are provided in an appendix to the Application/EIS for each assessment topic. A summary table of the Project-specific field baseline data collection programs undertaken for each assessment subject area is provided below (Table 5.5-1).

Table 5.5-1. Summary of Baseline Studies for the Murray River Project

Subject Area	Field Baseline Studies	Years of Available Data
Atmospheric Environment	Meteorology	2011-2013 Meteorology
	Air Quality	2011 Air Quality
	Noise	2012 Noise
Terrestrial Environment	Terrain and Surficial Geology	2010-2013 Geochemistry
	Landforms and Soils	2010-2012 Terrain and Soils
	Ecosystem and Vegetation	2010-2012 Wetlands 2010-2013 Ecosystems and Vegetation
	Wildlife and Wildlife Habitat Caribou Grizzly Bear Furbearers Birds	2010-2012 Wildlife
Freshwater Environment	Hydrology	2011-2012 Hydrology
	Groundwater (Hydrogeology)	2011-2014 Hydrogeology
	Water Quality Aquatic Ecology	2010-2014 Water Quality and Aquatics
	Fish and Fish Habitat Sediment Quality	2010-2013 Fish and Fish Habitat

(continued)

Table 5.5-1. Summary of Baseline Studies for the Murray River Project (completed)

Subject Area	Field Baseline Studies	Years of Available Data
Human Environment	Heritage (Archaeology)	2010-2013 Heritage
	Socio-Economic	2011-2012 Socio-Economics
	Non-traditional Land Use	2010-2012 Land Use
	Country Foods	2012 Country Foods
	Human Health and Well-Being	2013 Ethnographic Overview and Traditional Knowledge and Use Desk-based Research Report 2014 Saulteau First Nations Knowledge and Use Study

Detailed baseline information improves the ability of the EA to predict how the proposed Project would affect local environmental, social, economic, heritage and health current conditions, and how these components may respond to changes. Baseline studies also help to identify issues, concerns, and sensitivities in relation to the surrounding environment of the Project. Thus, baseline studies for the Project were conducted to:

- identify the key environmental, social, economic, health, and heritage conditions that may be affected by the Project components and activities;
- describe and where possible quantify characteristics of the existing conditions (nature, condition, quality, extent, etc.), both now and in the future in absence of the Project;
- provide data to aid the prediction and modelling of effects;
- to inform judgments about the sensitivity, vulnerability and/or importance of resources/ receptors; and
- characterize pre-disturbance conditions for the purpose of future monitoring and reclamation activities.

5.5.1 Data Sources

The existing conditions in the baseline monitoring study areas, as they pertain to the selected components, are discussed in each assessment chapter. This information includes:

- information from scientific studies, supplemented by Aboriginal traditional knowledge and community knowledge where available;
- references to supporting documents, including annual baseline data reports, engineering, and technical reports which are included in the appendices to the Application/EIS;
- desktop research such as FishWizard, other mine assessment reports, regional studies, etc.; and
- methodology guidance documents and/or operating statements specifying how baseline data should be collected (e.g., Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators; BC MOE 2011).

5.5.2 Methods

Baseline studies were conducted using a tiered approach beginning with a desk-based review of information available from government sources, engineering and technical reports, scientific studies, and peer-reviewed articles. The description of the baseline provides a high-level overview of methods used to collect baseline information, including a description of standards and methodologies used, and data collection and analytical methodologies, and any limitations encountered and assumptions made.

Because existing baseline data were limited, comprehensive baseline field programs were initiated in 2010, and were conducted annually through 2013 to support the Project; Table 5.5-1 provides a high-level summary of the field baseline studies that were undertaken for the Project.

Although the baseline studies were commenced prior to formal Aboriginal consultation, the studies considered publicly available information from previous projects in the area, such as the Roman Coal Mine Project, the Wildmare Wind Energy Project, the Mt. Milligan Copper Gold Project, and the Site C Clean Energy Project.

5.5.3 Characterization of Baseline Conditions

Characterization of the baseline condition was undertaken to describe and where possible quantify characteristics of the existing conditions (nature, condition, quality, extent, etc.). As noted, the baseline considers current conditions, as well as those changing conditions (i.e., trends) apparent in the baseline (e.g., depletion of wildlife populations). Each assessment chapter includes summaries of baseline data results with references to relevant Appendices, as applicable.

5.6 Establishing the Scope of the Effects Assessment

Issues scoping is fundamental to focusing the Application/EIS on those issues where there is the greatest potential to cause significant adverse effects, and to focus the assessment on those aspects of the biophysical and human environment that are of greatest importance to society. This, in turn, further improves the effectiveness and efficiency of the assessment, in part by facilitating the selection of appropriate study methods and focusing analysis on key Project-environment interactions (Beanlands and Duinker 1983). The preliminary scope of the effects assessment was determined as part of the BC EAO and the Agency processes, including release of the draft AIR and the EIS Guidelines for comment by regulators, Aboriginal communities, and the public.

Each assessment chapter of this Application/EIS includes a description of the issues scoping process used to identify potential effects of the Project which are likely to affect specific environmental, social, economic, heritage, and health components. The chapters also describe the scoping process used to select assessment boundaries and to understand the potential interaction or cause-effect pathways between Project activities and environmental, social, economic, health, and heritage components.

The scoping process for the Application/EIS consisted of the following five key steps:

- *Step 1:* conducting a desk-based review of available scientific data, technical reports, and other Project examples to compile a list of potentially affected VCs in the vicinity of the Project;
- *Step 2:* carrying out detailed field baseline studies to fill information gaps and confirm presence/absence of VCs;
- *Step 3:* consideration of feedback from the EA Working Group on the proposed list of VCs included in the AIR and the EIS Guidelines;
- *Step 4:* definition of assessment boundaries for each VC; and
- *Step 5:* identification of key potential effects on VCs.

5.6.1 Selecting Valued Components

Valued components (VCs) are components of the natural and human environment that are considered to be of scientific, ecological, economic, social, cultural, or heritage importance (CEA Agency 2006; BC EAO 2013a). To be included in the EA, there must be a perceived likelihood that the VC will be affected by the proposed Project. Valued components were scoped into the environmental assessment, based on issues raised during consultation on the dAIR and EIS Guidelines, with Aboriginal communities, government agencies, the public and stakeholders. Consideration of certain VCs may also be a legislated requirement, or known to be a concern because of previous project experience.

The following criteria and information was considered during the component scoping process:

- baseline studies;
- project footprint data;
- technical studies and engineering documents;
- impact matrix table (see Table 5.6-3);
- legislative requirements (e.g., AIR and EIS Guidelines, *Fisheries Act* (1985));
- established Operational Procedures and Best Practises;
- policy guidance;
- Dawson Creek Land and Resource Management Plan (British Columbia Integrated Land Management Bureau 1999);
- issues raised to date by potentially affected Aboriginal groups (as summarized in the Section 11 Consultation Reports);
- resilience of a component to change;
- potential interaction with another project/activity to create a cumulative effect(s);
- a review of available information (including past, proposed, and current mining EA projects);

- feedback from the EA Working Group, including Aboriginal groups;
- feedback from key stakeholders, including tenure holders, community and interest groups; and
- professional judgement.

When selecting candidate components, the following questions were considered:

- Is the component present in the local or regional area?
- Does the Project have the potential to interact with or adversely affect the component?
- Does a legally binding government requirement exist to protect the component?
- Does the component reflect a legislative or regulatory requirement or government management priority?
- Does the component pertain to Aboriginal interests, including claimed or proven Aboriginal rights (including title) and Treaty rights?
- Is there a potential for significant adverse cumulative effects? What known stressors are already occurring on the land base?
- Is the component itself, or the potential adverse effect, of particular concern to the public, Aboriginal groups, or government?
- Is the component particularly sensitive or vulnerable to disturbance?

To further refine the assessment, the following questions were considered when selecting sub-components, and defining indicators to measure effects:

- Could the potential effects of the project on the component be measured and monitored? Is the candidate component better represented/evaluated by using a different indicator?
- Could the potential effect on a VC be effectively considered within the assessment of another?
- Is the information about the VC needed to support the assessment of potential effects on another?

5.6.1.1 Identification of Potential Valued Components

During the development of the dAIR, a VC-scoping exercise was conducted to explore potential Project interactions with candidate VCs, and to identify the key potential adverse effects associated with those interactions. A preliminary list of potential VCs was developed based on professional judgement, combined with knowledge of the Project, and experience from previous mining projects.

The dAIR and EIS Guidelines provided this preliminary list. Chapters 6 through 19 of the Application/EIS provide detail on why specific VCs were identified as potential candidates for detailed environmental assessment.

5.6.1.2 *Consultation Feedback on Valued Components*

As part of the EA processes defined under the British Columbia *Environmental Assessment Act* (2002a) and CEAA, 2012 (2012), the preliminary list of VCs in the dAIR and draft EIS Guidelines was released for comment and feedback. Comments on both documents were received from regulators, Aboriginal groups, and the public over a period of 30 days. Comments were also received from regulators and Aboriginal groups outside of the 30 day public comments period through Working Group meetings and discussions. Chapters 6 through 19 of the Application/EIS describe the feedback that was received and how this feedback shaped the final list of VCs included in the EA.

The scoping process also relied on feedback from Proponent-led public consultation, and considerations under Treaty 8, and regulatory requirements.

5.6.1.3 *Valued Components Included in the Effects Assessment*

Specific rationale for why each subject area and VC was selected or excluded is included in the relevant assessment chapter of this Application/EIS and will be summarized using the table formats below (Table 5.6-1; Table 5.6-2). Supporting text discussing the selection process and rationalizing the final list of VCs will also be provided.

Table 5.6-1. Valued Components Included in the Application/EIS

Valued Components	Identified by*				Rationale for Inclusion
	AG	G	P/S	IM	

**AG = Aboriginal Group; G = Guideline requirement; P/S = Public/Stakeholder; IM = Impact Matrix.*

Table 5.6-2. Valued Components Excluded from the Application/EIS

Valued Components	Identified by*				Rationale for Exclusion
	AG	G	P/S	IM	

**AG = Aboriginal Group; G = Government; P/S = Public/Stakeholder; IM = Impact Matrix.*

The selected VCs identified for the Project can be grouped into the following assessment themes: atmospheric environment, terrestrial environment, freshwater environment, and the human environment (Table 5.6-3).

The final VCs selected for analysis in the impact assessment, including the environmental topic and supporting indicators and/or species (e.g. Wildlife - Caribou), along with the supporting rationale for why each VC was chosen is provided for each environmental topic in Chapters 6 through 19 of the Application/EIS.

Table 5.6-3. **Summary of Selected Valued Components for the Murray River Project**

Assessment Category	Valued Components	Indicators
ENVIRONMENT		
Atmospherics	• Air Quality	• Criteria air contaminants (CACs), including: o nitrogen oxides; o sulphur oxides; o carbon monoxide, o total suspended particulate (TSP) matter; o particulate matter (PM_{10}); and o respirable particulate matter ($PM_{2.5}$) • Dust deposition • GHGs
Hydrogeology	• Groundwater quantity • Groundwater quality	• Groundwater levels, flow patterns (gradients, flow directions and rates) • Groundwater flow patterns (gradients, flow directions and rates)
Surface Water and Aquatic Resources	• Surface water • Sediment • Aquatic resources	• Surface water quantity (average annual and monthly flows, peak flows, low flows) • Surface water quality (concentrations of total and dissolved metals, nutrients, major ions, total suspended solids (TSS), chemicals of potential concern (COPC)) • Sediment quality (particle size, nutrients, metal concentrations) • Habitat loss
Fish and Fish Habitat	• Fish (including Bull Trout and Arctic Grayling) • Fish habitat	• Changes to water quality and quantity • Changes to fish tissue metals (as measured in Slimy Sculpin) • Changes to water quality and quantity
Terrain	• Terrain stability	• Terrain mapping polygons and stability ratings
Terrestrial Ecology	• Ecologically valuable soil • Forested ecosystems • BC CDC listed ecosystems • Harvestable plants • Rare plants and lichens and associated habitat	• Loss of soil quality/quantity • Alteration or degradation of soil quality/quantity • Loss and/ or alteration of ecosystem function and extent • Loss and/ or alteration of ecosystem extent • Loss or alteration of ecosystem extent • Loss or alteration of rare plants and/ or lichens • Loss or alteration of rare plants and/ or lichen habitat

(continued)

Table 5.6-3. **Summary of Selected Valued Components for the Murray River Project (continued)**

Assessment Category	Valued Components	Indicators
ENVIRONMENT *(cont'd)*		
Wetlands	• Wetlands	• Wetland extent (location, size) • Wetland functions (Biochemical, Hydrological, Functional, and Habitat) as potentially affected by subsidence, hydrological effects, fragmentation effects, edge effects, dust deposition, sedimentation and water quality effects, and invasive species.
Wildlife and Wildlife Habitat	• Woodland caribou • Rocky Mountain elk • Moose • Mountain goat • Grizzly bear • Furbearers (fisher as a representative species) • Bats • Raptors • Waterfowl • Songbirds (black-throated green warbler as a representative species) • Amphibians (western toad as a representative species)	• Habitat loss and alteration – habitat suitability models, identification of habitat features, subsidence • Sensory disturbance – light, noise • Disruption to movement – impediments to movement corridors (noise or other disturbance, infrastructure) • Direct and indirect mortality • Attractants (food wastes, road use chemicals, fuels and oils, mine product processing chemicals) • Chemical hazards (presence of metals in water or fugitive dust)
ECONOMIC	• Employment and income	• Change in direct, indirect, induced employment (number) • Change in personal income ($)
	• Economic activity	• Change in direct, indirect, induced employment (number) • Labour force size and employment by industry of experience • Wage inflation

(continued)

Table 5.6-3. Summary of Selected Valued Components for the Murray River Project (continued)

Assessment Category	Valued Components	Indicators
SOCIAL	• Health Care Services • Emergency Services • Educational Services • Child Care Services	• Percentage of the population with a regular health care provider • Hospital readmission rate • NFPA 1710 response time standards • Ambulance response time • Ratio of K-12 school age children to available student spaces • Post-secondary acceptance rate • School completion rates and national and international assessments • Ratio of child care-aged children to child care spaces • Child care group size • Child to adult ratio
	• Community Infrastructure	• Change in infrastructure capacity • Change in wear on infrastructure
	• Housing	• Change in access to housing • Change in housing costs • Change in housing quality
	• Social Integration	• Social networks
	• Crime and Other Social Problems	• Number of reported crimes and case clearance rate
NON-TRADITIONAL LAND USE	• Harvesting • Recreational Use • Industrial Use • Navigation	• Change in access to land use areas • Change in quality and experience of the natural environment • Change in the abundance and distribution of resources • Damage to infrastructure • Changes to navigation of Murray River
CURRENT USE OF LANDS AND RESOURCES FOR TRADITIONAL PURPOSES	• Fishing Opportunities and Practice	• Change in access to fishing and the ability to access or use fishing areas • Change in quality of the natural experience for Aboriginal harvesters • Change in abundance and distribution of fish species harvested by Aboriginal harvesters • Change in quality of fished species

(continued)

Table 5.6-3. Summary of Selected Valued Components for the Murray River Project (completed)

Assessment Category	Valued Components	Indicators
CURRENT USE OF LANDS AND RESOURCES FOR TRADITIONAL PURPOSES *(cont'd)*	• Hunting and Trapping Opportunities and Practices	• Change in access to hunting and trapping areas and the ability to access or use hunting and trapping areas • Change in quality of the natural experience for Aboriginal harvesters • Change in abundance and distribution of wildlife species harvested by Aboriginal harvesters • Change in quality of hunted species
	• Gathering Opportunities and Practices	• Change in access to gathering areas and the ability to access or use gathering areas • Change in quality of the natural experience for Aboriginal harvesters • Change in abundance and distribution of plant resources harvested by Aboriginal harvesters • Change in quality of plant resources
	• Habitations, Trails, Burial Sites, and Cultural Landscapes	• Change in access to habitations, trails, burial sites, and cultural landscapes, and the ability to access and use gathering areas habitations, trails, burial sites and cultural landscapes • Change in quality of the natural experience for Aboriginal groups using habitations, trails, burial sites, and cultural landscapes
HUMAN HEALTH	• Drinking water quality	• Concentrations of total metals
	• Air quality	• NO_2 • SO_2 • CO • TSP • PM_{10} • $PM_{2.5}$ • Dust deposition
	• Quality of Country Foods	• Change in the quality of country foods (food chain modelling using soil, vegetation, sediment and water quality data)
	• Noise	• Sleep disturbance • Interference with speech communication • High annoyance
HERITAGE	• Archaeological and heritage sites • Significant paleontological sites	• Direct disturbance to known and unknown archaeological/paleontological sites (movement, excavation, or disturbance of soil; subsidence) • Indirect disturbance to known and unknown archaeological/ paleontological sites (increased human presence)

5.6.2 Assessment Boundaries

Assessment boundaries define the maximum limit within which the effects assessment is conducted. They encompass the areas within, and times during which, the Project is expected to interact with the VCs, as well as the constraints that may be placed on the assessment of those interactions due to political, social, and economic realities (administrative boundaries), and limitations in predicting or measuring changes (technical boundaries). The definition of these assessment boundaries is an integral part in VC scoping, and encompasses possible direct, indirect, and induced effects of the Project on VCs, as well as the trends in processes that may be relevant.

