Section E
Environmental Assessment

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E ENVIRONMENTAL ASSESSMENT

This section of Coalspur Mines (Operations) Ltd.'s (Coalspur's) Vista Coal Mine Project (Vista Project or Project) application constitutes the Environmental Impact Assessment (EIA) for the Project. Environmental baseline reports and impacts for each Project discipline are contained in Consultant Reports (CR #1 to CR #13). This section includes Coalspur's evaluation and summary of pertinent information from each of the Consultant Reports along with commitments to monitoring and mitigation measures relating to the environmental resources associated with the Project. The Socio-Economic Impact Assessment is presented in Consultants Report #8 (CR #8) and also evaluated in this section.

The EIA methodology used in this assessment is provided in Section D of the application. With this application, Coalspur is proposing the Vista Project which consists of area under an existing mine permit plus an expansion area (Figure A.1.0.2). Coalspur is applying for a mine permit amendment, mine and dump licences, and an Environmental Protection and Enhancement Act (EPEA) approval. The proposed Vista Project will involve:

- a surface coal mine including pits, external waste rock dumps, a full range of surface coal mining and support equipment and infrastructure. The coal seams on the Vista property will utilize modern open pit methods employing two large draglines with an associated dozer and truck-shovel fleet of equipment.
- associated infrastructure including raw and clean coal conveyors, run-of-mine (ROM) crushers and sizers, a coal processing plant and drying facilities, fresh water storage pond, processed fines settling pond and clean-coal load-out facility.
- access corridors, haul roads, utilities and environmental management systems for a 20-year mining area.

The coal is moderately low-rank bituminous, suited for thermal electric generation. The primary markets will be in the Asian Pacific Rim; other market opportunities will be considered. At a full annual production rate of 5 million clean tones.

The area proposed for disturbance totals approximately 2,649 ha. This includes all infrastructure, pits, rights-of-way and environmental management systems as summarized below:

Pit	912 ha
Sub-crop Rock Dump	207 ha
South Rock Dump	298 ha
North Rock Dump	579 ha
Plant Site	80 ha
ROM Conveyor & Access Road	15 ha
Corridor for Access Road/Conveyor/Load-out Corridor	51 ha
Fresh Water Pond	54 ha
Fines Settling Pond	296 ha
Environmental Management: Runoff Settling Ponds/Diversions/Soil Storage	157 ha

The final Terms of Reference were issued for the Project on January 24, 2012 and contained a number of conditions related to the information requirements for this application. These conditions from the Terms of Reference have been addressed by this application and each of the consultant's reports.

The Project EIA considers the following assessment scenarios:

- baseline case, which includes existing environmental conditions and existing projects or "approved" activities;
- application case, which includes the baseline case plus the Project; and
- planned development case (cumulative effects), which includes the "application case" combined with past studies, existing and anticipated future environmental conditions, existing projects or activities, plus other "planned" projects or activities.

For the purposes of defining assessment scenarios, "approved" means approved by any federal, provincial or municipal regulatory authority, and "planned" means any project or activity that has been publicly disclosed prior to the issuance of the Project's Terms of Reference or up to six months prior to the submission of the Project application and the EIA report, whichever is most recent.

The EIA report has addressed impact concerns by identifying Valued Environmental Components (VECs). VECs for the Project are those environmental attributes associated with the proposed Project development, which have been identified to be of concern either by directly-affected stakeholders, government or the professional community. VECs consider both biophysical (*i.e.,* ecosystem) and socio-economic attributes because of the broad-based definition of environmental effect as outlined both in federal and provincial legislation.

The factors used to assess the predicted environmental effects of the Project are specific to the VECs for each biophysical or socio-economic component. For example, the assessment of environmental effects and determination of significance for each VEC which is population based (*e.g*. fish, wildlife, vegetation) may not be applicable for those VECs which are not population based (*e.g*. air quality, groundwater). This section identifies potential adverse effects and the assessment of their significance. Where possible, the determination of significance makes reference to existing standards, guidelines or recognized thresholds (*e.g*., Alberta Ambient Air Quality Objectives).

E.1 AIR QUALITY

E.1.1 Introduction and Terms of Reference

Coalspur conducted an assessment of air quality for the proposed Project. The following section is a summary of the Air Quality Assessment that was prepared by Millennium EMS Solutions Ltd. and is included as Consultant Report #1 (CR #1). For full details of the assessment, please refer to CR #1.

Alberta Environment and Water issued the final ToR for the Project on January 24, 2012. The specific requirements for the air quality component are provided in Section 2.6 and Section 3.1, and are as follows:

2.6 Air Emissions Management

[A] Discuss the selection criteria used, options considered, and rationale for selecting control technologies to minimize air emission and for air quality management.

[B] Provide emission profiles (type, rate and source) for the Project's operating emissions including point and non-point sources and fugitive emissions (including mine faces), and for construction emissions. Consider both normal and upset conditions. Discuss:

- *a) odorous or visible emissions from the proposed facilities;*
- *b) annual and total greenhouse gas emissions for all stages of the Project. Identify the primary sources and provide examples of calculations;*
- *e) the Proponent's plans to manage emissions from the mining fleet;*
- *f) the amount and nature of Criteria Air Contaminant emissions; and*
- *g) the amount and nature of acidifying emissions, probable deposition patterns and rates.*

3.1 Air Quality, Climate and Noise

3.1.1 Baseline Information

[A] Discuss the baseline climatic and air quality conditions including:

- *a) the type and frequency of meteorological conditions that may result in poor air quality; and*
- *b) appropriate ambient air quality parameters.*

[B] Provide representative baseline noise levels at receptor locations.

3.1.2 Impact Assessment

[A] Identify components of the Project that will affect air quality, and:

- *a) describe the potential for reduced air quality (including odours and visibility) resulting from the Project and discuss any implications of the expected air quality for environmental protection and public health;*
- *b) estimate ground-level concentrations of appropriate air quality parameters;*
- *c) discuss any expected changes to particulate deposition, nitrogen deposition or acidic deposition patterns;*
- *d) identify areas that are predicted to exceed Potential Acid Input (PAI) critical loading criteria;*
- *e) discuss interactive effects that may occur resulting from co-exposure of a receptor to all emissions; and*
- *f) describe air quality impacts resulting from the Project, and their implications for other environmental resources, including habitat diversity and quantity, soil resources, vegetation resources, and water quality.*

[B Identify stages or elements of the Project that are sensitive to changes or variability in climate parameters, including frequency and severity of extreme weather events. Discuss what impacts the change to climate parameters may have on elements of the Project that are sensitive to climate parameters.

The size and location of the study areas were based on several factors and meet the requirements of AEW (2009a). The regional study area (RSA) encompasses all Project emission sources and additional regional emission sources within 40 km by 30 km of the Project sources (CR #1, Figure 2.1-1). The local study area (LSA) was defined as the region immediately surrounding the Project and is 11.5 km by 9 km (CR #1, Figure 2.1-1)

A number of potential VECs were identified during the issue scoping process as they relate to potential human or ecosystem health effects. The air quality VECs include:

- concentration of nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matter ($PM_{2.5}$), carbon monoxide (CO);
- concentration of specific volatile organic carbons (VOCs) and polycyclic aromatic hydrocarbons (PAHs);
- concentration of trace metals;
- greenhouse gas (GHG) emissions; and
- ozone (O_3) emissions.

Modelling was done using the CALMET/CALPUFF model, and was conducted according to AEW (2009). Four assessment cases were considered in the air quality assessment:

- baseline case– including all existing emissions from highways (paved / unpaved), gravel roads, compressor stations, gas plants, and Hinton community and industrial emissions;
- Project-only case for year 2029 (Vista Coal Mine Project) – including mining of McLeod, Val d'Or and McPherson seams, emissions from in-pit and north dump, haul road emissions, and coal processing facility emissions. This case does not include baseline emission sources;
- application case for 2029 – including baseline and Project case sources as defined above; and
- planned development case (PDC) – including application case sources (baseline and Vista Coal Mine), CN Rail Clean Coal Load-out and the emissions from a potential future expansion near the Vista project.

Predictions were made for the maximum point of impingement (MPOI) determined using a grid of receptors (spaced from 50 m to 1 km) as well as at 25 specific receptors (CR #1, Table 2.5-3 and Figure 2.3-1). These predictions were compared to the Alberta Ambient Air Quality Objectives (AAAQO), Alberta Ambient Air Quality Guideline (AAAQG, for hourly $PM_{2.5}$ only) and the Canada Wide Standards (CWS) for regulated compounds (CR #1, Table 2.4-1). The objectives refer to averaging periods ranging from one hour to one year. For modelling purposes, the hourly objectives are applied to the 9th highest predictions, and daily objectives are applied to the 2nd highest annual prediction.

E.1.2 Baseline Conditions

E.1.2.1 Background Concentrations

Background concentrations were obtained from select stations in the West Central Airshed Society (WCAS) network and from AEW's Mobile Air Monitoring Laboratory (MAML). A summary of air contaminant concentrations measured in the region (2006 to 2010) is presented in CR #1, Table 3.3.1.

No exceedances of either the SO_2 or NO_2 AAAQO were measured in the region. Maximum particulate ($PM_{2.5}$ and PM_{10}) values were high at all stations as the data reported includes measurements during periods of forest fire activity. The ambient measurements which were used as background values are presented in Table E.1.2.1.

Table E.1.2.1 Ambient Background Concentrations for Modelled Criteria Air Contaminants (CACs)

Compounds	Hourly (µg/m^3)	8-Hour (µg/m^3)	24-Hour (µg/m^3)	Monthly (µg/m^3)	Annual (µg/m^3)	Data Source
SO_2	2.6	-	2.6	0	0	Hightower Ridge, December 1, 2007 – December 31, 2010 [(a)]
NO_2	5.6	-	-	-	1.5	Hightower Ridge, December 1, 2007 – December 31, 2010 [(a)]
$PM_{2.5}$	6.4	-	6.4	-	1.5	Steeper, March 1, 2009 to September 30, 2011 [(a)]
PM_{10}	16	-	16	-	6.3	Steeper, March 1, 2009 to September 30, 2011 [(a)]
TSP	32	-	32	-	13	2x PM_{10} Background Values
CO	573	573	--	-	--	MAML – Town of Edson [(b)]

[(a)] Source: CASADATA 2011.
[(b)] Source: AEW 2002b.
- No AAAQO for this averaging period, therefore background concentration not required.

E.1.2.2 Baseline Concentrations

Baseline emissions utilized in the air dispersion modelling are listed in Tables E.1.2.2 and E.1.2.3. The baseline case emissions included all existing emissions from highways (paved / unpaved), gravel roads, compressor stations, gas plants, and Hinton community and industrial emissions (CR #1, Section 4.3). Model predictions for the baseline case are discussed in Section E.1.3.

Table E.1.2.2 Summary of RSA Maximum Daily Emissions (kg/d) - Summer Conditions

No.	Description	SO_2	NO_x	CO	TSP	PM_{10}	$PM_{2.5}$
1	Vista Mines and Waste Dumps (Project, Application, and PDC)	17.7	1,108	3,136	825	432	53
2	Vista Haul Roads (Project, Application, and PDC)	11.6	2,821	150	5,688	2,292	314
3	Vista Stockpiles (Project, Application, and PDC)	0.2	46	3	184	104	14
4	Vista Stack(Project, Application, and PDC)	119	711	43	427	213	64
5	Public Roads (Baseline, Application, and PDC)	7.0	208	90	12,759	3,048	343
6	Obed Load Out (Baseline, Application, PDC)	0.3	11	19	3	1.4	0.2
7	Gas Plants and Compressor Stations (Baseline, Application, and PDC)	0	702	422	0	0	0
8	West Fraser Mills Hinton Facilities & Border Paving (Baseline, Application, and PDC)	4,338	2,978	2,696	1,291	1,031	772
9	Hinton Town (Baseline, Application, and PDC)	0.1	1	4	15	11	7
10	Train Load Out (PDC)	0.6	21	37	6	3	0.4
11	Potential future expansion Vista Mines and Waste Dumps (PDC)	17.7	1,108	3,136	825	432	53
12	Potential future expansion Haul Roads (PDC)	11.6	2,821	150	5,688	2,292	314
13	Potential future expansion Stockpiles (PDC)	0.2	46	3	184	104	14
14	Potential future expansion Stack (PDC)	119	711	43	427	213	64
TOTAL for Baseline Case		**4,345**	**3,900**	**3,230**	**14,068**	**4,092**	**1,115**
TOTAL for Project Only Case 2029		**149**	**4,686**	**3,332**	**7,124**	**3,041**	**445**
TOTAL for Application Case		**4,494**	**8,586**	**6,561**	**21,192**	**7,132**	**1,561**
TOTAL for PDC Case		**4,643**	**13,293**	**9,930**	**28,322**	**10,176**	**2,007**

Table E.1.2.3 Summary of RSA Maximum Daily Emissions (kg/d) - Winter Conditions

No.	Description	SO_2	NO_x	CO	TSP	PM_{10}	$PM_{2.5}$
1	Vista Mines and Waste Dumps (Project, Application, and PDC)	17.7	1,108	3,136	825	432	53
2	Vista Haul Roads (Project, Application, and PDC)	11.6	2,821	150	2,975	1,178	176
3	Vista Stockpiles (Project, Application, and PDC)	0.2	46	3	184	104	14
4	Vista Stack(Project, Application, and PDC)	119	711	43	427	213	64
5	Public Roads (Baseline, Application, and PDC)	7.0	208	90	2,340	515	90
6	Obed Load Out (Baseline, Application, PDC)	0.3	11	19	3	1.4	0.2
7	Gas Plants and Compressor Stations (Baseline, Application, and PDC)	0	702	422	0	0	0
8	West Fraser Mills Hinton Facilities & Border Paving (Baseline, Application, and PDC)	4,338	2,978	2,696	1,291	1,031	772
9	Hinton Town (Baseline, Application, and PDC)	0.1	1	4	15	11	0.1
10	Train Load Out (PDC)	0.6	21	37	6	3	0.4
11	Potential future expansion Vista Mines and Waste Dumps (PDC)	17.7	1,108	3,136	825	432	53
12	Potential future expansion Haul Roads (PDC)	11.6	2,821	150	2,975	1,178	176
13	Potential future expansion Stockpiles (PDC)	0.2	46	3	184	104	14
14	Potential future expansion Stack (PDC)	119	711	43	427	213	64
TOTAL for Baseline Case		**4,345**	**3,900**	**3,230**	**3,649**	**1,558**	**862**
TOTAL for Project Only Case 2029		**149**	**4,686**	**3,332**	**4,411**	**1,927**	**307**
TOTAL for Application Case		**4,494**	**8,586**	**6,561**	**8,060**	**3,484**	**1,170**
TOTAL for PDC Case		**4,643**	**13,293**	**9,930**	**12,477**	**5,414**	**1,478**

E.1.3 Potential Impacts

The Project will result in atmospheric emissions from fossil fuel combustion sources, fugitive emissions from mine equipment, coal processing plant, soil handling, coal movement and wheel entrainment. At sufficiently high concentrations, these air emissions can have direct and indirect effects on humans, animals, vegetation, soil and water.

CAC emission sources within the RSA, for all assessment scenarios, are summarized in Tables E.12.2 (summer road conditions) and E.1.2.3 (winter). From the tables, the following observations are relevant:

- the highest SO_2 and NO_x emission sources in the RSA are industrial facilities at Hinton;

- public roads are the biggest sources of dust in summer and they are comparable to Vista haul roads in winter; and
- winter conditions substantially reduce emissions from roadways but not other sources.

Emission summaries of organic compounds, PAHs and metals are presented in CR#1, Tables 4.4-3 to 4.4-5 respectively. For most organic compounds and PAHs, baseline emissions are significant and often many times larger than emissions associated with the Project.

E.1.3.1 Sulphur Dioxide (SO_2)

The CALPUFF model was used to estimate the concentration of SO_2 that would occur for the assessment scenarios. The change in both the RSA-MPOI and LSA-MPOI values between the baseline, application and planned development cases was negligible to small. Modelling predicted a slight increase or no change in the ground-level SO_2 concentrations at special receptor locations. No exceedances of the AAAQO were predicted for any of the averaging periods, for any modelling case (CR #1, Table 5.1-1).

The patterns of SO_2 concentration for the 9th highest hourly, 2nd highest daily, monthly, and annual averages for the three assessment scenarios are shown on CR #1, Figures 5.1-1 to 5.1-8, respectively and presented in Table E.1.3.1.

Table E.1.3.1 Summary of Key Predicted Air Quality Concentrations

	SO_2				NO_2		CO		$PM_{2.5}$	PM_{10}	TSP
	9th Highest 1-hr	2nd Highest 24-hr	Monthly	Annual	9th Highest 1-hr	Annual	9th Highest 1-hr	CO Max 8-hr	2nd Highest 24-hr	2nd Highest 24-hr	2nd Highest 24-hr
Baseline Case											
RSA Maximum (µg/m³)	137	24	4.0	2.2	138	13	935	807	9.4	43	138
LSA Maximum (µg/m³)	51	12	1.7	0.81	35	2.5	600	612	6.9	18	40
Application Case											
RSA Maximum (µg/m³)	137	24	4.1	2.2	159	14	3246	3551	12	44	139
LSA Maximum (µg/m³)	51	12	1.7	0.96	159	14	3246	3551	12	38	68
Application increase relative to Baseline (%) – RSA Max	0	0	0	0.5	16	13	247	340	23	2	0.8
Application increase relative to Baseline (%) – LSA Max	0.2	0	0.9	18	361	465	441	480	67	105	71
Planned Development Cases											
RSA Maximum (µg/m³)	137	24	4.2	2.2	204	17	4985	4540	12	47	146
LSA Maximum (µg/m³)	52	11	2.6	1.5	166	16	3459	4445	12	40	69
PDC increase relative to Baseline (%) – RSA Max	0	0	2.8	1.4	48	35	433	463	28	9	5.4

Table E.1.3.1 Summary of Key Predicted Air Quality Concentrations											
	SO_2				**NO_2**		**CO**		**$PM_{2.5}$**	**PM_{10}**	**TSP**
	9th Highest 1-hr	**2nd Highest 24-hr**	**Monthly**	**Annual**	**9th Highest 1-hr**	**Annual**	**9th Highest 1-hr**	**CO Max 8-hr**	**2nd Highest 24-hr**	**2nd Highest 24-hr**	**2nd Highest 24-hr**
PDC increase relative to Baseline (%) – LSA Max	1.0	-7	54	83	380	450	476	626	73	114	74
AAAQO (μg/m³)	450	125	30	20	300	45	15,000	6,000	30	50	100

E.1.3.2 Nitrogen Dioxide (NO_2)

The CALPUFF model was used to estimate the concentration of NO_2 that would occur for the assessment scenarios. Using both the Ozone Limiting Method (OLM) and the Total Conversion Method (TCM) the model predicted no exceedances of the AAAQOs of NO_2 for any of the assessment scenarios for any averaging period (CR #1, Table 5.2-1). The patterns of NO_2 concentration for 9th highest 1-hour and annual average for the three development scenarios are shown on CR #1, Figures 5.2-1 to 5.2-4, respectively and presented in Table E.1.3.1.

E.1.3.3 Carbon Monoxide (CO)

The CALPUFF model was used to estimate the concentration of CO that would occur for the assessment scenarios. No exceedances of the AAAQO were predicted for any of the averaging periods, for any modelling case (CR #1, Table 5.3-1). The regional patterns for dispersion for CO are presented in CR #1, Figures 5.3 to 5.3-6 and a summary of air quality predictions are presented in Table E.1.3.1.

E.1.3.4 Particulate Matter less than 2.5 microns ($PM_{2.5}$)

The CALPUFF model was used to estimate the concentration of ground-level $PM_{2.5}$ for each of the assessment scenarios. The secondary production of nitrates and sulphates within the dispersion model was included in the predicted results along with direct emissions. To account for the mitigating influences of forest vegetation, the predictions were reduced by 75%, less than the minimum recommended reduction. The hourly air quality guideline and the daily air quality objective were not exceeded for any of the assessment scenarios (CR #1, Table 5.4-1). The 2nd highest daily predicted concentrations are shown in CR #1, Figures 5.4-1 and 5.4-2 and a summary of air quality predictions for the three scenarios are presented in Table E.1.3.1.

E.1.3.5 Particulate Matter less than 10 microns (PM_{10})

The CALPUFF model was used to estimate the concentration of ground-level PM_{10} for each of the assessment scenarios. The predicted PM_{10} concentrations are compared to the 2nd highest daily air quality objective for British Columbia (BC Environment 2009) as no AAAQO exists for this compound. To account for the mitigating influences of forest vegetation, the predictions were reduced by 75%, less than the minimum recommended reduction. When the mitigated approach is considered, the B.C. Air Quality Objective (BCAQO) is not exceeded for any of the assessment scenarios (CR #1, Table 5.5-1). The spatial distribution of daily PM_{10} predictions is presented in CR #1, Figures 5.5-1 to 5.5-3 and a summary of air quality predictions for the three scenarios are presented in Table E.1.3.1.

E.1.3.6 Total Suspended Particulate Matter (TSP)

The CALPUFF model was used to estimate the concentration of ground-level TSP for each of the assessment scenarios. As with $PM_{2.5}$ and PM_{10}, it is expected that the surrounding vegetation will reduce the predicted ground-level concentrations of TSP by 75%. A summary of air quality predictions are presented in Table E.1.3.1.

Mitigated maximum 24-hour predictions at all locations within the LSA are below the AAAQO for TSP. The maximum 24-hour prediction at the RSA-MPOI exceeds the AAAQO for all assessment cases. However, the Project does not introduce any new exceedances or appreciably contribute to the exceedance.

Exceedances are also predicted at 10 receptors, for each assessment case, all located along the Robb Road. The frequency of the exceedance ranges from 1.1 % to 73%, depending on the proximity of the receptor to the gravel road. However, the maximum increase in the frequency due to the application case is 2.1%, and the maximum increase in the PDC over the baseline case is 3.1%, indicating traffic on the existing road is the main contributor.

The CALPUFF model was also used to estimate TSP deposition. Maximum TSP deposition for the three assessment scenarios was predicted to occur along the Robb Road. In general, the greatest effects of TSP deposition are found near all unpaved road sources. These maximum predictions are much less than the dustfall guidelines (CR #1, Table 5.7-1), which are meant to address the nuisance effects of dust particles larger than TSP.

E.1.3.7 Nitrogen Deposition

Deposition of nitrogen can lead to eutrophication in water bodies or changes in growth rates of terrestrial vegetation, and its calculation includes both wet (removal in precipitation) and dry (direct contact with surface features) processes. The results of CALPUFF modelling indicate that the regional maximum predicted nitrogen deposition was 24 kg/ha/yr for baseline, application and planned development cases (CR #1, Table 5.8-1).

E.1.3.8 Potential Acid Input (PAI)

Precursor emissions for PAI include NO_X and SO_2. The results of CALPUFF modelling in the RSA are shown in CR #1, Table 5.9-1. The maximum predicted PAI value is approximately 0.25 keq/ha/yr in the baseline, application and PDC and therefore the Project contribution to the maximum prediction is negligible. The pattern of PAI is presented in CR #1, Figures 5.9-1 to 5.9-3. There are no predicted exceedances of the critical load of 0.25 keq/ha/yr for the most sensitive ecosystems in the RSA in any assessment case.

E.1.3.9 Volatile Organic Compounds (VOCs) and Polycyclic Aromatics (PAHs)

The Project generates trace chemical compounds from fuel combustion at the plant and fuel combustion for vehicles and mine equipment. The chemical compounds assessed have been identified as those emitted by the proposed Project that may potentially have a deleterious effect on human health if present in air in sufficient concentration, and whose concentrations are subject to AAAQOs. The Chemicals of Potential Concern (COPCs) addressed include:

- Acetaldehyde;
- Benzene;
- Benzo[a]pyrene;

- Formaldehyde;
- Toluene; and
- Xylene.

There is limited availability of ambient measurements for some COPC so measurements from outside the RSA were used. For some species, this resulted in very conservative predictions as the modelling predictions (for all cases) were often much smaller than the background values. No exceedances of AAAQOs were predicted for any COPC and, in most cases, the concentrations at the RSA-MPOIs are many orders of magnitude below the AAAQOs (CR #1, Tables 5.9-1 to 5.9-10). Effects from a longer list of COPCs are considered in the human health risk assessment (Section E.5 and CR #5). For most chemicals, the Project contribution is negligible at all locations.

E.1.3.10 Metals

Sources of metals include exhaust emissions from diesel combustion, combustion of coal in the dryer and fugitive emissions from the re-suspension of road dust and material handling in pit operations. The metals considered in this assessment are based on those available *in situ* measurements of soil and overburden. Not all metals have associated diesel combustion emission factors and if there were no emission factors available for a particular species, then the primary emission source would be from the soil/dust component.

In addition, there is limited availability of background ambient measurements for metals so measurements from outside the RSA were used. Ambient measurements tend to be available from areas with higher levels of industrialization than the Project area, so the background concentrations introduce additional conservatism to the predictions. For some species, this resulted in very conservative predictions as the modelling predictions (for all cases) were much smaller than the background values.

No exceedances of the AAAQO were predicted for any metal, for any averaging period.

E.1.3.11 Odour

The maximum predicted concentrations for select compounds that may be emitted from the Project are compared with established odour thresholds. Compounds evaluated include:

- Acenaphthene;
- Acetaldehyde;
- Acrolein;
- Benzene;
- Carbon Monoxide;
- Formaldehyde;
- Naphthalene;
- Nitrogen Dioxide;
- Sulphur Dioxide;
- Toluene; and
- Xylene.

As odour can be perceived within a short time span, the air concentration used in the comparison was based on a three-minute averaging period. The mean odour threshold was met or exceeded by the 3-minute prediction for nitrogen dioxide only, in the PDC only (CR #1, Table 5.11-1). Exceedance of the average odour threshold was predicted to occur infrequently (0.13% of the time) at the RSA-MPOI (CR #1, Table 5.11-2), which is located on the western edge of the mine permit. The Project does not contribute to any other potential odour issues in the region.

E.1.3.12 Ozone (O_3)

Surface O_3 can be formed through photochemical production from emissions of anthropogenic NO_x, anthropogenic VOCs, and biogenic VOC compounds. The potential is greatest during summer periods characterized by high ambient temperatures (*i.e.* above 30^{o}C) and stagnant weather conditions (*i.e.* low wind speeds).

Fox and Kellerhaus (2008) used the CMAQ model to estimate future O_3 concentration throughout Alberta that could result from foreseeable emission increases. Of the source sectors considered in the study, those most applicable to the Hinton area were oil and gas, resources, and power generation; future emission increases in these sectors were estimated to be negligible and about 25%, respectively. On-road emission changes were also negligible and are likely to decline with new emission reduction advances. Under these assumptions, there was at most a 1% increase in the 4th highest daily maximum eight-hour O_3 concentration (the metric used in the Canada Wide Standard). The CMAQ model approach would infer a negligible change in regional O_3 concentrations with the addition of the Project.

E.1.3.13 Start-Up/Upset Emissions

Emissions for haul roads and mines construction have already been accounted for in the emissions for the Project. When the wash plant starts up, shuts down or is engaged in certain upset / alarm conditions, emissions from the thermal dryer are diverted to the bypass stack, for up to several minutes. Each time the bypass stack is opened there will be a short period of uncontrolled emissions. During normal start-up, the bypass will only be open a few minutes, quite likely with only the gas igniters on (prior to the ignition of coal fuel). Emissions as a result of gas combustion are much lower than those from the combustion of pulverized coal. During normal shut-down the bypass will open as the burners are stopped. The greatest source of uncontrolled emissions would be during emergency shutdown where the coal feed and coal fuel might be stopped instantaneously and simultaneously the by-pass would open. Uncontrolled emissions in this case are expected to last a maximum of a few minutes. In all these cases uncontrolled emissions averaged over one hour (the lowest average period when predictions are reported), will be only slightly higher than emissions for normal operating conditions.

E.1.4 Cumulative Effects

The Project will be developed in an airshed that has other emission sources and the addition of the Project will change the air quality. The Project contribution of $S0_2$ to RSA emissions is very small due to very high emissions of SO_2 from industry in Hinton. The Project contribution to other emissions in the RSA is larger and emissions would increase with a further addition of a potential future expansion. Table E.1.4.1 lists key emissions for each of the assessment cases and shows the contribution of the Project to the baseline case in the study area.

Table E.1.4.1 Comparison of Emissions Scenarios (Annual Average Emissions)

Scenario	SO_2	NO_x	CO	TSP	PM_{10}	$PM_{2.5}$
Project Contribution (year 2029) only (t/d)	0.15	4.69	3.33	5.78	2.49	0.38
Baseline Case (t/d)	4.35	3.90	3.23	8.86	2.82	1.00
Application Case (year 2029) (t/d)	4.50	8.59	6.56	14.64	5.31	1.38
Application increase relative to Baseline (%)	3	120	100	65	88	38
Planned Development Case	4.64	13.29	9.93	20.42	7.81	1.75
PDC increase relative to Baseline (%)	7	240	210	130	180	76

E.1.5 Mitigation and Monitoring

E.1.5.1 Mitigation

In order to reduce potential impacts of the Project on air quality, Coalspur will employ the following actions:

- ensure the mine fleet is regularly upgraded and by 2029, equipment will be newer and more efficient than assumed in emission estimation. Exhaust emissions from the U.S. EPA Tier 4 (2015) standards were used in Project emission estimates and it is likely that off-road standards will be more stringent by 2029;
- systematically apply water and/or chemical dust suppressants to haul roads and to the plant access road to minimize dust;
- retain snow cover on the road during the winter months, unless the cover would compromise the safety of vehicle operations;
- Maintain a cover over the length of the clean coal conveyor to avoid dust generation;
- Spray dust suppressant on the coal after each rail car has been filled, as needed;
- Maintain a drop chute on the load-out facility to minimize dusting during loading;
- competent gravel or crushed rock is used on the plant access road and haul roads. Gravel is observed to produce less dust than clay and sandy surfaces;
- maintain the active surface (grade) of the road to reduce the effective silt content of the running surface;
- progressively reclaim mined areas which reduces windblown fugitive dust emissions from the unvegetated land; and
- retain trees and bushes around the mine and plant new forest cover effectively trapping dust emissions from mining activities and reducing dust concentrations.

E.1.5.2 Monitoring

In order to verify that the mitigation measures have been effective, Coalspur will:

- conduct monitoring as required in the EPEA approval; and
- establish a continuous ambient climate and air quality monitoring station in or near the proposed plant site and include monitoring of 10-m wind speed and wind gust, 10-m wind direction, precipitation and temperature and $PM_{2.5}$.

E.1.6 Summary

Table E.1.6.1 summarizes air quality impact ratings for Project residual effects. The influence of the Project will be felt primarily within the LSA, with the extent of the impact dropping off quickly with increased distance from the Project. The Project influence on predictions of $PM_{2.5}$, PM_{10} and TSP in communities with the study region was not appreciable. The addition of the Project did not result in exceedances of the CWS, AAAQOs or odour thresholds. All Project air quality impacts are reversible and the ambient air quality is expected to revert to its original state after the Project ceases to operate.

Table E.1.6.1 Summary of Impact Ratings on Air Quality Valued Environmental Components (VECs)

Measurable Parameter	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[a]	Duration[b]	Frequency[c]	Reversibility[d]	Magnitude[e]	Project Contribution[f]	Confidence Rating[g]	Probability of Occurrence[h]	Impact Rating[i]
1. NO_2 Concentration												
	Potential human health effects	Section E.1.5	Project Residual	Local	Medium	Continuous	Reversible in long term	Moderate	Negative	High	High	Low
			Cumulative	Regional	Medium	Continuous	Reversible in long term	Moderate	Negative	Moderate	Medium	Low
2. SO_2 Concentration												
	Potential human health and vegetation effects	Section E.1.5	Project Residual	Local	Medium	Continuous	Reversible in long term	Nil to	Neutral to Negative	High	High	Low
			Cumulative	Regional	Medium	Continuous	Reversible in long term	Nil to Low	Negative and Negative	Moderate	Medium	Low
3. $PM_{2.5}$ Concentration												
	Potential human health effects and visibility impairment	Section E.1.5	Project Residual	Local	Medium	Continuous	Reversible in long term	Moderate	Negative	Moderate (greater uncertainty in PM secondary formation)	High	Low
			Cumulative	Regional	Medium	Continuous	Reversible in long term	Moderate	Negative	Moderate	Medium	Low
4. CO Concentration												
	Potential human health effects	Section E.1.5	Project Residual	Local	Medium	Continuous	Reversible in long term	Moderate	Negative	High	High	Low
			Cumulative	Regional	Medium	Continuous	Reversible in long term	Moderate	Negative	Moderate	Medium	Low

Table E.1.6.1 Summary of Impact Ratings on Air Quality Valued Environmental Components (VECs)

Measurable Parameter	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[(a)]	Duration[(b)]	Frequency[(c)]	Reversibility[(d)]	Magnitude[(e)]	Project Contribution[(f)]	Confidence Rating[(g)]	Probability of Occurrence[(h)]	Impact Rating[(i)]
5. PAI Deposition												
	Potential acidification of sensitive soils, water bodies and vegetation	Based on management of precursors as identified in CR #1, Section 4.3	Project Residual	Local	Medium	Continuous	Reversible in long term	Nil to Low	Negative	Moderate (more uncertainty in deposition estimates)	Medium	Low
			Cumulative	Regional	Medium	Continuous	Reversible in long term	Nil to Low	Negative	Low	Low	Low
6. Nitrogen Deposition												
	Potential eutrophication of sensitive ecosystems	Based on management of precursors as identified in CR #1, Section 5.14	Project Residual	Local	Medium	Continuous	Reversible in long term	Nil to Low	Negative	Moderate (more uncertainty in deposition estimates)	Medium	Low
			Cumulative	Regional	Medium	Continuous	Reversible in long term	Nil to Low	Negative.	Low	Low	Low
7. Particulate Deposition												
	Potential nuisance effects	Section E.1.5	Project Residual	Local	Medium	Continuous	Reversible in long term	Nil to Low	Negative	Moderate (more uncertainty in deposition estimates)	Medium	Low
			Cumulative	Regional	Medium	Continuous	Reversible in long term	Nil to Low	Negative.	Low	Low	Low

Table E.1.6.1 Summary of Impact Ratings on Air Quality Valued Environmental Components (VECs)

Measurable Parameter	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[(a)]	Duration[(b)]	Frequency[(c)]	Reversibility[(d)]	Magnitude[(e)]	Project Contribution[(f)]	Confidence Rating[(g)]	Probability of Occurrence[(h)]	Impact Rating[(i)]
7. Ozone Concentration												
	Potential human health effects	Based on management of precursors as identified in CR #1, Section 5.14	Project Residual	Regional	Medium	Continuous	Reversible in long term	Nil to Low	Negative	High	High	Low
			Cumulative	Regional	Medium	Continuous	Reversible in long term	Nil to Low	Negative	Low	Medium	Low
8. VOC, PAH and Metal Concentration												
	Potential human health effects	Section E.1.5	Project Residual	Local	Medium	Continuous	Reversible in long term	Nil to Low in an absolute sense	Negative	Moderate	Medium	Low
			Cumulative	Regional	Medium	Continuous	Reversible in long term	Nil to Low in an absolute sense	Negative	Low future (regional emissions less certain)	Medium	Low
9. Odour												
	Potential nuisance effects	Section E.1.5	Project Residual	Local	Medium	Continuous	Reversible in long term	Nil to Low in an absolute sense	Negative	Moderate	Medium	Low
			Cumulative	Regional	Medium	Continuous	Reversible in long term	Nil to Low in an absolute sense	Negative	Low future (regional emissions less certain)	Medium	Low
10. Greenhouse Gas												
	Potential ecological effects	Section E.1.5	Project Residual and Cumulative	Regional	Long	Continuous	Reversible in long term	Low	Negative	Moderate (information to include indirect emissions was not	Medium	Low

Table E.1.6.1 Summary of Impact Ratings on Air Quality Valued Environmental Components (VECs)

Measurable Parameter	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[(a)]	Duration[(b)]	Frequency[(c)]	Reversibility[(d)]	Magnitude[(e)]	Project Contribution[(f)]	Confidence Rating[(g)]	Probability of Occurrence[(h)]	Impact Rating[(j)]
										available)		

(a) Local, Regional, Provincial, National, Global

(b) Short, Long, Extended, Residual

(c) Continuous, Isolated, Periodic, Occasional

(d) Reversible in short term, Reversible in long term, Irreversible - rare

(e) Nil, Low, Moderate, High

(f) Neutral, Positive, Negative

(g) Low, Moderate, High

(h) Low, Medium, High

(i) No Impact, Low Impact, Moderate Impact, High Impact

E.2 FISHERIES

E.2.1 Introduction and Terms of Reference

Coalspur conducted an assessment of aquatic resources for the proposed Project. The following section is a summary of the Aquatic Resource Environmental Impact Assessment that was prepared by Pisces Environmental Consulting Services Ltd. and is included as Consultants Report #2 (CR #2). For full details of the assessment please refer to CR #2.

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the aquatic resource component are provided in Section 3.5 of the ToR and are as follows:

3.5 AQUATIC ECOLOGY

3.5.1 Baseline Information

[A] Describe and map the existing fish and other aquatic resources (e.g., benthic invertebrates) of the lakes, rivers, ephemeral water bodies and other waters. Describe the species composition, distribution, relative abundance, movements and general life history parameters. Also identify any species that are:

- *a) listed as "at Risk, May be at Risk and Sensitive" in The Status of Alberta Species (Alberta Sustainable Resource Development);*
- *b) listed in Schedule 1 of the federal Species at Risk Act; and*
- *c) listed as "at risk" by COSEWIC; and*
- *d) traditionally used species.*

[B] Describe and map existing critical or sensitive areas such as spawning, rearing, and over-wintering habitats, seasonal habitat use including migration and spawning routes.

[C] Describe the current and potential use of the fish resources by aboriginal, sport or commercial fisheries.

[D] Describe and quantify the current extent of aquatic habitat fragmentation.

3.5.2 Impact Assessment

[A] Describe the potential impacts to fish, fish habitat, and other aquatic resources (e.g., stream alterations and changes to substrate conditions, water quality and quantity) considering:

- *a) fish tainting, survival of eggs and fry, chronic or acute health effects, and increased stress on fish populations from release of contaminants, sedimentation, flow alterations, temperature and habitat changes;*
- *b) potential impacts on riparian areas that could affect aquatic biological resources and productivity;*
- *c) the potential for increased fishing pressures in the region that could arise from the increased workforce and improved access resulting from the Project. Identify the implications on the fish resource and describe any mitigation strategies that might be planned to minimize these impacts, including any plans to restrict employee and visitor access;*
- *d) changes to benthic invertebrate communities that may affect food quality and availability for fish; and*
- *e) the potential for increased fragmentation of aquatic habitat.*

[B] Identify the key aquatic indicators that the Proponent used to assess project impacts. Discuss the rationale for their selection.

[C] Discuss the design, construction and operational factors to be incorporated into the Project to minimize impacts to fish and fish habitat and protect aquatic resources. Describe how any water intakes have been designed to avoid entrapment and entrainment of fish and provide information on the species of fish considered.

[D] Identify plans proposed to offset any loss in the productivity of fish habitat. Indicate how environmental protection plans address applicable provincial and federal policies on fish habitat including the development of a "No Net Loss" fish habitat objective.

[E] Describe the effects of any surface and sub-surface water withdrawals considered including cumulative effects on fish, fish habitat and other aquatic resources.

The Project area is divided into two smaller areas: the Permit Area, referring to the mine permit area; and the Access Corridor, referring to the access road and conveyor line corridor (CR #2, Figure 1). The LSA for the aquatics component of the EIA encompassed the spatial area where Project-specific effects may occur and was selected based on the Permit Area boundary, the Access Corridor alignment, and drainage basin characteristics of waterbodies in the area. Waterbodies within the LSA include McPherson Creek, several tributaries to McPherson Creek, a tributary to the McLeod River, a tributary to the Athabasca River, Trail Creek and a tributary to Trail Creek (CR #2, Table 2.1 and Figure 2).

The RSA for the aquatics assessment encompasses the geographic extent of any potential impact to aquatic resources associated with Project development (CR #2, Figure 2). The RSA for the Project encompassed the LSA and also includes a portion of the McLeod River extending from its confluence with McPherson Creek downstream approximately 16 km (consistent with the RSA boundary for the water quality assessment) and a portion of the Athabasca River extending from the confluence with Athabasca River Tributary #1, 12 km downstream to near the confluence with Roundcroft Creek (consistent with the RSA boundary for the water quality assessment).

Several VECs were selected to assess the significance of potential impacts to aquatic resources within the LSA and RSA including:

- Arctic Grayling;
- Bull Trout;
- Rainbow Trout; and
- Benthic Invertebrates.

Information obtained during baseline aquatic field programs was the primary source of information for assessing impacts to the aquatic ecosystem potentially arising from construction and operational activities associated with the Project. In addition, the conclusions from the surface water quality assessment (Section E.6 and CR #6) and hydrology assessment (Section E.10 and CR #10) were used extensively for the impact assessment.

E.2.2 Baseline Setting

In the early phases of project planning, Coalspur elected to develop a mine plans with the intention that mine infrastructure would not result in a direct physical footprint on fish habitat. In accordance with this strategy and in support of the fisheries and aquatic resources component of the EIA for the proposed Project, key to baseline investigations was the identification of fish habitat locations within the Project area. Existing (baseline) aquatic resources in watercourses on and adjacent to the Project area were assessed using both historical information and field investigations.

McPherson Creek, the primary watercourse that drains the Project area, originates to the west of the Project and trends in a southeast direction through the center of the mine permit area eventually flowing into the McLeod River (CR #2, Figure 2). There are seven north-bank tributaries to McPherson Creek (that drain the proposed pit area) and five south-bank tributaries. Almost all of these tributaries are either intermittent or ephemeral. The northeast portion of the mine permit area is drained by a small unnamed tributary to the McLeod River (CR #2, Figure 2). The proposed access road and convey corridor alignment will cross the upper Trail Creek, an unnamed tributary to Trail Creek, and an unnamed tributary to the Athabasca River at two locations at the northwest end of the corridor (CR #2, Figure 2).

Baseline investigations included identification of all watercourses, waterbodies and potential waterbodies that could be impacted by the proposed Project, and a ground-level reconnaissance of the Project area to determine which of the potential watercourses would require detailed assessment and field surveys. A summary of baseline data collection is included in Table E.2.2.1. The results of baseline investigations in the mine area are summarized on CR #2, Figure 3. The figure provides approximate locations of sample sites and a summary of historical and baseline sampling results, and delineates available fish habitat in the area.

Table E.2.2.1 Summary of Aquatic Resource Baseline Field Investigations

Waterbody	Waterbody Code	Assessment Component
Mine Area		
McPherson Creek	MC	Reconnaissance, Electrofishing surveys, Habitat inventories, Field water quality, Lower trophic sampling
McPherson Creek Tributary #1	MCT1	Electrofishing surveys, Habitat inventories, Field water quality
McPherson Creek Tributary #2	MCT2	Electrofishing surveys, Habitat inventories, Field water quality
McPherson Creek Tributary #3	MCT3	Habitat inventories
McPherson Creek Tributary #4	MCT4	Electrofishing surveys, Habitat inventories, Field water quality
McPherson Creek Tributary #5	MCT5	Habitat inventories
McPherson Creek Tributary #6	MCT6	Electrofishing surveys, Habitat inventories
McPherson Tributary #8	MCT8	Electrofishing surveys, Habitat inventories, Field water quality
McPherson Tributary #9	MCT9	Habitat inventories, Water Quality
McPherson Tributary #10	MCT10	Electrofishing surveys, Habitat inventories, Field water quality
McPherson Tributary #11	MCT11	Electrofishing surveys, Habitat inventories, Field water quality
McLeod River Tributary #1	MRT1	Electrofishing surveys, Habitat inventories, Field water quality
	MRT1A	Electrofishing surveys, Habitat inventories, Field water quality

Table E.2.2.1 Summary of Aquatic Resource Baseline Field Investigations

Waterbody	Waterbody Code	Assessment Component
McPherson Tributary #1 Pond #1	MCT1 Pond 1	Winter habitat conditions assessment, Field water quality
McPherson Tributary #1 Pond #2	MCT1 Pond 2	Winter habitat conditions assessment, Field water quality
McPherson Tributary #2 Pond #1	MCT2 Pond 1	Winter habitat conditions assessment, Field water quality
McPherson Tributary #2 Pond #2	MCT2 Pond 2	Winter habitat conditions assessment, Field water quality
McPherson Tributary #3 Pond	MCT3 Pond	Winter habitat conditions assessment, Field water quality
McPherson Tributary #10 Pond	MCT 10 Pond	Winter habitat conditions assessment, Field water quality
McPherson Creek Pond	MC Pond	Winter habitat conditions assessment, Field water quality
McLeod River Tributary #1 Pond	MRT Pond	Winter habitat conditions assessment, Field water quality
Conveyor/Access Corridor		
Trail Creek	TC	Electrofishing surveys, Habitat inventories, Field water quality
Trail Creek Tributary #1	TCT1	Electrofishing surveys, Habitat inventories, Field water quality
Athabasca River Tributary #1	ART1	Electrofishing surveys, Habitat inventories, Field water quality

E.2.2.1 Fish Populations

Baseline investigations within the Project LSA confirmed the presence of fish in McPherson Creek, McPherson Creek Tributary #2 (MCT2), McLeod River Tributary #1 (MRT1), Athabasca Tributary # 1 and Trail Creek (CR #2, Table 4.53, Figure 3). Rainbow Trout were the most common and widespread species within the LSA and RSA (caught at 10 of 13 electrofishing sample sites). Based on catch-per-unit-effort (CPUE), Rainbow Trout were most abundant in McPherson Creek tributary #2 (MCT2). Two other sport fish species, encountered much less frequently than Rainbow Trout, were also captured during baseline sampling (Brook Trout and Burbot). Other species, including Lake Chub, Longnose Dace, Longnose Sucker, Pearl Dace, Spoonhead Sculpin and White Sucker were also captured.

None of the species captured during baseline investigations are listed under the federal *Species at Risk Act* (2003). Provincially, there is one species listed as *At Risk* (Rainbow Trout (Athabasca)), one species listed as *May be at Risk* (Spoonhead Sculpin), two species that are listed as *Sensitive* (Arctic Grayling, Bull Trout), two species listed as *Undetermined* (Pearl Dace, Finescale Dace), and one species listed as *Exotic/Alien* (Brook Trout). The remaining species are listed as Secure.

McPherson Creek

McPherson Creek was found to support a diverse fish community with nine species inventoried including Rainbow Trout that possibly utilize the creek for all life cycle phases (CR #2, Figure 3). Rainbow Trout were the most abundant sport fish and were found throughout the creek while Burbot were captured frequently at upstream sample sites but were not found closer to the confluence. Historically, Brook Trout were also captured rarely and were only found near the mouth of McPherson Creek. The species assemblage appears to have changed over time as Arctic Grayling were not captured during baseline investigations but were relatively common and widespread within McPherson Creek in 1981 (Techman 1982). Bull Trout were also found in McPherson Creek historically but were not captured during baseline investigations. Given the frequency of their occurrence and considering habitat conditions within McPherson Creek, it is suspected that Bull Trout use is limited to occasional feeding forays by individual fish that are resident to the McLeod River.

McPherson Creek Tributary #2

MCT2 exhibited importance to the Rainbow Trout population of the McPherson Creek drainage. Catch rates were higher in MCT2 than for any other stream within the study area with the lower 400 m to 600 m of MCT2 providing high quality habitat for Rainbow Trout spawning and rearing. Redd sites were identified during the spring and young-of-the-year Rainbow Trout were captured in the fall. Rainbow Trout were the only sport fish captured from the tributary during baseline investigations but historical sampling indicates that Burbot and Bull Trout have also been captured near the confluence of the creek (FWMIS 2011). Forage fish were also captured on MCT2 during baseline sampling, including two Lake Chub.

Other McPherson Creek Tributaries

With the exception of MCT2, no fish were captured from McPherson Creek tributaries during baseline investigations. Historical sampling information is limited but there is record of one Rainbow Trout, several Lake Chub and one Longnose Sucker in MCT4 near the confluence of the tributary (FWMIS 2011). Finescale Dace were also reportedly found in one of the ponds that feeds MCT1 (FWMIS 2011).

McLeod River Tributary #1

A total of three Rainbow Trout were found utilizing the habitat of MRT1 near the northern boundary of the Project area. Historical sampling at two locations along MRT1 found Rainbow Trout and Burbot (FWMIS 2011).

McLeod River Tributary #1A

Fish sampling during baseline investigations at three different locations on MRT1A failed to capture any fish (Figure 3). In addition, no fish were found during historical sampling near MRT1A-2 (FWMIS 2011). However, several Rainbow Trout were captured in 2007 at a sample site located further downstream (Figure 3, FWMIS 2011).

Athabasca River Tributary #1

Brook Trout were captured from ART1 just upstream of Highway 16 despite the fact that the culverts for the railway and Highway 16 were perched and posed a severe impediment to fish passage. However, no other fish were captured from ART1 during baseline investigations and historical sampling in the headwaters of the tributary also failed to capture fish (FWMIS 2011). The habitat of ART1 is discontinuous in between the sample sites ART1-2 and ART1-3. The channel deteriorates to sections of underground flow and complete channel loss in a wetland area that would likely prevent upstream movement of fish.

Trail Creek (TC) and Trail Creek Tributary #1

The headwaters of Trail Creek and TCT1 were assessed just upstream of where they converge. Habitat at both sites was similar, consisting of relatively high-energy habitat. Both creeks were less than one metre wide and had limited discharge when assessed. Rainbow Trout were found in Trail Creek near Highway 16 and were also observed in the vicinity of the conveyor/access road crossing. However, upstream movement into the creek may be limited since the culvert that carries the railway over Trail Creek near Highway 16 is perched and likely poses an impediment to fish movements.

E.2.2.2 Fish Species Richness and Diversity

A quartile ranking system (CR #2, Table 4.55) was used to rank richness in streams within and adjacent to the Project (Table E.2.2.2). The species richness of streams within the LSA was determined by comparing the number of species present in specific watercourses within the LSA to the total number of species potentially present.

Table E.2.2.2 Ranking of Streams in the LSA According to their Fish Species Richness

Watercourse	Ranking	Number of species (% of potential)
Mine Area		
McPherson Creek	4	12 of 13 potential species (92%)
McPherson Creek Tributary #2 (MCT2)	2	5 of 13 potential species (38%)
McPherson Creek Tributary #4 (MCT4)	1	3 of 13 potential species (23%)
All other tributaries to McPherson Creek	1	3 of 13 potential species (23%)
McLeod River Tributary #1 (MRT1)	1	2 of 13 potential species (15%)
McLeod River Tributary #1A (MRT1A)	1	1 of 13 potential species (8%)
Access Road and Conveyor Line Corridor		
Trail Creek	1	1 of 14 potential species (7%)
Trail Creek Tributary #1 (TCT1)	1	0 of 14 potential species (0%)
Athabasca Tributary #1 (ART1)	1	1 of 14 potential species (7%)

The presence or absence of listed species and species richness rankings were used to rank overall fish species diversity for watercourses in and adjacent to the Project by adding the individual ranks of the two indicators; species status, as described by Alberta Sustainable Resource Development (ASRD 2010), and species richness. Combining the two indicators, an overall score for fish species diversity (biodiversity ranking) was assigned (Table E.2.2.3).

Table E.2.2.3 Ranking of Streams in the LSA According to their Biodiversity

Watercourse	Ranking	Ranking Description
Mine Area		
McPherson Creek	4	High
McPherson Creek Tributary #2 (MCT2)	3	Moderate
McPherson Creek Tributary #4 (MCT4)	3	Moderate
All other tributaries to McPherson Creek	1	Very Low
McLeod River Tributary #1 (MRT1)	3	Moderate
McLeod River Tributary #1A (MRT1A)	3	Moderate
Access Road and Conveyor Line Corridor		
Trail Creek	3	Moderate
Trail Creek Tributary #1 (TCT1)	1	Very Low
Athabasca Tributary #1 (ART1)	1	Very Low

E.2.2.3 Fish Habitat

A reconnaissance of the watercourses within the LSA was conducted to qualitatively assess potential fish habitat. These investigations included evaluation of habitat and channel characteristics, measurement of surface flows, and photo documentation of typical conditions. Using the results of the habitat reconnaissance and considering proposed mine plans, habitat inventories were conducted at select locations on watercourses within the Project area.