Each assessment chapter of the Application/EIS provides and describes the spatial, temporal, administrative, and technical assessment boundaries (if applicable).

5.6.2.1 Spatial Boundaries

Spatial boundaries are determined based on the location and distribution of VCs, and the spatial extent of Project effects. The spatial scale of an assessment may encompass the Project footprint, a local study area (LSA), and a regional study area (RSA). Beyond the spatial boundaries, the Project is expected to have negligible potential effects.

Spatial boundaries for each subject area are based on the following criteria:

- the scope of the EA (i.e., the biophysical or socio-economic extent of the Project activities and components, and associated effects);
- the location and distribution of VCs;
- the extent to which traditional and contemporary land and resource use could potentially be affected by the Project; and
- feedback and input received during consultation activities.

To define and describe the spatial boundaries for each effects assessment, each assessment chapter of the Application/EIS includes the following information:

- criteria used to determine the extent of spatial boundaries for each VC;
- a description of the local and regional spatial extent of the assessment relative to each VC; and
- maps outlining the spatial extent of the local and regional study areas.

For the purpose of the Application/EIS, the following definitions are used to define the study areas:

- Infrastructure Footprint is defined as the area of land or water associated with the proposed sites for all physical structures and activities that comprise the Project.
- Mine Site Assessment Footprint is defined as an area that extends beyond the Infrastructure Footprint and provides a conservative area assumed to be functionally lost due to Project activities. The Assessment Footprint allows for an area of disturbance beyond the anticipated

Infrastructure Footprint to allow for minor adjustments in the realized footprint disturbances between completion of the EA and ground disturbance during physical activities related to Project development. The boundaries of the Mine Site Assessment Footprint were developed using best professional judgement and were based on the boundaries of Terrestrial Ecosystem Mapping (TEM) polygons to the extent possible.

- Local Study Area (LSA) is defined as the Project footprint and surrounding area within which there is a reasonable potential for immediate direct and indirect effects on a specific VC due to an interaction with a Project component(s) or activities.
- Regional Study Area (RSA) is defined as the spatial area within which direct and indirect effects are anticipated to occur.

5.6.2.2 *Temporal Boundaries*

The potential effects of the Project will change over time, depending on the activities that occur during each phase of the Project. Temporal boundaries are the time periods considered in the assessment. Each assessment chapter of the Application/EIS presents the temporal boundaries for each VC, as well as the rationale for boundary selection. Potential effects will be considered for each phase of the Project (where relevant), which are:

- Construction: 3 years;
- Operation: 25 year run-of-mine life;
- Decommissioning and Reclamation: 3 years (includes project decommissioning, abandonment and reclamation activities as well as temporary closure and care and maintenance); and
- Post-closure: 30 years (includes ongoing reclamation activities and post-closure monitoring).

The temporal boundaries were then refined, where appropriate, in relation to planned activities over the lifetime of the Project, within which a reasonable expectation of interaction with a VC can be predicted. These boundaries were adjusted as appropriate to reflect seasonal variations or life-cycle requirements of biological receptors, or forecasted trends in social, economic, health or heritage receptors. In some cases, effects were assessed or predictions modelled only for those phases of the Project where predicted effects would be expected to peak (e.g., the majority of air quality emissions occur only during Construction and Operation phases).

Outside of these temporal boundaries, the Project is expected to have negligible potential effects.

5.6.2.3 *Administrative Boundaries*

Administrative boundaries arise when jurisdictional (i.e., political) issues, or time and money constraints impact the scientific process of identifying Project effects. These boundaries may include existing datasets collected on the basis of regional or provincial boundaries that are not the same as the spatial boundaries of the selected VCs. Other examples of administrative boundaries include confidentiality associated with sensitive cultural sites or archaeological remains, or newly imposed policy requirements on the EA process itself (e.g., timelines).

Administrative boundaries may not apply to every VC. However, where administrative boundaries may affect the identification and/or assessment of potential effects, the nature of the administrative boundaries and their effect on the assessment are included and described in the relevant assessment chapter.

5.6.2.4 Technical Boundaries

Technical boundaries limit the ability to sample the environment (e.g., a legal restriction prohibiting the sampling of species listed under the *Species at Risk Act* (2002b)), and, thereby limit the ability to predict or measure change. Sampling may be compromised when dealing with large geographical settings, or widely dispersed species. Elusive or sensitive species may only practically be sampled by proxy (i.e., the existence of suitable and/or potential habitat), rather than by actual measurement. Each assessment chapter documents technical boundaries, and how they affect the EA process and ability to identify Project effects.

Technical boundaries may not apply to every VC. However, where technical boundaries may affect the identification and/or assessment of potential effects, the nature of the technical boundaries and their effect on the assessment are included in the relevant assessment chapter.

5.6.3 Identifying Potential Effects

An important step in the assessment process is to determine how the selected VCs may be affected by the Project. An evaluation by Project phase (i.e., Construction, Operation, Decommissioning and Reclamation, and Post-closure) is completed in each assessment chapter that addresses the following questions:

- what are the types of effects that result from the interaction of the Project's components and activities with VCs?
- over what assessment boundaries (spatial and temporal) are these effects anticipated to occur?

The description of these linkages will include, where relevant, direct, indirect, and induced effects. A direct effect is an effect that results from a direct interaction between the Project and an environmental, social, economic, heritage, or health component. Direct effects result from specific Project interactions with VCs throughout the project footprint and LSA, including the mine site. Indirect effects are the result of direct effects of the Project that lead to other effects (i.e., increase in the consumption of goods and services). Induced effects are the effects that result from other activities (which are not part of the Project) that happen as a consequence of the Project, such as an increase in household income leading to altered spending habits which result in changes to retail sales). Depending on the nature of the effect, potential effects may be experienced at multiple spatial scales.

The evaluation of the strength of interaction considers any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design, regardless of the results of the EA Process). An example of an embedded control is a standard acoustic enclosure that is designed to be installed around a piece of major equipment. This avoids the situation where an effect is assigned a magnitude based on a hypothetical version of the Project that considers none of the embedded controls.

To focus the assessment and reveal key interactions that have greater potential to result in significant adverse residual effects, or to be of particular concern to government, Aboriginal groups, or the public, an impact matrix approach is used, for some subject areas where such a visual graphic was considered to be useful, to identify and rank Project-Component interactions (see Table 5.6-4). To populate the impact matrix, the following questions or criteria were screened for each VC:

- Based on the information available, is there potential for a serious adverse residual effect, even with available mitigation?
- Does the component pertain to Aboriginal interests, including claimed or proven rights and title, and Treaty rights?
- Does the component reflect a legislative or regulatory requirement or government management priority (e.g., species of conservation concern)?
- Is there potential for serious adverse cumulative effects?
- Is the component itself, or the potential effect, of particular concern to the public, Aboriginal groups, or the government?
- Is the component particularly sensitive or vulnerable to disturbance?

The interactions were then ranked as follows:

- Grey — no interaction anticipated.
- Green — negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; effects are well-understood and well-regulated, and may be managed under another government process; no monitoring required, no further consideration warranted. Effects ranked as such may be readily addressed through the implementation of proven effective mitigation measures or Best Management Practises (BMPs). Effects identified as negligible to minor and the mitigation measures to address these effects will be very briefly discussed, but **will not be carried forward in the assessment**.
- Yellow — potential for moderate adverse effect requiring unique active management/ monitoring/mitigation; warrants further consideration and **will be carried forward in the assessment**.
- Red — key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration and **will be carried forward in the assessment**.

Supporting rationale for assigned rankings is provided in each assessment chapter.

For those interactions marked yellow or red in Table 5.6-4 (i.e., are being carried forward in the assessment), the effects assessment applies best practice methods to predict the nature and extent of effects that may result from the Project. For subject areas that did not utilize the above approach to determine key potential interactions, the justification for this decision is provided within the individual chapter text as well as a description of the methodology used to determine these key interactions.

Table 5.6-4. Example of Ranking Potential Effects on Valued Components

Project Activities	Project Component/ Physical Activity	Potential Effects on <Subject Area> and/or <Valued Components>						
		Effect 1	Effect 2	Effect 3	Effect 4	Effect 5	Effect 6	Effect 7
Construction	Project component/activity 1	L	M	H	O	L	L	L
	Project component/activity 2	L	L	L	L	L	L	L
Operation	Project component/activity 3	L	L	L	L	L	L	L
	Project component/activity 4	L	L	L	L	L	L	L
Decommissioning and Reclamation	Project component/activity 5	L	L	L	L	L	L	L
	Project component/activity 6	L	L	L	L	L	L	L
Post Closure	Project component/activity 7	L	L	L	L	L	L	L
	Project component/activity 8	L	L	L	L	L	L	L

Notes:

O	*Spatial and temporal overlap, but no interaction is anticipated, no further consideration warranted.*
L	*Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*
M	*Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
H	*Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

Only effects related to planned events are discussed here; effects related to unplanned events (e.g., spills, traffic accidents) are discussed in Chapter 22, Accidents and Malfunctions.

5.7 Assessment of Potential Effects and Mitigation

The key effects identified in Section 5.6.3 (i.e., those with potential for a moderate to major impact on the receptor VC/indicator) are further described in this section, and any relevant mitigation is identified and discussed. This process is iterative in nature; and key effects and relevant mitigation may be refined and identified multiple times. Any effects remaining after all feasible mitigation measures are identified are considered to be the Project's residual effects, which are considered in Section 5.8.

5.7.1 Key Effects

The assessment chapters of the Application/EIS discuss the key effects of Project components and activities on selected VCs. A key effect is an effect that may cause a moderate to major effect on the receptor VC.

A range of characterization and prediction methods are used, including quantitative, semi-quantitative and qualitative techniques. The specific methods used for each VC are described in the Appendices to each assessment chapter. For some VCs, modelling is used to predict and characterize aspects of the interactions, including the following predictive models:

- air quality dispersion model;
- noise model;
- groundwater model;

- hydrological modelling, including a water balance;
- surface water quality modelling;
- habitat suitability modelling; and
- economic modelling.

For each assessment topic and subject area, relevant references, analyses, and explanations are included, that define:

- how scientific, engineering, community and Aboriginal traditional knowledge is used in the assessment;
- which studies include the assistance of communities and individuals, who was involved (if the information can be made public), and how contributors were selected;
- any limitation on data collection, model assumptions and study methodologies (detailed results and methodologies are provided in the Appendices to each assessment chapter); and
- study and model outputs, calculations, supporting analyses, and an explanation of results.

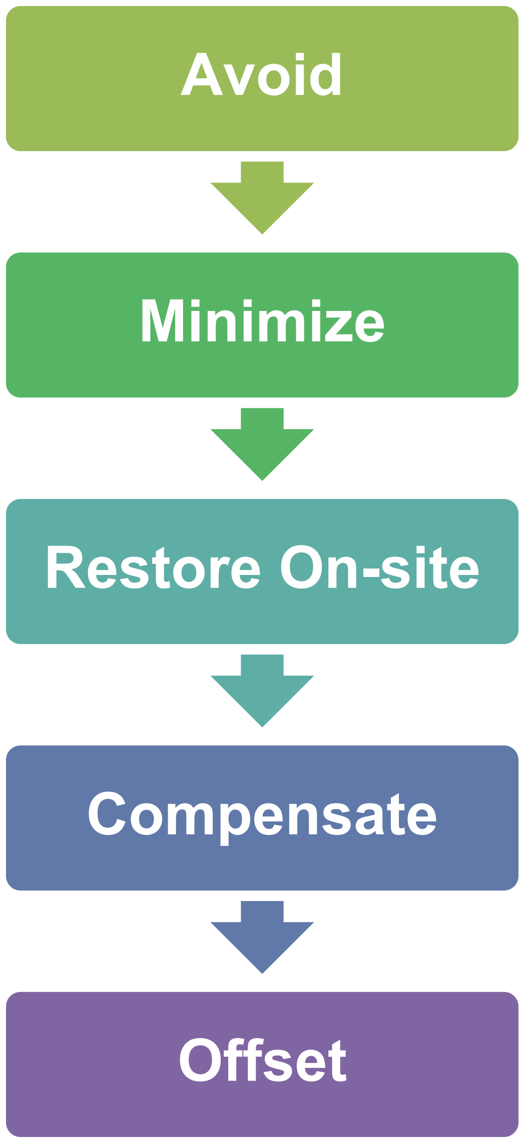
Baseline data, modelling results and professional judgement are used, to the extent possible, to predict the effect of the Project on VCs. A discussion of any shortcomings, limitations or uncertainty in the methodologies or results is also included.

5.7.2 Mitigation Measures

Each assessment chapter of the Application/EIS discusses the availability and implementation of mitigation measures to avoid, minimize, control, restore on-site, compensate, or offset adverse effects to VCs. A mitigation hierarchy is followed as presented in Figure 5.7-1. Note that decisions regarding the need for and scope of mitigation, including compensation and offset, does not pre-suppose the outcome of the effects assessment.

Key approaches to applying the hierarchy to mitigate potential effects include:

- **Optimizing Alternatives**: Preventing or reducing adverse effects by changing an aspect of the Project (e.g., altering coarse coal rejects pile location to not directly affect fish habitat).
- **Design Changes**: Preventing or reducing adverse effects by redesigning aspects of the Project (e.g., altering coarse coal rejects pile location to not directly affect fish habitat), or changing the timing of an activity (e.g., minimizing or prohibiting road usage during key migration periods).
- **Best Achievable Control Technology (BACT):** Eliminating, minimizing, controlling, or reducing adverse effects through the use of technological applications (e.g., long-wall mining).
- **Management Practices**: Eliminating, minimizing, controlling, or reducing adverse effects on VCs through management practices (e.g., watering unpaved roads to control dust).


Avoid
Minimize
Restore On-site
Compensate
Offset

- **Restoration**: Restoration focuses on establishing appropriate composition, structure, pattern, and ecological processes necessary to make systems sustainable, resilient, and healthy under current and future conditions. Restoration is different from avoiding and minimizing residual effects because it can be implemented at a later date.
- **Compensation**: Offsetting remaining effects that cannot be prevented or reduced through remedial or compensatory actions, so that the net effect on the community or ecosystem is neutral or beneficial (e.g., enhancement of similar habitat in another area, enhancement of other social/economic/cultural benefits).