McPherson Creek

Habitat within McPherson Creek was varied with shallow, slow moving habitat common in the upper reaches, deeper and more complex habitat prevalent near the middle section of the stream, and more rapidly flowing shallow to moderate depth habitat present near the mouth of the creek. The upper portion of the creek had a streambed that was comprised primarily of fine material with the frequency of coarse substrates generally increasing with downstream direction. Spawning surveys and habitat assessment conducted in 1981 identified the upstream portion of McPherson Creek as the area that was important for Rainbow Trout spawning (Techman 1982). Fish sampling and habitat inventories completed in McPherson Creek during baseline investigations indicate that the preferential spawning areas may now be located in the lower and middle portions of the creek.

Previous winter habitat assessments suggest that McPherson Creek exhibited a high potential for overwintering habitat (Techman 1982). During baseline investigations, McPherson Creek was found to be flowing at all five assessment sites and dissolved oxygen measurements suggested that oxygen levels were not a limiting factor for any of the potential sport fish species overwintering in McPherson Creek.

McPherson Creek Tributary #2

The lower part of MCT2 was primarily stony substrate, dominated with cobble, relatively free of fine materials. The stream has an average wetted width of approximately two metres, primarily high velocity riffles interspersed with slower section of runs. Further upstream, the channel becomes smaller and dominant substrates transition from gravels to fine materials. Eventually the channel becomes poorly defined and gradually disappears in a wetland area approximately 1350 m upstream from the confluence with McPherson Creek (CR #2, Figure 4). The wetland represents the upstream limit of fish habitat within MCT2.

Approximately 600 m upstream from the confluence with McPherson Creek MCT2 receives water from a second fork (entering from the Right Upstream Bank), MCT2A. This small watercourse drains from a wetland area containing two standing waterbodies (ponds). The MCT2A channel rises from the MCT2 main channel to a marshy plateau. The stream substrate changes from coarse substrate to fine materials and the channel loses definition in the large wetland area. The MCT2A channel immediately adjacent to the lower pond within the drainage is undefined and flowing through wetland vegetation. The channel conditions could potentially allow for fish passage into the downstream pond of the drainage. The conditions observed in between the two ponds effectively remove any potential for fish habitat upstream of the downstream pond, due to an absence of channel and any observable flow.

Other McPherson Creek Tributaries

Other tributaries to McPherson Creek consisted of small, generally poorly defined channels, often lacking connectivity to McPherson creek or exhibiting barriers to fish passage within a short distance from McPherson Creek. In general, the five north bank tributaries, excluding MCT2, exhibited less flow and reduced channel quality when compared to the south bank tributaries (CR #2, Table 4.30). The south bank tributaries despite displaying greater flow were still limited by fish barriers and poor channel definition.

McLeod River Tributary #1

The habitat of MRT1 was judged as favourable for Rainbow Trout; habitat was generally comprised of shallow runs and riffles with one large shallow pond located in the upper reaches. Fine substrate dominated in the pond and run habitats, while cobble and gravel was higher in the riffle habitat.

Habitat of MRT1A was judged to have limited suitability for sport fish species as it was heavily influenced by beaver activity that had resulted in a series of relatively deep ponds interspersed with sections of poorly defined and intermittent channel. Fines substrates were predominant and flows were either absent or extremely low. The size of the beaver dams and the high frequency of occurrence not only limited habitat suitability but were also considered to be impediments to fish passage. The upstream limit of fish habitat was determined to be the large wetland area located approximately 3.8 km upstream from the confluence with MRT1 (CR #2, Figure 12).

Ponds/Standing Waterbodies

Seven of the eight study ponds were inaccessible to fish due to lack of surface connection to downstream fish bearing waters. Ponds were situated in low-lying wetland areas and were surrounded by marshland; frequently with no defined inlet or outlet visible. However, a small, poorly defined outlet channel was identified on MCT2 Pond 2 and may provide a surface connection to MCT2 during periods of high flow. The extremely low dissolved oxygen concentrations found during the winter likely precludes salmonid survival.

Athabasca River Tributary #1

The habitat of Athabasca River Tributary #1 was found to be suitable for sport fish with fish presence confirmed at ART1-2 by the capture of a Brook Trout. However, the section of creek at ART1-3 and upstream cannot be accessed by fish due to undefined channel, underground flow and complete channel loss in a wetland located between ART1-2 and ART1-3 acting as a fish barrier.

Trail Creek and Trail Creek Tributary #1

The habitat of Trail Creek and Trail Creek Tributary #1 at the point of crossing with the access and conveyor line corridor was best described by riffle interspersed with cascades. The portions of both streams within their respective study sections provided suitable high-energy habitat for select fish species, rich in oxygen but limited by significant flow and depth.

E.2.2.4 Fish Habitat Potential Utilization and Ranking

Habitat within watercourses in the LSA was evaluated in terms of its potential to support various life cycle phases (spawning, rearing, overwintering, feeding). The ranking system primarily considers the life cycle requirements of salmonid species, most specifically Rainbow Trout (CR #2, Table 4.59).

Table E.2.2.4 provides a summary of habitat utilization information and a habitat potential/utility ranking for watercourses within the Project LSA. Ephemeral watercourses were excluded from ranking given the lack of a defined channel over the study section and severe habitat limitations that were present in these streams.

Table E.2.2.4 Habitat Potential Utilization and Ranking for Streams Assessed for the Project

Waterbody	Habitat Potential Utilization				Limiting Factors	Overall Rank
	Spawning	Rearing	Overwintering	Feeding		
Mine Permit Area						
McPherson Creek	Moderate	Moderate	Moderate	Moderate	-lacking appropriate spawning substrates -limited class 1 habitat	Moderate
MCT2	High	High	Low	Low	- limited cover - limited Class 1 habitat	High
MRT1	Low	Low	Low	Moderate	-limited Class 1 habitat -limited flows -lacking appropriate spawning substrate	Moderate to Low
MRT1A	Low	Low	Low	Low	- limited Class 1 habitat - limited flows -lacking appropriate spawning substrates - poorly defined channel -extensive beaver activity	Low
Conveyor Line and Access Corridor						
ART1	None	None	None	None	-lacking connectivity with downstream habitat - low flows	None

Table E.2.2.4 Habitat Potential Utilization and Ranking for Streams Assessed for the Project

Waterbody	Habitat Potential Utilization				Limiting Factors	Overall Rank
	Spawning	Rearing	Overwintering	Feeding		
Trail Creek	Low	Low	Low	Moderate	- limited flows - absence of Class 1 habitat	Low
TCT1	Low	low	Low	Moderate	- limited flows - absence of Class 1 habitat	Low

E.2.2.5 Benthic Invertebrates

Benthic invertebrate sampling was conducted at two sample sites (MC-2, MC-4) on McPherson Creek (CR #2, Figure 3). A total of 30 taxa were collected from MC2 and 23 taxa were collected from MC4. Ephemeroptera dominated the benthic invertebrate communities at both sites comprising almost 70 % of all samples. Plectoptera were the second most common group at both sites while Chironmidae and Hydrachnidia were the third most abundant groups at MC-2 and MC-4 respectively. All other groups comprised less than five percent of the total community (CR #2, Table 4.19). Various physical habitat measurements were taken at lower trophic sampling sites (CR #2, Table 4.20).

E.2.3 Potential Impacts

The mine plan was developed so that direct impacts to fish habitat would be avoided. This included development of a mine plan and a surface water management plan that would not result in an instream footprint and the design of clear-span watercourse crossing structures that would not disturb the bed and banks of the watercourse. As such, construction, operation, and reclamation activities with the potential to affect aquatic resources are primarily related to those activities that could indirectly affect aquatic resources (including fish, fish habitat and benthic invertebrates) leading to impacts to the selected VECs. (CR #2, Table 5.2).

The issues identified as potentially affecting fish habitat potential, the abundance, health and survival of fish populations (in general) and the abundance, health and survival of VEC aquatic life within the RSA and LSA are principally related to:

- potential changes to physical habitat components;
- potential changes to flow regime;
- potential changes to water quality (sediment and other chemical contaminants); and
- potential changes to the fisheries resource access and utilization.

E.2.3.1 Physical Habitat

Direct physical disturbance may occur if the development involves any activities that impinge on or into waterbodies. Direct physical disturbance may result in loss of habitat components, as in the case of an instream footprint resulting from infrastructure; or in habitat fragmentation, as in the case of an anthropogenic barrier to fish migration. Direct physical disturbance can have direct impact on fish abundance, biodiversity, and distribution depending on the extent that the habitat is utilized by fish as well as the magnitude and duration of the impact. As previously described, the mine plan was developed so that direct impacts to fish habitat will be avoided, therefore no direct impacts to fish habitat are expected.

In total, the Project will require installation of five watercourse crossings including one haulroad crossing on McPherson Creek and four access road/conveyor crossings on Athabasca River tributaries (CR #2, Figure 2). The crossing structure over McPherson Creek (at MC-1.5) will consist of a clear-span bridge that will span the bank full width and will not encroach on or alter the streambed and/or banks of the stream. The crossing structures over Trail Creek and the tributary to Trail Creek will also be a clear-span bridge. The two culverts that will be installed on Athabasca Tributary #1 will be located upstream of the upstream limit of fish distribution.

A single end pit lake will exist on the landscape once reclamation is complete (Figure F.4.1.1). The lake will not encroach on existing fish habitat but will be designed to maximize habitat, biological diversity and use by native fish populations. Final design will incorporate guiding principles that are described in the draft guidelines for end pit lake development at coal mine operations (EPLWG 2004) and/or procedures provided in similar guideline documents that may be available in the future. In general, it is expected that the lake will result in a substantial increase in available fish habitat in the McPherson system.

Activities associated with the Project that have potential to directly impact fish habitat and consequently fish populations will not extend into the RSA. The impacts to fish populations as a result of the mining and pit filling is expected to be minimal since downstream flows will be managed to adhere to IFN as per the WMF. Impacts to flows in McPherson Creek, MCT2, MRT1, and MRT1A that may occur post reclamation (CR #2, Table 5.6) will have a negligible impact on flows in the McLeod River (CR #6) and therefore impacts to fish populations due to flow changes in the McLeod River are not expected.

E.2.3.2 Flow Regime

Although streams tend to exhibit considerable natural seasonal variation in volume of flow or discharge, changes in discharge can have an adverse effect on lotic communities. As a general rule, induced changes in volume of flow that do not exceed natural seasonal extremes have little effect. Reductions in volume of flow during normal low flow periods tend to adversely affect aquatic resources as habitat for fish and benthic invertebrates is least available at low flows. Increases in discharge during the normal high flow period tend to adversely affect habitat, principally due to the effects of erosion.

Tree clearing for the Project could result in increased peak flows and total runoff. These effects will be managed internally by the pit, settling ponds and storage reservoirs (Section E.6 and CR #6) and are therefore not expected to impact aquatic habitat.

Potential impacts to hydrology as a result of Project operations are outlined in Section E.6 and will be mitigated through implementation of a Water Management Framework (WMF) that will be developed to define streamflow augmentation protocols to maintain instream flow needs (IFN) during mining operations. Table E.2.3.1 provides a general description of potential changes to the flow regimes of watercourses draining the Project area during mining and includes a summary of the associated impact on fish habitat.

Table E.2.3.1 Summary of Surface Flow Impacts and Corresponding Effects on Habitat Availability during Mining Operations.

Watercourse	Description of Potential Change to Flow Regime[1]	Description of Potential Impact to Fish Habitat
McPherson Creek	• Potential small reduction in peak flows depending on location (due to diversion of North bank tributaries). • Low flows remain essentially unchanged. • Slight increase in mean annual flows. • Flows will be augmented under the WMF.	• Negligible, no measurable impact to fish habitat expected. Under the WMF, flows will be managed/augmented to meet downstream IFN.
MCT2	• Regulation of peak flows. • Increase in low and average flows. • Flows will be augmented under the WMF.	• Negligible, no measurable impact to fish habitat expected. Under the WMF, flows will be managed/augmented to meet downstream IFN.
MRT1	• Small reduction of peak flows. • Slight increase or decrease in low flows .	• Negligible, no measurable impact to fish habitat expected. Under the WMF, flows will be managed/augmented to meet downstream IFN.
MRT1A	• Small reduction of peak flows. • Slight increase or decrease in low flows.	• Negligible, no measurable impact to fish habitat expected. Under the WMF, flows will be managed/augmented to meet downstream IFN.
ART1, Trail Creek, TCT1	• Activities limited to localized clearing and access road/conveyor construction that will only have negligible impact on flows.	• Negligible, no measurable impact to fish habitat expected since impacts to flows will be negligible.

[1] Detailed information provided in Matrix (2012). Assumes implementation of WMF to meet IFN.

Some changes in the flow regime in watercourses draining the Project will occur when the end-pit lake is filled (Section E.6 and CR #6). Table E.2.3.2 provides a general description of potential changes to the flow regimes of watercourses draining the Project area post mining and includes a summary of the corresponding impact on fish habitat.

Table E.2.3.2 Summary of Surface Flow Impacts and Corresponding Effects on Habitat Availability During and After Mine Reclamation.

Watercourse	Description of Potential Change to Flow Regime[1]	Description of Potential Impact to Fish Habitat
McPherson Creek	• Slight reduction in peak flows depending on location. • Variation in low flows (either slight reduction or small to moderate increase in low flows depending on location). • Variation in mean annual flow (either slight reduction or small increase depending on location).	• Negligible, no measurable impact to fish habitat expected. Potential reduction in peak flows are not expected to substantially affect downstream channel size (Matrix 2012).
MCT2	• Regulation of peak flows. • Variation of low flows (potential small increase or decrease). • Potential small reduction in mean annual flow.	• Negligible, no measurable impact to fish habitat expected. Potential regulation in peak flows are not expected to substantially affect downstream channel size.

Table E.2.3.2 Summary of Surface Flow Impacts and Corresponding Effects on Habitat Availability During and After Mine Reclamation.

Watercourse	Description of Potential Change to Flow Regime[1]	Description of Potential Impact to Fish Habitat
MRT1	• Small increase or reduction of peak flows depending on location. • Slight increase of low flows. • Slight increase of mean annual flows.	• Negligible, no measurable impact to fish habitat expected. Potential changes in peak flows are not expected to substantially affect downstream channel size.
MRT1A	• Reduction of peak, low, and mean annual flows.	• Negligible, no measurable impact to fish habitat expected. Habitat consists of standing, ponded water that is heavily influenced by beaver activity.

[1] Detailed information provided in Matrix (2012).

There is potential for the temperature regime downstream of the lake to be affected once the lake is on line. Mean summer temperatures can increase downstream of impoundments with the degree of change (in temperature) influenced mainly by the size of impoundment (depth and surface area), residence time, and whether the lake stratifies or not (Wotton 1995, Lessard and Hayes 2003). In addition, groundwater inputs can act as a cooling factor and can limit the extent of temperature effects due to impoundments (Lessard and Hayes 2003). Raleigh et al. (1984) suggests that the optimal water temperature for Rainbow Trout eggs falls between 7 and 12^{O}C and average maximum temperatures would have to be above 20^{O}C before habitat suitability declines. Given existing temperature regimes (CR #2, Figure 14) it seems unlikely that the proposed end pit lakes will increase water temperatures to the point that the habitat is no longer suitable for Rainbow Trout.

E.2.3.3 Water Quality

Increased sediment deposition can result in the infilling of overwintering habitat as well as degradation of spawning habitat for fish species that spawn over coarse substrates. Benthic habitat can be diminished by the infilling of interstitial spaces in coarser substrate and can also affect the periphytic algal community which can impact macroinvertebrate grazers. In addition, excessive sediment deposition can also impact the structure of the benthic community causing a shift towards chironomid dominant communities.

Certain chemical contaminants may have chronic or lethal effects on aquatic biota, depending on the character and concentration of the contaminant. Recommended guidelines for fish and aquatic life are used as standards in assessing effects of mining on the aquatic ecosystem. Changes in water quality parameters are deemed harmful to fish and aquatic life when the threshold values in the guideline documents are exceeded. The Canadian Council of Ministers of the Environment (CCME 2006) and the surface water quality guidelines given by AEW (AE 1999) are the standards normally applied in assessing potential water quality effects to fish and aquatic life.

Changes in water quality that impact aquatic habitat are primarily related to potential increases in sediment loads in streams within the LSA and RSA that could occur during the construction, operation, and/or reclamation phases of the Project. Tree clearing and construction of haulroads and watercourse crossings are the primary Project components that have potential to increase sediment loads in aquatic habitat. Sediment can be generated during disturbance to the active channel (during watercourse construction) and can also be introduced into the aquatic ecosystem from surface runoff over disturbed ground and or cleared land. Potential adverse effects to aquatic habitat arising from sediment introduction during construction are limited temporally to the construction period. Therefore, effects are generally related to short-term potential impacts on fish health/fish distribution and do not typically extend to long-term effects on physical habitat.

Construction activities including land clearing and haulroad crossing construction have the potential to increase sediment loads that can directly affect fish populations. Well-established mitigation measures will be implemented to reduce potential sediment effects to a minimum and potential effects of construction activities on surface water quality are expected to be low (Hatfield 2012). As such, no adverse effects on fish populations within the LSA are expected to occur as a result of water quality changes due to construction activities.

The surface water quality assessment (Section E.10 and CR #10) that was conducted determined that impacts during the operations phase were primarily related to the following:

- surface runoff during mining operations and discharge from impoundments and diversions has potential to increase sediment loads in receiving waterbodies;
- Nitrogen-based explosives will be used during mining and has potential to leach into surface waters; and
- changes in surface runoff or groundwater discharge may potentially impact surface water quality.

Proven, effective mitigation strategies will be employed to reduce these potential effects to a minimum such that residual effects on surface water quality as a result of these activities are expected to be low (Section E.10 and CR #10). As such, adverse effects on fish populations within the LSA as a result of changes in water quality during the operation phase are not expected.

Water quality within the proposed end-pit lake is expected to be suitable for aquatic life based on analysis of other end-pit lakes in the area (Section E.10 and CR #10). As a result, potential effects on fish populations in the LSA due to end-pit lake water quality are expected to be low.

Potential changes in surface water quality in the RSA were assessed as low (Section E.10 and CR #10) and are not expected to significantly impact fish populations in the RSA. While elevated selenium concentrations in surface waters can occur downstream of some coal mines, the geology of the coal bearing stratum at the Project is similar to the geology at other regional thermal coal mines (which typically do not have elevated concentrations) and is different than the geology at the metallurgical mines (where elevated selenium levels have been documented). Therefore, selenium concentrations in receiving waters for the Project are not expected to be an environmental issue (Section E.10 and CR #10) and are not expected to impact fish populations in the RSA.

E.2.3.4 Fisheries Resource Access and Utilization

Increased access to aquatic resources due to the development of roads is sometimes perceived to cause an increase in resource utilization. The potential for adverse effects resulting from increased access is mitigated during the mining phase by restricting access to mine property. Public access will not be permitted on haul roads or other access routes without the permission of Coalspur. In the longer term, potential adverse effects from increased access will be mitigated by the existing fisheries regulation regime as prescribed by ASRD.

No additional access to water bodies in the RSA is expected to occur as a result of the Project. In addition, it was assumed that the current fisheries management regulation regime was adequate to prevent over exploitation of the fish resource in the RSA, whether the Project proceeds or not.

E.2.3.5 Valued Environmental Components

Rainbow Trout

Rainbow Trout were abundant and widespread within the LSA during baseline investigations and historical information indicates they are relatively common in the RSA (FWMIS 2011). Rainbow Trout are widespread in Alberta, mostly due to historical introductions; however, some populations in the Athabasca River drainage, including those within the LSA and RSA, are thought to be native (Nelson and Paetz 1992). This native Athabasca strain of Rainbow Trout is ranked as 'At Risk' under the Alberta Species at Risk Program (ASRD 2010).

Impacts to Rainbow Trout that are related to direct habitat loss or alteration are not expected. There will be no direct impacts to fish habitat due to mining (construction, operation, reclamation) and all watercourse crossings over fish habitat will consist of clear-span structures that will not result in any disturbance to the bed and banks of the watercourse.

Potential adverse effects associated with potential changes in surface flows will be mitigated during the construction phase by implementation of a WMF whereby flows will be augmented to ensure that downstream IFN are maintained.

Water quality effects will be mitigated by implementation of appropriate erosion control measures and best management practices during the construction phase of the Project, implementation of a surface water management plan during mining operations, and revegetation of exposed ground and riparian areas at Project closure.

Rainbow Trout is a popular sport fish species and is subject to harvest in the McLeod and Athabasca River basins. Increased access and utilization of the fisheries resource, including allowable harvest of this species, is not anticipated to occur as a result of the Project.

Given that potential effects of the Project on Rainbow Trout can be fully mitigated, the Project is not expected to have a negative effect on this VEC. The potential impact of the Project on Rainbow Trout is considered low.

Arctic Grayling

Arctic Grayling is a popular sport fish and is classified as *Sensitive* and considered a *Species of Special Concern* in Alberta (ASRD 2010). Arctic Grayling were not captured from McPherson Creek during baseline sampling but historic record from 1981 show Arctic Grayling present in McPherson Creek (Techman 1982) and it is known that Arctic Grayling are present in the McLeod River near the Vista Coal Project site (FWMIS 2011).

Given the distribution pattern of Arctic Grayling, potential impacts to this VEC relate primarily to downstream water quality effects, including sediment effects, on Arctic Grayling habitat, and Arctic Grayling directly. These impacts are mitigable through implementation of the surface water management plan during construction activities and operation of the mine. After mine closure and reclamation, activities with the potential to generate sediment will cease and revegetation of exposed ground and riparian areas will mitigate potential for sedimentation due to surface run-off.

Impacts to Arctic Grayling that are related to direct habitat loss or alteration are not expected. There will be no direct impacts to fish habitat due to mining (construction, operation, reclamation) and all watercourse crossings over fish habitat will consist of clear-span structures that will not result in any disturbance to the bed and banks of the watercourse.

Potential impacts to Arctic Grayling related to changes in flow regime are not anticipated since no significant alteration to the flow *regime* of the McLeod River or the Athabasca River is expected to occur as a result of the Project.

Arctic Grayling are a popular sport fish species but are not subject to harvest in the McLeod River and Athabasca River basins. There are no potential effects related to increased resource utilization as the Project is not expected to result in increased public access to the McLeod River and Athabasca River basins. In addition, the potential effects of increased resource utilization are addressed by the fisheries regulation regime currently in effect for these basins, which stipulate a 'zero catch limit' for Arctic Grayling.

Given that potential effects of the Project on Arctic Grayling can be fully mitigated, the Project is not expected to have a negative effect on this *VEC*. The potential impact of the Project on Arctic Grayling is considered low.

Bull Trout

Bull Trout are listed as *Sensitive* and are considered a *Species of Special Concern* in Alberta (ASRD 2010). Bull Trout were not captured during baseline sampling but historical information indicates that Bull Trout have been found in the McPherson Creek both in 1981 and 1996 (Techman 1982, FWMIS 2011). It is also known that Bull Trout are found in the McLeod and Athabasca Rivers adjacent to the Vista Coal Project (FWMIS 2011).

Given the distribution pattern of Bull Trout, potential impacts to this VEC relate primarily to downstream water quality effects, including sediment effects, on Bull Trout habitat, and Bull Trout directly. These impacts are mitigable through implementation of the surface water management plan during construction activities and operation of the mine. After mine closure and reclamation, activities with the potential to generate sediment will cease and revegetation of exposed ground and riparian areas will mitigate potential for sedimentation due to surface run-off.

Impacts to Bull Trout that are related to direct habitat loss or alteration are not expected. There will be no direct impacts to fish habitat due to mining (construction, operation, reclamation) and all watercourse crossings over fish habitat will consist of clear-span structures that will not result in any disturbance to the bed and banks of the watercourse.

Potential adverse effects associated with potential changes in surface flows will be mitigated during the construction phase by implementation of a WMF whereby flows in McPherson Creek will be augmented to ensure that downstream IFN are maintained. No major long-term changes to the flow regime of McPherson Creek, the McLeod River, or the Athabasca River are expected to occur as a result of the Project.

Bull Trout are a popular sport fish species but are not subject to harvest in the McLeod River and Athabasca River basins. There are no potential effects related to increased resource utilization as the Project is not expected to result in increased public access to these basins. In addition, the potential effects of increased resource utilization are addressed by the fisheries regulation regime currently in effect for these basins, which stipulates a 'zero catch limit' for Bull Trout.

Given that potential effects of the project on Bull Trout can be fully mitigated, the Project is not expected to have a negative effect on this VEC. The potential impact of the Project on Bull Trout is considered low.

Benthic Invertebrates

As previously described, the mine plan was developed so that direct impacts to fish habitat will be avoided. As such, the extent of the impact to benthic invertebrate communities as a result of direct habitat impacts is expected to be low. In general, it is expected that the end-pit lake will result in a substantial increase in benthic invertebrate biomass in the area.

Changes in the flow regime in watercourses in the LSA during and after mining will likely occur. During mining the effect of these activities will be mitigated through implementation of the WMF that will involve a flow augmentation plan that ensures that downstream IFN are maintained. Therefore, the impacts to benthic invertebrate populations as a result of these flow changes is expected to be minimal since low flows will be maintained (or slightly increased) and peak flows will be moderated. Impacts to benthic invertebrate populations as a result of the pit filling is expected to be minimal since the lake filling will be completed gradually so that downstream IFN are maintained.

Mining activities during the construction, operation, and reclamation phases of the Project have the potential to increase sediment loads which can directly affect benthic invertebrate populations. Well-established mitigation measures will be implemented to reduce potential sediment effects to a minimum and potential effects of these activities on surface water quality are expected to be low (Section E.10).

As such, potential adverse effects on benthic invertebrate populations due to changes in water quality as a result of mining activities is expected to be low. In addition, water quality within the proposed end-pit lake is expected to be suitable for aquatic life (Section E.10) and the lake is expected to support a healthy benthic invertebrate population.

E.2.4 Cumulative Effects

The landscape within the RSA has been impacted historically by various activities that are expected to persist into the future including mining, timber harvesting, road and railway corridors, natural gas activities, and urban development. Mitigation strategies employed for the Project are based on proven, effective, methodologies that have been used by the coal mining industry in the past. Through proper implementation of these strategies the project specific effects to aquatic resources arising from the Project are expected to be fully mitigated and are deemed unlikely to contribute to cumulative effects.

E.2.5 Mitigation and Monitoring

E.2.5.1 Mitigation

In order to reduce the potential impacts of the Project on aquatic resources Coalspur will:

- design and construct all defined watercourse crossings to meet the regulatory requirements for approval under the provincial *Water Act* and federal *Fisheries Act*;
- construct clear-span bridges over fish habitat (McPherson Creek, Trail Creek, TCT1) following measures outlined DFO Alberta Operation Statement for clear-span bridges (DFO 2007);
- implement a surface water management plan for the life of the Project to eliminate or minimize the potential adverse effects on the aquatic ecosystem associated with changes in water quality. Key elements of the plan include the following components:
  - surface water collector ditches for disturbed areas and diversion ditches for undisturbed areas;
  - runoff settling ponds and/or impoundments to settle suspended solids, prior to releasing flows back to the environment;
  - pump and pipeline systems to recycle water from the runoff settling ponds and mine pit to the Fines Settling Pond (FSP);

  - provision to release or pump water from runoff settling ponds to augment streamflows for habitat requirements; and
- develop a Water Management Framework (WMF) to define streamflow augmentation protocols to maintain instream flows during mining operations.

E.2.5.2 Monitoring

In order to monitor the effectiveness of mitigation measures Coalspur will:

- implement a water quality monitoring program for the life of the project which will include regular compliance monitoring of impoundments as well as effects monitoring for surface water quality in natural watercourses, both upstream and downstream of Project activities (Hatfield 2012).
- monitor flows and TSS at all settling ponds;
- conduct continuous monitoring of flow on McPherson Creek, MCT2, MRT1, and MRT1A during operation;
- develop and implement a benthic invertebrate biomonitoring program to assess the effectiveness of the surface water management;
- design and implement a monitoring program to monitor sedimentation and stream "embeddedness" patterns in McPherson Creek to assess the effectiveness of surface water management; and
- once constructed, evaluate the end pit lake through a monitoring program to assess fish use, biological productivity, water quality, and other physical properties.

E.2.6 Summary

Project design plans were used in conjunction with baseline data and information from other environmental assessments to assess the potential effects to aquatic resources VECs. Potential impacts to the selected VECs relate primarily to changes in surface water hydrology and surface water quality issues. Predicted effects on selected VECs are summarized in Table E.2.6.1.

Table E.2.6.1 Summary of Impact Ratings on Aquatic Resources Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Impact or Effect	Geographical Extent [1]	Duration [2]	Frequency[3]	Reversability[4]	Magnitude [5]	Project Contribution[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
Rainbow Trout												
	Direct habitat impacts	Section E.2.5	Project	Local	Short	Occasional	Reversible	Nil	Negative	High	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
	Changes in flow regime		Project	Local	Long	Occasional	Reversible	Low	Negative	Moderate	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
	Changes in water quality		Project	Local	Long	Occasional	Reversible	Low	Negative	Moderate	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
	Changes in resource access		Project	Local	Long	Occasional	Reversible	Low	Negative	High	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
Bull Trout												
	Direct habitat impacts	Section E.2.5	Project	Local	Short	Occasional	Reversible	Nil	Negative	High	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
	Changes in flow regime		Project	Local	Long	Occasional	Reversible	Low	Negative	Moderate	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
	Changes in water quality		Project	Local	Long	Occasional	Reversible	Low	Negative	Moderate	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
	Changes in resource access		Project	Local	Long	Occasional	Reversible	Low	Negative	High	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
Arctic Grayling												
	Direct habitat impacts	Section E.2.5	Project	Local	Short	Occasional	Reversible	Nil	Negative	High	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
	Changes in flow regime		Project	Local	Long	Occasional	Reversible	Low	Negative	Moderate	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
	Changes in water quality		Project	Local	Long	Occasional	Reversible	Low	Negative	Moderate	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
	Changes in resource access		Project	Local	Long	Occasional	Reversible	Low	Negative	High	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
Benthic Invertebrates												
	Direct habitat impacts	Section E.2.5	Project	Local	Short	Occasional	Reversible	Nil	Negative	High	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
	Changes in flow regime		Project	Local	Long	Occasional	Reversible	Low	Negative	Moderate	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								
	Changes in water quality		Project	Local	Long	Occasional	Reversible	Low	Negative	Moderate	Low	Low
			Cumulative	No cumulative effects as project contribution to effect can be fully mitigated								

E.3 HYDROGEOLOGY

E.3.1 Introduction and Terms of Reference

Coalspur conducted a hydrogeological assessment for the proposed Project. The following section is a summary of the Hydrogeological Assessment that was prepared by Millennium EMS Solutions Ltd. and is included as Consultants Report #3 (CR #3). For full details of the assessment please refer to CR #3.

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the hydrogeology component are provided in Section 3.2 of the ToR and are as follows:

3.2 HYDROGEOLOGY

3.2.1 Baseline Information

[A] Provide an overview of the existing geologic and hydrogeologic setting from the ground surface down to, and including, the coal zones, and if applicable, to the base of any deeper strata that would be potentially impacted by mining. Document any new hydrogeological investigations, including methodology and results, undertaken as part of the EIA, and:

- *a) present regional and Project Area geology to illustrate depth, thickness and spatial extent of lithology, stratigraphic units and structural features;*
- *b) present regional and Project Area hydrogeology describing:*
  - *i. the major aquifers, aquitards and aquicludes (Quaternary and bedrock), their spatial distribution, properties, hydraulic connections between aquifers, hydraulic heads, gradients, groundwater flow directions and velocities. Include maps and cross sections,*
  - *ii. the chemistry of groundwater aquifers including baseline concentrations of major ions, metals and hydrocarbon indicators,*
  - *iii. the potential discharge zones, potential recharge zones and sources, areas of groundwater-surface water interaction and areas of Quaternary aquifer-bedrock groundwater interaction,*
  - *iv. water well development and groundwater use, including an inventory of groundwater users,*
  - *v. the recharge potential for Quaternary aquifers, and*
  - *vi. potential hydraulic connection between coal zones and other aquifers resulting from Project operations.*

3.2.2 Impact Assessment

[A] Describe Project components and activities that have the potential to affect groundwater resource quantity and quality at all stages of the Project.

[B] Describe the nature and significance of the potential Project impacts on groundwater with respect to:

- *a) inter-relationship between groundwater and surface water in terms of surface water quantity and quality;*
- *b) implications for terrestrial or riparian vegetation, wildlife and aquatic resources including wetlands;*
- *c) changes in groundwater quality and quantity;*
- *d) conflicts with other groundwater users, and proposed resolutions to these conflicts;*
- *e) potential implications of seasonal variations; and*

f) groundwater withdrawal for Project operations, including any expected alterations in the groundwater flow regime during and following Project operations.

[C] Describe programs to manage and protect groundwater resources including:

a) the early detection of potential contamination;

b) groundwater remediation options in the event that adverse effects are detected; and

c) monitoring groundwater production or dewatering impacts.

Previous environment assessments in the region (*e.g.* Luscar 1999, Luscar 2005, CVRI 2008) have demonstrated that hydrogeological impacts of coal mining in this region do not extend beyond the site boundaries. Therefore, the local study area, which is intended to represent the area of Project influence, will be the mine permit boundary (CR #3, Figure 1). There will be no differentiation between the local and regional study areas for the purposes of the hydrogeological assessment. Reference will be made to regional hydrogeology; however this will be to set appropriate context and not because it is essential to the impact assessment.

There are a number of valued environmental components (VEC) that lie outside the study area including:

- surface water bodies;
- bedrock aquifers; and
- water wells.

E.3.2 Baseline Setting

The baseline study was completed based on a review of publically available information (which includes the Manalta 1982 EIA that was completed for the McLeod River Project on the same area (Manalta 1982)) and data collected specifically for the Project. Baseline information was obtained from a network of piezometers established for the Project. Water levels were measured, hydraulic conductivity testing was completed, and water samples were taken and analyzed for major ion and trace metals analysis.

The plant, mine and associated facilities are located within the McLeod River watershed. High ground results in a surface water divide between the McLeod River watershed and the Athabasca River watershed to the northwest. The ground surface elevation within the RSA ranges from about 1440 to 1150 metres above sea level (masl) (CR #3, Figure 2).

E.3.2.1 Geology

Surficial deposits within the study area include predominantly glacial and some more recent deposits. Recent deposits include alluvial deposits of sand and silt along the McPherson Creek valley, often overlain by a veneer of organic deposits. Coarse-grained sands and gravels occur along the McLeod River valley. The glacial deposits are primarily till with a silt loam to sandy loam matrix. Given the predominance of fine-grained materials within the surficial deposits and generally limited thickness, this unit is expected to act primarily as an aquitard with the potential for localized aquifers.

The uppermost bedrock consists of Upper Cretaceous to Tertiary age non-marine sediments of the Saunders Group, which overlie Upper Cretaceous marine sediments of the Wapiabi Formation of the Alberta Group. The Saunders Group includes the Tertiary Paskapoo Formation, upper Cretaceous to Tertiary sediments of the Coalspur Formation and underlying Upper Cretaceous Brazeau Formation (Hamilton *et al*. 1999).

The Paskapoo Formation is characterised by fine grained, cross-bedded sandstone, siltstone/mudstone and minor lenses of carbonaceous shale. The Paskapoo Formation forms the uppermost bedrock potentially underlying the Plant site and areas of higher elevation towards the north of the existing permit area.

The Coalspur Formation has a total thickness of 300 m or more and includes argillaceous sandstone, siltstone/mudstone, coal, thinly interbedded claystone in the upper part, minor volcanic tuff in the lower portion and locally conglomeratic sandstone known as the Entrance Member at the base (Manalta 1982).

The dominant lithology of the Coalspur Formation is sandstone with intervals of 10 to 30 m and up to 70 m (KCB 2012a). Occasional thin intervals of bentonite were encountered, generally associated within or near coal seams. Correlatable coal seams within the Coalspur Formation include (in descending order) the Val d'Or, Arbour, McLeod, McPherson, Silkstone and Mynheer coal seams. The Val d'Or, McLeod and McPherson are the target of extraction where they occur.

The bedrock that overlies the uppermost portion of the Val d'Or ranges in thickness from 0 m to 55 m. The Val d'Or comprises seven individual coal seams and has a total average thickness, including partings, of approximately 27 m (Golder Associates Ltd 1995). The Val d'Or is generally more fractured and weathered than the McPherson seams (Manalta 1982). The McPherson is approximately 85 m below the Val d'Or seam and varies in thickness from 5 to 25 m (Manalta 1982).

The study area is located on the western erosional margin of the northwest-southeast trending structure referred to as the Alberta Syncline and eastern limb of the Prairie Creek Anticline. The bedding planes of the bedrock units dip gently to the northeast at 5 to 9^{o}. Fracturing occurs predominantly along strike (northwest-southeast) and dip (northeast to southwest). The fracture systems occur with varying degree in all bedrock units, are more developed in the shallow bedrock units and become healed with depth. Significant faulting has not been identified in the study area (Golder 1995).

E.3.2.2 Hydraulic Conductivity

The hydraulic conductivity values in the surficial deposits fall into a relatively narrow range from 1.0×10^{-6} m/s to 8.6×10^{-6} m/s. Materials from which these tests were performed include mainly sand and gravel with one location completed in till.

Slug tests conducted in six monitoring wells completed within Val d'Or seams show that hydraulic conductivity values fall into a range from 1.9×10^{-7} m/s to 1.8×10^{-5} m/s with a geometric mean of 1.6×10^{-6} m/s (CR #3, Table 1). The McPherson seam hydraulic conductivity ranges from 6.6×10^{-7} m/s to 2.8×10^{-5} m/s (CR #3, Table 1) with a geometric mean value of 2.3×10^{-6} m/s which is consistent with the Val d'Or coal seam and regionally. A continuous two day pumping test at a rate of 98 m^3/day for the Val d'Or seam and a rate of 21 m^3/day for the McPherson seam indicated an average transmissivity of 6.5 m^2/day and storativity of 0.003 for the semi-confined Val d'Or seam (Manalta 1982) and a transmissivity of 1.7 m^2/day and storage coefficient of 0.0007 for the McPherson seam which forms a confined aquifer (Manalta 1982). The transmissivity in the McPherson seam is lower probably because the saturated thickness is thinner or possibly poorer fracture development. The lower storage coefficient has been attributed to discontinuity of the fractures within the McPherson seam. Test data in the Val d'Or seam indicated initial anisotropic conditions with greater drawdown in the strike direction observation well as compared to the dip direction well. Later stages of pumping appear isotropic. Test data for the McPherson seam indicate isotropic conditions. There was no indication of leaky aquifer conditions and no boundary conditions were observed.

E.3.2.3 Groundwater Flow

In the surficial deposits shallow groundwater flow is relatively horizontal, with some perched or confined intervals, and moves from the topographically high portions of the site towards the McLeod River located to the south-east. Groundwater flow in this unit generally follows the topography and flows from north-west to south-east with a horizontal hydraulic gradient of 0.02 m/m. The average linear velocity is calculated to be 4 m per year using a geometric mean hydraulic conductivity value of 2.0 x 10^{-6} m/s, the horizontal hydraulic gradient and an assumed effective porosity of 30%.

The water elevation within the Val d'Or seam ranged from 1275 masl (CPM10-47) to 1177 masl (CPM10-29) (CR #3, Figure 11). The depth to the water table within the Val d'Or ranged from 13.4 mbgs to 3.0 mbgs. Groundwater flow within the Val d'Or and McPherson coal seams is from north-west to south-east along the strike of the coal seam (Golder Associates, 1995) towards the McLeod River with a horizontal hydraulic gradient of 0.01 m/m and 0.007 m/m respectively. The average linear velocity is calculated to be 3 m/year in the Val d'Or seam and 5 m/year in the McPherson seam using a geometric mean hydraulic conductivity value of 2.4 x 10^{-6} m/s and 6.6 x 10^{-6} m/s respectively.

E.3.2.4 Groundwater Chemistry

Surficial deposit total dissolved solids (TDS) concentration in the shallow groundwater falls into a relatively narrow range of 298 to 357 mg/L (CR #3, Figure 10). The water is of calcium bicarbonate type. Groundwater from the surficial deposits can have concentrations of arsenic, iron and zinc that exceed the freshwater aquatic life guidelines. Average concentrations of metals are below the freshwater aquatic life guidelines with the sole exception of iron.

The TDS concentration in groundwater from the Val d'Or coal seam was measured as 377 mg/L to 549 mg/L while the McPherson coal seam generally more mineralized (TDS 376 mg/L to 1,730 mg/L). Analytical results from groundwater within the Val d'Or were relatively consistent with analytical results found in groundwater within the surficial deposits. CR #3, Figure 12 and 14 presents the major ions in groundwater samples obtained from the Val d'Or and McPherson coal seams. The water in both seams is predominantly sodium bicarbonate in type.

Groundwater from the Coalspur Formation can have concentrations of aluminum, arsenic, cadmium, copper, selenium and zinc that exceed the freshwater aquatic life guidelines. On an average basis most of these metals are below the freshwater aquatic life guidelines (CR #3, Table 1). Arsenic is within a two fold increase of the freshwater aquatic life guidelines on an average basis. Zinc appears to be somewhat naturally elevated.

E.3.2.5 Groundwater Recharge

Groundwater recharge generally occurs in the higher topographic areas from infiltration of precipitation and is expected to discharge through the local flow system into surface water bodies and wetlands. A review of the available water level information indicates a dominant downward gradient from the surficial deposits to the Val d'Or coal seam and again to the McPherson coal seam (CR #3, Figures 5 to 7). In topographically lower areas where discharge may be occurring throughout the year groundwater levels are frequently nearly equivalent to the surface elevation.

Previous estimates of groundwater discharge over a larger area than the current RSA were on the order of 3,000 m^3 per day based on 7% infiltration of precipitation (Manalta 1982). A minor proportion of groundwater in the shallower system, estimated as less than 10%, is expected to recharge the regional flow system.

E.3.2.6 Groundwater Users

There are 161 groundwater well records in the AEW's Water Well Information Database (2012) within a 10 km radius of the mine permit area (CR #3, Figure 15); 93 were identified as for domestic use (mostly Town of Hinton), 55 indicate industrial use, and five indicate municipal use. The remaining records indicate stock, investigation, observation, other or unknown uses. There are not any licensed groundwater diversions identified within the RSA.

E.3.3 Potential Impacts

The measureable parameters for hydrogeology are water quantity (water levels) and water quality. This assessment evaluates the following;

- effects of pit dewatering on water quantity (groundwater, water wells, surface water);
- effects of mine spoil on groundwater quality; and
- effects of mine operations on groundwater quality.

E.3.3.1 Effects of Pit Dewatering on Water Quantity

Dewatering wells will be used to reduce groundwater seepage into the pit and support potable and plant water demands. These wells would likely be installed and begin operation about one year in advance of mining. Pumping of groundwater whether from an open pit or dewatering well causes the formation pressure to decrease. This effect spreads outwards over time as a cone of pressure decline in the potentiometric surface. The reduction in formation pressure could reduce production for other wells in the same unit or hydraulically connected units and could alter the seepage from or discharge to hydraulically connected surface water bodies.

Due to the geological structure at the Project (*i.e*. the units dip downward to the northeast) the drawdown cone will expand laterally across the units. In settings where the bedding planes are approximately horizontal the drawdown would expand laterally within each unit. The permeability between units is expected to be substantially lower than within each unit, due to the presence of bentonite layers and a poorly developed vertical fracture system. The high vertical hydraulic gradients observed at the site are indicative of these conditions. The result of the geological structure and the low permeability in this direction is to reduce the drawdown influence away from the pit.

The historical information from comparable mines with depths of 30 to 120 m in the region indicate that groundwater impacts associated with pit dewatering is expected to be restricted to distances of 100 to 200 m and that water levels recover rapidly once dewatering ceases (CVRI 2008).

Groundwater

A numerical groundwater model was completed to estimate the inflows to the pit (KCB 2012c). This model was used to evaluate the pit inflows with and without production from dewatering wells. Groundwater production was simulated from 20 wells each at a rate of 5 L/s for a total of 8,640 m^3/day (100 L/s).

Predicted drawdowns are highest in the vicinity of the dewatering wells and on the order of 100 m at the end of the mining period. As a result of the low conductivity units, the water level drawdown diminishes quickly with distance away from the pit and dewatering wells. The model simulation predicts no measurable drawdown at the mine permit boundaries until the Year 8 simulation. The Year 20 simulation suggests as much as 10 m of drawdown could be observed at the mine permit boundaries.

These simulation results are consistent with the previous assessment that estimated 90 to 100 m of drawdown in the centre of the mine pit areas and as much as 130 m near the pit margins (Manalta 1982). Due to topographic relief, the drawdown at the edge of the mine permit boundary was not anticipated to be more than a few metres (Manalta 1982).

The residual effects of mine dewatering on groundwater quantity in bedrock aquifers resulting from the construction and operations of the Project are predicted to be low.

Water Wells

The water well records indicated three industrial wells from oil exploration and associated camps within the mine permit boundary. There are no licenses within this area and it is concluded that these are not in use. Similar wells are located 4.0 km south of the pit boundary and a private domestic well is on record approximately 5 km south-southwest of the mine permit boundary. As the drawdown impacts associated with pit dewatering will be limited to the study area, no impacts are predicted to this water well or more distant water wells such as those in Pedley, Carldale, East River Estates, Willow Creek Bungalows or near Hinton. No impacts are predicted to groundwater quantity in local water wells related to effects of mine dewatering during the construction and operations of the Project.

Surface Water

The dewatering program will intercept groundwater that would otherwise have been providing seasonal groundwater discharge to watercourses. This impact will be more important during the fall and winter months when groundwater discharge represents a greater proportion of stream flow. During operations, intercepted groundwater seepage within the pit will be transferred to settling ponds prior to discharge to watercourses for stream augmentation. Groundwater discharge to surface water bodies will resume once water levels recover within the reclaimed pit. With mitigation, the effects of mine dewatering on water quantity in surface waterbodies is low.

E.3.3.2 Mine Spoil on Groundwater Quality

Potential impacts to groundwater quality relate to the placement of mine waste materials. Additional concerns relate to the compatibility of groundwater discharging to surface water, either from operational pit dewatering or after reclamation groundwater migrating through replaced waste rock will discharge either into the end-pit lake or other nearby surface watercourses. This portion of the assessment will consider potential impacts related to nitrate from residual explosives and potential leaching from waste rock.

The baseline groundwater chemistry at this Project is comparable to the Coal Valley Mine (CVRI 2008). The available groundwater chemistry for the Coal Valley Mine (CVRI 2008, CVRI 2012, Hackbarth 1999) has shown that no notable effects to groundwater quality have been observed related to historical mining activities, while some impacts are observed in discharge from mine spoil. This historical information indicates potentially elevated nitrate concentrations in mine spoil discharge; however there is no indication of elevated selenium concentrations. Elevated concentrations of sulphate were also observed which are not anticipated to pose a risk to aquatic life.

The background groundwater quality from the Coalspur Formation at the Project is comparable to that observed at the Coal Valley Mine. Groundwater can have concentrations of aluminum, arsenic, cadmium, copper, selenium and zinc that exceed the freshwater aquatic limits; however on an average basis these are generally not anticipated to exceed the guidelines. Groundwater quality is considered acceptable for discharge to surface water bodies.

Potential Project effects on groundwater quality in bedrock aquifers are assessed to be low.

E.3.3.3 Mine Operations on Groundwater Quality

Hydrocarbon fuels will be present at the plant site either in vehicles or storage tanks. With implementation of best management practices, including secondary containment for fuel storage tanks, spill prevention and leak detection monitoring, there should be no possibility of potential effects to shallow groundwater quality except through upset condition (*i.e*. accidental spills or leaks). In the event of a spill or leak, a spill response plan will be executed to control and minimize the extent of any impact.

Potential effects of mine operations on groundwater quality in bedrock aquifers resulting from the construction and operations of the Project are predicted to be low.

E.3.4 Cumulative Effects

E.3.4.1 Pit Dewatering on Groundwater Quantity

Groundwater levels in the vicinity of the pit will be impacted by the dewatering wells and pumping from the pit. The effects associated with the reclaimed Project site are anticipated to be low and restricted to a localized area.

The possible future expansion of the Vista Project is a reasonably foreseeable activity, located immediately to the west of the Project. The expansion is anticipated to include pit dewatering, although it is not certain whether dewatering wells would also be included. It is assumed that dewatering impacts associated with the expansion would be of similar extent and magnitude as those assessed for the Project and those observed at existing coal mines in the region. As a result of the localized extent of the dewatering impacts at both Vista and the expansion, they will not interact and result in a cumulative impact. Therefore a cumulative effect assessment is not required related to groundwater level changes associated with pit dewatering.

E.3.4.2 Mine Spoil on Groundwater Quality

Localized changes to groundwater quality are assessed relative to discharge of groundwater from mine spoil. There are no other planned or reasonably foreseeable projects within the study area that are anticipated to act in cumulative manner with these effects and therefore a cumulative effects assessment is not required for this Project effect.

E.3.4.3 Mine Operations on Groundwater Quality

Mine operations have the potential to result in localized changes to groundwater quality as a result of accidental spills or leaks. There are no other planned or reasonably foreseeable projects within the study area that are anticipated to act in cumulative manner with these effects and therefore a cumulative effects assessment is not required for this Project effect.

E.3.5 Mitigation and Monitoring

E.3.5.1 Mitigation

In order to reduce the potential impacts of the Project on groundwater, Coalspur will:

- augment flows in fish bearing watercourses during low flows with water from settling ponds and other sources; and
- implement a spill response plan.

E.3.5.2 Monitoring

In order to verify that the mitigation measures have been effective, Coalspur will:

- implement a ground water monitoring program in accordance with the EPEA approval and Water Act licence; and
- monitor water levels and water chemistry in selected monitoring wells on an ongoing basis.

E.3.6 Summary

A summary of the predicted effects on groundwater VECs is included in Table E.3.6.1. The conclusions of the Project effects evaluations are as follows:

- pit dewatering through pumping from the pit and dewatering wells during active mining should have no impact on water wells and a high impact on the quantity of groundwater in bedrock aquifers and groundwater discharge to surface water bodies;
- mine spoil or waste rock is assessed to have a low residual impact on the quality of groundwater within bedrock aquifers and a low impact to the quality of surface water; and
- mine operations are assessed to have a low residual impact on groundwater quality within bedrock aquifers and no impact to water wells or surface water.

Table E.3.6.1 Summary of Impact Ratings on Groundwater Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Impact or Effect	Geographical Extent [1]	Duration [2]	Frequency [3]	Reversability [4]	Magnitude [5]	Project Contribution [6]	Confidence Rating [7]	Probability of Occurrence [8]	Impact Rating [9]
1. Water Wells												
Pit dewatering on water quantity			Application	Local	Long	Continuous	Reversible in short term	Nil	Neutral	High	NA	No Impact
			Cumulative	Not evaluated due to local extent of project effects								
2. Discharge to surface water bodies												
Pit dewatering on water quantity			Application	Local	Long	Continuous	Reversible in short term	Low	Negative	High	Medium	Low Impact
			Cumulative	Not evaluated due to local extent of project effects								
Mine spoil on water quality		Monitoring program	Application	Local	Long	Continuous	Reversible in short term	Low	Negative	High	Medium	Low Impact
			Cumulative	Not evaluated due to local extent of project effects								
3. Bedrock Aquifers												
Pit dewatering on water quantity		Monitoring program	Application	Local	Long	Continuous	Reversible in short term	High	Negative	High	High	Low Impact
			Cumulative	Not evaluated due to local extent of project effects								
Mine spoil on water quality		Monitoring program	Application	Local	Long	Continuous	Reversible in short term	Low	Negative	High	Medium	Low Impact
			Cumulative	Not evaluated due to local extent of project effects								
Mine operations on water quality		Spill prevention, spill response	Application	Local	Long	Occasional	Reversible in long term	Moderate	Negative	High	Medium	Low Impact
			Cumulative	Not evaluated due to local extent of project effects								

1. Local, Regional, Provincial, National, Global
2. Short, Long, Extended, Residual
3. Continuous, Isolated, Periodic, Occasional
4. Reversible in short term, Reversible in long term, Irreversible - rare
5. Nil, Low, Moderate, High
6. Neutral, Positive, Negative
7. Low, Moderate, High
8. Low, Medium, High
9. No Impact, Low Impact, Moderate Impact, High Impact

E.4 HISTORICAL RESOURCES

E.4.1 Introduction and Terms of Reference

Coalspur conducted an historical resources assessment for the proposed Project. An Historical Resources Impact Assessment (HRIA) was prepared by Lifeways of Canada Limited and was submitted under separate cover to Alberta Culture and Community Spirit (ACCS). A synopsis of the HRIA is included as Consultants Report #4 (CR #4). This section is a summary of the information provided in CR #4. For full details of the assessment please refer to CR #4.