Proposed mitigation and monitoring activities for each assessment subject area are described in the applicable sections of the Application/EIS, and compiled into discrete subject area Environmental Management Plans (EMPs). Each EMP applies a systematic approach for integrating Project-specific mitigation and monitoring activities throughout the life cycle of the Project (i.e., into each Project phase). Environmental management and effects monitoring plans are provided in Chapter 23.

If the proposed implementation controls and mitigation measure(s) are not sufficient to eliminate a key Project-Component effect, a residual effect is identified. Residual effects on VCs will be carried through to a significance determination exercise (Sections 5.8 and 5.9).

5.8 RESIDUAL PROJECT EFFECTS

Predicted changes or residual effects are those adverse effects remaining after the implementation of all mitigation measures, and are therefore the potential consequences of the Project on the VCs. Each assessment chapter of the Application/EIS describes direct, indirect and/or induced residual effects of the Project as applicable.

For each residual effect that is identified, the Application/EIS makes use of standard ecological risk assessment frameworks that categorize the levels of detail and quality of the data required for the effects assessment. These frameworks generally include the following tiers of information (CEA Agency 2013b):

- **Tier 1**: Qualitative (expert opinion, including traditional and local knowledge, literature review, and existing site information, if available);
- **Tier 2:** Semi-quantitative (measured site-specific data and existing site information); and
- **Tier 3**: Quantitative (recent field surveys and detailed quantitative methods, e.g., predictive modelling).

Residual effects will only be assessed qualitatively if a quantitative assessment is not possible. Where quantitative analyses are not possible, a rationale will be provided.

A detailed assessment was undertaken for each identified residual effect to support a determination of significance for the predicted effect. Residual effects were analyzed using best practice methods to predict the nature and extent of effects that could result from the Project. These methods are described in each assessment chapter. For each VC, the assessment chapter includes any relevant references, analyses, and explanations that define:

- how scientific, engineering, community and Aboriginal knowledge were used in the assessment;
- which studies included the assistance of communities and individuals and who was involved (if the information can be made public);
- data collection methods and limitations;
- model assumptions and study methodologies, including statistical analysis or mathematical modelling;
- study and model outputs, calculations, supporting analyses, and an explanation of results; and
- reference literature or other information sources for any contributions, including traditional knowledge.

A summary of residual effects or predicted changes is provided for each assessment category using the format shown in Table 5.8-1.

Table 5.8-1. Example of Summary of Residual Effects/Predicted Changes after Mitigation

Valued Component	Project Phase	Project Component / Physical Activity	Description of Cause-Effect	Description of Mitigation Measure(s)	Description of Residual Effect

[1] Project phases are Construction, Operation, Decommissioning and Reclamation, and Post-closure

5.9 CHARACTERIZATION OF RESIDUAL EFFECTS, SIGNIFICANCE, LIKELIHOOD AND CONFIDENCE

Residual effects to VCs are described using the attributes defined below. Any modifications to these characterization criteria are discussed in the relevant Application/EIS chapter. Each assessment chapter describes individual ranking criteria pertaining to a particular effect, and where possible, assigns and rationalizes quantitative levels or values (e.g., threshold values).

- **Magnitude:** This refers to the expected magnitude or severity of the residual effect. The corresponding significance levels are defined as:
  - *Low*: differing from the average value for baseline conditions to a small degree, but within the range of natural variation and well below a guideline or threshold value;
  - *Moderate*: differing from the average value for baseline conditions and approaching the limits of natural variation, but below or equal to a guideline or threshold value; or
  - *High*: differing from baseline conditions and exceeding guideline or threshold values so that there will be a detectable change beyond the range of natural variation (i.e., change of state from baseline conditions).
- **Geographic Extent**: This refers to the spatial scale over which the residual effect is expected to occur, and includes:
  - *Local*: an effect is limited to the Project footprint;
  - *Landscape/Watershed*: an effect extends beyond the Project footprint to a broader area;

- *Regional*: an effect extends across the regional study area; or
- *Beyond Regional*: an effect that extends possibly across or beyond the province of BC.

The corresponding **geographic extent** definitions for social, economic, and health receptors are:

- *Individual/Household*: an effect limited to individuals, families and/or households;
- *Community*: an effect extending to the community level;
- *Regional/Aboriginal peoples*: an effect extending across the broader regional community or economy, or an effect extending to one or more Aboriginal groups; or
- *Beyond Regional*: an effect extending possibly across or beyond the province.

- **Duration:** This refers to the length of time the effect lasts; the duration of an effect can be:
  - *Short-term*: an effect that lasts approximately 1 to 5 years;
  - *Medium-term*: an effect that lasts between 6 to 25 years;
  - *Long-term*: an effect that lasts between 26 and 50 years; or
  - *Far Future*: an effect that lasts more than 50 years.
- **Frequency:** This refers to how often the effect occurs; the frequency of an effect is defined as:
  - *Once:* an effect that occurs once during any phase of the Project;
  - *Sporadic*: an effect that occurs at sporadic or intermittent intervals during any phase of the Project;
  - *Regular*: an effect that occurs regularly during any phase of the Project; or
  - *Continuous*: an effect that occurs constantly during any phase of the Project.
- **Reversibility:** This refers to the degree to which the effect is reversible and is classified as:
  - *Reversible Short-Term*: an effect that can be reversed relatively quickly;
  - *Reversible Long-Term*: an effect that can be reversed after many years; or
  - *Irreversible*: an effect cannot be reversed (i.e., is permanent).
- **Ecological or Social Context:** This refers to the current condition of the VC and its sensitivity. For example, an effect may have more of an impact in an area that is ecologically sensitive or a greenfield site, rather than a disturbed or brownfield location. The corresponding levels are defined as:
  - *Low*: the component is considered to have little to no unique attributes;
  - *Neutral*: the component is considered to have some unique attributes; and
  - *High*: the component is considered to be unique.

5.9.1 Significance of Residual Project Effects

The Agency's *Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects* (1994) was used as guidance in evaluating the significance of the adverse residual effects for the Project. The significance of residual effects of the Project is founded on a comparison of the current VC if the Project does not proceed, with the predicted state of the VC if the Project proceeds, after mitigation measures described in Section 5.7.2 are applied.

To assess the significance of a residual effect, the Application/EIS relies on detailed information including statistical analysis or mathematical modelling. Where data is lacking, professional judgment has been used to support the assessment.

When defining and evaluating the ultimate significance of a residual effect, each assessment chapter in the Application/EIS defines how significance is determined. Where available, thresholds are used (e.g. aquatic life receiving environment criteria, ambient air criteria, or land and resource management planning objectives) to assist with the determination of significance. Each assessment chapter defines thresholds of significance as well as the source literature for those thresholds.

The significance of effects are ranked according to the three categories described below. Each assessment chapter clearly defines how the term 'significant' was considered in relation to each VC, and provides a detailed rationale for the significance determination.

- **Not Significant (Minor)**: Residual effects have no or low magnitude, local geographic extent, short- or medium-term duration, and occur sporadically if at all. The effects on the VC (e.g., at a species or population level) are indistinguishable from background conditions (i.e., occur within the range of natural variation as influenced by physical, chemical, and biological processes). Land and resource management plan objectives will be met.
- **Not Significant (Moderate)**: Residual effects have medium magnitude; have local, watershed, or regional geographic extent; are short-term to chronic (i.e., may persist into the far future); and occur at all frequencies. Residual effects on the VC may be distinguishable at the population, community, and/or ecosystem level. The ability to meet land and resource management plan objectives may be impaired.
- **Significant (Major)**: Residual effects have high magnitude; have regional or beyond regional geographic extent; are chronic (i.e., persist into the far future); and occur at all frequencies. Residual effects on the VC are consequential (i.e., structural and functional changes in populations, communities, and ecosystems are predicted). The ability to meet land and resource management plan objectives is impaired.

5.9.2 Likelihood and Confidence

The likelihood of a residual effect occurring is expressed as a probability, to determine the potential for the Project to cause a residual effect. Probability is determined according to the attributes identified below.

Probability: This refers to the likelihood that an adverse effect will occur in circumstances where it is not certain that the effect will materialize and is classified as:

- *Low*: an effect that is unlikely, but could occur;
- *Medium*: an effect that is likely, but may not occur; or
- *High*: an effect that is highly likely to occur.

Narrative descriptions and justifications for the likelihood (probability) assessment are provided along with the valuation of these attributes in each of the chapters within the Application/EIS.

Confidence: This can be thought of as scientific uncertainty, and is a measure of how well residual effects are understood, which includes a consideration of the acceptability of the data inputs and analytical methods used to predict and assess Project effects. It depends on the certainty of the predicted outcome, and it allows the decision-maker to evaluate risk associated with the Project. Confidence is defined as:

- *Low* (< 50% confidence): The cause-effect relationship(s) between the Project and its interaction with the environment is poorly understood and/or data for the Project area or scientific analyses are incomplete, leading to a high degree of uncertainty;
- *Medium* (50 to 80% confidence): The cause-effect relationship(s) between the Project and its interaction with the environment is not fully understood, and/or data for the Project area or scientific analyses are incomplete, leading to a moderate degree of uncertainty; or
- *High* (> 80% confidence): The cause-effect relationship(s) between the Project and its interaction with the environment is well understood, and/or data for the Project area or scientific analyses are complete, leading to a low degree of uncertainty.

In some situations (e.g., a combination of significance, high likelihood, and low confidence), it may be necessary to conduct additional risk analyses. Where this is warranted, the process and methodology used for the risk analysis will be clearly described in the specific chapter.

5.9.3 Conclusion

A summary of residual effects or predicted changes is provided in each assessment chapter (Chapters 6 through 19), using the format shown in Table 5.9-1.

5.10 CUMULATIVE EFFECTS

5.10.1 Introduction

Cumulative effects are the result of a project-related effect interacting with the effects of other human actions (i.e., anthropogenic developments, projects, or activities) to produce a combined effect. This section describes the method used for the Murray River Coal Project Cumulative Effects Assessment (CEA).

Cumulative effects are assessed in each of the assessment chapters (Chapters 6 through 19), as required by the BC EAO (2013a). A synthesis of these sections is provided as Chapter 21, to address CEA Agency (2013a) requirements.

The method for assessing cumulative effects generally follows the same steps as the Project-specific effects assessment, as described in Sections 5.6 to 5.9:

1. scoping and identification of potential effects;
2. description of potential effects and mitigation measures, with subsequent identification of residual cumulative effects; and
3. identification and characterization of residual cumulative effects.

Table 5.9-1. Example of Characterization of Residual Effects, Significance, Confidence and Likelihood

Residual Effect	Residual Effects Characterization Criteria							Significance of Adverse Residual Effects	Likelihood and Confidence	
	Magnitude	Duration	Frequency	Geographic Extent	Reversibility	Resiliency	Context		Probability	Confidence

However, because of the broader scope and greater uncertainties inherent in CEA (e.g., data limitations associated with some human actions, particularly future actions), there is greater dependency on qualitative methods and expert judgement. This method for assessing cumulative effects is tailored to how much information is available and facilitates comparison between the project-specific assessment and the cumulative effects assessment. It also facilitates comparison between assessment categories.

5.10.2 Other Human Actions Considered in the CEA

An initial list of past, present, and future human actions to be considered in the CEA was developed as part of the Murray River Land Use Baseline Report via desk-based review of existing information and field research conducted between 2010 and 2014 (see Appendix 16-A) for a detailed description of this methodology). For the purposes of the CEA, this list was augmented with information on past historic mining operations retrieved from the BC Ministry of Energy, Mines, and Natural Gas, information on current and future hydroelectric projects from BC Hydro, FortisBC, and Columbia Power Corporation, and information on future actions from the BC EAO and the BC Ministry of Forests, Lands, and Natural Resource Operations.

Human actions considered in the CEA are presented in Table 5.10-1.

Table 5.10-1. List of Human Actions Considered in the Murray River CEA

Industrial Projects				
Timeframe		**Name of Action**	**Dates Active**	**Proponent (If Applicable)**
Past	Historic	Hasler Coal Mine	1941 – 1945	Hasler Creek Coal Company
		Sukunka (Bullmoose) Mine	1972 – 1975	BP Exploration Canada Ltd.
	Recent	Bullmoose Mine	1983 – 2003	Teck Corporation
		Dillon Coal Mine	2004 – 2007	Walter Energy / Western Coal
		Quintette (Babcock) Mine	1983 – 2000	Teck Corporation
		Willow Creek Mine	2000 – 2013	Walter Energy
Present		Brule Mine	2005 – 2016	Walter Energy
		Trend Mine	2003 – 2016	Peace River Coal
		Quality Wind Project	2013 – unknown	Capital Power
		Peace Canyon Dam	1980 – unknown	BC Hydro
		Wolverine Mine (Perry Creek) and EB Pit	2004 – 2016	Walter Energy
		WAC Bennett Dam	1961 – unknown	BC Hydro
Future	Certain	Hermann Mine	2014 – 2025	Walter Energy
		Quintette Mine	2013 – 2025	Teck Corporation
		Roman Mine Project	2013 – 2024	Peace River Coal
		Thunder Mountain Wind Park	2014 – unknown	Aeolis Wind
		Tumbler Ridge Wind Project	2013 – unknown	Pattern Energy Group
		Wartenbe Wind Project	2014 – unknown	Avro Wind Energy Inc.

(continued)

Table 5.10-1. List of Human Actions Considered in the Murray River CEA (completed)

Industrial Projects				
Timeframe		Name of Action	Dates Active	Proponent (If Applicable)
Future (*cont'd*)	Reasonably Foreseeable	Echo Hill Mine	2015 – 2029	Hillsborough Resources Ltd.
		Coastal Gaslink Project	2015 – 2048	TransCanada Pipelines
		Horizon Mine	2015 – 2038	Peace River Coal
		Meikle Wind Energy Project	2015 – 2041	Meikle Wind Energy Partnership
		Northern Gateway Pipeline	2016 – 2068	Enbridge Northern Gateway Pipelines
		Rocky Creek Energy Project	2015 – unknown	Rupert Peace Power Corporation
		Site C Clean Energy Project	2015 – 2115	BC Hydro
		Sukunka Coal Mine Project	2016 – 2038	Glencore
		Sundance Wind Project	2015 – 2040	EDF Energies Nouvelles
		Wildmare Wind Energy Project	2014 – 2039	Wildmare Wind Energy Limited Partnership
	Hypothetical	Babcock Creek Wind Project	Unknown	Babcock Ridge Wind Limited Partnership
		Belcourt Saxon Coal Project	Unknown	Walter Energy / Peace River Coal
		Huguenot Mine	Unknown	Colonial Coal International
		Moose Lake Wind Power	Unknown	Moose Lake Wind Power Corporation
		Septimus Creek Wind Power Project	2014-2039	Renewable Energy Systems Canada Inc.
		Suska Mine	Unknown	Glencore / JX Nippon
		Wapiti River Coal Project	Unknown	Canadian Dehua International Mines Group Inc.

OTHER LAND USE ACTIVITIES

- Aboriginal harvest (fish, animals, and plants)
- agriculture and range
- forestry and manufacturing
- industrial roads
- coal and mineral exploration
- oil and gas drilling and exploration
- other fishing and trapping (commercial and recreational)
- recreation and tourism
- transportation (road and rail access and traffic)

Figures 5.10-1 and 5.10-2 respectively present the spatial locations and timelines of these human actions relative to the Project. Spatial footprints for these human actions were digitized from maps published in permitting applications, SEDAR filings, news releases, or other materials prepared by the relevant proponents. These maps were converted into TIFF images and then geo-referenced in ArcMap 10.1 using a minimum of three control points for each image. Where a project footprint was not explicitly delineated in the documentation available, the full extent of the relevant proponent's tenure was used as a proxy in order to give a conservative estimate of the potential dimensions of the direct spatial disturbance.