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the HRIA are provided in Section 4.0 of the ToR and are as follows:

4 HISTORICAL RESOURCES

4.1 Baseline Information

[A] Provide a brief overview of the regional historical resources setting including a discussion of the relevant archaeological, historic and palaentological records.

[B] Describe and map known historic resources sites in the Project area, considering:

- *a) site type and assigned Historic Resources Values (HRVs); and*
- *b) existing site specific Historical Resources Act requirements (if applicable).*

[C] Provide an overview of previous Historical Resources Impact Assessments (HRIAs) that have been conducted within the Project Area, including:

- *a) a description of the spatial extent of previous assessment relative to the Project Area, noting any assessment gap areas; and*
- *b) a summary of Historical Resources Act requirements and/or clearances that have been issued for the Project to date (if applicable);*

[D] Identify locations within the Project Area that are likely to contain previously unrecorded historic resources. Thoroughly describe the methods used to identify these areas.

4.2 Impact Assessment

[A] Describe Project components and activities that have the potential to affect historic resources at all stages of the Project;

[B] Describe the nature and significance of the potential Project impacts on historical resources, considering:

- *a) effects on historic resources site integrity; and*
- *b) implications for the interpretation of the archaeological, historic and palaeontological records.*

[C] Discuss mitigation measures that can be used to minimize impacts on historical resources. Clearly identify those mitigation measures recommended for implementation and provide rationale for their selection.

Section 33 of the *Historical Resources Act* outlines the requirement to conduct a HRIA and submit a report to the Minister prior to undertaking any activities. As such, the objective of the HRIA is to meet the requirements outlined in the *Historical Resources Act* and various regulations and guidelines and to obtain clearance for development from ACCS.

The LSA is defined as the proposed Mine Permit area (CR #4, Figure 1). The RSA has been defined as an area within 20 kilometres of the LSA (CR #4, Figure 5) which provides a meaningful sample of the types of sites found and more importantly potentially found in the area. If 10 km is often seen as a reasonable sphere of movement on a daily basis for human groups occupying and using the region, then the RSA would represent roughly two days travel from the Project area. The RSA includes meaningful regional geographical and topographic variability of the Foothills area, including even a small portion of the Embarras Plateau. It also incorporates portions of a number of the meaningful drainages in the region, including the McLeod River, Athabasca River, Gregg River, McPherson Creek, White Creek, Anderson Creek, Prest Creek, McNeill Creek, and Lambert Creek along with a number of drainages including Corral Creek, Sandstone Creek, Hunt Creek, Cache Percotte Creek, Hardisty Creek, Maskuta Creek, and others.

E.4.2 Baseline Conditions

In the Province of Alberta, historical resources are defined and regulated under the Alberta *Historical Resources Act*. Historical resources include historic, archaeological, and palaeontological resources. These resources include sites, artifacts, fossils and certain types of traditional use sites identified by First Nations. The Project area is in close proximity to Hinton and the historic Coal Branch towns and results in elevated potential for the presence of Historic Period sites.

Historic sites are those sites that post-date the exploration and settlement of an area by peoples primarily of Euro-Canadian descent and “Western European Culture.” They may include sites with standing structures/structural remains such as towns, mining camps, cabins, mines, prospects, graves, trails, roads, and railroads.

Archaeological sites related to aboriginal peoples who seasonally and occasionally occupied these lands over the past 10,000 years are known and were predicted to exist within the Project area. These sites include surface and buried sites. Many areas, particularly along the McPherson Creek and the McLeod River, have high potential for significant Precontact archaeological sites. In addition to the previous experience and knowledge indicating this, many of the legal subdivisions within the Project lands were listed as Historical Resources Value (HRV) 4 or 5 for archaeological sites.

Palaeontological sites and fossils include both surficial and bedrock deposits and the fossilized remains of both living and extinct species of plants and animals.

Due to concerns related to the protection of significant historical resources and under directives issued by ACCS, sensitive site information pertaining to specific site locations (maps, descriptions, tables) are withheld. This detailed information is contained in the HRIA reports submitted to the HRMB of ACCS and can be requested.

E.4.2.1 Historic Resources Potential

HRIA work for the Project was conducted on the Vista Coal Mine Project area and a larger zone encompassing additional Coalspur Mines Ltd. coal leases (CR #4, Figure 1). The Project area is situated in high, undulating terrain in the foothills between the McLeod River drainage to the southeast, and the Athabasca drainage to the northwest. The lowest elevations are in the vicinity of the confluence of McPherson Creek and the McLeod River and the highest are at the northwest end along the high plateau remnants overlooking the Athabasca valley. The dominant geographic feature of the Project area is McPherson Creek which runs through the centre of the Project area, and its tributaries drain the vast majority of the area.

Existing disturbance in the Project area is relatively high and includes numerous well pads, pipelines, gravel roads, smaller logging roads, seismic exploration trails, cutlines, and harvested cutblocks. Approximately 27% of the Project area has been harvested. Considering the high correlation of harvestable stands of timber with landforms suitable for the presence of archaeological sites, the actual impact to high potential landforms has been widespread.

The Project lands have been subjected to HRIA work previously but required additional efforts to bring the studies up to a modern, comprehensive standard. In total, 18 Precontact and Historic archaeological sites had been previously recorded within the Project area, and two others in the direct vicinity but outside of the Project area. This previous work has demonstrated the overall high historical resources potential, particularly along McPherson Creek (CR #4, Figure 1).

Although there are no known palaeontological sites within immediate vicinity of the Project, the Diss Palaeontological Site (located at SW-8-48-20-W5M) has demonstrated that significant vertebrate fossils in the form of small mammals and amphibians as well as plant fossils are present regionally in the Coalspur Formation and may also be present in the Paskapoo Formation in the Project area. However, the presence or absence of such fossils can only be determined once mining operations commence.

E.4.2.2 Site Assessment

Standard field procedures followed for the HRIA field program included surface reconnaissance, inspection of exposures, and shovel prospecting in areas of elevated site potential (CR #4, Figures 1 to 4). Many areas of low or moderate potential were ground-truthed while traveling between high potential zones or in targeted searches. The field program involved completion of over 2,000 shovel tests; 1,731 for this Project and the remainder were completed in association with other projects in the area (CR #4, Figure 4).

The HRIA programs recorded 45 precontact and historic sites associated with the Project; 38 are within the currently proposed and existing mine permit area and of those 10 are found within the currently proposed disturbance footprint. Table E.4.2.1 describes the relationship of each known site to the Project footprint, and provides recommendations for mitigation, if any.

The palaeontological field assessment for this Project involved inspecting bedrock exposures for fossil material. There were no palaeontological remains identified in the development zones during the course of the archaeological HRIA program.

Table E.4.2.1 Archaeological Sites Recorded in the Vista Project Area

Borden Num.	Site Class	Site Type	Archaeo-logical Significance	Recom-mended Historical Resource Value	Relationship to Proposed Vista Project Footprint	Recommendations
FiQh-1	Historic	logging camp	regional	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Historical research, vegetation clearing, detailed mapping, and test excavations on a feature by feature basis
FiQh-2	Historic	logging camp	regional	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Historical research, vegetation clearing, detailed mapping, and test excavations on a feature by feature basis
FiQh-3	Precontact	campsite	regional	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I mitigation program of 30 m² excavation, second stage dependent on results of first
FiQh-4	Precontact	campsite	high local	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed Stage I mitigation program of 5 m² excavation, second stage dependent on results of first
FiQh-5	Precontact	workshop	high local	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I mitigation program of 10 m² excavation, second stage dependent on results of first
FiQh-6	Precontact	campsite	regional	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, test excavations in proposed footprint commensurate with size of footprint, additional work, if any, based on results of testing
FiQh-7	Precontact	workshop	high local	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I testing program of 3 m² excavation, second stage dependent upon results of first
FiQh-8	Historic/ Precontact	cabin/cam psite	regional	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Precontact Stage I mitigation program of 15 m² excavation, Historic vegetation clearing, detailed mapping, 5 m² Stage I mitigation; Stage II on both components dependent upon results of first
FiQh-9	Precontact	scatter >10	regional	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I mitigation program of 15 m² excavation, second stage dependent on results of the first
FiQh-10	Precontact	scatter <10	local	HRV 0	inside Vista permit area but outside of impact footprint	No further work
FiQh-11	Precontact	workshop	high local	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I mitigation program of 4 m² excavation on ST1/Ronaghan positive location

Table E.4.2.1 Archaeological Sites Recorded in the Vista Project Area

Borden Num.	Site Class	Site Type	Archaeo-logical Significance	Recom-mended Historical Resource Value	Relationship to Proposed Vista Project Footprint	Recommendations
FiQh-20	Precontact	scatter <10	local	HRV 0	inside Vista permit area but outside of impact footprint	No further work
FiQh-21	Precontact	isolated find	local	HRV 0	inside Vista permit area but outside of impact footprint	No further work
FiQh-22	Precontact	isolated find	local	HRV 0	inside Vista permit area but outside of impact footprint	No further work
FiQh-23	Precontact	isolated find	local	HRV 0	inside Vista permit area but outside of impact footprint	No further work
FiQh-24	Precontact	scatter <10	high local	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I testing program of 5 m^2 excavation, second stage dependent upon results of first
FiQh-25	Precontact	scatter <10	local	HRV 0	within impact footprint	No further work
FiQh-26	Precontact	scatter <10	high local	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I testing program of 3 m^2 excavation, second stage dependent upon results of first
FiQh-27	Precontact	campsite	high local	HRV 4	within impact footprint	If to be disturbed, Stage I mitigation program of 4 m^2 excavation on ST1/ST2 location, second stage dependent on results of the first
FiQh-28	Historic	pit	local	HRV 0	within impact footprint	No further work
FiQh-29	Precontact	scatter <10	local	HRV 0	inside Vista permit area but outside of impact footprint	No further work
FiQh-30	Precontact	campsite	regional	HRV 4	within impact footprint	If to be disturbed, Stage I mitigation program of 40 m^2 excavation, second stage dependent on results of first
FiQh-31	Precontact	campsite	high local	HRV 4	within impact footprint	If to be disturbed, Stage I mitigation program of 4 m^2 excavation at ST1, 1 m^2 at ST2, second stage dependent on results of first

Table E.4.2.1 Archaeological Sites Recorded in the Vista Project Area

Borden Num.	Site Class	Site Type	Archaeo-logical Significance	Recom-mended Historical Resource Value	Relationship to Proposed Vista Project Footprint	Recommendations
FiQh-32	Precontact	scatter <10	regional	HRV 4	within impact footprint	If to be disturbed, Stage I mitigation program consisting of 5 m² of dispersed test units followed by 15 m² block excavation, second stage dependent on results of the first
FiQh-33	Precontact	scatter <10	local	HRV 0	within impact footprint	No further work
FiQh-34	Precontact	campsite	high regional	HRV 4	in possible future expansion area	If to be disturbed, Stage I mitigation program of 75 m² excavation, second stage dependent on results of the first
FiQh-35	Precontact	isolated find	local	HRV 0	inside Vista permit area but outside of impact footprint	No further work
FiQh-36	Precontact	scatter <10	local	HRV 0	within impact footprint	No further work
FiQh-37	Historic	logging camp	regional	HRV 4	in possible future expansion area	If to be disturbed, Historical research, vegetation clearing, detailed mapping, and test excavations on a feature by feature basis
FiQi-1	Precontact	scatter >10	local	HRV 0	within impact footprint	No further work
FiQi-2	Precontact	scatter >10	high regional	HRV 4	in possible future expansion area	If to be disturbed, Stage I mitigation program of 60 m² excavation, second stage dependent on results of the first
FiQi-3	Precontact	scatter >10	local	HRV 0	in possible future expansion area	No further work
FiQi-4	Precontact	scatter <10	local	HRV 0	in possible future expansion area	No further work
FiQi-5	Precontact	scatter <10	local	HRV 0	in possible future expansion area	No further work
FiQi-6	Precontact	isolated find	local	HRV 0	within impact footprint	No further work

Table E.4.2.1 Archaeological Sites Recorded in the Vista Project Area

Borden Num.	Site Class	Site Type	Archaeo-logical Significance	Recom-mended Historical Resource Value	Relationship to Proposed Vista Project Footprint	Recommendations
FiQi-7	Precontact	isolated find	local	HRV 0	inside Vista permit area but outside of impact footprint	No further work
FiQi-10	Precontact	scatter <10	local	HRV 0	inside Vista permit area but outside of impact footprint	No further work
FiQi-11	Precontact	campsite	regional	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I mitigation program of 25 m² excavations, second stage dependent on results of the first
FiQi-12	Precontact	scatter <10	high local	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I mitigation program of 4 m² excavation at ST1
FiQi-13	Precontact	scatter >10	high local	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I mitigation program consisting of 7 m² testing at ST2-5 locality and 3 m² at ST1 locality, second stage dependent on results of testing
FiQi-14	Precontact	isolated find	local	HRV 0	inside Vista permit area but outside of impact footprint	No further work
FiQi-15	Precontact	campsite	high local	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I mitigation program consisting of 4 m² excavation placed on ST1 and 4 m² placed on ST2, second stage dependent on results of first
FiQi-16	Precontact	campsite	high local	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I mitigation program consisting of 5 m² of dispersed test units, second stage dependent on results of the first
FiQi-17	Precontact	isolated find	local	HRV 0	outside of project area	No further work
FiQi-18	Precontact	campsite	high local	HRV 4	inside Vista permit area but outside of impact footprint	If to be disturbed, Stage I testing program of 5 m² dispersed excavation units, second stage dependent upon results of first

E.4.3 Potential Impacts

All of the proposed development footprint was included in the HRIA programs through either pre-field potential assessment, ground-truthing, surface inspection, or subsurface testing. No further HRIA reconnaissance work is needed relative to the development footprint. However, due to subsequent changes to the proposed Mine Permit area, several small areas have not been specifically subjected to archaeological HRIA assessment or field work (CR #4, Table 3). All of these areas are outside of the development footprint and most are low in historical resources potential. If the development footprint were to be modified to include these areas, it is recommended that limited amounts of additional work will be required.

Of the total of 45 historical resource sites recorded during the HRIA, 38 are located within the proposed mine permit boundary (Table E.4.2-1). A total of 20 historical resource sites have been recorded within the proposed mine permit area, disturbance footprint, or other areas during the HRIA program for the Project on which no further work is recommended prior to disturbance (Table E.4.2-1). These sites are typically small, have low artifact density or diversity, or are heavily disturbed.

A total of four significant historical resource sites have been recorded within the proposed mine permit area that also lie within or directly adjacent to the currently proposed disturbance footprint for the Project. These sites are considered to be of high local, regional, or high regional archaeological significance and it is recommended that additional investigation be required prior to impact of these sites.

A total of 21 significant sites were recorded within the proposed Project mine permit area, but outside areas currently slated for ground disturbing activities. These sites require either continued avoidance or mitigation should development plans change to include impact. These sites are considered to be of high local, regional, or high regional archaeological significance and it is recommended that additional investigations be required prior to impact.

E.4.4 Cumulative Effects

Cumulative effects on historical resources include those directly related to the Project in relation to those from other past, present, and future development projects in the region which have or may disturb historical resources. Cumulative effects on historical resources are assessed by comparing HRIA results in the LSA to those in the RSA. One must consider overall known site loss in relationship to site significance, and the effects of this on the ability of archaeologists to interpret historical resources in the future.

Of the 38 sites in the LSA, 10 will be removed or disturbed during mine development. Six of the sites are considered to be of low historical resources potential; that is, the artifact density, diversity, and distributions at those sites indicates that additional investigation in the form of excavation or other forms of recording is unlikely to contribute in a meaningful manner to the understanding of the past. Four precontact sites that are considered to have elevated potential to contribute to the knowledge of the area's past through additional investigation will be removed. These sites are considered to be of high local or regional archaeological significance.

Within the RSA, a total of 179 archaeological sites have been recorded (CR #4, Table 2). Of these sites, 143 are Precontact sites, 34 are Historic Period, and two are known to have both Precontact and Historic components. Thirty-nine percent of the previously recorded sites were or are considered to be worthy of additional investigation for data recovery prior to disturbance.

Following development of the Project, 67% of the known, significant historical resources in the surrounding region will be extant and available for future study of both Precontact and Historic periods.

An unknown but large number of significant sites are assumed to be present in undeveloped portions of the region, likely numbering well into the hundreds. As historical resources are not mobile, the precise impact of future development on these resources can only truly be assessed once those developments are proposed and HRIA work is undertaken. Many sites already removed have been appropriately studied and information collected prior to removal, so it can be expected that implementation of the *Historical Resources Act* on any future developments will result in an appropriate balance between information loss, information gain from mitigation, and preservation of a large sample of sites for future research. The development of the Project will leave 74% of the known significant historical resources within the Mine Permit area intact, including several sites with some of the highest research potential currently known in the region.

The development of the Project, in combination with existing developments and possible future development will not have a deleterious cumulative effect on historical resources in the area. Any losses are typically offset by the data gained during mitigation activities, which are typically the only source of information on the historical resources in the area.

E.4.5 Mitigation and Monitoring

E.4.5.1 Mitigation

In order to reduce potential impacts of the Project on historical resources, Coalspur will:

- obtain clearance from ACCS, as required, prior to development;
- undertake mitigation measures as recommended and agreed upon with ACCS; and
- stop work if a historical resource is encountered during mining that has not been identified under an HRIA and notify ACCS and the Royal Tyrell Museum of Palaeontology (RTMP).

E.4.5.2 Monitoring

Coalspur will provide a professional Palaeontologist (AB) and/or staff of the Royal Tyrrell Museum of Palaeontology with access to overburden or waste spoil piles and/or a stable mine face once a year during snow- and frost-free conditions for the purpose of examining exposed bedrock for significant fossil material.

E.4.6 Summary

The HRIA works completed for the Project have resulted in the recording of 38 archaeological sites in the Project area. These sites range considerably in size, age, and significance. Four sites within or directly adjacent to the Project footprint require additional investigation. A total of 21 significant sites have been recorded within the mine permit area, but outside of areas currently slated for ground disturbing activities. These areas require continued avoidance or additional investigations prior to impact.

Coalspur will apply to ACCS for *Historical Resources Act* clearance for ground disturbing activities throughout the existing and proposed Project mine permit area except for:

- some small areas within the proposed mine permit area but outside of the current development footprint;
- four sites within or adjacent to the current development footprint that are considered to be of high local, regional, or high regional archaeological significance;
- 21 sites within the mine permit area but outside of the current development footprint, that are considered to be of high local, regional, or high regional archaeological significance.

E.5 HUMAN HEALTH

E.5.1 Introduction and Terms of Reference

Coalspur conducted a human health risk assessment for the proposed Project. The following section is a summary of the Human Health Risk Assessment (HHRA) that was prepared by Intrinsik Environmental Sciences Inc. (Intrinsik) and is included as Consultant Report #5 (CR#5). For full details of the assessment please refer to CR #5.

Intrinsik also conducted a Screening Level Wildlife Risk Assessment (SLWRA) for the proposed Project. The following summary also includes select information from the SLWRA included in Consultant Report #5 (CR #5, Appendix F).

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the Human Health Risk Assessment and SLWRA are provided in Section 6.0 of the ToR and are as follows:

6 PUBLIC HEALTH AND SAFETY ASSESSMENT

[A] Describe those aspects of the Project that may have implications for public health or the delivery of regional health services. Determine whether there may be implications for public health arising from the Project. Specifically:

- *a) assess the potential health implications of the compounds that will be released to the environment from the Project in relation to exposure limits established to prevent acute and chronic adverse effects on human health;*
- *b) provide the data, exposure modeling calculations, and describe the methods the Proponent used to assess impacts of the Project on human health and safety;*
- *c) provide information, including chemical analyses and modeling results, on samples of selected environmental media (e.g., soil, water, air, vegetation, wild game, etc.) used in the assessment;*
- *d) discuss the potential for changes to water quality, air quality and soil quality to increase human exposure to contaminants taking into consideration all Project activities;*
- *e) identify the human health impact of the potential contamination of country foods and natural food sources taking into consideration all Project activities;*
- *f) document any health concerns raised by stakeholders during consultation on the Project;*
- *g) document any health concerns identified by aboriginal communities or groups resulting from impacts of existing development and of the Project specifically on their traditional lifestyle and include an aboriginal receptor type in the assessment;*
- *h) assess the cumulative human health impacts to receptors, including First Nations and Métis receptors;*

The HHRA describes the nature and significance of potential short-term (acute) and long-term (chronic) health risks to people associated with exposure to the chemicals of potential concern (COPCs) emitted or released from the proposed Project. The HHRA examines potential health risks attributable to the Project in combination with existing developments. The SLWRA addresses the same components with respect to wildlife.

The HHRA and SLWRA focused on potential health risks associated with predicted chemical concentrations in two study areas defined by the Air Quality Assessment (CR #1):

- the LSA consisting of a 9 km (north-south) by 12 km (east-west) area centered on the Project area where the greatest intensity of mining activity and associated emissions are expected; and
- the RSA consisting of a 30 km (north-south) by 40 km (east-west) area surrounding the Project.

The receptor locations evaluated in the LSA consist of recreation areas (*i.e.*, lakes). Outside the LSA receptor locations consist of recreation areas (*e.g.*, lakes), campgrounds, cabins, residential areas and community complexes (*e.g.*, Hospital and Sportsplex). Several receptor locations within the Community of Hinton have been included in the HHRA based on public consultation (Section G, Stakeholder Engagement).

The HHRA and SLWRA assessed both short and long term health risks to people associated with the chemicals emitted from the Project. The two exposure durations used in the assessment can be described as follows:

- acute: exposure extends over a time period covering minutes to a day (for SWLRA hours to days); and
- chronic: exposure occurs continuously or regularly over extended periods, lasting for periods of months to years, and possibly extending over an entire lifetime.

Although the operational life of the Project is estimated to be 20 years (*i.e.*, 2015 to 2035), the HHRA and SLWRA assumed that the chemical emissions attributable to the Project would continue for a period of 80 years. The assumption of 80 years coincides with a person's assumed lifespan (Health Canada 2009a).

E.5.2 Assessment Approach

Potential human health risks associated with Project emissions or releases were examined using a conventional risk assessment paradigm. The risk assessment paradigm is consistent with those developed by Alberta Health and Wellness (AHW 2011), Health Canada (2009a), the Canadian Council of Ministers of the Environment (CCME 2006), and the U.S. Environmental Protection Agency (US EPA OSW 2005). This methodology has been endorsed by a number of provincial regulatory authorities in the past, including AEW, AHW and the Alberta Energy Resources and Conservation Board (ERCB).

The SLWRA was conducted according to principles provided by Environment Canada and the Canadian Council of Ministers of the Environment protocols (Gaudet et al. 1994; CCME 1996).

The risk assessment paradigm for both HHRA and SLWRA involves the following four steps:

- problem formulation;
- exposure assessment;
- toxicity assessment; and
- risk characterization.

E.5.2.1 Problem Formulation

Problem formulation is the initial step of the assessment, in which all chemicals associated with Project emissions or releases are identified, people potentially at risk are characterized, and relevant exposure pathways are identified. The problem formulation step "sets the stage" for the detailed analysis of the HHRA.

Identification of COPCs

The COPCs for the Project were identified through the development of a comprehensive inventory of chemicals that could be emitted from the Project and to which people might be exposed. Development of the initial chemical inventory considered both possible Project air emissions and water releases. Only Project emissions or releases resulting in potential changes to environmental quality were considered as COPCs within the HHRA. As the Project will not release any chemicals into groundwater or surface water, the COPCs for the HHRA were based on air emissions only.

The selection of COPCs for this Project also took into consideration whether or not sufficient toxicological information is available to assess the health risks. When toxicological information was not available, the HHRA searched for the availability of chemical surrogates to represent any of the substances or groups of substances.

The COPCs used in the HHRA and SLWRA assessment are listed in CR #5, Table 3-1 and include:

- criteria air contaminants (CACs);
- metals;
- polycyclic aromatic carbons (PAHs);
- petroleum hydrocarbon (PHC) fractions; and
- volatile organic compounds (VOCs).

Characterization of People Potentially at Risk

People in the region who have the highest potential health risks associated with Project emissions include individuals who might be most highly exposed to Project emissions and/or more sensitive or susceptible to Project emissions. In this regard, consideration was given to:

- the people who are known or anticipated to spend time near the Project;
- the physical characteristics of the people in the region who could result in increased exposure;
- the lifestyles of the individuals in the region that could result in increased exposure (*e.g.*, consumption patterns, portions of diet obtained locally); and
- sensitive or more susceptible individuals in the region (*e.g.*, infants and young children, the elderly, individuals with compromised health).

Recognizing that people use the area in the immediate vicinity of the Project for recreational or traditional activities such as hunting, trapping, all-terrain vehicle access and plant gathering, the HHRA included an assessment of adverse health risks to people active along the boundary of the Project area. Specifically, at the location within the LSA where the highest ground-level air concentrations of the COPCs were predicted to occur. It is important to note that access into the principle development area is prohibited and will be managed. Thus, locations at the development boundary were identified that represent the maximum predicted COPC air concentrations associated with the Project that any individuals who visit the area could be exposed to.

Twenty five discrete locations within the RSA were selected for consideration in the HHRA, with two falling inside the LSA (CR #5, Figure 1). The 25 receptor locations included in the HHRA were grouped according to their assumed land-use. It was assumed that the physical characteristics of people in each group were generally similar. However, the lifestyles and behaviours of individuals in established residential communities, and who are active in the RSA for seasonal or recreational activities, were captured in the HHRA.

The discrete receptor locations were organized into the following groups in the HHRA:

- LSA-MPOI: Local MPOI and includes people who may be present at the locations where the highest COPC concentration could occur in the LSA;
- RSA-MPOI: The location where the highest COPC concentration could occur in the RSA;
- Resident group: It was assumed that individuals within this group live permanently in the area, and practice a lifestyle that involves a high level of consumption of local country foods, garden vegetables and traditional plants. It also includes individuals who may use the cabins located in the RSA as a temporary shelter while engaged in activities such as hunting, fishing or trapping. Although the exact frequency of use is not documented, for the purposes of the HHRA, it was assumed that these individuals use these recreational areas on a regular basis for several months per year;
- Recreational group: This group includes individuals who may visit local campgrounds or other sites for recreational purposes (*e.g.*, fishing or hunting) for various durations of time (days, months) but do not permanently reside in the area; and
- Commercial group: This group includes individuals who work for or use essential services (*e.g.*, post office or hospital) or visit local centers for recreational purposes (*e.g.*, Sportsplex or Gun Range) for short durations of time (days to weeks). These locations are considered for acute exposures and were also assessed for workers on a chronic basis.

It was assumed that temporary visitors would be near the Project only on a short-term (acute) basis, and that they could be exposed to concentrations within the LSA. Inhalation of the COPCs emitted from the Project to the air was deemed to be the only potential exposure pathway for this group. There are no work camps planned for the Project where people will live during construction and operation of the mine. Therefore, the HHRA did not include a Worker group.

Potentially long-term exposed individuals residing in the RSA may be exposed through multiple pathways. All age classes (life stages) were considered in a multiple pathway exposure assessment. The five receptor life stages that were included in the HHRA are consistent with Health Canada guidance (Health Canada 2009a):

- Infant (0 to 6 months = 0.5 years);
- Toddler (7 months to 4 years = 4.5 years);
- Child (5 to 11 years = 7 years);
- Adolescent (12 to 19 years = 8 years); and
- Adult (20 to 80 years = 60 years).

For the assessment of carcinogens, a “composite individual” who represents all life stages (*e.g.*, from infant to adult) was used to represent cumulative exposure over an 80-year lifetime.

<u>Exposure Pathways Identification</u>

For human exposure to take place (and potential health risks to occur), exposure pathways must exist that link Project emissions to exposure by humans. Based on predicted Project air emissions, local residents and persons spending any time near the Project site or in local communities could be exposed via inhalation of COPCs to the atmosphere from the Project. The Resident group also might be exposed to the chemical emissions on a long-term basis through secondary exposure pathways (*e.g.*, inhalation of dust, food and water ingestion, and dermal contact).

The following exposure pathways were included in this HHRA for the Resident group:

- inhalation of air;
- inhalation of dust;
- ingestion of soil (inadvertent);
- ingestion of water;
- ingestion of local above-ground plants (including fruit and vegetables);
- ingestion of local below-ground plants (root vegetables);
- ingestion of local traditional plants (Labrador tea and cattail);
- ingestion of local fish;
- ingestion of local wild game (moose, snowshoe hare and ruffed grouse);
- ingestion of water while swimming;
- dermal contact with water; and
- dermal contact with soil.

E.5.2.2 Exposure Assessment

Potential exposures to COPCs were estimated based both on ambient measurements (for baseline conditions) and predictive exposure modelling for COPCs that will be emitted from the Project. Air dispersion models were used to estimate maximum air concentrations resulting from Project emissions (Section E.1). Exposure models were then used to estimate potential human and wildlife exposures based on predicted air concentrations.

Inhalation Assessment

Inhalation exposure estimates were based on the results of the air dispersion modelling, for the HHRA and SLWRA that were described in the Air Quality Assessment (Section E.1). In the HHRA predicted air concentrations were presented over different averaging periods (*e.g.*, 10-minute, 1-hour, 8-hour, 24-hour and annual) to allow for the assessment of both acute and chronic health risks. In addition, predicted air concentrations were presented for various assessment cases (*i.e.*, baseline case, application case and PDC) to characterize risks from the Project in combination with existing and proposed sources.

Multiple Exposure Pathway Assessment

In order to assess the potential health risks associated with the secondary pathways, it was necessary to identify those COPCs emitted by the Project that, although emitted into air, could potentially be deposited nearby and possibly persist or accumulate sufficient quantities for people to be exposed via soil, food and water pathways. For this purpose, only relatively non-volatile COPCs were considered, including PAHs and VOCs. Metals were automatically included in the multiple pathway exposure assessment. The CACs were automatically excluded from the multiple pathway exposure assessment as these chemicals predominantly exist in air and relate only to inhalation exposures.

The volatility and accumulation potential of organic COPCs required further consideration based on physical and chemical properties that influence their fate and persistence in the environment. The results of the physical-chemical screening revealed that 17 organic COPCs are eligible for inclusion in the multiple pathway assessment, provided that defensible exposure limits are available (CR #5, Table 3-7).

E.5.2.3 Toxicity Assessment

The toxicity assessment involves having an understanding of the critical toxicological effects that can result from exposure to the COPCs and the condition in which these effects might occur. Potential health effects associated with exposures to the COPCs, along with the basis and selection of the exposure limits, are described in CR #5, Appendix A.

When evaluating the toxicological potential for a substance in relation to health, consideration must be given to the dose to which a person is exposed, as the dose determines the type and potentially the severity of any adverse effects that may be observed. In addition, consideration must be given to the route of exposure (*i.e.*, inhalation, oral, or dermal), as the route of exposure influences absorption, distribution and excretion of the toxicant.

Two categories of COPCs were assessed based upon their mechanism of toxicity: threshold and non-threshold COPCs. Threshold substances are generally those that require that a certain level of exposure (or minimum dose) be exceeded before toxic effects occur. In general, threshold substances are non-carcinogenic (*i.e.*, non-cancer causing), but there are some chemicals that demonstrate a mode of carcinogenicity that has a threshold. Non-threshold substances are carcinogens capable of producing cancer through one or more possible mechanisms (*e.g.*, mutagenicity, cytotoxicity, inhibition of programmed cell death, mitogenesis (uncontrolled cell proliferation) and immune suppression) that, in theory, do not require the exceedance of a threshold (US EPA OSW 2005).

<u>Exposure Limits</u>

Exposure limits (also known as TRVs) that have been developed by scientific and/or regulatory agencies aimed at the protection of human health were identified for each of the COPCs on both an acute and chronic basis. Separate assessments were completed for both the acute and chronic exposure scenarios in recognition of the fact that the toxic response produced by chemicals and the target tissues affected can change, depending on whether exposure is short term (acute) or long term (chronic). As a result, different exposure limits were selected for each chemical included in the acute and chronic assessments (CR #5, Tables 3-11 to 3-15).

<u>Chemical Mixtures</u>

Given that chemical exposures rarely occur in isolation, the potential health effects associated with mixtures of the COPCs were assessed in the HHRA. In accordance with Health Canada guidance, additive interactions were assumed for the HHRA (Health Canada 2009a).

Potential additive interactions were identified for specific COPCs that may cause:

- eye irritation;
- nasal irritation;
- respiratory irritation;
- kidney toxicity;
- liver toxicity;
- reproductive and developmental effects;
- neurotoxicity;

- gastrointestinal toxicity; and
- lung tumours.

E.5.2.4 Risk Characterization

This final step of the risk assessment involves comparing estimated exposures (identified in the exposure assessment) with exposure limits (identified in the toxicity assessment) to determine potential health risks for the different assessment cases. Risk estimates are presented as potential Project-specific effects and cumulative effects for both acute and chronic exposures. The potential health risks associated with emissions from the Project are expressed as risk quotients (RQs) for the non-carcinogenic COPCs and as incremental lifetime cancer risks (ILCRs) for the carcinogenic COPCs.

Non-Cancer Risk

In the HHRA the RQ values were calculated by comparing the predicted levels of exposure for the non-carcinogenic COPCs to their respective exposure limits (CR #5, Appendix B) that have been developed by regulatory and scientific authorities. Interpretation of the RQ values is as follows:

- **RQ ≤1** Indicates that the estimated exposure is less than or equal to the exposure limit (*i.e.*, the assumed safe level of exposure). RQ values less than or equal to 1.0 are associated with negligible health risks, even in sensitive individuals given the level of conservatism incorporated in the derivation of the exposure limit and exposure estimate.
- **RQ >1** Indicates that the exposure estimate exceeds the exposure limit. This suggests an elevated level of risk, the significance of which must be balanced against the degree of conservatism incorporated into the risk assessment (*i.e.*, the margin of safety is reduced but not removed entirely).

Cancer Risk

Health Canada and AEW have specified an incremental (*i.e.*, over and above background) lifetime cancer risk of one in 100 000, which these agencies consider acceptable, tolerable or essentially negligible (AEW 2009; Health Canada 2009a). In the HHRA the ILCR values were calculated by comparing the predicted level of exposure to carcinogenic COPC's to their carcinogenic exposure limit. Interpretation of the ILCR values proceeded as follows:

- **ILCR ≤1.0** Denotes an incremental lifetime cancer risk that is below the benchmark ILCR of 1.0 in 100,000 (*i.e.*, within the accepted level of risk set by AEW and Health Canada).
- **ILCR >1.0** Indicates an incremental lifetime cancer risk that is greater than the de minimus risk level of 1.0 in 100,000, the interpretation of which must consider the conservatism incorporated into the assessment.

Wildlife Health

The risk characterization step of the SLWRA for inhalation exposure involved comparing maximum predicted COPC air concentrations for each of the assessment cases to wildlife inhalation toxicological reference values (TRVs). Hazard quotient (HQ) values were then calculated by dividing the predicted contaminant concentration in air by the available TRV.

Interpretation of the predicted HQ values was as follows:

- **HQ < 1:** estimated maximum exposure is less than the associated TRV, indicating that risks to wildlife are negligible for the COPC.

- **HQ >1:** estimated maximum exposure is greater than the associated TRV, indicating that potential wildlife health effects may exist.

Maximum predicted COPC soil and surface water concentrations was compared to soil quality guidelines (CR #5, Table F-10) and surface water quality guidelines (CR #5, Table F-11). Where maximum predicted concentrations did not exceed soil quality guidelines (SQGs) or surface water quality guidelines (SWQG), it was assumed that potential risks to wildlife would be negligible. Where maximum predicted COPC concentrations exceed SQGs or SWQGs, it was assumed that potential wildlife health effects may exist and the potential health risks were discussed further.

E.5.3 Potential Impacts

HHRA risk assessment results are predicted for:

- acute inhalation;
- chronic inhalation;
- chronic multiple pathways; and
- mixtures.

The discussion of the results focused on risk estimates that exceeded 1.0, as these values could signify potential health risks.

SLWRA risk assessment results are predicted for:

- acute inhalation pathway;
- chronic inhalation pathway;
- chronic soil pathway; and
- chronic water pathway.

E.5.3.1 Acute Inhalation

In the HHRA all RQ values are below 1.0 indicating that adverse health effects on an acute basis are not expected (CR #5, Table 4-1 to Table 4-5) with the exception of the RSA-MPOI. RQ values for 10-min SO_2 were above 1.0 at the RSA-MPOI (RQ=2.1) in the baseline case, application case and PDC.

The degree of conservatism incorporated into the SO_2 exposure limit must be considered in the interpretation of the likelihood of potential adverse health effects with the predicted exceedance at the RSA MPOI. A review of the scientific literature indicates that no adverse effects among healthy individuals are observed for brief periods of exposure to concentrations of SO_2 less than 1,300 µg/m³ (CR #5, Table 4-6). The maximum predicted hourly SO_2 concentration at the RSA-MPOI (636 µg/m³) in the baseline case, application case and PDC are within the range of air concentrations where increased airway resistance and potential bronchoconstriction in asthmatic or sensitive individuals is observed when engaged in moderate exercise. All changes in airway resistance are reversible and shortness of breath or other clinical signs may be observed depending on severity of the asthmatic condition. The probability of exceeding the WHO 10-minute SO_2 exposure limit of 500 µg/m³ at the RSA MPOI is less than 0.007% (*i.e.*, 3 hours in 5 years or 43,824 hours). Finally, the maximum concentration of SO_2 in the application case is predicted to occur between the town of Hinton and the Project near the Cache Percotte Camp (CR #1).

Based on the low likelihood of SO_2 concentrations exceeding guidelines, the conservatism incorporated in the exposure limit and the low likelihood that an individual will be present at the RSA-MPOI at the exact time when maximum concentrations are reached, the predicted acute SO_2 risks are likely overstated and adverse impacts from short-term exposures to SO_2 at the RSA-MPOI are not expected.

In the SLWRA all predicted acute HQ values for all assessment cases were below 1.0 (*i.e.*, predicted exposures were less than the assumed TRVs) for both mammalian and avian receptors. Therefore, it was concluded that predicted acute exposures to the COPCs would not have an adverse effect on either avian or mammalian wildlife in the region.

E.5.3.2 Chronic Inhalation

In the HHRA chronic inhalation risks were evaluated for the resident and commercial group only. The MPOI locations were not evaluated on a chronic basis as they are intended to reflect worst-case exposure to a hypothetical, transient person who might be in the area when worst case emissions and meteorological conditions are occurring. As such, the chronic inhalation pathway is not considered relevant to the LSA-MPOI or RSA-MPOI. In addition, the recreational group was not assessed on a chronic basis as it was assumed that exposures for extended periods of time would not occur at these locations.

Non-Carcinogens

All chronic RQ values were less than 1, suggesting that the predicted long-term air concentrations of the COPCs are not expected to result in adverse health effects (CR #5, Table 4-7). The predicted RQ values for the baseline case and application case were generally very similar suggesting that the contributions of the Project with respect to air emissions will likely have a negligible impact on health.

Carcinogens

All predicted ILCR values were predicted to be less than 1 in 100,000, indicating that the incremental contributions from the Project emission sources are associated with an essentially negligible degree of risk (CR #5, Table 4-9 and Table 4-10).

Wildlife Chronic Inhalation

Predicted chronic inhalation HQ values did not exceed 1 (*i.e.*, predicted exposures were less than the exposure limits) for all of the assessment cases for mammalian wildlife receptors (CR #5, Appendix F, Table F9). Thus, it was concluded that predicted chronic exposures to the COPCs would not have an adverse effect on mammalian wildlife in the region.

E.5.3.3 Chronic Multiple Exposure Pathway

The HHRA assumed that people living in the area on either a permanent or seasonal basis (*i.e.*, the Resident group) were exposed to COPCs via multiple exposure pathways over their entire lifetime (80 years). The LSA-MPOI, RSA-MPOI, recreational group and commercial group were excluded from the multiple pathway assessment, as these do not represent locations where people are likely to spend extended periods of time engaging in activities with potential oral exposures (*e.g.*, food and water consumption).

Non-Carcinogens

All multiple pathway RQ values for the baseline case, application case and PDC for the resident group were less than 1.0 (CR #5, Table 4-11), with the exception of manganese and methyl mercury. For all of the COPCs, negligible changes in RQ values were predicted between the baseline case and application case, indicating that the incremental change associated with the Project is negligible. Overall, the potential for adverse non-carcinogenic health impacts is anticipated to be low.

The predicted chronic manganese exposure is associated with an RQ value of 1.2 in the baseline case, application case and PDC for the toddler. The RQ value for the adult life stage is predicted to be 0.62 for manganese in the baseline case, application case and PDC. The Project is not expected to measurably increase manganese-related health risks for residents in the region.

Manganese is commonly present in the environment and is an essential element. In this assessment, the primary exposure pathways contributing to the RQ values for the toddler and adult are the consumption of plants and fish. The estimated daily intake of manganese for the toddler is predicted to be 2.8 mg/day. This intake level is below the recognized NOAEL of 10 mg/day (Health Canada 2009b; US EPA 1996; WHO 2000). As the estimated intake levels in this assessment fall within the range of typical Canadian exposure levels, at which adverse effects have not been observed, the predicted manganese RQ values are not expected to be associated with adverse health effects.

Methyl mercury is the form of mercury that is of greatest concern with respect to accumulation in biological organisms, and subsequent consumption by people (Health Canada 2007). Food intake is the primary route of exposure to mercury compounds in humans, with fish and seafood being the most significant contributors to human exposure (ATSDR 1999). For the Resident group, the highest RQ value was predicted for the toddler life stage, where 100% of the estimated daily intake of methyl mercury is attributable to local fish consumption. The methyl mercury concentration (*i.e.*, 95UCLM) in fish used in the HHRA is 0.11 mg/kg wet weight (CR #5, Appendix B). This concentration is below the subsistence fish consumption guideline of 0.2 mg/kg recommended by Health Canada (2007).

Carcinogens

All ILCR values were less than 1.0, indicating that the Project is associated with negligible incremental cancer risks (*i.e.*, less than 1 in 100,000) for the resident group (CR #5, Table 4-14).

E.5.3.4 Mixture Results

Acute Inhalation Mixture Results

The acute inhalation mixture RQ values are below 1.0 except for the eye irritant, nasal irritant and respiratory irritant group (CR #5, Table 4-15 to Table 4-19).

The maximum mixture RQ value for the eye irritants group was predicted to be 1.4 in the application case. The relative contribution of COPCs to the RQ value is predicted as follows: acrolein (57%), formaldehyde (38%) and acetaldehyde (4%). The RQ value for the eye irritants mixture is thought to overstate the actual risk for combined exposure to these COPCs, based on the following rationale:

- individual RQ values for all COPCs in the mixture were less than 1.0;
- negligible changes in RQ values were predicted between the baseline case and application case, indicating that the incremental change associated with the Project is negligible;
- acrolein is the primary contributor, comprising 57% of the mixture at the RSA-MPOI;
- the predicted acrolein concentration at the RSA-MPOI in the application case was 2.1 µg/m³ and the background concentration was assumed to be 0.6 µg/m³, which represents 30% of the predicted concentration;
- the predicted formaldehyde concentration at the RSA-MPOI in the application case was 27.52 µg/m³ and the background concentration was assumed to be 27.5 µg/m³, which represents 100% of the predicted concentration;
- there is a margin of safety incorporated into the acute acrolein exposure limit. Thus the exceedance of the mixture RQ value does not necessarily indicate that people's health will be

adversely affected. All predicted concentrations are seventy times below the reported LOAEL of 140 µg/m³ in humans; and

- the predicted maximum hourly concentration for acrolein (*i.e.*, 2.1 µg/m³) is predicted to occur in the vicinity of R13 within the town of Hinton and is entirely due to community combustion sources and the background concentration assumed in the Air Quality Assessment (CR #1).

The maximum mixture RQ value for the nasal irritants group was predicted to be 1.5 in the application case. The relative contribution of COPCs to the RQ value as follows: acrolein (56%), formaldehyde (38%) and acetaldehyde (4%). The RQ value for the nasal irritants mixture is thought to overstate the actual risk for combined exposure to these COPCs, based on the following rationale:

- individual RQ values for all COPCs in the mixture were less than 1.0;
- negligible changes in RQ values were predicted between the baseline case and application case, indicating that the incremental change associated with the Project is negligible;
- acrolein is the primary contributor, comprising 56% of the mixture at the RSA-MPOI;
- the predicted acrolein concentration at the RSA-MPOI in the application case was 2.1 µg/m³ and the background concentration was assumed to be 0.6 µg/m³, which represents 30% of the predicted concentration;
- the predicted formaldehyde concentration at the RSA-MPOI in the application case was 27.52 µg/m³ and the background concentration was assumed to be 27.5 µg/m³, which represents 100% of the predicted concentration;
- there is a margin of safety incorporated into the acute acrolein exposure limit. The exceedance of the mixture RQ value does not necessarily indicate that people's health will be adversely affected. All predicted concentrations are 70 times below the reported LOAEL of 140 µg/m³ in humans; and
- the predicted maximum hourly concentration for acrolein (*i.e.*, 2.1 µg/m³) is predicted to occur in the vicinity of R13 within the town of Hinton and is entirely due to community combustion sources and the background concentration assumed in the Air Quality Assessment (CR #1).

The maximum mixture RQ value for the respiratory irritants group was predicted to be 3.8 in the application case. The relative contribution of COPCs to the RQ value is SO_2 (55%), NO2 (20%) and acrolein (21%). The RQ value for the respiratory irritants mixture is thought to overstate the actual risk for combined exposure to these COPCs, based on the following rationale:

- the maximum RQ values for acrolein and NO_2 were less than 1.0 on an individual basis;
- SO_2 is the only COPC predicted to exceed its exposure limit;
- SO_2 is the primary contributor, comprising 55% of the mixture at the RSA-MPOI;
- the mixture RQ values are unlikely to exceed 1.0 as the SO_2 concentrations used in the mixture calculation are based on 1-hour maximums, and are predicted to exceed their guidelines less than 0.007% of the time; and
- NO_2 concentrations are predicted to contribute approximately 20% of the respiratory irritant mixture at the RSA-MPOI. However, the isopleth maps (CR #1) clearly show that the maximum concentrations of NO_2 and SO_2 are not predicted to occur at the same location and are at least 14 km apart when these maximums are predicted to occur. Similarly, the maximum concentrations of acrolein and SO_2 are not predicted to occur at the same location and are at least 5 km apart when these maximums are predicted to occur.

Based on the low likelihood of SO_2 concentrations exceeding guidelines, the fact that no other mixture components exceed their respective guidelines, and the low likelihood that an individual will be present at either MPOI location at the exact time when maximum concentrations are reached, the predicted acute SO_2 risks are likely overstated and adverse impacts from short-term exposures to the respiratory irritant mixture at the RSA MPOI are not expected.

Chronic Inhalation Mixture Results

As people are unlikely to remain for extended periods of time at locations where the MPOI may occur, the MPOI was not included in the chronic mixtures assessment. In addition, the recreational group was excluded from the chronic mixtures assessment based on similar assumptions. All non-carcinogenic chronic inhalation mixture RQ values for the resident and commercial group were less than 1.0 (CR #5, Table 4-20 and Table 4-21), indicating that the risk of additive effects occurring as a result of the combined exposure to COPCs with common chronic toxicological endpoints is low. Similarly, the mixture ILCR values for the resident and commercial group were less than 1.0 for the carcinogenic mixture in the chronic inhalation assessment (CR #5, Table 4-22 and Table 4-23).

Chronic Multiple Exposure Pathway Mixture Results

The RQ values for the neurotoxicants and reproductive and developmental toxicants mixtures were greater than 1.0 for the resident group (CR #5, Table 4-24). There are no apparent differences between the baseline case and application case RQ values for the resident, indicating that the Project will have a negligible impact on the mixture risks.

The neurotoxicants mixture consists of aluminum, lead, manganese, methyl mercury and selenium. Combined, methyl mercury (48%) and manganese (43%) contribute over 90% of the risk. The RQ values for both manganese and methyl mercury are likely overstated because of the conservative assumptions incorporated into the HHRA. Overall, the potential for adverse neurotoxicological effects is considered to be low.

The reproductive and developmental toxicants mixture consists of aluminum, lead, methyl mercury, nickel and vanadium. Methyl mercury contributes over 85% of the risk. The RQ value for methyl mercury is likely overstated because of conservative assumptions incorporated into the HHRA. All methyl mercury risks are attributable to the estimated consumption of local fish.

E.5.4 Cumulative Effects

As stated in Section E.1.4, the Project will be developed in an airshed that has other emission sources and the addition of the Project will change the air quality. The Project contribution of $S0_2$ to RSA emissions is very small due to very high emissions of SO_2 from industry in Hinton. The Project contribution to other emissions in the RSA is larger and emissions would increase with a further addition of a potential future expansion. The potential impacts to human and wildlife health were evaluated and discussed in Section E.5.3.

E.5.4 Mitigation and Monitoring

Coalspur is committed to ongoing monitoring and mitigation. Monitoring programs for key disciplines are provided within the individual consultant reports as appropriate and are summarized as follows:

- air monitoring (CR #1);
- surface water monitoring (CR #10); and
- groundwater monitoring (CR #3).

E.5.5 Summary

The chemical emissions from the Project are not expected to result in adverse health effects in the region. For most of the COPCs, the magnitude of the differences in predicted health risks between the baseline and application case is negligible. The key findings of the HHRA are summarized as follows.

- Acute Inhalation Assessment - The potential short-term health risks associated with the Project and other emission sources were evaluated through the comparison of predicted air concentrations (10-minute, 1-hour, 8-hour or 24-hour) against health-based exposure limits. Overall, there were minimal changes between the baseline and application cases, indicating that the Project emissions are not anticipated to have an impact on human health in the area. RQ values for 10-minute SO_2 were above 1.0 at the RSA-MPOI (RQ=2.1). Adverse effects from exposure to SO_2 are not expected based on the low likelihood of SO_2 concentrations exceeding guidelines and the low likelihood that an individual will be present at the MPOI at the exact time when maximum concentrations are reached.
- Chronic Inhalation Assessment - Predicted risks associated with continuous, long-term inhalation of the COPCs were evaluated through the comparison of predicted annual average air concentrations with health-based exposure limits. No exceedances of health-based exposure limits were predicted in the chronic inhalation assessment. All incremental lifetime cancer risks were predicted to be less than 1.0 in 100,000, indicating that the cancer risks associated with the Project are essentially negligible.
- Chronic Multiple Pathway - The potential long-term health risks associated with exposure to the COPCs via multiple pathways of exposure were evaluated for permanent and seasonal residents in the area. In most instances, potential risks were determined to be negligible. All incremental lifetime cancer risks associated with exposure via multiple pathways of exposure were predicted to be less than 1.0 in 100,000, suggesting that the cancer risks associated with the Project are negligible. Predicted chronic manganese exposure is associated with an RQ value of 1.2 and 0.62 in the baseline and application case for the toddler and adult resident, respectively. The Project is not expected to measurably increase manganese-related health risks for residents in the region. The predicted exceedance is largely based on conservative assumptions used in the HHRA for plant and vegetation concentrations combined with a large portion of the diet derived from local sources. In addition, adverse effects from manganese exposure are not expected as the estimated intake levels in the HHRA fall within the range of typical Canadian exposure levels, at which adverse effects have not been observed. Predicted exposure to methyl mercury is associated with RQ values greater than 1.0 for the resident group in the multiple pathway assessment. The maximum RQ value of 1.3 for the resident group is not predicted to change from the baseline case to application case. The Project is not expected to increase methyl mercury-related health risks in the region. Adverse effects from methyl mercury in fish are not expected because the 95UCLM mercury concentration is below the subsistence fish consumption guideline of 0.2 mg/kg recommended by Health Canada (2007).