Figure 5.10-1
Other Human Actions Near the Murray River Project

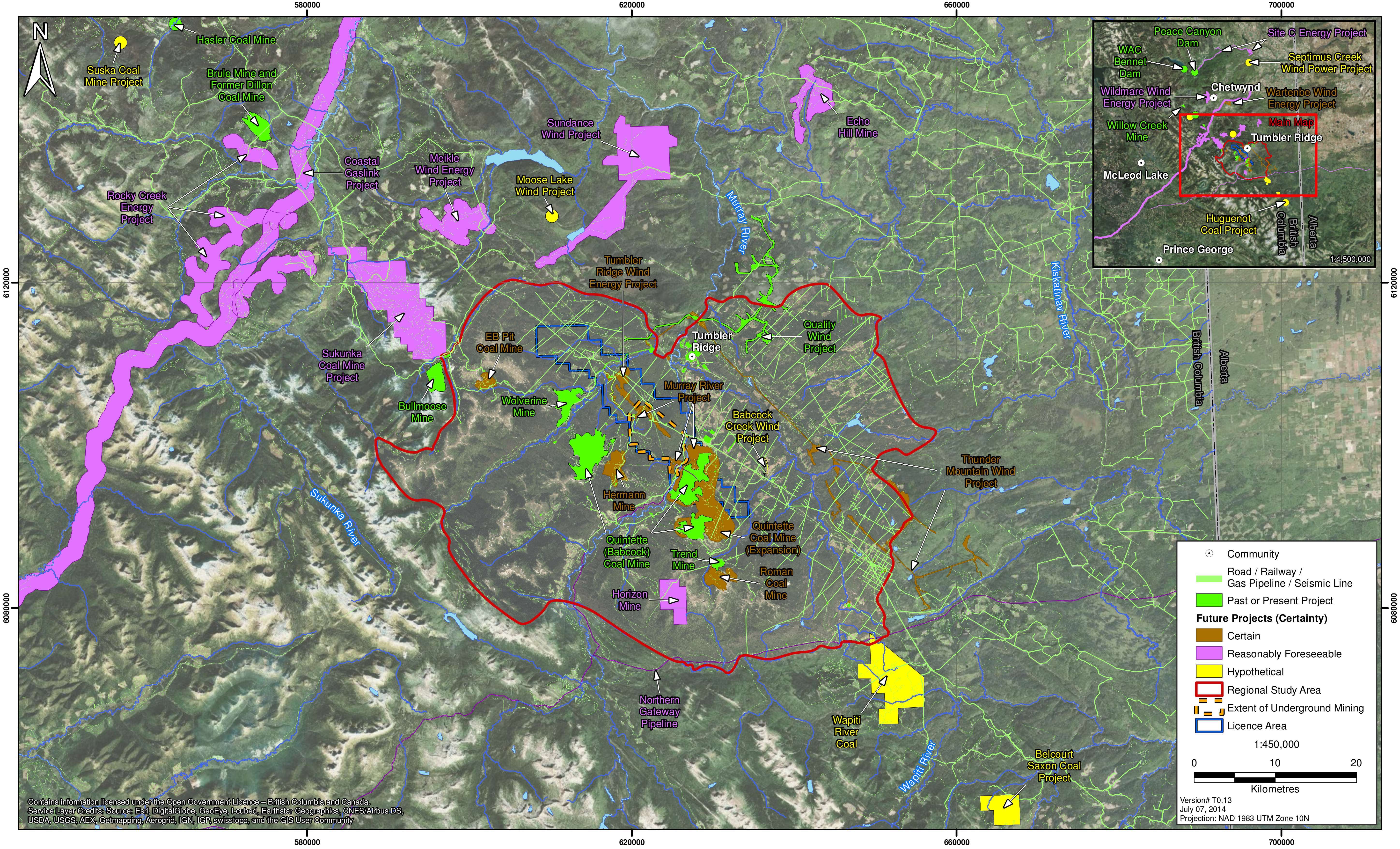
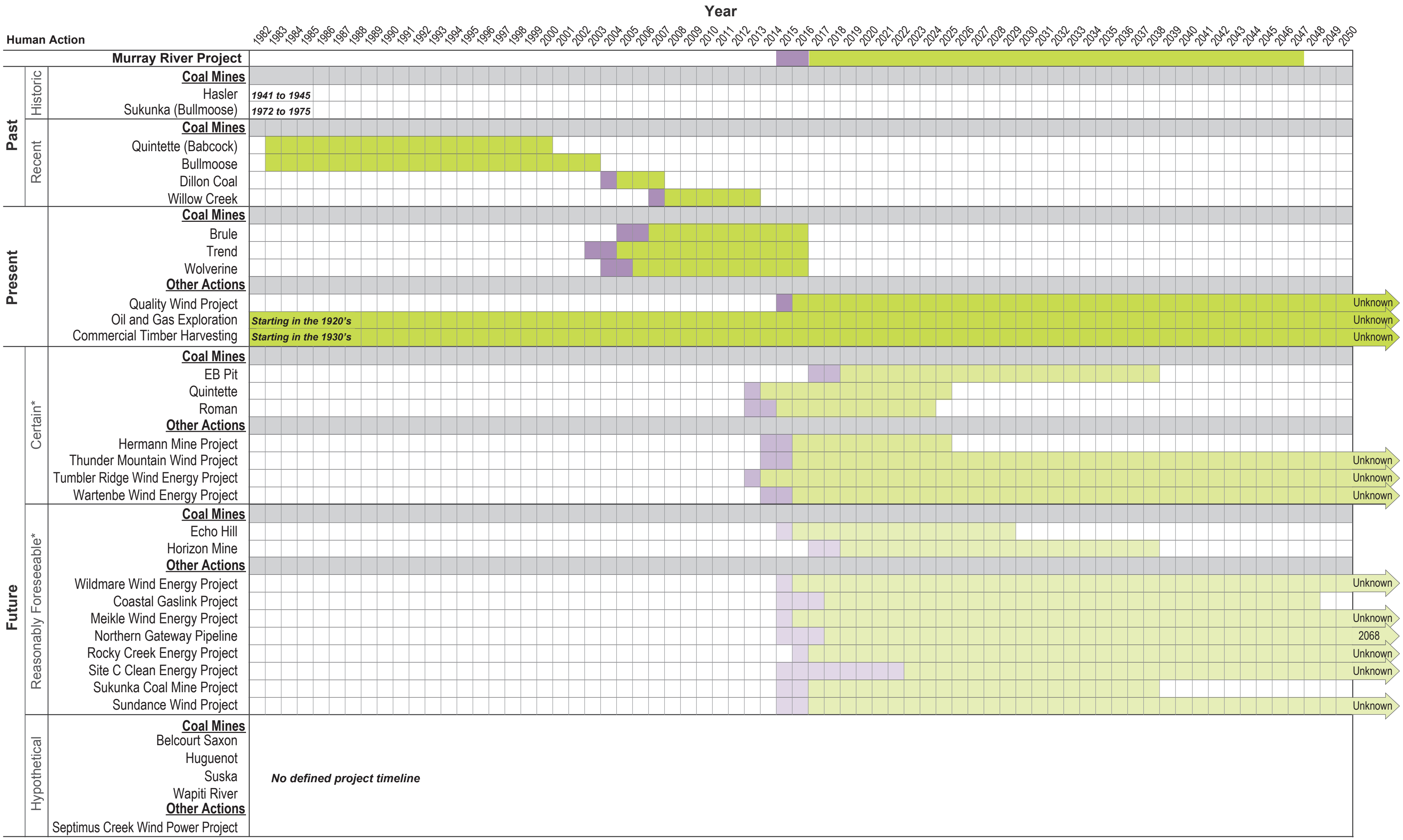


Figure 5.10-2

Estimated Past, Present and Future Human Action Timelines



Legend

Construction
Operation

Note: Additional human actions considered in the cumulative effects assessment (e.g., ongoing mining and energy exploration) do not appear on this schedule.
** These timelines are speculative based on the documentation available for these actions (e.g., Project Description or Environmental Assessment Application on file with the BC EAO).*
Lighter shading indicates decreasing certainty that the action will proceed

The original maps and documents came from different sources and varied in both quality and scale. For some human actions, the accuracy of the georeferencing was restricted because no coordinate system was provided and/or because no sources were listed for the datasets used to create the original map, making it difficult to locate good control points. In some cases, the background data used to make the original image was not accessible. Another limitation of the digitization process for the footprints was the scale at which the original maps had been produced; precise digitization is challenging at a 1:1,000.000 scale or above.

Sections 5.10.5.1 to 5.10.5.5 provide high-level descriptions of each human action. For the purposes of the CEA, where relevant data on these actions are not available, professional judgement and data from comparable projects are used to predict trends. The assumptions made as well as the data sources used are documented in each assessment category chapter.

5.10.2.1 Past Industrial Actions (Historic)

Coal mining has an extensive history in and around the RSA, beginning in the 1940s. The mine locations are shown in Figure 5.10-1 and their activities are summarized below.

<u>Hasler Coal Mine</u>

Coal mining in the region began with the Hasler Coal Mine about 80 km northwest of the Project. The Hasler Coal Mine produced less than 5,000 tonnes of coal from adits and open-cut benches between 1941 and 1945 (BC MEMRCR 2013a).

- **Location:** 55º30'31" N, 121º59'26" W.
- **Production:** 590, 789, and 3,206 tonnes of bituminous coal in 1941, 1944, and 1945, respectively (BC MEMRCR 2013a). During 1942 and 1943, the 85 m main adit was cleaned out in preparation for an underground mine, but no production was attempted (Canadian Department of Energy 1976).
- **Facilities:** A tipple (i.e., a structure used for loading coal into trucks for transport) and camp buildings. Nine additional drill holes were made for exploration purposes by the BC Department of Lands and Forests in 1946 and 1951.
- **Project Lifespan:** 4 years.
- **Footprint:** Benches totalled approximately 175 m in length, with an unknown width (Canadian Department of Energy 1976). The exact footprint of the other mine facilities is unknown.
- **Access:** Via a 14 km mining road which followed Hasler Creek northwards and connected to Highway 97, which was then called the Hart Highway. This road crossed Hasler Creek a dozen times and made a fording crossing of the Pine River (McKechnie 1955).

<u>Sukunka (Bullmoose) Mine</u>

From 1972 to 1975, the Sukunka (Bullmoose) Mine, an open pit coal mine located approximately 35 km to the northwest of the Project, mined a little over 82,000 tonnes of coal (BC MEMRCR 2013a).

- **Location:** 55°11'00" N, 121°31'05" W.
- **Production:** 12,000, 32,674, and 37,384 tonnes of bituminous coal in 1972, 1973, and 1975, respectively.
- **Project Lifespan:** 3 years.
- **Access:** Via an unpaved road running from Chetwynd along the Sukunka River Valley. This road was also used by the Quintette Mine and by logging teams operating in the area (BP Coal Limited 1977).

5.10.2.2 Past Industrial Actions (Recent)

Bullmoose Mine

The nearby Bullmoose Mine, operated by Teck Cominco Limited continuously from 1983 to 2003, produced nearly 46 million tonnes (Mt) of coal for overseas steel markets. The mine included an open pit and an adjacent processing plant (BC MEMRCR 2013b).

- **Location:** 55°08'50" N, 121°30'30" W.
- **Production:** approximately 1.7 Mt of bituminous coal per year.
- **Facilities:** A processing plant, waste dump, tailings pond, three sedimentation ponds, access road, storage silos, and rail load-out (Butcher 1987; Straker et al. 2004).
- **Project Lifespan:** 20 years.
- **Project Footprint:** 789 ha total; of this, 707 ha were reported as successfully reclaimed by 2003 (Straker et al. 2004).
- **Access:** 34 km mining road connecting to rail load-out and Highway 29.
- **Water (inputs/outputs):** Water was withdrawn at a rate of 75.7 L/s from wells near Bullmoose Creek for use in sewage systems, fire-fighting, dust suppression, and as processing plant make-up water. A series of ditches collected runoff from mining activities and channeled it into three sedimentation ponds for removal of particulate matter. Decant from the ponds was discharged to Bullmoose Creek. Fine tailings from the preparation plant and treated domestic sewage effluent were diverted to an exflitrating tailings pond (Butcher 1987).

Dillon Coal Mine

Western Coal Corporation (now Walter Energy) produced 1.2 Mt of coal between 2005 and 2007 at the Dillon Coal Mine, roughly 65 km northwest of the Murray River Project and outside the RSA (BC MEMRCR 2013b).

- **Location:** 55°23'12" N, 121°49'12" W.
- **Production:** Permitted at 240,000 tonnes annually.
- **Facilities:** Support and camp buildings, waste rock dumps, coal stockpiles, maintenance facilities, primary and secondary crushing plants, sewage treatment and disposal system. Coal hauled 94 km via truck to the Bullmoose rail load-out.

- **Project Lifespan:** 3 years.
- **Footprint:** Unknown, but forms part of Brule Mine footprint (see Section 5.10.5.2).
- **Employment:** During operation, 63 people, with 50 additional workers employed as drivers by a coal haul contracting firm.
- **Access:** 11 km down the Blind Creek Road, 2.9 km along the Lower Burnt Road, then via the Sukunka Forest Service Road 16.6 km to Highway 29 (Western Canadian Coal 2005).

Quintette (Babcock) Mine

To the immediate west of the Project, Teck Resources Ltd.'s Quintette Mine opened in 1983, mining over 135 Mt of coal from four open pits in three separate mining areas before its closure in 2000 (BC MEMRCR 2013b). Teck has plans to re-open this project; information about the Quintette restart can be found in Section 5.10.5.3.

- **Location:** 55º01'40" N, 121º11'45" W.
- **Production:** Approximately 7.1 Mt of coal per year, mostly from the Mesa, Wolverine, and Shikano pits. Some coal was mined from the Windy Pit on Mount Babcock between 1997 and 2000.
- **Facilities:** Access and haul roads, pits and spoils areas, a transmission line, a processing plant, storage and load-out facilities, mining offices and maintenance facilities, a sewage treatment facility, tailings facilities (dam, pipeline, and pond), diversion ditches, and settling ponds. At closure, the proponent removed mobile equipment and reclaimed much of the surface disturbance associated with the open pits, waste rock spoils and tailings facilities. The processing plant and other infrastructure were put into care and maintenance (Teck 2012)
- **Project Lifespan:** 17 years.
- **Footprint:** 3,708 ha.
- **Access:** Via a mine road, the Murray River Forestry Service Road, and Highway 52.

Willow Creek Mine

About 82 km to the northwest of the Project (outside the RSA), the Willow Creek Mine produced coal between 2001 and early 2013. The project comprised an open pit metallurgical coal mine with a processing plant and a rail load-out facility (BC MEMRCR 2013b).

- **Location:** 55º36'00" N, 122º12'00" W.
- **Production:** 1.5 Mt mined between 2001 and 2006 by a previous proponent, Pine Valley Coal Limited; Western Coal Corp. (later aquired by Walter Energy; Western Coal Corp. 2010) later received a permit to expand production to additional 1.7 Mt annually. The mine reopened in 2008 and closed in 2013. Production in 2010 and 2011 was approximately 400,000 and 900,000 Mt, respectively (DeGrace 2011).
- **Project Lifespan:** 12 years.