The results of the SLWRA indicate that the overall risks posed to wildlife health will be low. No impacts to wildlife populations are expected based on estimated wildlife exposures to predicted maximum acute and chronic air concentrations and measured soil and surface water concentrations. The confidence in the prediction is high since highly conservative assumptions were applied in the SLWRA.

E.6 HYDROLOGY

E.6.1 Introduction and Terms of Reference

Coalspur conducted a hydrology assessment for the proposed Project. The following section is a summary of the Surface Hydrology Assessment that was prepared by Matrix Solutions Inc. and is included as Consultant Report #6 (CR#6). For full details of the assessment please refer to CR #6.

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the hydrology component are provided in Section 3.3 of the ToR and are as follows:

3.3 HYDROLOGY

3.3.1 Baseline Information

[A] Describe and map the surface hydrology. Include flow regimes of streams in the Project Area.

[B] Provide surface flow baseline data, including:

a) seasonal variation, low, average and peak flows for watercourses; and

b) low, average and peak levels for waterbodies.

[C] Identify any surface water users who have existing approvals, permits or licenses.

[D] Describe current sedimentation patterns in receiving waters from the proposed Project.

3.3.2 Impact Assessment

[A] Discuss changes to watersheds, including surface and near-surface drainage conditions, potential flow impediment, and potential changes in open-water surface areas caused by the Project.

[B] Describe the extent of hydrological changes that will result from disturbances to groundwater and surface water movement:

a) include changes to the quantity of surface flow, water levels and channel regime in watercourses (during minimum, average and peak flows) and water levels in waterbodies;

b) assess the potential impact of any alterations in flow on the hydrology and identify all temporary and permanent alterations, channel realignments, disturbances or surface water withdrawals;

c) discuss both the Project and cumulative effect of these changes on hydrology (e.g., timing, volume, peak and minimum flow rates, river regime and lake levels), including the significance of effects for downstream watercourses; and

d) identify any potential erosion problems in watercourses resulting from the Project.

[C] Discuss changes in sedimentation patterns in receiving waters resulting from the Project.

[D] Describe impacts on other surface water users resulting from the Project. Identify any potential water use conflicts.

[E] Describe potential downstream impact if surface water is removed.

[F] Discuss the impact of low flow conditions and in-stream flow needs on water supply and water and wastewater management strategies.

[G] Discuss how potential impacts of temporary and permanent roads on wetland hydrology will be minimized and mitigated.

The surface hydrology assessment presents proposed water management plans and addresses the potential impact of the Project on:

- the quantity of surface water flow; and
- sediment loading in streams.

The project area is located almost entirely within the McPherson Creek watershed and two Unnamed tributaries to the McLeod River, which all drain east to the McLeod River. Therefore, the regional impact assessment study area (RSA) primarily focuses on the McLeod River basin upstream of its confluence with the Embarras River (CR #6, Figure 2) as it encompasses the Vista Project and other coal mines in the basin. The proposed conveyor and mine access road extends into three tributaries draining to the Athabasca River. The RSA includes these tributaries down to the Athabasca River.

The locally affected streams (local study area; LSA) encompassing the project area are McPherson Creek and the two Unnamed tributaries (named here as Unnamed Creeks A and B) draining east to the McLeod River (CR #6, Figure 3). Trail Creek and an Unnamed Creek draining northwest to the Athabasca River that are crossed by the main access road and conveyor line corridor are also included in the LSA.

For the hydrology assessments, the VECs selected include water flows (high, low, and mean) and water quality (sediment concentrations) and channel geomorphology for the streams and tributaries impacted by the Project.

E.6.2 Baseline Setting

Long term data are required to describe surface hydrology conditions because of the considerable natural variability of water flows and sediment concentrations seasonally and from year to year. In the absence of site-specific long term data, available long-term regional data from hydrologically similar areas are used and compared with short term site-specific data. This comparison facilitates the generation of long-term flow patterns, high and low flow values and sediment conditions that are applicable to the Project area streams.

The baseline data consists of local data from the following sources:

- long-term regional flows and data on small to large watersheds; and
- short term site-specific streamflows in the project area.

The baseline description forms the hydrologic basis for computing flows and conducting water balances for water use and the design of stream crossings, settling ponds and water management facilities.

Historic climatic data (primarily temperature and precipitation) are available at a number of long term stations (AES 2011) located around the Project (CR #6, Figure 2) including Obed Lookout, Yellowhead Lookout, Entrance, Jasper East Gate, Robb Ranger Station, Hinton (short term 2000-2011), Edson and the Coal Valley and Luscar mines. The most comprehensive long-term data are available at Edson with records since 1914.

E.6.2.1 Climate

Climatic factors are important for characterizing surface water hydrologic conditions because variability in precipitation, temperature, and evaporation significantly affects basin runoff characteristics and streamflows. The climate in the study area is characterized as continental with short, hot summers and cold, long winters. Temperatures typically range from a minimum daily of -35°C usually occurring in January to a maximum daily of 30°C occurring in July or August.

Precipitation data from the stations listed above were reviewed to estimate the precipitation in the vicinity of the Project. The estimated mean annual precipitation in the Project area (which ranges in elevation from about 1,150 to 1,420 m) is 609 to 621 mm. Based upon 25 years of record at Coal Valley which has similar precipitation to the Project, the annual precipitation has ranged from a high of 1,069 mm in 1980 to a low of 323 mm in 2003. July typically has the highest monthly precipitation at 110 mm with February the lowest at 19 mm. Approximately one-third of the annual precipitation falls as snow with intense summer storms typically comprising a significant percentage of the annual precipitation.

This shows estimated monthly rainfall in 2011 (May-October) (CR #6, Figure 4) based upon a weighting of daily data from Edson, Hinton, Obed Lookout, Yellowhead Lookout, Coal Valley and Luscar. Precipitation was above average in June due to a significant period of rain from June 14-20, 2011 when 73.5 mm was estimated. The total estimated precipitation from May-October 2011 was 380 mm or about 82% of the estimated long term average. Averaging of the available regional station data gives a much higher total precipitation over this period of 452 mm which is about equal to the long term average.

A review and analysis of precipitation data from Atmospheric Environment Service (AES) regional stations, data from operating coal mines and the station at Edson was conducted to review rainfall intensity duration frequency distributions (IDF curves). To account for observed higher intensities at higher elevations with closer proximity to the mountains, these values reported for Edson using data from 1970 to 1992 (AES 2011) were increased by 10% to estimate intensities for the Project area. Based on this, the estimated 100-year, 24-hour maximum storm rainfall for the project area is 102 mm and the 10-year maximum 24-hour rainfall is 73.8 mm.

Regional estimates of probable maximum precipitation (PMP - the rational upper-limit to precipitation that is physically possible) were provided by Environment Canada (2011) for Entrance and Robb RS stations. PMP values are 366 mm for 24 hours, 553 mm for two days and 631 mm for three days. For probable maximum flood (PMF) calculation purposes, these extreme precipitation values may be applied to the Project area assuming: a mid-June event, with above average winter snowpack and delayed melt to May such that the basin is 100% primed (*i.e.*, no losses for depression storage or infiltration).

Estimated monthly and annual lake evaporation and areal evapotranspiration values are based upon an average of reported values for Edson and Jasper climate stations (AENV 1993). The resulting annual values are as follows:

- mean annual lake evaporation – 622 mm; and
- mean annual evapotranspiration - 327 mm.

By comparison, the 1971-2000 estimated mean annual gross evaporation, as computed by PFRA (2001), is 3% higher at 643 mm using the average of Jasper and Edson values.

CR #12, Figure 4 shows a typical small basin water balance based on the above mean annual precipitation and evapotranspiration rates with a mean annual runoff rate of 180 mm, as discussed in the next section. The resulting balance from these values leaves approximately 114 mm that goes into storage and groundwater. This value appears high at well over a rule-of-thumb range of 10% of precipitation which suggests the estimate of mean annual precipitation may be lower and/or actual evapotranspiration may be higher due to the effect of lakes and wetlands in the Project area.

E.6.2.2 Regional Flow

The McLeod River station, located above its confluence with the Embarras River, has continuous year around flow data. The other stations have flow data during the May to October period. The period of flow record varies from five years on the Embarras River at Robb to 57 years on the McLeod River above Embarras.

Minimum, mean and maximum monthly flow patterns expressed in terms of flows (cubic metres per second; m^3/s) and runoff or flow per unit area (litres per second per square kilometre; $L/s/km^2$) for small regional watersheds (the streams in the Tri-Creek Watersheds and the two small creeks near Hinton) are shown in CR #6, Figure 5. The runoff is noticeably higher in the Tri-Creek watersheds than the two small creeks near Hinton. The Project area runoff may be expected to be in between these ranges based upon its location and elevation. Data indicates similar monthly flow patterns for the regional medium to large sized watersheds (McLeod and Gregg Rivers) (CR #6, Figure 6).

Features of the data and differences to note between these small to large watersheds are:

- the station data show that considerable monthly variability exists due to precipitation and snowmelt runoff variability;
- the highest maximum monthly flow has occurred in June or July at these stations. The highest mean monthly flows tend to be in May and June for the smaller Tri-Creek stations and in June for medium to large stations. The highs in May and June reflect steeper well drained basins with quicker response due to snowmelt and rainfall whereas the delayed highs in June-July may reflect basins with greater storage or more response to the greater rainfall in June-July;
- the average monthly unit runoff ($L/s/km^2$) at the stations show the high, early runoff response of Wampus and Deerlick Creeks in May and June versus a lower and later runoff peak in the small creeks near Hinton. The McLeod River above Embarras monthly runoff appears to be an average of the regional stations;
- the lowest flow month is February which, based on the McLeod River station, averages about one-sixth of the flow in October; and
- the lower runoff on the Embarras River reflects its lower elevation and much higher proportion of wetlands.

Regional relationships for low open water flows (7Q10 - the 7 day, 1-in-10 year low flow and 1Q10 - the 1 day, 1-in-10 year low flow) and maximum instantaneous flows for floods from 1:2 year to 1:100 year return periods are presented in CR #6, Figure 8. These relations can be used to estimate flow ranges for natural, pre-mined condition streams in the Project area, knowing the drainage area of the stream at a specific location. Site specific conditions may warrant variations from these regional hydrologic relationships depending upon the specific basin characteristics and design considerations for water management works. Specific basin characteristics to consider are: basin slope, basin shape, extent of wetland/marsh areas and related soils. Steep, bare or poorly vegetated watersheds will result in increased, short duration flood peaks with lower relative low flows compared to the regional relations. Site-specific monitoring is used as an aid in assessing the variations from the regional stations and relationships.

E.6.2.3 Project Flow Data

Streamflow and lake level monitoring was conducted at various locations over the 2011 runoff season and in 1981 as part of the original Project application. These sites and the period of flow data collected are identified in CR #6, Figure 3. Streamflow runoff data (2011) for the local stations that were monitored in the Project area were compared with Wampus Creek and other regional stations. Wampus Creek was considered the most representative regional station to use for comparative purposes because of its size, proximity, physiographic basin characteristics and its recorded length as an active long term station. May to October precipitation in 2011 was 82% of the estimated local average totalling 380 mm. However, June 14 to July 6 precipitation was estimated at 131 mm for the Project area, resulting in the high peak that dominated the season hydrograph (CR #6, Figure 9). The greatest precipitation during this storm event appeared to have been centred in the upper McLeod basin.

Allowing for the local variability of the runoff and precipitation, the tabulated comparison of the 2011 data in CR #6, Figure 9 suggests the following:

- McPherson Creek runoff may average about 63% of Wampus Creek;
- overall runoff from Upper McPherson appears slightly greater than Lower McPherson. This likely reflects greater downstream groundwater flow contributions progressing downstream in the watershed and the storage effect of the wetland areas in the lower valley sections;
- the Unnamed Creek A runoff is much lower than McPherson Creek and only about 40% of Wampus Creek on average;
- the lowest low flow / baseflows rates occurred in September, dropping to 0.4 to 0.6 L/s/km² on McPherson Creek and were only 0.1 L/s/km² on Unnamed Creek A where there is little wetland terrain;
- the estimated daily peak flows in 2011 on McPherson were lower than Wampus at 158 L/s/km² at the Upper station, 114 L/s/km² at the Lower and 207 L/s/km2 on the Unnamed Creek A compared to 318 L/s/km² on Wampus Creek. The preliminary daily peak on the McLeod River near Cadomin was rated in excess of a 1:25 year flood event (as compared to Wampus Creek which has about a 1:13 year event). This suggests 1:10 year peak flows on McPherson Creek may be much lower than the regional. The high unit peak on Unnamed Creek A reflects its steeper more responsive characteristics compared to the McPherson Creek gauging stations; and
- runoff coefficients (ratio of runoff to rainfall) during the storm events varied modestly depending upon baseflow conditions and local conditions. Values were 0.6 to 0.5 for the peak event on Upper and Lower McPherson, respectively and 0.47 on Unnamed Creek A. Seasonal coefficients were 0.45 on McPherson and 0.32 on Unnamed Creek A.

From the above comparative review, the mean annual runoff in the Project area is estimated at 181 mm with 154 mm occurring from May to October with a monthly distribution similar to Wampus Creek.

Winter flow monitoring conducted during warm conditions on February 1 to 2, 2012 did not record any measurable velocities. Based upon site observations and equipment low flow velocity limitations, estimated flows were as follows:

- Upper McPherson < 7 L/s
- Lower McPherson < 9 L/s
- Unnamed Creek A flow was observed between ice layers but was not measurable. It was visually estimated as less than 5 L/s.
- South tributary to Unnamed Creek A had no flow. Other observations on this creek indicated a flow of 2 L/s on October 19, 2011 and less than 2 L/s during melt conditions on April 12, 2012.

Based upon this data and the 1981 winter measurements, where low flows of 20L/s and 30 L/s were measured in March, McPherson Creek flows are expected to be sustainable through the winter with minimum flows dropping to as low as 5 to 7 L/s (Upper to Lower). The Unnamed Creeks A and B and the south tributary to Unnamed Creek A are expected to regularly drop to zero flow during the winter and possibly at other times in the year.

E.6.2.4 Sediment Concentrations

Available total suspended sediment (TSS) concentration or sediment concentration data were reviewed and summarized for the region. The data show that sediment concentrations can vary by two orders of magnitude for the same flow indicating sediment concentrations are not uniquely related to flow magnitude. Streams can generate high sediment concentrations because of snowmelt, windblown sources, unstable banks and slopes, dirt filled gullies and natural bed material movement that may be independent of flow and variable from stream to stream.

Maximum recorded concentrations over 19 years at the WSC stations were 622 mg/L at Eunice Creek, the unlogged control watershed, and 1,370 mg/L at Wampus Creek, the partially logged watershed. The 1:10 year estimated flood peaks shown for these stations (CR #6, Figure 10) shows that sediment concentrations in these streams may be expected to exceed 350 mg/L at this flood magnitude and at even much lower return periods. Eunice and Deerlick Creeks had slightly lower concentrations for similar return period flows than the other larger streams.

Sediment concentrations in McPherson Creek and other streams in the Project were sampled as part of the water quality monitoring program. Spot samples collected in the summer, fall and winter of 2011 and 2012 were mostly <3 mg/L. The highest spot sample recorded within the Project area was 6 mg/L in 2011 (fall) on the south tributary to Unnamed Creek A. Natural sediment concentrations similar to or lower than Eunice and Deerlick Creeks may be expected based upon the lower gradient conditions and wetland terrain along the valley in the McPherson Creek watershed.

E.6.2.5 Traditional Use Knowledge

One of the most commonly raised issues for aboriginal people is water quality and how the Project will mitigate impacts and protect the water resources. Concerns raised by some are that development impacts cannot be reduced or that water pollution may be irreversible. Specific watercourses of interest include McPherson Creek, McLeod River as well as seeps and mineral licks utilized by wildlife. Section E.11 addresses the TEK and Aboriginal concerns in more detail.

The valid issues and concerns raised are addressed by application of the mitigation measures (Section E.6.5.1 and the development and application of appropriate water management plans. The main surface water management mitigation measure that addresses these issues is that the mine will essentially operate as a closed system with all water within the mine captured (in ponds, the pit and the water supply/containment and reuse reservoirs). In an upset event, where a settling pond size may not be adequate, it will overflow back into the pit or larger reservoir or be pumped back to the pit. Only after testing for appropriate sediment quality in the larger ponds, will water be released (typically via pumps) to receiving streams. A 100 m minimum setback is provided along McPherson Creek and at least 30 m along all other streams. Where particularly sensitive TEK areas are identified, additional setbacks and monitoring may need to be provided.

E.6.3 Potential Impacts

Elements of the Project that could have an effect on runoff and sediment include:

- land clearing and stripping;
- waste rock dumps and soil stockpiles;
- haul roads;
- mine pits and dewatering;
- water diversions (during mining and restoration);

- water withdrawals and use; and
- water impoundments during filling and after mining.

E.6.3.1 Project Impacts on Flows and Sediment Load

A detailed surface water management plan has been provided in Appendix 7-1 and forms the basis for the surface hydrology assessment.

Land Clearing

Natural watersheds typically generate less direct runoff because of the greater transpiration, interception and retention in the understory. Forest harvesting and clearing effects include increases in annual water yield, increases in late summer and fall low flows (the effects on winter baseflows or during dry periods are less certain), increases in peak flow, and possibly earlier timing of peak flows.

Results of the extensive studies concluded that, on average, a 20% to 40% increase in the annual water yield, a 1.5 to 3 times increase in the storm peaks, as well as a 30% to 65% increase in flow during the snowmelt freshet can be expected when 30% to 80% of a watershed is logged. An advance in peak flows due to melt can be expected to be in the range of 1 to 2 weeks. Clearing effects on the hydrology for the Project may be estimated as follows:

- McPherson Creek below MCT2 tributary (22% of basin area is cleared for dumps and pit) - results in a potential 43% increase in peaks and 10% increase in runoff. These potential increases will be accommodated by collecting and retaining the runoff in the pit and settling ponds.
- Unnamed Creek A and its tributary below the Project will have a greater amount retained by the fresh water pond (FWP) and the fines settling pond (FSP) than that attributable due to clearing. Over 25% of the basin runoff is retained by the FWP and FSP versus 4.4% of Unnamed Creek A cleared for dumps. Although 49% of Unnamed Creek A tributary is dumps, 30% of the basin is covered by the FSP and it collects the runoff from over 80% of the watershed.

Thus, the net effects of clearing and stripping will be managed internally by the pit, settling ponds, and storage reservoirs.

The hydrologic recovery period, due to reclamation following mining, falls in the range of 60 to 100 years (Golding 1981; and Uunila et al. 2006) although the ongoing effects may reduce to a low impact after about 25 years.

Retention of the understory during logging and maintaining 10 m wide buffers along small watercourses, in addition to providing woody debris, can significantly reduce the impact and thus the sediment loads (Rex 2007). Sediment control ponds and buffers are key to limiting sediment loads from Project operations.

Waste Rock Piles

The porous nature of waste rock piles typically results in increased infiltration compared to natural terrain and seepage through the rock. Evapotranspiration from reclaimed areas may be lower but groundwater infiltration will be much higher because of these more permeable spoil material conditions. The net runoff effect may be a reduction in peaks with negligible change in mean annual runoff and eventually an increase in minimum or low flows downstream as a stable groundwater regime develops. Based on commonly applied rainfall-runoff coefficients (from 0.1 to 0.2 for waste rock piles and 0.2 to 0.4 for natural watersheds) peak runoff rates from waste rock piles can be 50% to 33% of the natural area.

Sediment loads tend to increase until the waste material is washed and settled, and then stable drainage paths develop through the rock.

Dump areas in McPherson Creek amount to 10% of the basin area below MCT2 confluence. The impact of the dump areas may initially correspond to a reduction in runoff volumes and peaks of 3% to 7%. Similarly, rock dump areas in Unnamed Creek A amount to 4.4% of its basin and nearly 50% of Unnamed Creek A tributary. Corresponding reductions in runoff volumes and peaks may amount to 2% to 3% in Unnamed Creek A and 25% to 33% in Unnamed Creek A tributary, if considered alone. These impacts are expected to diminish over time.

Haul Road Runoff

Haul roads are much less permeable than natural basins with runoff coefficients in the 0.6 to 0.9 range versus the 0.2 to 0.4 range typical for the natural basins in the region. Compared to natural basin runoff, haul roads result in higher peak flows, rapid runoff response and reduced low flows.

Haul roads can be a major source of sediment. Runoff and sediment control is especially dependent upon road maintenance work, such as grading, berming and ditch controls. Containment of haul road runoff is one of the largest ongoing operational efforts required in maintaining clean water at most mines.

With the Project layout and conveyor system up to the plant and the directly adjacent disposal areas, the active haul roads are mostly internal to the pit area or drain to the pit such that nearly all road runoff will be contained within the pit area. The effect of haul roads on natural downstream flows and sediment is therefore expected to be effectively managed.

Mine Pits and Dewatering

Surface flows may decrease, particularly to McPherson Creek, due to dewatering of groundwater around or in the mine pit and water use for mining purposes. Groundwater modelling analyses (Appendix 7-2) confirms that streamflow losses from the creeks to the pit are expected to be minimal. Streamflow augmentation and other runoff factors will offset any potential reduction in streamflow due to pit dewatering.

The mine pit will act as an impoundment during high runoff events with water collecting in the pit and then pumped to settling ponds. During extreme high runoff events, greater backup and some inundation of the pit will occur depending upon pump capacities. This reduces downstream peak flows as a result of the temporary storage, although the total runoff amount will likely be increased. Earlier snowmelt in the pit areas will also occur. Pits may therefore increase water yields overall by two to three times natural area runoff. For the total pit area in McPherson Creek, this impact, if considered alone, would correspond to an increase in runoff below MCT2 confluence of from 12% to 24%. The combined impact of the pit and groundwater use and drawdown during operations, may be a net increase in flow to McPherson Creek with peaks regulated by the in-pit storage.

Depending upon the storage backup and controls provided in the pits, they can assist to significantly reduce sediment loads as well as peak flows. If appropriate runoff storage and separation from active working areas is not provided, extremely high sediment loads may be pumped resulting in overloading of settling ponds. Layout planning of the sumps and active pit bottom areas will be key to minimizing this potential concern.

Impoundments

Impoundments, such as the planned settling ponds, FWP, FSP or end pit lake, generally reduce downstream peak flows as a result of storage. Increases in low flows can result from a more gradual release of the water stored in the impoundment. Pond evaporation losses may be considerable at times but is near balanced with direct precipitation on a mean annual basis. Impoundments can effectively reduce sediment loads. One end pit lake is planned for the Project.

Water Diversions

Diversions will be sized and designed to safely convey peak flows. As a result, diversions do not typically affect the magnitude of downstream flows. Diversion ditches with major side-hill cuts may intercept and re-direct near surface groundwater flows. This effect would be localized to within the sub-watershed. With erosion control incorporated into the design and construction the impact on sediment loads is usually negligible.

Water Withdrawals

There are a total of 114 licences listed within the RSA with 98 of these in the McLeod River basin. The total annual allocation of these licenses amounts to 0.3% of the mean annual flow in the McLeod River above Embarras (with 0.2% as consumptive use). There are 16 local active licences in the Athabasca basin near the Project.

Project water withdrawals will reduce flows by a measurable amount. Withdrawals will have no impact on sediment with stable water withdrawal facilities provided. The Project will contain runoff water on-site for use with required releases during high runoff periods or for flow augmentation to meet instream flow needs (IFN).

As part of the Project approval conditions, a Water Management Framework (WMF) is proposed to be developed to define the flow augmentation protocols to maintain instream flows. Four main flow release points are proposed for the Project for flow maintenance or augmentation purposes with at least four flow monitoring sites used to document instream flows (CR #6, Figure 11). These are on the four fish bearing streams that receive flows from the Project. Flows would also be supplemented with monitored releases from other settling ponds. Details on the proposed flow release policy for the April to October period are provided in CR #6, Section 4.3.7. Due to the limited site specific flow data, ongoing baseline monitoring will be needed to define baseline flow conditions.

An overall site water balance analysis was conducted to determine Project water requirements, reservoir storage volumes, and flow releases on a monthly basis over the 20 year Project life (Section C.6 and Appendix 7-1). The water balance analysis results show that there is sufficient flexibility/storage in the system to meet Project demands and maintain natural flows under a variety of assumed operating and hydrologic conditions.

E.6.3.2 Climate Change

Climate change is a potential effect to consider with Project activities and water management planning aspects. In view of the climatic variations and resulting intensification of the hydrologic cycle, the practice of applying precautionary measures in water management and design is prudent to account for potentially both higher and lower flow extremes at times. In addition, increased icing issues may occur due to reduced early snow cover. This implies the need for greater monitoring and maintenance (such as clearing and removing icings) during operations and possibly reviewing and refining designs where appropriate (adding a greater degree of conservatism into diversions, crossings and settling ponds by adjusting the rainfall intensity, the return period design or, increasing the freeboard). However, in view of the moderately short time frame of most water management facilities and the Project (~ 20 years), significant design changes may not be warranted. The longer term facilities for the Project may require upgrading or modifications over time. However, with appropriate vigilant monitoring and maintenance, any hydrologic changes as a result of climate change can be addressed and managed. No specific follow-up programs or adaptive management considerations are proposed at this time.

E.6.3.3 Impacts in Flow Rates by Watershed

A summary of estimated impacts on surface flows during mine operations, lake filling, and following reclamation and closure is provided in Table E.6.3.1.