- **Facilities:** Open pits, waste rock dumps, temporary coal reject pile, haul roads, water management structures, in-pit maintenance facility, office building, processing plant, coal handling and rail load-out facilities (Western Coal Corp. 2010).
- **Access:** Via the Willow Creek Forestry Service Road and the Falling Creek Haul Road. The junction with Highway 97 was upgraded when the mine reopened in 2008.
- **Employment:** 510 people , including contract and temporary workers (DeGrace 2011).

5.10.2.3 Present Industrial Actions

Brule Mine

Once resources at the Dillon Coal Mine were exhausted in 2007, Walter Energy continued mining at the immediately adjacent Brule Mine, which is still in operation today (BC MEMRCR 2013b). As of 2012, over 8 Mt of coal had been mined at Brule. Coal is transported by truck to the now-closed Willow Creek Mine (which is on the CN Rail line and has coal loading facilities) for processing and shipping. (see Section 5.10.5.1; DeGrace 2011; Walter Energy Inc. 2011a). Brule is expected to continue to operate until 2016.

- **Location:** 55º23'12" N, 121º49'12" W.
- **Production:** Approximately 1.2 and 1.3 Mt in 2010 and 2011, respectively; anticipated to be an average of 2 Mt annually (DeGrace 2011).
- **Facilities:** Processing plant and associated infrastructure, load-out facility and haul route, two pits (Brule and Blind), and two transmission lines (Western Canadian Coal 2005).
- **Project footprint:** 773 ha including footprint of Dillon Coal Mine (Western Canadian Coal 2005).
- **Project lifespan:** 2007 to 2017.
- **Access:** To reduce hauling distance Walter Energy (Western Coal Corp.) built the 60 km Falling Creek Connector gravel haul route, which directly connects Brule Mine to Willow Creek Mine (see Section 5.10.5.1; DeGrace 2011; Walter Energy Inc. 2011a).
- **Employment:** 416 people in 2011, including contract and temporary employees (DeGrace 2011; Walter Energy Inc. 2011a)

Trend Mine

Peace River Coal's Trend Mine has been operational since December 2005. The mine is located approximately 10 km to the southeast of the Project (BC MEMRCR 2013b). The coal is hauled to a rail loadout that is located along Highway 52, adjacent to the Coal Processing Site. As discussed in Section 5.10.5.3, the proponent intends to integrate the Trend Mine with another of its operations, the Roman Mine (Peace River Coal 2010).

- **Location:** 54º52'48"N, 120º57'43"W
- **Production:** Approximately 1.2 and 1.4 Mt in 2010 and 2011 (DeGrace 2011), respectively; production capacity of 1.5 Mt per year (Anglo American 2013a).

- **Facilities:** Open pits, 25 kV power line, explosives facility, offices, maintenance facility, rail load-out facility, haul road, sediment ponds,
- **Project Lifespan:** 2005 to 2015.
- **Project Footprint:** Approximately 1,700 ha (Anglo American 2013b).
- **Access:** Via a non-status road (known as Talisman Road), along Canadian Natural Resources Road PDR-46 to Highway 52 (Peace River Coal 2010).
- **Employment:** 350 people (DeGrace 2011).

Quality Wind Project

Capital Power's Quality Wind Project, about 22 km northeast of the Murray River Project, is the only wind farm currently operating in the RSA. This project has been in operation since late 2012 (Capital Power 2013).

- **Location:** 55°10' N, 120°51' W.
- **Production:** 79 turbines producing 142 MW (Capital Power 2010).
- **Facilities:** turbines, access roads, 30.3 km of collector lines, a substation, and a staging area (Capital Power 2010).
- **Project lifespan:** 2012 to 2037.
- **Project footprint:** 46.8 ha (Capital Power 2010).
- **Access:** Along 25.3 km of new road and 22.8 km of upgraded existing resource roads to Highway 52.
- **Employment:** During operation, between 8 and 12 people (EPCOR 2009).

Peace Canyon Dam

The Peace Canyon Dam is a major hydroelectric dam on the Peace River, completed by BC Hydro in 1980. The dam is 5 km southwest of Hudson's Hope, about 180 km north-northwest of the Project.

- **Location:** 55°58′55″N 121°59′40″W
- **Production:** 4 hydraulic generating units producing 700 MW.
- **Facilities:** 50 m high, 534 m long concrete dam impounding a 21 km long reservoir (Dinosaur Lake) in a narrow box canyon with a storage capacity of 216 Mm^3, and a six-gate spillway that can bypass river flow at up to 10,300 m^3/s.
- **Project lifespan:** 1980 to unknown future date.
- **Project footprint:** Reservoir covers 800 ha.
- **Access:** Via Highway 29.
- **Employment**: Unknown.

Wolverine Mine (Perry Creek) and EB Pit

About 10 km west of the Project lies Walter Energy's Wolverine Mine, which began operations in 2006. The property includes coal processing and rail loadout facilities as well as the Perry Creek open pit coal mine. The Wolverine-Perry Creek mine produces metallurgical coal for the steel industry (DeGrace 2011; Walter Energy Inc. 2011b).

- **Location:** 55 º 05' 10" N, 121º 14' 43" W.
- **Production:** Approximately 2 and 1.8 Mt in 2010 and 2011; capacity of 3.0 Mt per year, and is expandable to 3.5 Mt (DeGrace 2011).
- **Facilities:** Surface mine complex (the EB Pit), Perry Creek underground mine, processing plant/load-out facility, and common facilities for surface and underground operations.
- **Project lifespan:** 2006 to 2016.
- **Project footprint:** 6,106 ha.
- **Access:** Via resource road 16 km east to Wolverine Forest Services Rad, connecting to Highway 29.
- **Employment:** 477 people, including contract and temporary workers (DeGrace 2011).

WAC Bennett Dam

Two hundred km north-northwest of the Project is the WAC Bennett Dam, the largest hydroelectric dam in BC, completed by BC Hydro in 1967. Together with the Peace Canyon Dam, it provides approximately 40% of the hydroelectrical power utilized by the province.

- **Location:** 56°01′00″N 122°12′02″W
- **Production:** 7 generating units producing 2,876 MW.
- **Facilities:** 183 m high, 2 km wide concrete dam at the head of Peace River Canyon impounding Williston Lake, British Columbia's largest reservoir.
- **Project lifespan:** 1963 to unknown future date.
- **Project footprint:** 176,100 ha.
- **Access:** Via Canyon Drive, connecting to Highway 29.
- **Employment**: Unknown.

5.10.2.4 Future Industrial Actions (Certain)

Hermann Mine

Walter Energy also owns the Hermann property, which possess a total of 40 Mt of proven coal reserves. The project has an approved EA certificate and is awaiting approvals for production, which could begin as early as 2014 (DeGrace 2011; Walter Energy Inc. 2011b).

- **Location:** 55°0'13.36" N, -121°9'3.76" W

- **Production:** 0.8 to 1.1 Mt annually, for a total of 9 Mt.
- **Facilities:** Four open pits, two ex-pit dumps and one in-pit dump, a coal handling site, a fuel storage facility, a water management facility, a diesel generating station, and an office and shop complex; raw coal will be trucked 22 km to the Wolverine plant site (see Section 5.10.5.4) for processing and shipping.
- **Project lifespan:** 10 years
- **Project footprint:** 288 ha
- **Access:** Via existing Nabors Road passing north under the Quintette conveyor, east onto the Quintette Mesa Pit connector road, then east on Monkman Park Road connecting to Highway 29 southeast of Tumbler Ridge.
- **Employment:** Unknown during construction; from 43 to 94 workers during operations phase.

<u>Quintette Mine</u>

As noted previously, Teck Coal is seeking to re-open the former Quintette mine. Teck recently received the required regulatory permits to proceed with a restart of the Babcock mining area of the original Quintette Mine; the new operation would re-open one of the original pits and develop a new pit in order to recover 3.4 Mt of coal annually (BC MEMRCR 2013c). However, the company has temporarily placed the project on hold (Teck 2013b).

- **Location:** 55°01'40" N, 121°11'45" W
- **Project Lifespan:** 15 years.
- **Production:** 41 Mt of coal (average of approximately 3.4 Mt annually).
- **Facilities:** The project will expand the existing Windy Pit and develop the new Window Pit on the north and west faces of Mount Babcock, respectively. A new stockpile will be developed between the two pits, and a 5.5 km overland conveyor will transport raw coal to the existing processing plant, which is being refurbished. New transmission lines, water management facilities, haul roads, and spoils areas will be constructed (Teck 2012).
- **Footprint:** The restart will add 1,317 ha to the existing disturbance from the former Quintette operations (3,708 ha), for a combined total of 5,025 ha (Teck 2012).
- **Employment:** 268 person-years of employment during the 31-month construction period; and a 565-person workforce at peak production (Teck 2012).
- **Access:** Via the existing Quintette mine road, the Murray River Forestry Service Road, and Highway 52.

<u>Roman Mine Project</u>

An Environmental Assessment Certificate for the Roman Mine Project (Peace River Coal) was issued on December 14, 2012 (BC EAO 2013b). Construction was expected to commence in 2013, with production beginning in 2014 (Anglo American 2013a).

- **Location:** 54°52' N, 120°57' W

- **Project Footprint:** 810 ha total, 498 ha is new disturbance, and other 312 ha is overlap with existing Trend mine (Peace River Coal 2010; Anglo American 2013b).
- **Facilities:** Three linear open pits: one large central pit flanked by two shallower pits, waste rock dumps to the north and south of the pits, sedimentation ponds and collection ditches, in-pit tailings impoundment, soil stockpiles, modular sewage treatment plant, new processing plant to process ore from both Roman and Trend.
- **Access:** Shares access route with the Trend Mine: via a non-status road (known as Talisman Road), along Canadian Natural Resources Road PDR-46 to Highway 52 (Peace River Coal 2010).
- **Water:** Surface runoff water from mining will initially flow via ditches to three sediment ponds (RP1 and RP2, to the south and north of the central pit, respectively; and SP4, an existing Trend pond). RP1 and RP2 will discharge to Babcock Creek, and SP4 will discharge to Gordon Creek. Once the central pit is developed, it will be used as an in-pit tailings storage facility called RP3, and RP1 will be decommissioned (Peace River Coal 2010).
- **Employment:** 100 workers; 450 total when combined with Trend Mine (DeGrace 2011; Anglo American 2013a).

<u>Thunder Mountain Wind Park</u>

Thunder Mountain Wind Park, located 29 km east of the Project and 18 km southeast of Tumbler Ridge, was awarded an EA certificate in 2009. In February 2011, Brookfield Renewable Power Inc. acquired a controlling interest over the project from Aeolis Wind Power Corporation. As of 2012, the project was on hold until a long term power purchase agreement could be secured (Aeolis 2012). The project is being developed as the first phase of a larger future development with an estimated total power production capacity of 1,500 MW.

- **Location:** 54°54' 56.87" N, 120°28' 59.88" W
- **Production:** 320 MW.
- **Facilities:** 160 wind turbine generator, up to five substations, a 65 km, 230 kV transmission line connecting to the BC Hydro grid, access and maintenance roads, laydown and storage areas, a temporary office, batch plant areas, and local quarries adjacent to the access roads.
- **Project lifespan:** 40 years.
- **Project footprint:** 737 ha.
- **Access:** Road access will require upgrades to 45 km of existing petroleum development or forestry roads, as well as 50 km of new roads, connecting to five separate points on Heritage Highway (Highway 52), which joins with Highway 29.
- **Employment:** Between 60 and 120 workers during construction, and between 6 and 10 workers during operation.

<u>Tumbler Ridge Wind Energy Project</u>

Finavera's Tumbler Ridge Wind Energy Project received an EA certificate from the BC government in 2012. This wind farm is located about 9 km northeast of the Project and 8 km southwest of Tumbler

Ridge (Finavera 2011b; Canada Newswire 2012). In April 2013, Finavera announced the sale of the Tumbler Ridge project and the Meikle Wind Project (see Section 5.10.5.5) to Pattern Renewable Holdings Canada ULC, a subsidiary of Pattern Energy Group LP (Canada Newswire 2013).

- **Location:** 55°5' N, 121°6' W
- **Production:** 50 MW
- **Facilities:** 33 wind turbine generators, connector and access roads, electrical connections, substation and operations centre; and overhead transmission line to connect the Project to the existing electrical grid.
- **Project lifespan:** 26 years.
- **Project footprint:** ~100 ha.
- **Access:** From northern portion of the project, a new 5.2 km road connecting to Mast Creek Shell Road, and from southern portion of the project, via Road M01158 up slope 3.5 km to Mast Creek Shell Road; from there, both routes join the Wolverine Forest Service Road and run east to Highway 29.
- **Employment:** 560 person-years of employment during 10-month construction phase, 510 person-years of employment during 25-year operation phase.

Wartenbe Wind Project

The Wartenbe Wind Project is about 110 km north-northwest of the Project, southeast of Chetwynd and approximately 7 km south of Highway 97. The project was originally developed by Dokie Energy, and received an EA certificate in 2006. The project was subsequently purchased by Avro Wind Energy Inc., and in September 2011, the new proponent received a five-year extension to the EA certificate.

- **Location:** 55°42' N, 121°39' 0" W
- **Production:** 70.5 MW
- **Facilities:** 47 wind turbines generating 1.5 MW each, 15.4 km of new access roads and upgrades to existing roads, a 15.5 km electrical network, a substation, and a 320 m, 230 kV transmission line; as well as an off-site maintenance building, concrete batch plant, and gravel pits.
- **Project lifespan:** Minimum of 20 years.
- **Project footprint:** 136 ha
- **Access:** New access roads connecting ridges and turbine sites to an existing forestry road west of the project, connecting to Lone Prairie Road and Highways 97 and 29.
- **Employment:** 40 to 80 construction jobs; 8 to 10 operations and maintenance jobs.

5.10.2.5 Future Industrial Actions (Reasonably Foreseeable)

Some projects described in this section are in the early stages of permitting at the time of writing, but their proponents have not yet submitted EA applications. Where the text specifies that a project is in the pre-application stage of the EA process, project details are drawn from preliminary project descriptions or pre-feasibility documentation, and thus may be subject to significant change.

Echo Hill Mine

The Echo Hill Mine, being developed by Hillsborough Resources Limited, is a coal mine located 45 km northeast of the Project. Hillsborough have indicated that they plan to submit an EA application to the BC EAO in March of 2015.

- **Location:** 55° 22′ 01″ N, 120° 48′ 10″ W
- **Production:** 1.0 to 1.5 Mt per year.
- **Facilities:** contour wall and auger mine, mine office, maintenance facilities, access and haul roads, a coal handling and storage facilities, water management structures; raw coal will be transported by rail off-site to either Trend or Bullmoose mine sites for processing.
- **Project lifespan:** 10 to 14 years
- **Project footprint:** 325 ha.
- **Access:** 30 km of new access roads connecting to Moore Forest Service Road and Highway 52.
- **Employment:** Unknown during construction phase, an estimated 80 workers during operation phase.

Coastal Gaslink Project

TransCanada Pipeline’s proposed Coastal Gaslink Project comprises an approximately 650 km long natural gas pipeline running from near Dawson Creek in northeastern BC to the proposed LNG Canada export facility near Kitimat. At its nearest point, the pipeline ROW is approximately 30 km northwest of the Project RSA. The pipeline project is currently in the pre-application stage of the EA process, with Application Information Requirements approved by the BC EAO in May of 2013.

- **Location:** 55° 29' 6.72" N, 120° 30' 6.48" W; to 54° 1' 45.22" N, 120° 41' 16.8" W.
- **Production:** 2 to 3 billion cubic feet (bcf) per day, with potential to expand up to 5 bcf/day.
- **Facilities:** 1,219 mm diameter pipeline, meter stations, and 8 compressor stations; in addition, TransCanada has indicated that they may also require a natural gas liquid injection facility and hydrocarbon dew point control facility.
- **Project lifespan:** 30+ years.
- **Project footprint:** Unknown.
- **Access:** Via nearest all-season road or newly constructed roads along length of project right-of-way.
- **Employment:** 2,000 to 2,500 jobs during 2- to 3-year construction phase; 15 to 20 jobs during operations phase.

Horizon Mine

Peace River Coal has also been evaluating and advancing the Horizon Project (known as the Five Cabin Coal Project when it was being developed by former proponent Hillsborough Resources Limited), about 20 km southeast of the Project and 10 km west of the existing Trend Mine (DeGrace 2011). This project has been in the pre-application phase of the EA process since 2005, and has had an approved Terms of Reference (the former term for the Application Information Requirements document) since 2007. The proponent has not publically indicated when the EA application for this project may be submitted.

- **Location:** 54°50' N, 121°3' W.
- **Production:** 1.6 Mt per year.
- **Facilities:** three open pits, upgraded access roads and mine haul roads, topsoil and waste storage areas, a wash plant, tailings area and coal handling facility, a mine camp, and a 15 km transmission line.
- **Project lifespan:** 20 years
- **Project footprint:** Unknown.
- **Access:** Via Canadian Natural Resources Limited's Barbour petroleum development road, connecting to the Murray Forest Service Road and Highway 52.
- **Employment:** Unknown during construction phase; over 200 workers during operation phase.

Meikle Wind Project

The environmental assessment certificate application for the Meikle Wind Project, located 20 km from Tumbler Ridge, is under review by the BC EAO. The Meikle project, as stated earlier, was recently purchased from Finavera by Pattern Energy (Canada Newswire 2013).

- **Location:** 55º15'14"N, 121º23'44"W
- **Production:** 187 MW.
- **Facilities:** 68 wind turbines and associated foundations, a 230 kV transmission line and substation, connector and access roads, two meteorological towers, six temporary laydown areas, borrow pits, and local aggregate sources.
- **Project Lifespan:** 20014 to 2041.
- **Project Footprint:** Approximately 216 ha during construction, 135.8 ha during operation.
- **Access:** Two-way access road connecting to Highway 2.
- **Employment:** 179 during construction, 18 during operation (Meikle Wind Energy Limited Partnership 2013).

Northern Gateway Pipeline

Enbridge's Northern Gateway Pipeline is a proposal to construct twinned pipelines, 1,177 km in length, running west from the Athabasca oil sands in Alberta to a new marine terminal in Kitimat, BC. The eastbound pipeline would import hydrocarbon natural gas condensate and the westbound pipeline would export bitumen diluted with the condensate to the new marine terminal in Kitimat, for transport by oil tankers. The proposed route for the pipeline runs through the southern part of the Project RSA.

Enbridge's EA application was submitted in 2010 for evaluation by a Joint Review Panel established by the CEA Agency and the National Energy Board. In December 2013, the Joint Review Panel for the Enbridge Northern Gateway Project recommended that the federal government approve the project, subject to a list of 209 required conditions. Enbridge is now awaiting a decision from the Governor in Council on whether or not the project should proceed; the window for this decision is six months from the Panel's recommendation.

- **Location:** Bruderheim, Alberta to Kitimat, BC.
- **Production:** 83,400 m^3 (525,000 barrels) of oil per day; 30,700 m^3 (193,000 barrels) of condensate per day.
- **Facilities:** 914 and 508 mm diameter pipelines and associated right-of-way, ten pump stations, two tunnels, and the Kitimat marine terminal.
- **Project lifespan:** 30+ years.
- **Project footprint:** 8,276 ha
- **Access:** New and upgraded access roads along project right-of-way.
- **Employment:** 3,000 direct workers during peak of 42-month construction phase; during operations phase, 104 permanent operating positions within Northern Gateway and 113 positions with the associated marine services.

Rocky Creek Energy Project

The Rocky Creek Energy Project is proposed by Rupert Peace Power Corporation, and will be situated on three ridge tops approximately 80 km northwest of Tumbler Ridge and 40 km south of Chetwynd. The Application Information Requirements for the project were approved by the EAO in April 2013, and it remains in the pre-application stage of the EA process at the time of writing.

- **Location:** 55°16' 8.0034" N, 121°55' 50.0154" W.
- **Production:** 500 MW.
- **Facilities:** 200 to 250 wind turbine generators, three substations, transformers and operation centres, a new road network linking the turbines, and a new 20 km transmission line connecting the turbines to the Sukunka substation northeast of the project site.
- **Project lifespan:** 25 to 30 years.
- **Project footprint:** Unknown.

- **Access:** Via a series of existing access roads: the Sukunka Main Road, the Sukunka Road, Rocky Creek Forest Service Road, Rocky Creek Road, Lower Burnt Road, Blind Creek Road, Jilg Road and the Gulf Road, connecting to Highway 29.
- **Employment:** 20 full-time jobs during operation.

Site C Clean Energy Project

The Site C Clean Energy Project is BC Hydro's proposal to build a major new hydroelectric generating station on the Peace River. The project's EA application is currently under review as part of both federal and provincial EA processes.

- **Location:** 56°11'42.27" N, 120°54'51.02" W
- **Production:** 1,100 MW
- **Facilities:** Dam, generating station, seven-gate spillway, reservoir, substation, Highway 29 realignment, temporary and permanent access roads, worker accommodations, and 77 km transmission lines to Peace Canyon Dam.
- **Project lifespan:** 100+ years.
- **Project footprint:** 5660 ha
- **Access:** Access to the north side of the dam site from Fort St. John and Highway 97 via existing municipal and provincial public roads; access to the north side via Jackfish Lake Road and an unpaved network of rail, transmission, oil and gas, and forest service roads.
- **Employment:** The Project will provide an estimated 7,650 direct construction jobs (for approximately 10 years), and up to 35,000 direct and indirect jobs through all stages of the project (The CSE Group 2011).

Sukunka Coal Mine Project

Glencore is developing the Sukunka mine—an integrated surface and underground mining operation—55 km southwest of Chetwynd. Mine life is expected to exceed 20 years. The project is currently in the pre-application phase of the BC environmental assessment process (EAO 2013; Stantec 2013).

- **Location:** 55°11'47" N, 121°34'8" W.
- **Production capacity:** 1.5 to 2 Mt of coal per year, increasing to 6 Mt per year at peak production.
- **Project lifespan:** 2016 to 2038.
- **Footprint:** 2,400 ha.
- **Facilities:** Three open pits and an underground longwall mining operation, a coal handling and process plant, coal storage facilities, engineered waste rock stockpiles (with co-disposed tailings), new transmission line, and haul roads.
- **Access.** A new mine site haulage road connecting to the Chamberlain Road, 33 km north along the Sukunka FSR, which connects to Highway 29.
- **Employment:** 250 jobs during construction, 700 jobs during operations (Stantec 2013).

Sundance Wind Project

EDF Energies Nouvelles' proposed Sundance Wind Project is located approximately 20 km north of Tumbler Ridge. The project is in the pre-application stage of the EA process, and has approved Application Information Requirements as of May 2013.

- **Location:** 55.35465186 Latitude, -121.0845309 Longitude
- **Production:** 250 MW.
- **Facilities:** between 85 and 125 turbines, electrical collector system, 17 km transmission line, substation, temporary and permanent meteorological towers, and access roads.
- **Project lifespan:** 20 to 25 years.
- **Project footprint:** Unknown; at least <1 ha per turbine.
- **Access:** Via the Moose Lake forest service road to Highway 29.
- **Employment:** 250 jobs during construction phase; 10 jobs during operation phase.

Wildmare Wind Energy Project

The Wildmare Wind Energy Project is located 5 km west of Chetwynd. The company anticipates project operations to begin in 2014 and supply power to up to 25,000 homes (Finavera 2011c).

- **Location:** 55°42′0″N, 121°44′0″W
- **Production:** 77.4 MW.
- **Project Lifespan:** 2014 to 2039 or longer.
- **Footprint:** Between 129 and 142 ha during construction, and between 108 and 121 ha during operation.
- **Facilities:** Wind turbines, high voltage transmission line, collector network and substation, meteorological tower, connector and access roads, laydown area, and quarries.
- **Access:** New road connecting to Wildmare Forest Service Road, north on Schilling road, connecting to Highway 97.
- **Employment:** 116 during construction, 12 during operation (Finavera 2011a).

5.10.2.6 Future Industrial Actions (Hypothetical)

Babcock Creek Wind Project

About 20 km east-southeast from the Project lies Babcock Ridge Wind Limited Partnership's Babcock Creek Wind Project. The proponent filed an investigate and monitoring phase land use application in November of 2013, which is currently under review by the Ministry of Forests, Lands, and Natural Resource Operations. The project is expected to be under the regulatory thresholds requiring an environmental assessment.

- **Location:** 55° 0' 31.8882" N, 120° 50' 27.7044" W
- **Production:** Unknown (assumed to be <50 MW).

- **Facilities:** Seven wind turbines, a meteorology tower (already installed, connector roads, collector line, and substation.
- **Project lifespan:** Unknown (assumed to be ~25 years).
- **Project footprint:** Unknown.
- **Access:** Via new connector roads joining an existing paved road running northeast from Highway 52 (Heritage Highway).
- **Employment**: Unknown.

Belcourt Saxon Coal Project

The Belcourt Saxon Coal Project, jointly owned by Walter Energy and Peace River Coal, is being developed about 60 km southeast of the Project. The project is currently in an exploration phase, and has not entered the EA process.

- **Location:** 54° 37' 0" N, 120° 27' 5.00" W.
- **Production:** 4 Mt per year
- **Facilities:** Unknown.
- **Project lifespan:** 40 years.
- **Project footprint:** Unknown.
- **Access:** Unknown.
- **Employment**: Unknown.

Huguenot Mine

Colonial Coal is developing the Huguenot Mine 80 km southeast of the project. The property was explored in the mid-1970s by Denison Mines, the original developer of the Quintette Mine, while Colonial Coal's exploration program began in 2008. This project will trigger an environmental assessment under both the BC *Environmental Assessment Act* and the *Canadian Environmental Assessment Act*, but is not yet in the pre-application stage.

- **Location:** 54° 31' 11.7372" N, 120° 17' 50.517" W.
- **Production:** 3 Mt per year.
- **Facilities:** Three pits and underground longwall mining works, plant site, access roads, rail link (to existing rail line south of Tumbler Ridge), and eight sediment and diversion ponds.
- **Project lifespan:** 31 years.
- **Project footprint:** Unknown.
- **Access:** Via new access roads and/or upgrades to existing forestry, coal exploration, and oil and gas development roads connecting to Highway 29 and Highway 52 (Heritage Highway).
- **Employment**: Unknown.

Moose Lake Wind Power

The Moose Lake Wind Power project is being developed approximately 30 km north-northwest of the Project. Few details are currently available about this project, but it is expected to be under the regulatory thresholds requiring an environmental assessment.

- **Location:** 55° 17' 17.0586" N, 121° 15' 55.6416" W.
- **Production:** Unknown (assumed to be <50 MW).
- **Facilities:** Unknown.
- **Project lifespan:** Unknown (assumed to be ~25 years).
- **Project footprint:** Unknown.
- **Access:** Via new or upgraded access roads connecting to Highway 29.
- **Employment**: Unknown.

Septimus Creek Wind Power Project

Located over 115 km north of the Project and 25 km southwest of Taylor is Renewable Energy Systems Canada Inc.'s Septimus Creek Wind Power Project. The proponent filed an investigative and monitoring phase land use application in November of 2013, which is currently under review by the Ministry of Forests, Lands, and Natural Resource Operations. The project is under the regulatory thresholds requiring an environmental assessment.

- **Location:** 56° 4' 26.3994" N, 120° 55' 15.6" W.
- **Production:** 15 MW
- **Facilities:** Six to ten wind turbines, a meteorological tower, below- and above-ground electrical collector system
- **Project lifespan:** 25 years.
- **Project footprint:** Unknown.
- **Access:** New and upgraded access roads connecting with Highway 97.
- **Employment:** 15 to 80 workers during construction phase; 10 full-time and part-time workers during operations and maintenance phase.

Suska Mine

Glencore (formerly Xstrata) and JX Nippon are developing the Suska Mine roughly 65 km west-southwest of the Project. Initiation of the prefeasibility study for this major coal project was announced by the proponents and Premier Christy Clark in June of 2012. This project is expected to trigger an environmental assessment under both provincial and federal legislation, but is not yet in the pre-application stage.

- **Location:** 55° 14' 41.7474" N, 122° 7' 32.5194" W

- **Production:** Unknown.
- **Facilities:** Open pit mine(s).
- **Project lifespan:** Unknown.
- **Project footprint:** Unknown.
- **Access:** Via Hasler and Sukunka forestry service roads connecting to Highway 29.
- **Employment:** Unknown during construction phase; ~600 during operations phase.

Wapiti River Coal Project

The proposed Wapiti River Coal Project is located over 60 km southeast of the Project and 45 km northeast of Tumbler Ridge. This project is still in an exploration stage and has not yet entered the pre-application stage of the EA process.

- **Location:** 54° 46' 35.8746" N, 120° 19' 18.408" W
- **Production:** Unknown.
- **Facilities:** Underground longwall coal mine.
- **Project lifespan:** Unknown.
- **Project footprint:** Unknown.
- **Access:** Unknown.
- **Employment:** Unknown.

5.10.2.7 Other Land Use Activities

Aboriginal Harvest (Fish, Animals, and Plants)

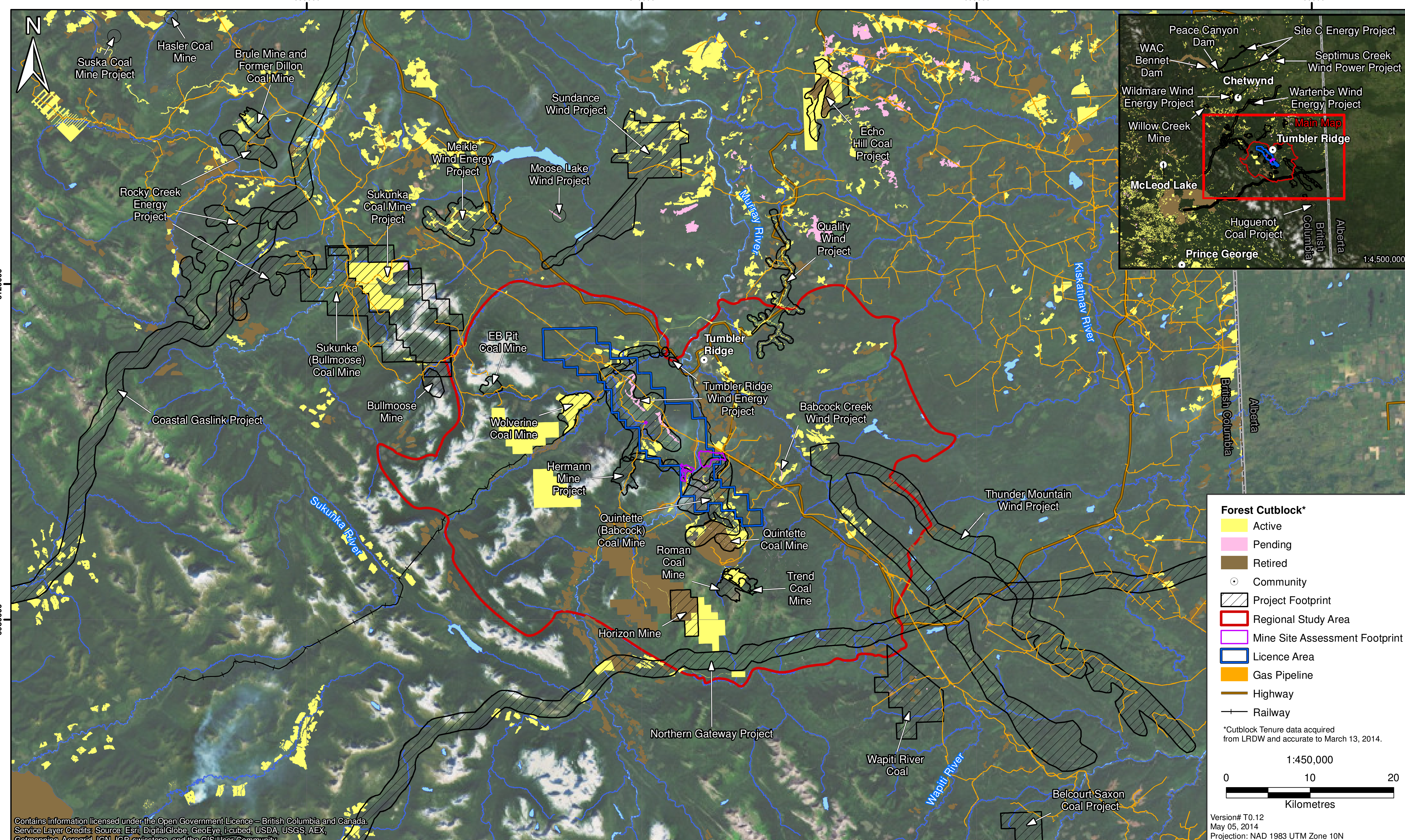
Subsistence activities, such as trapping, hunting, and fishing are common land uses regionally. Three trapping tenures and four guide-outfitting tenures overlap the RSA. Multiple recreation tenures, as well as temporary and permanent residences exist within the Project area. The nearest trapline cabin is 1.7 km from the Project, the nearest campground is 9.5 km from the Project, the nearest hunt camp is 26 km from the Project, and the nearest residential area (Tumbler Ridge) is 12.4 km from the Project.

Forestry and Manufacturing

Commercial timber harvesting is a continuing human action within the RSA (Figure 5.10-3), and will likely contribute to ongoing new disturbances. The region has two Timber Supply Areas (TSAs): the Fort St. John TSA, which covers 4.673 million ha; and the Dawson Creek TSA, which covers 2.078 million ha.

The annual allowable cuts have remained stable for the past few years, after being increased in 2003 to 1.86 million m^3 for Dawson Creek TSA and to 2.115 million m^3 for Fort St. John TSA (BC Stats 2012; NPEDC 2012; SPEDC 2012b). Harvesting in the Dawson TSA is currently focusing on pine, due to the effects of the Mountain Pine Beetle (MPB) in the TSA. Trees that have been infested with MPB are still of saw-log quality within the first few years of infestation (B. Pate, Pers. Comm., 2012).

Figure 5.10-3
Forest Cutblocks Near the Murray River Project



In addition to timber harvest, the PRRD has an active forest manufacturing industry. It is home to various large lumber and pulp and paper mills and remanufacturing facilities, where the majority of the harvested timber is processed (BC Stats 2012; NPEDC 2012). The forest industry in the PRRD has been facing many challenges in recent years. It was negatively affected by the global economic downturn in 2008/2009. In early 2008, Chetwynd saw the closure of its Canfor sawmill. This was followed by the shutdown of the Tembec pulp mill in February 2009. Both operations re-opened in early 2010 due to strong demand in Asian markets (CA 2010). As a result, the past two years have seen a revival in the regional forest industry (ICABC 2012).

Industrial Roads

The RSA contains 245 active road use tenures to support the various industrial land uses noted previously. These types of industrial roads are typically unpaved. Forestry interests hold 24 forestry road permits, five forest service roads, and two forestry-related special use permits. Petroleum interests hold 33 petroleum development roads and eight petroleum access roads. There are also 16 *Land Act* Crown land roadways tenures. Additionally, the RSA contains portions of (paved) Highways 52 and 29. The LSA is also criss-crossed by a number of roads and utilities. The Murray River Forest Service Road (FSR) is the main access road through the LSA and is held by the Peace Forest District. Apart from this, there are five road permits (divided into a number of different sites) held by West Fraser Mills Ltd., a special use permit held by Finavera, eight petroleum development roads, three notations of interest, and three transportation permits are located in the LSA. Highway 52 runs through the north east section of the LSA.

Coal and Mineral Exploration

At the time of writing, 32 companies hold a total of 772 coal tenures in a diagonal stripe, roughly 40 km wide, running northwest to southeast across the RSA (Figure 5.10-4), covering a total of over 659,980 ha. Most of the tenures within the RSA are held by the companies associated with the projects described in Section 5.10.5, although some tenures belong to other proponents. While there are no mineral tenures within the RSA, Fertoz International Inc. holds two sets of tenures to the west and south-southeast of the RSA (known as Wapiti West and East, respectively) in which it is carrying out phosphate exploration. Another large cluster of mineral tenures, held by various entities, can be found about 50 km southwest of the RSA.

Oil and Gas Drilling and Exploration

Oil and gas drilling and exploration has seen significant growth in the region in the last three decades. Hundreds of active and inactive petroleum and natural gas (PNG) wells dot the landscape of the RSA, with their associated networks of pipelines, ancillary facilities, and seismic lines, particularly to the northeast (Figure 5.10-5). These PNG facilities are operated by proponents such as Apache Canada Ltd., Canadian Natural Resources Limited, ConocoPhillips Canada Operations Ltd., Devon Canada Corporation, Encana Corporation, Shell Canada Limited, and Talisman Energy Inc. (BC OGC 2013). Nearly all of this PNG development has occurred within the past 20 years (DataBC 2013). In addition, at least two major pipeline projects—the Northern Gateway Pipeline and the Coastal Gaslink Project—are proposed for the region.

The PRRD has large reserves of oil and natural gas and remains the hub for exploration activity and production in the province. The area sits on the Montney Basin, which holds reserves estimated between 77 and 176 trillion cubic feet of marketable gas (SPEDC 2012a). The primary areas of activity are around Fort St. John and Dawson Creek, which are part of the Fort St. John Geological Region (BC MEMPR 2009). Recent industry activity has centered on unconventional reservoirs in the South Peace area (BC MEMPR 2009). There are around 99 oil and gas companies operating in the South Peace area alone with over 254 oil and gas wells approved in 2009 (SPEDC 2012a). The major operators in the Fort St. John Region are Canadian Natural Resources Limited and ConocoPhillips Canada Resources Corp. In 2007, Canadian Natural Resources Limited was also the second largest gas producer by sales volume in BC (BC MEMPR 2009). Technological advances in drilling and completion as well as high commodity prices have stimulated the production of tight gas in the region in recent years (BC MEMPR 2010). The Provincial Government has also supported the oil and gas industry by implementing an incentive package that reduced royalty rates for wells drilled from September 2009 to June 2010, and provided a 15% royalty deduction for natural gas deep drilling (CA 2010). The BC Government has also implemented an Infrastructure Royalty Credit Program to promote investment in oil and gas roads and pipelines (BC MEMPR 2010).

Recreation and Tourism

Tourism is becoming increasingly important in the RSA, and it is a sector with significant growth potential both demographically and economically (Norton 2006). The Northeast accommodation market has been steadily increasing in recent years, and revenue growth has surpassed that of any other region in the Province. From 2007 to 2008, the greatest increase in room revenue in Northern BC occurred in the Northeast Development Region (12.6%) compared to just 4.5% for the Province as a whole. Room revenues in the Northeast Development Region have risen quickly over the last decade, surging by more than 130% between 2000 and 2009, an increase six times larger than the provincial average (Stroomer 2010; BC Stats n.d.). The Northeast Development Region generated nearly $76 million in room revenue in 2009, 3.8% of the provincial total (Tourism BC 2010).

Tourists are drawn to the area because of its relatively remote location and wide-open spaces. Outdoor activities such as hiking, white-water rafting and fishing make the region an attractive location for travellers looking for a unique opportunity to "get away" (Stroomer 2010). The PRRD offers tourism opportunities that reflect the natural wilderness of the area as well as its cultural and economic activity. The tourism industry provides strong potential for business investment, job creation, economic growth and rural development in the RSA. Key tourist interests and activities include backcountry and eco-adventure tourism, and guide-outfitting, hunting and fishing. In recent years, development has also occurred in agriculture tourism; cultural and heritage tourism, and Aboriginal tourism, among others (NPEDC 2012; SPEDC 2012d).

Transportation (Road and Rail Access and Traffic)

The RSA is serviced by three provincial highways: 97, 29 and 52. Highway 97 is further classified as 97N (which is part of the Alaska Highway) and 97S (known as the John Hart Highway, which connects to Prince George). Highway 52 is further classified as 52N (Heritage Highway) and 52E (Boundary Road). Tumbler Ridge is located at a meeting point of Highways 29, 52N and 52E.

Figure 5.10-4

Mineral, Placer, and Coal Tenures Near the Murray River Project

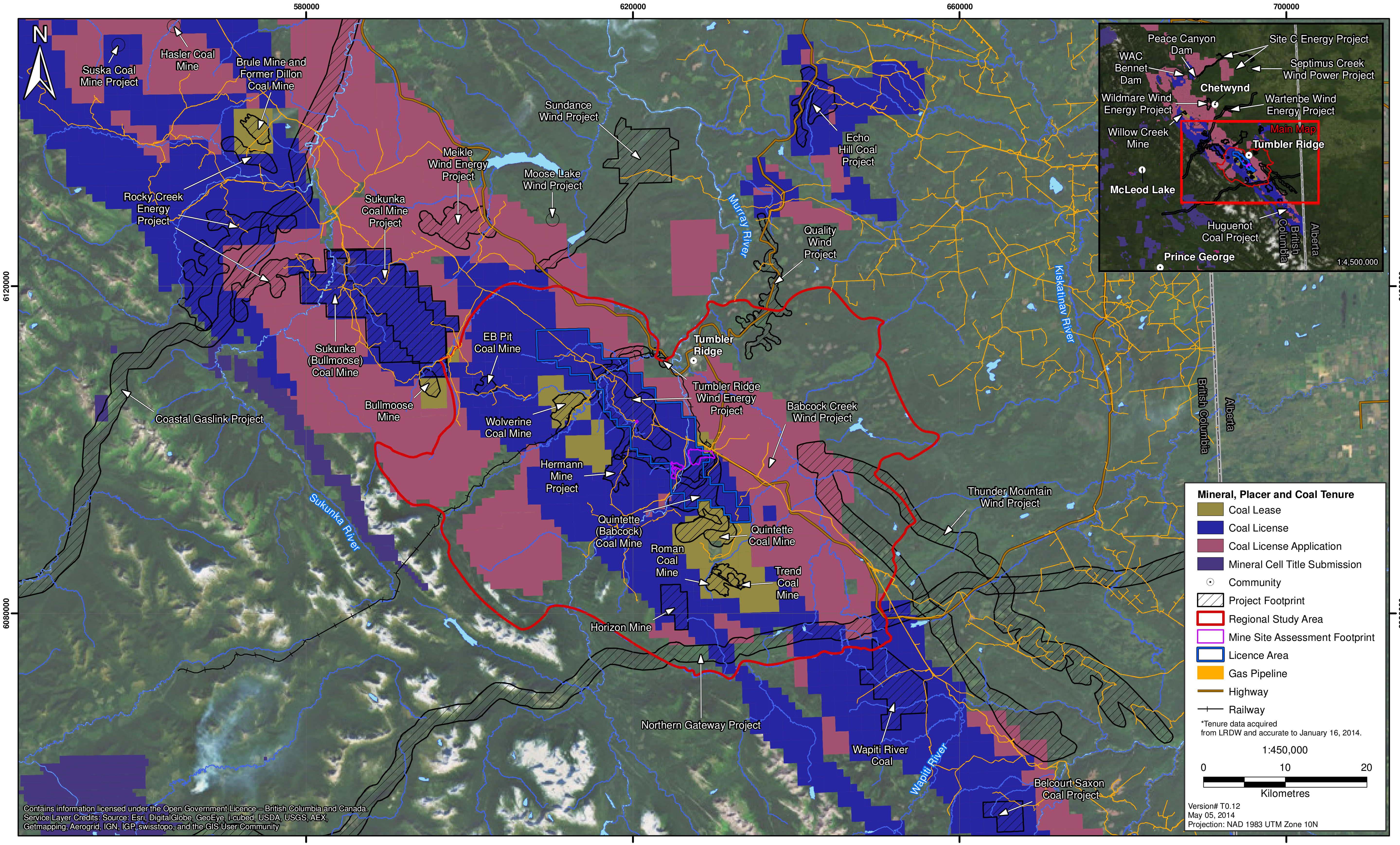
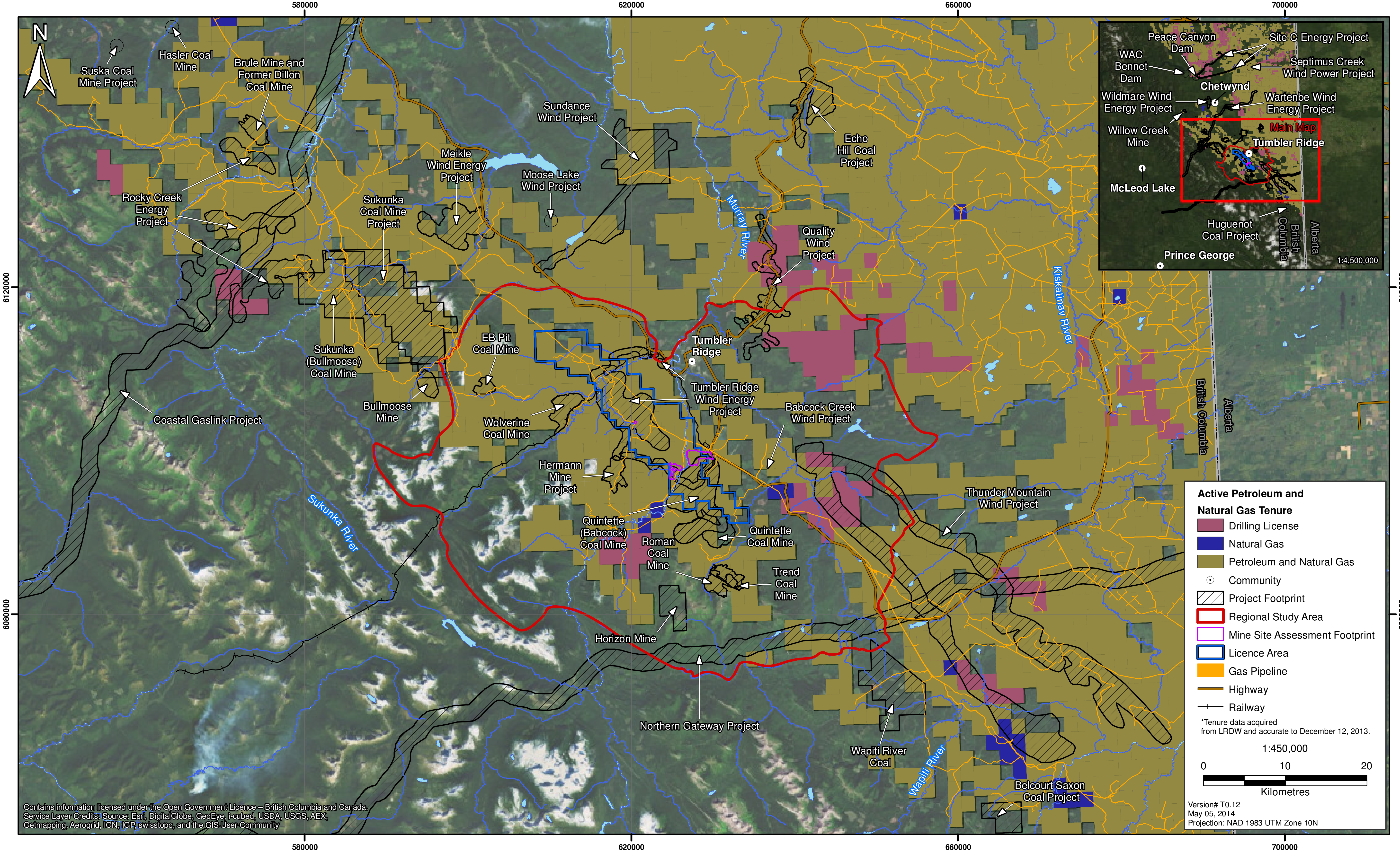


Figure 5.10-5
Active Petroleum and Natural Gas Tenures Near the Murray River Project



According to the BC Ministry of Transportation and Infrastructure (BC MOTI) Service Plan for 2013/2014, $20 million will be invested in the next two fiscal years in rehabilitating the existing public road infrastructure in the Northeast region of the province. This investment is intended to help eliminate seasonal road restrictions and extend the winter drilling season for oil and gas exploration, thereby attracting new investment, creating jobs and improving safety for both industry and residents (BC MOTI 2013).

BC MOTI is also working with local governments and stakeholders to identify priority areas for improving the performance of highway corridors through projects such as passing lanes, four-laning, left-turn slots, realignments and safety upgrades. Projects include widening Highway 2 and Highway 97 North near Dawson Creek and Fort St. John (BC MOTI 2013).

Highway 97N (Alaska Highway)

This northernmost section of Highway 97 (beginning at Mile ‘0’ in Dawson Creek- see Plate 4.2-2) is 965 km long (600 mi), and travels north through largely unpopulated areas, intersecting the communities of Fort St. John and Fort Nelson, travelling north to the Northwest Territories. Here, the highway veers generally northwestward into areas spotted with small hamlets. As it passes over the Rocky Mountains, the highway parallels the Liard River before terminating just over the BC/Yukon border at Watson Lake, where the Alaska Highway is numbered as Yukon Highway 1 (British Columbia Highway News n.d.). Most of the two-lane highway is paved or chip sealed, and many of the rough areas are marked, though not all (Bell's Travel Guides 2012; OutWestNewspaper.com n.d.).

A study conducted on the Highway 97 corridor between Dawson Creek and Fort St. John determined that intersections along Highway 97 are operating at sufficient capacity for the current traffic levels. While the actual number of collisions along the stretch is low, in comparison to the amount of traffic on the highway, the collision rate is higher than the average for highways province-wide. The predominant collision type is wildlife collisions. The issue of most concern to stakeholders was the lack of passing opportunities along the highway. (Opus Hamilton 2008).

Recent upgrades to the highway include expansions to four lanes in crucial areas and heightening of bridges and overpasses to meet the minimum standard of 5.0 m (InvestBC n.d.).

Highway 97S (John Hart Highway)

This 405 km (252 mi) long stretch of Highway 97 begins at Prince George, travelling for 152 km (94 mi) north through the small hamlet of Summit Lake (which is situated at the Continental Divide) as well as through Crooked River Provincial Park, Bear Lake and McLeod Lake, to its intersection with Highway 39. It then journeys northeast another 150 km (93 mi) through the Continental Divide, at which point the time zone changes from Pacific Time to Mountain Time. After emerging from the Pine Pass, the highway intersects with Highway 29 at the town of Chetwynd. After a trek of another 97 km (60 mi) east, the Hart Highway terminates at Dawson Creek (British Columbia Highway News n.d.).

Highway 97S is paved the entire way from Prince George through to Dawson Creek. Most of the highway is two-lane, with intermittent three-lane sections for passing. Within the city of Prince George the highway widens to four lanes (S. Holahan, Pers. Comm., 2013).

Highway 29 (Don Phillips Way)

This highway starts at its junction with Highway 97 northwest of Charlie Lake and continues via Hudson's Hope to the junction with Highway 97 at Chetwynd, and from there southeast to Tumbler Ridge where it intersects with Highway 52 (BC MOTI n.d.). It passes by the community of Moberly Lake as well as the W.A.C. Bennett and Peace Canyon Dams (BC Adventure.Com 1995-2013). Highway 29 is a two-lane paved highway with passing lanes (L. Norman, Pers. Comm., 2013).

Highway 52N and E (Heritage Highway/Boundary Road)

This highway starts at its junction with Highway 97 at Arras (11 km west of Dawson Creek) south to its junction with Highway 29 in Tumbler Ridge (distance 98 km), and then loops back, traveling north and east (approximately 145 km) to Route 2 at the unincorporated settlement of Tupper (BC Adventure.Com 1995-2013; BC MOTI n.d.).

Highway 52N (Heritage Highway) is paved for all but one 20 km section of its length, the remainder being chip seal. The entire highway is two-lane with intermittent passing lanes (L. Norman, Pers. Comm., 2013). Highway 52E (Boundary Road) is an unpaved gravel road that is used mostly by locals (BC Adventure.Com 1995-2013).

Air, Rail and Bus Transportation

The largest airport in the PRRD is Fort St. John Regional Airport, located 7 km east of the community (YXJ n.d.). The airport has two runways (InvestBC n.d.) and 6 helicopter pads (FSJ n.d.). Carriers serving the airport include Air Canada Jazz, Central Mountain Air, and North Cariboo Air (the latter only by charter- YXJ n.d.). The airport serves a total of 56 non-stop flights per week (InvestBC n.d.) to various cities including major cities such as Vancouver, Calgary, and Edmonton (NPEDC 2012). Seven helicopter companies are also based at the airport (FSJ n.d.).

The City of Dawson Creek's airport is served by two carriers: Central Mountain Air, which offers direct flights to Fort Nelson and Vancouver; and Swanberg Air, which offers connecting flights to Fort Nelson, Edmonton and Calgary and direct flights to Fort St. John and Grande Prairie. The airport is also served by Charter companies such as Borek Air, Alta Flights, Villers Air, and North Caribou Air, and is also used by various helicopter companies (Dawson Creek 2011).

The District of Chetwynd owns and operates the Chetwynd Municipal Airport, centrally located within the town's boundaries. The airport is registered for day and night use; however, it is not able to be utilized by commercial airlines. It supports Air Ambulance, local businesses and industry and the local flying club (Chetwynd 2012; SPEDC 2012c). There is also a small airport site located 11 km south of Tumbler Ridge, which is primarily used by chartered and private local flights. The airport has a 4,000 feet asphalt runway (DTR 2009, n.d.).

Canadian National Railway (CN Rail) provides cargo services to the local industry. CN Rail provides freight service to Fort Nelson and to the ports of Prince Rupert and Vancouver. It has also reinstated operations along its Grande Prairie Subdivision between Hythe, Alberta and Dawson Creek (Dawson Creek 2011). The railway has cargo-bulk, container, liquid, and multi-commodities capability (InvestBC n.d.).

Greyhound provides bus service to Fort St. John, Dawson Creek, Chetwynd and other communities in the Peace Region (Greyhound 2011).

5.10.3 Establishing the Scope of the Cumulative Effects Assessment

The following two criteria for the relevance of evidence pertaining to other human actions are considered in the scoping of the CEA:

1. a residual effect of the Project must be demonstrated to operate cumulatively with the effects of another human action; and
2. the other human action must be known to have been carried out, or it must be probable (using best professional judgement) that it *will be* carried out.[1]

As stipulated in the Application Information Requirements (BC EAO 2013a), only residual effects are carried forward from the Project-specific effects assessment into the CEA. Thus, the VCs used as focal points for the Project-specific environmental assessment, selected as described in Section 5.6.1, are also captured in the CEA. However, the assessment boundaries for the CEA may be expanded in order to consider a broader scale of environmental concerns, as described in Sections 5.10.2.1 to 5.10.2.3.

5.10.3.1 Spatial Boundaries

Spatial boundaries for the CEA are determined individually for each assessment category, and comprise the area within which the VCs affected by the Project could also be affected by past, present, or future human actions (as defined in Section 5.10.2.2). It is not necessary for the spatial extent of the Project's effects to physically overlap with that of another human action, only for the Project to affect *the spatial extent of the same VC* affected by another human action. For some assessment categories, spatial boundaries correspond to the RSA, as described in Section 5.6.2.1; a larger spatial extent (for example, the range of caribou herds) is selected for other assessment categories to encompass the full area utilized by the VC under consideration.

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[1] These criteria are based on the report of the Joint Review Panel for the Express Pipeline Project (National Energy Board 1996). The Joint Panel specifically excluded consideration of "hypothetical" human actions from CEA. However, the CEA Agency's Practitioner's Guide states, "best practice suggests that effort should be made in identifying actions if there is reason to believe they may occur, yet are not overly hypothetical" (Hegmann et al. 1999). Further, the CEAA's more recent Operational Policy Statement added, "the Agency position has evolved to include 'certain' and 'reasonably foreseeable' projects and, where appropriate those projects that are 'hypothetical'" (CEA Agency 2007). Therefore, in accordance with best practices, future human actions that are hypothetical but are still judged to be probable are considered in this assessment.

5.10.3.2 *Temporal Boundaries*

The temporal boundaries for the CEA go beyond the phases of the Project, beginning before major human actions were undertaken in the region, and extending into the future. While precisely forecasting which other human actions will occur at the end of the Project's post-closure phase would be pure conjecture, an extrapolation of a likely future development scenario for the next several decades—based on information available today—is attempted.

The following temporal periods are evaluated as part of the CEA:

- **Past:** 1940 (to capture the early non-Aboriginal human activities in the region) to 2010 (when baseline studies at the Murray River Project began);
- **Present:** 2010 (from the start of the Project baseline studies) to 2014 (completion of the environmental assessment); and
- **Future:** temporal boundaries are stated in each assessment chapter, and vary according to the time estimated for VCs to recover to baseline conditions (taking into account natural cycles of ecosystem change).

The other human actions considered in the CEA (described in Section 5.10.5) fall into the following temporal categories:

- **Past** (closed) human actions;
- **Present** (continuing and active) human actions; and
- **Future** human actions, which may be:
  - **certain actions:** those actions that have received regulatory authorizations but are not as yet built or operating;
  - **reasonably foreseeable actions:** those actions that are currently in some stage of a regulatory authorization process, and for which a general concept is available from which potential cumulative effects may be anticipated; and
  - **hypothetical actions:** those actions that are conjectural but probable, based on best professional judgement of currently available information, including leases, licences, and extrapolations from historical development patterns; *the potential cumulative effects of such actions are discussed on a conceptual basis only in this CEA*.

5.10.3.3 *Administrative and Technical Boundaries*

As defined and described in Sections 5.6.2.3 and 5.6.2.4, administrative and technical boundaries may not apply to every VC. However, where these boundaries may affect the identification and/or assessment of potential effects, the nature of the boundaries and their effect on the assessment are discussed in the relevant assessment chapter.

5.10.3.4 *Identification of Potential Cumulative Effects*

Residual effects carried forward from the Project-specific assessment are considered in combination with the residual effects of past, present, and future human actions, where some spatial and temporal overlap occurs (as described in Sections 5.10.2.1 and 5.10.2.2). Unless there is a spatial overlap, temporal overlap is considered irrelevant.

The results are presented in an impact matrix, as shown in Table 5.10-2. If there is no spatial and temporal overlap between the residual effects of the Project and those of another human action, the relevant cell is marked with a dash (-). Where there is spatial and temporal overlap, but no interaction is anticipated, the cell is marked grey (■), and a rationale as to why no interaction is predicted is given in the accompanying text. If there is overlap, and an interaction is anticipated, the cell is marked with a green (■), yellow (■), or red (■), as described in Section 5.6.3 and summarized in the footnotes to Table 5.10-2. Supporting rationale for the rankings assigned to interactions is then provided in the text.

Table 5.10-2. Example of Ranking Potential for Residual Effects to Interact Cumulatively with Effects of Other Human Actions on a VC.

Murray River Coal Project Residual Effect	Potential for Cumulative Effect with Other Human Actions						
	Human Action 1	Human Action 2	Human Action 3	Human Action 4	Human Action 5	Human Action 6	Human Action 7
Residual Effect 1	L	L	O	L	M	-	-
Residual Effect 2	H	-	M	H	-	M	-
Residual Effect 3	-	H	H	H	M	M	-
Residual Effect 4	-	M	M	M	-	-	-
Residual Effect 5	L	L	-	L	-	-	-
Residual Effect 6	M	-	M	M	-	M	-
Residual Effect 7	L	L	-	L	-	-	-
Residual Effect 8	-	-	-	-	-	-	-

Notes:

(-)	*No spatial or temporal overlap.*
O	*Spatial and temporal overlap, but no interaction is anticipated, no further consideration warranted.*
L	*Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*
M	*Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
H	*Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

As in the Project-specific effects assessment, only potential adverse effects ranked as moderate or major (yellow or red) before active application of mitigation measures will be carried forward in the CEA.

5.10.4 Description of Potential Cumulative Effects and Mitigation

In a similar process to the one described in Section 5.7, the potential effects identified as moderate or major (as discussed in Section 5.10.2) are next described in detail. Where data are lacking, assessors employ best professional judgement, and document the specific data limitations encountered and assumptions made.

After describing each potential effect, any additional measures proposed as mitigation are identified and summarized. Quantitative, semi-quantitative, and qualitative techniques are used to assess the anticipated results of this mitigation, and the specific methods and assumptions used are documented.

Potential cumulative effects that are expected to persist after mitigation measures are applied are called **residual cumulative effects**. In light of the relevant mitigation measures proposed, anticipated residual effects are also described. This step of the assessment is summarized in a format similar to the one presented in Table 5.10-3.

Table 5.10-3. Example of Summary of Residual Cumulative Effects

Valued Component	Murray River Activity	Other Human Action Activity	Description of Potential Cumulative Effect	Description of Mitigation Measure(s)	Description of Residual Cumulative Effect

If a potential effect is judged to be fully mitigated, it is not considered further in the CEA; only residual cumulative effects are carried forward and characterized (as described in Section 5.10.4).

5.10.5 Characterization of Residual Cumulative Effects, Significance, Likelihood, and Confidence

The residual cumulative effects to VCs are next characterized using the same criteria described in Section 5.9 (e.g., Magnitude, Geographic Extent, Duration, Frequency, Reversibility, Context). Each assessment chapter documents if and how these generic criteria have been tailored to the specific assessment category. Narrative descriptions and justifications for the application of each descriptor are provided in the accompanying text.

Significance, probability and confidence are also assessed using the same criteria described in Section 5.9. A summary of the assessment of residual cumulative effects is provided at the conclusion of each assessment chapter in a format similar to that presented in Table 5.10-4.

5.11 CONCLUSION

The Application/EIS will provide a summary description of the key residual and cumulative residual effects and the Proponent's conclusion on the potential for significant adverse environmental effects resulting from the Project.

A summary of the residual Project and cumulative effects is provided at the conclusion of each assessment chapter in a format similar to that presented in Table 5.11-1.

Table 5.10-4. Example of Characterization of Residual Cumulative Effects, Significance, Confidence and Likelihood

Residual Cumulative Effect	Effect Characterization								
	Magnitude	Duration	Frequency	Geographic Extent	Reversibility	Context	Significance	Probability	Confidence
Effect 1									
Effect 2									
Effect 3									

Table 5.11-1. Example of Summary of Residual Effects, Mitigation, and Significance

Residual Effects	Project Phase	Mitigation Measures	Residual Effect Significance	Residual Cumulative Effect Significance
<Valued Component 1>				
Description of Residual Effect 1				
Description of Residual Effect 2				
<Valued Component 2>				
Description of Residual Effect 1				
Description of Residual Effect 2				

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