Table E.6.3.1 Surface Water Flow Impacts Summary by Watershed

Watershed (CR #6, Figure 3)		McPherson Creek (MCT9 to above MCT7)	McPherson Creek (below outlet @MCT7)	McPherson Creek (MCT7 to above MCT2)	MCT2 at mouth	McPherson below MCT2 confluence	Unnamed Creek A below mine boundary	Unnamed Creek A Tributary below mine	Unnamed Creek A below Tributary confluence	Unnamed Creek B at mouth
Existing Basin Area (km^2)		44.8 - 50.8	51.65	51.65-71.9	6.30	78.2	16.2	4.30	23.3	2.92
Proposed Mine Footprint (km^2)[1]		3.5-7.0	7 +	17.35	2.86	20.21	1.79	3.54	5.33	0.52
Post Mining Basin Area (km^2)		44.8-45.8	56.29	56.29-72.9	5.79	78.7	17.34	2.65	23.0	2.81
Impact (%) During Mining[2]	High Flows	0 to -10	-7 to -15	-15	0 to -15	0 to -15	-15	-15	-15	-18
	Low Flows	±5	±5	±5	0 to +20	0 to +20	±10	±10	±10	0 to -18
	Mean Annual Flow	±10	±10	±10	0 to +25	-5 to + 20	±10	±15	±10	-10 to -18
Impact (%) During Lake Filling[3]	High Flows	0 to -5	-15 to -20	-15	-15	-15	n/a	n/a	n/a	n/a
	Low Flows	0	0 to +8	0 to -5	0 to -5	0 to -5	n/a	n/a	n/a	n/a
	Mean Annual Flow	0 to -5	-8 to -10	-15	-15	-15	n/a	n/a	n/a	n/a
Residual Impact (%)[4,5]	High Flows	0 to -5	-8 to -11	-10 to -13	0 to -22	-8 to -11	±10	-30 to -45	+5 to -15	+5 to -15
	Low Flows	0 to -5	+4 to +20	-2 to +5	-8 to +10	+10	+5 to +10	0 to -40	< -2	-5
	Mean Annual Flow	0 to -5	+12	+6 to +12	0 to -15	±1	-1 to +15	-15 to -45	±10	+5 to -10

1. Maximums on existing watershed areas
2. Estimated maximum magnitude of impact, effects can vary significantly and be reduced depending upon specific mine operations and hydrologic conditions at the time.
3. Based upon maintaining downstream instream flow needs as per WMF guidelines by pumping out of lake, as required. Percentage reductions in high flows may be greater for more extreme events.
4. Magnitude of high / low flow impacts can vary slightly depending upon size /configuration of lake outlet control to create backup during high flows.
5. Lower range reductions in high and mean flows is over time with groundwater table re-establishment and increased runoff from dump areas.
6. Negative (-) = reduction in flow; Positive (+) = an increase in flow. High flows = 2 year to 10 year peaks. Low Flows = baseflow to mean November-March flow.

McPherson Creek

The north side tributaries of McPherson Creek (MCT3, 5, 7, 8 and 9; CR #6, Figure 3) will initially be diverted as clean water bypasses around the initial active pit area. The diverted flows will be split to drain both west and east to discharge into McPherson Creek. These will assist in maintaining natural flows in McPherson Creek during mining. As mining proceeds, controlled releases from the flow augmentation site A3 (CR #6, Figure 11) and from the settling ponds will be used to maintain flow impacts within the acceptable ranges according to the established WMF. In this manner, impacts of water diversion and use, as well as any potential groundwater drawdown, will be compensated for along McPherson Creek according to the established framework.

Required releases from the main settling pond account for the estimated 20% increase in low to mean flows expected in McPherson Creek below MCT2 confluence and up to 25% in MCT2. As these increased flow volumes will be regulated, increases in peak flows are not expected and changes in channel regime are not expected by these increased flows.

Following mining and reclamation, filling of the end pit lake will occur. Due to the large lake volume, the estimated time to fill the lake is 63 years. Mitigation measures can be implemented to reduce the time required to fill the lake. The principal residual impact following lake filling is the regulating effect of the lake which will decrease peak flows in McPherson Creek below MCT2 and increase low flows. The regulating effect on high flows is expected to have a stabilizing impact on the geomorphology of McPherson Creek downstream. Since average annual flow regime changes are expected to be low, significant downstream changes in channel size are not expected as a result of the regulating effect of the lake. Long-term gradual channel entrenching with less meandering and steeper channel slope is typically predicted.

Predicted impacts with a ±10% change in the mean annual flood on McPherson Creek are: a ±5% change in channel width, a ±3% change in bankfull channel depth and a ±3% change in slope. Since McPherson Creek channel is well formed and moderately stable, these potential long term impacts indicate more of a tendency in direction rather than the magnitude of change which actually would occur.

McPherson Creek Tributary 2 (MCT2)

During mining, MCT2 will have a major settling pond in its watershed to collect runoff from above the pit area and pumped water from the pit area. The upper 45% of the watershed will drain to this pond. As a result, significant release flows will be directed to the main stem of MCT2. Low and average flows are expected to be above natural with peaks regulated. In the event excessive flows may need to be released from this pond, potentially affecting the channel, more water would be re-directed to the pond on McPherson Creek near site M3.

The pit reduces the post mine drainage area by 8%. During lake filling, pumped releases from the lake are expected to be required to maintain flows within the WMF guidelines. Following lake filling small outlet flows from the lake are expected to offset reductions in runoff due to the reduced drainage area of MCT2 and possible groundwater losses to the end pit lake.

Unnamed Creek A

All runoff in the upper 1.34 km² (8.3%) portion of this watershed will be controlled by the plant area and the Fresh Water Reservoir (FWR) with 15% of the total basin area below the mine license boundary being controlled by the Project. Site A4 and the FWP will be used to augment and maintain water flows. Augmentation flow releases are not anticipated during the winter months since winter baseflows are negligible at the upstream end.

Following reclamation, the FWP would be breached to restore the upper basin drainage. Estimated changes in flow are expected to be an increase but may range from ±10%.

Unnamed Creek A Tributary

Over 80% of this watershed is controlled by the Project. Due to the low natural flows to zero winter flow conditions, no flow releases would be proposed for the November to March period unless melts occur and pond releases are feasible. Peak flows could be maintained with peak settling pond releases provided for channel maintenance purposes.

Reclamation of the dump and fine settling pond is designed to maximize the area draining to this watershed; a net 38% of the pre-mine drainage area is directed towards the main Unnamed Creek A to the north. Estimated reductions in flow range from zero when no flow is commonly expected to possibly as high as 45% under high flow conditions. This maximum expected impact reduces to less than 25% at its mouth.

Unnamed Creek B

The FSP is located within 18% of the headwaters of this small watershed. Toe drainage ditches below the FSP will collect local berm runoff and seepage. The water will be captured in small local settling ponds and either released downstream, used for the Project, or used for augmentation flow releases elsewhere. Since this creek is expected to frequently have no flow in the headwaters, the impact will frequently be zero.

Athabasca Tributaries

The activities in these watersheds are localized. Clear span crossings for the road and conveyor will be provided at the fish bearing streams with road culverts and aerial crossings for the conveyor at the other crossings. These development works do not alter drainage patterns and represent small percentages (1% to < 10%) of the specific watersheds. They will have negligible impact upon stream flows.

Grading runoff controls and a local settling pond will be provided at the load out facility to collect runoff from the stockpile and developed pad area. With mitigation increases in sediment loading to the streams crossed will be negligible.

E.6.4 Cumulative Effects

Other activities in the local watersheds that could have a cumulative effect on stream flows and sediment concentrations in the receiving streams are:

- timber harvesting operations;
- roads; and
- petroleum and natural gas activities.

These activities all generally increase runoff and peak flows and sediment loads. Their cumulative effects on flows are negligible compared to the mine development impacts considering the overlapping effects, in many cases, with respect to the roads and cleared areas. Therefore, cumulative effects in the basins are not significantly different than those already identified as a result of the mine activities.

The total area of the mine will occupy 1.3% of the McLeod River basin below the Project and about 0.5% of the McLeod River basin above Embarras. Maximum potential impacts on McLeod River flows will be much lower than this 1.3%. In the event post mine lake filling via the McLeod River is proposed, this would be a short term (5 year) licensed impact that would be managed. The specific impact on other users and withdrawal management protocols would be developed at that time to minimize impacts on other users and address instream flow needs.

The majority of the non-mine disturbance areas are either cleared or road-and-pad areas which all tend to increase average and peak runoff rates. Downstream in the larger McLeod and Embarras basins the effects of the mine on river flows diminish to negligible.

With sediment control measures implemented at the mines, roads, pipelines and other projects in the basins, the cumulative effects on sediment loading will be negligible compared to natural variations.

E.6.5 Mitigation and Monitoring

E.6.5.1 Mitigation

In order to reduce the impacts of the Project on surface hydrology, Coalspur will:

- develop and implement a water management framework to deal with natural streamflows and augmentation for the Project;
- plan and layout facilities in an effort to minimize drainage diversions and runoff interception (*e.g.*, maintain natural vegetated buffers between active mine areas and undisturbed streams);
- direct runoff from active mining areas, spoil piles and roads to settling ponds or retention area for sediment settling treatment and possible Project use;
- design settling ponds according to the latest sizing methodology (1:10 year storm event and safely convey up to the 1;100 year flood event);
- divert runoff from natural undisturbed area around mine activities;
- direct ditch run-off to disperse into the adjacent vegetation such that it does not directly enter the watercourses at the crossings;
- divert McPherson Creek tributary streams above and around the active mine area in a controlled manner to maintain clean flows;
  - provide armouring and/or lining of ditches or use culverts where appropriate to control erosion and limit seepage losses;
  - provide oversized ditch/mini-ponds at the downstream ends where water would be pumped to the FWP or would overflow to drain to McPherson Creek;
  - collect clean water in in-pit sumps to isolate and keep clear of mine operations;
  - use temporary pumps to direct water around pits where short term bypasses (usually less than 1 year) are required;
  - directing all dirty water to settling facilities or the fines settling pond and then to the water supply pond or receiving stream when required once regulatory guidelines have been met;
  - size diversion capacities according to the design life of the diversion, seasonal flows (where < 1yr) and potential flooding;
  - maintain a 100 m minimum setback from McPherson Creek and MCT2, a 30 m setback along all other streams, and a vegetated buffer of at least 10 m from intermittent streams;
  - design and construct watercourse crossings to meet or exceed the regulatory requirements for approval under the provincial *Water Act* and the federal *Fisheries Act and Navigable Waters Protection Act*;
  - construct clear span crossings over all watercourses identified as potential fish bearing streams;

- use 0.9 m culverts, as required, to maintain drainage along non-fish bearing streams and ephemeral drainage draws;
- install haul road berms to contain road runoff and direct it to designated runoff control works;
- incorporate flow and erosion control measures, such as ditch check structures, natural depressions or low areas to trap sediment, silt fences or exfiltration ditches in small, low gradient areas adjacent to soil and stockpiles areas;
- use local wetland areas for release areas to provide an additional sediment filter before draining into receiving watercourses in a stable, controlled manner; and
- train personnel to minimize disturbances and use and maintain drainage and sediment controls.

E.6.5.2 Monitoring

In order to reduce potential impacts of the Project on surface hydrology, Coalspur will:

- conduct flow and TSS monitoring at all settling ponds;
- conduct regular inspections of all drainage works and upstream and downstream water quality sampling; and
- conduct continuous monitoring of flow on McPherson Creek (upstream and downstream), its tributary MCT2, and Unnamed Creek A and Unnamed Creek A tributaries.

E.6.6 Summary

Table E.6.6.1 summarizes the overall impact ratings during the operational and closure phases for the Valued Environmental Components (VECs). These VECs include all the main watercourses and reaches for which some degree of hydrologic impact is expected. The effects are all considered local in terms of the watersheds in the LSA with the possible exception of using the McLeod River following closure to lake filling. Application and cumulative effects are essentially rated the same as the application case effects dominate hydrologic conditions locally.

Low ratings are indicated in most cases as estimated changes in flows are generally less than the degree of accuracy of flow measurements or published data for small streams in most cases and are well within natural variability and threshold levels. Controlling sediment levels to less than licensing requirements are considered as a low rating. Some effects may be either positive or negative, depending upon the location within a watershed and the variable conditions that are possible during high, low and average flow periods. The assessments and ratings are expected to have a high degree of confidence based upon the various sensitivities considered and the extensive level of water management and flexibility in the system to meet project demands and maintain natural flow conditions.

Table E.6.6.1 Summary of Impact Ratings on Hydrologic Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/Protection Plan	Type of Impact or Effect	Geographical Extent [1]	Duration [2]	Frequency[3]	Reversability[4]	Magnitude [5]	Project Contribution[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
1. Impact on High Flows on McPherson and Unnamed Creek A During Project												
Increase in peaks due to clearing & logging, haul roads, pumped dewatering. Mitigation: by settling ponds/storage, in pit storage, FWP /FSP storage (see Section 4.0) Net decreases in peaks due to storage / flow regulation is predicted.			Application	Local	Long	Periodic	in long term	Low/Moderate	Neutral	High	High	Low
			Cumulative	Local	Long	Periodic	in short term	Low	Neutral	High	High	Low
2. Impact on Low Flows on McPherson and Unnamed Creek A During Project												
Decreases in flow due to project use/storage. Mitigation: augmentation flows with monitoring stations (see Section 4.3.7).			Application	Local	Long	Periodic	in short term	Low	Negative	High	High	Low
			Cumulative	Local	Long	Periodic	in short term	Low	Negative	High	High	Low
3. Impact on Mean Flows on McPherson and Unnamed Creek A During Project												
Increase and decrease in flows due to storage / containment in pit and ponds, redirection of runoff patterns. Mitigation: augmentation flows with monitoring stations (see Section 4.3.7) and regulate required releases.			Application	Local	Long	Continuous	short-long term	Low/Moderate	Negative & Positive	High	High	Low
			Cumulative	Local	Long	Continuous	short-long term	Low/Moderate	Negative & Positive	High	High	Low
4. Impact on McPherson and Unnamed Creek A Channel Regimes During and After Closure												
Changes in mean annual flows and peak flows can result in changes in channel geomorphology. Mitigation: See Section 4.0 – manage/plan drainage layout /release areas, regulated releases to not increase peaks, re-direct excess water to larger receiving streams.			Application	Local	Long	Continuous	Irreversible	Low	Neutral	Moderate	Medium	Low
			Cumulative	Local	Long	Continuous	Irreversible	Low	Neutral	Moderate	Medium	Low
5. Impact on Sediment Concentrations on McPherson and Unnamed Creek A During Project												
Risk of increased sediment loadings to			Application	Local	Long	Periodic	in short term	Low	Negative	High	High	Low

Table E.6.6.1 Summary of Impact Ratings on Hydrologic Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/Protection Plan	Type of Impact or Effect	Geographical Extent [1]	Duration [2]	Frequency[3]	Reversability[4]	Magnitude [5]	Project Contribution[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
streams from: haul and access roads, clearing and logging, pit & pit dewatering, temporary clean water diversions and spoil piles. Mitigation: See Section 4.0 – plan/design/layout of drainage controls/settling ponds, 100 m setbacks from streams, internal water management controls, applying BMPs, education, monitoring and maintenance.			Cumulative	Local	Long	Periodic	in short term	Low	Negative	High	High	Low
6. Impact on McPherson Creek and McLeod River During End Pit Lake Filling												
Decrease in mean to low flows and long duration to fill. Mitigation: See Section 4.5.1 – temporary licensed pumped withdrawal from McLeod River during high flow periods.			Application	Local	Extended	Isolated	in short term	Low	Negative	High	High	Low
			Cumulative	Regional	Extended	Isolated	in short term	Low	Negative	High	High	Low
7. Impact on High / Low / Average Flows on McPherson and Unnamed Creek A After Closure												
Changes in runoff patterns / drainage basins due to end pit lake and waste disposal areas and regulating effect of lake on flows. Mitigation: See Section 4.0 - grade waste areas to minimize changes from pre-mine drainage basins, two sized outlet controls from end pit lake to maintain flows.			Application	Local	Residual	Continuous	Irreversible	Low	Negative & Positive	Moderate	Medium	Low-Moderate
			Cumulative	Local	Residual	Continuous	Irreversible	Low	Negative & Positive	Moderate	Medium	Low - Moderate

1. Local, Regional, Provincial, National, Global
2. Short, Long, Extended, Residual
3. Continuous, Isolated, Periodic, Occasional
4. Reversible in short term, Reversible in long term, Irreversible - rare
5. Nil, Low, Moderate, High
6. Neutral, Positive, Negative
7. Low, Moderate, High
8. Low, Medium, High
9. No Impact, Low Impact, Moderate Impact, High Impact

E.7 NOISE

E.7.1 Introduction and Terms of Reference

Coalspur conducted a Noise Impact Assessment (NIA) for the proposed Project. The following section is a summary of the NIA and the baseline noise report that was prepared by aci Acoustical Consultants Inc. and included as Consultants Report #7a (CR #7a) and Consultant Report #7b (CR #7b). For full details of the assessment please refer to CR #7.

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the NIA are provided in Section 3.1 of the ToR and are as follows:

3.1 AIR QUALITY, CLIMATE AND NOISE

3.1.1 Baseline Information

[B] Provide representative baseline noise levels at receptor locations.

3.1.2 Impact Assessment

[C] Identify components of the Project that have the potential to increase noise levels and discuss the implications. Present the results of a noise assessment. Include:

a) potentially-affected people and wildlife;

b) an estimate of the potential for increased noise resulting from the development; and

c) the implications of any increased noise levels.

The purpose of the NIA was to generate a computer noise model of the Project under application case conditions and compare the resultant sound levels to the Alberta Energy Resources Conservation Board (ERCB) permissible sound level guidelines (Directive 038 on Noise Control, 2007 (D38)). In accordance with D38 the broadband A-weighted (dBA) sound levels were also compared to the C-weighted (dBC) sound levels to determine if there is the potential for the noise to have a low frequency tonal component. As specified in D38, if the dBC-dBA sound levels are less than 20 dB, the noise is not considered to have a low frequency tonal component.

The study area for the Project is located approximately 1.8 km east of Hinton. Major roads in the area include Highway 16 (Yellowhead Highway) which runs through the middle of Hinton. There is also the CN Rail mainline which runs parallel to, and north of, Highway 16. The transportation related noise within Hinton and surrounding areas is already considerable. The only existing industrial noise source is the West Fraser Pulp Mill, located at the northern edge of Hinton.

Topographically, the land in the study area is very hilly with changes in elevation of approximately 510 m within the area 1.5 km from the MPB. At times, this can provide a significant level of acoustical shielding and at times this can increase the noise levels by elevating the proposed noise sources relative to the receptors.

E.7.2 Baseline Conditions

Baseline noise monitoring was conducted at two locations within and adjacent to Hinton to obtain baseline noise levels (aci 2012). The noise monitoring locations were also included as receptors during the application case conditions. The noise monitor located near 24403 East River Road indicated an LeqNight of 32.8 dBA when the trains were removed and 37.8 dBA with the 10 night-time train passages included. The noise monitor conducted near Resident-18 resulted in an LeqNight of 48.3 dBA and the noise levels never dropped below 37 dBA for the entire 24-hour monitoring period.

Directive 038 also requires the assessment to include background ambient noise levels in the model. As specified in Directive 038, in most rural areas of Alberta where there is an absence of industrial noise sources the average night-time ambient noise level is approximately 35 dBA. This is known as the average ambient sound level (ASL). For areas greater than 500 m from a heavily traveled road or rail line with a population density between 9 - 160 per quarter section (some of the residents east of Hinton), the ASL is 38 dBA. For areas less than 500 m from a heavily traveled road or rail line with a population density less than nine per quarter section (Carldale residents), the ASL is 40 dBA. For areas less than 500 m from a heavily traveled road or rail line with a population density of 9 - 160 per quarter section (other Hinton residents), the ASL is 43 dBA. These ASL values were used as the ambient condition in the modelling with the various Project related noise sources added.

E.7.3 Potential Impacts

E.7.3.1 Noise Sources

The proposed mining operations involve using earth moving equipment (dozer, back hoe, trucks), a drill rig and explosives, and draglines. These operations occur 24 hours a day. The equipment and processes occur in various areas at various times throughout the life-span of the Project.

The coal is transported by haul trucks to a conveyor located east of the mining area. The conveyor transports the material north to the Processing Plant and from there, a conveyor transports the clean coal to the northwest to the Train Loadout where it is loaded onto rail cars for transport. The conveyor will cross over Highway 16 to get to the rail line.

The noise sources for the equipment associated with the Project were obtained from:

- noise measurement assessments carried out for other projects using similar operating equipment;
- aci in-house information and calculations using methods presented in various texts; and
- sound level information provided by equipment suppliers/manufacturers.

E.7.3.2 Permissible Sound Levels

D38 sets the permissible sound level (PSL) at the receiver location based on population density and relative distances to heavily traveled road and rail (CR #7, Table 1). In most instances, there is a Basic Sound Level (BSL) of 40 dBA. For some receptors the BSL can increase up to 48 dBA due to population density, proximity to Highway 16 or proximity to the CN Rail Line. In all cases, the BSL forms the Permissible Sound Level (PSL) for the night-time while the day-time PSL is 10 dBA higher.

D38 also specifies that new facilities must meet a PSL-Night of 40 dBA at 1,500 m from the facility fence-line. The fence-line is considered the MPB with a slight extension to the west of the train loadout to cover the noise from the diesel locomotives. The PSLs at a distance of 1,500 m are a LeqNight of 40 dBA and a LeqDay of 50 dBA.

E.7.3.3 Modelling Results

The computer noise modelling was conducted using the CADNA/A (version 4.2.140) software package. Results were calculated in two ways:

- at the nearby residential and the theoretical 1,500 m receiver locations. A total of 26 receptors were placed in the model to cover the residential and other identified receptors and 39 theoretical receptors were placed along the 1,500 m buffer line surrounding the MPB and Train Loadout; and
- using a 50 m x 50 m receptor grid pattern within the entire study area.

To determine the effect of the Project on the surrounding noise climate, four scenarios (mining activity for years 02, 05, 10, and 15 of the mine-life) were modelled to cover the mining activity in different stages of the Mine. The modelling results for the 26 modelled residential receptors are not specifically shown for all modelling years except Mining Year 10 because the highest noise levels for the residential receptors were during Mining Year 10.

Mining Year 02

The modelled noise levels are under the PSLs with Project noise combined with the ASL values at all theoretical 1,500 m receptor locations (CR #7, Table 2 and Figure 2).

The modelling results at the theoretical 1,500 m receptor locations indicated C-weighted (dBC) sound levels will be less than 20 decibels (dB) above the dBA sound levels at all except seven locations (CR #7, Table 3). At six of these locations, the source of the low frequency noise is the train loadout locomotive noise. While the possibility for a low frequency tonal component exists, all of the nearby residential receptors are modelled to have noise levels well below 35 dBA. As a result, the possibility of a low frequency noise complaint is low.

At one location, the dBC-dBA difference is due to the large distance between the noise sources and the receptor location and the fact that the mid-high frequency noises (largely responsible for the dBA sound level) attenuate more than the low frequency noise (largely responsible for the dBC sound level) over large distances and hilly terrain. The overall noise levels at this location are still very low and there are no residential receptors nearby. The possibility of a low frequency noise complaint is low.

Modelling Results Mining Year 05

The modelled noise levels are under the PSLs with Project noise combined with the ASL values at all theoretical 1,500 m receptor locations (CR #7, Table 4 and Figure 3).

The modelling results at the theoretical 1,500 m receptor locations indicated C-weighted (dBC) sound levels will be less than 20 dB above the dBA sound levels at most locations (CR #7, Table 5). As with the results of modelling for mining year 02, there is the potential for a low frequency tonal component at seven locations but the possibility of a low frequency noise complaint is low.

Modelling Results Mining Year 10

The modelled noise levels are under the PSLs with Project noise combined with the ASL values at all theoretical 1,500 m receptor locations (CR #7, Table 4 and Figure 6).

The highest noise levels of the four mining scenarios were obtained in mining year 10. The dominant noise sources were the diesel locomotive noise from the train associated with the loadout, the loadout activity itself, and the adjacent conveyor. As a result of the slowly moving noise source, a number of locations were modelled for the locomotives (three in total) to determine the highest noise levels for all of the adjacent residential and other identified receptors. The modelled noise levels are well under the PSLs with Project noise combined with the ASL values at all residential receptor locations (CR #7, Table 7).

The modelling results at the theoretical 1,500 m receptor locations indicated C-weighted (dBC) sound levels will be less than 20 dB above the dBA sound levels at all but eight locations (CR # 7, Table 8). For six receptor locations the source of the low frequency noise is the train loadout locomotive noise. While the possibility for a low frequency tonal component exists, all of the nearby residential receptors are modelled to have noise levels well below 35 dBA. As a result, the possibility of a low frequency noise complaint is low. For two locations, the overall noise levels are still very low and there are no nearby residential receptors. The possibility of a low frequency noise complaint is low.

The modelling results at the residential receptor locations indicated that the C-weighted (dBC) sound levels will be greater than 20 dB above the dBA sound levels at all locations (CR #7, Table 9). The sources of the low frequency noise are the diesel locomotives associated with the train loadout. All of the nearby residential receptors are modelled to have noise levels well below 35 dBA. The possibility of a low frequency noise complaint is low.

Modelling Results Mining Year 15

The modelled noise levels are under the PSLs with Project noise combined with the ASL values at all theoretical 1,500 m receptor locations (CR #7, Table 10 and Figure 5).

The modelling results at the theoretical 1,500 m receptor locations indicated C-weighted (dBC) sound levels will be less than 20 dB above the dBA sound levels at all but eight locations (CR #7, Table 11). At six of these locations, the source of the low frequency noise is the train loadout locomotive noise. All of the nearby residential receptors are modelled to have noise levels well below 35 dBA. As a result, the possibility of a low frequency noise complaint is low. At two locations, the overall noise levels are still very low and there are no nearby residential receptors. The possibility of a low frequency noise complaint is low.

E.7.4 Mitigation and Monitoring

E.7.4.1 Mitigation

In order to reduce the potential impacts of the Project due to noise, Coalspur will:

- conduct blasting during the day-time and not every day;
- implement equipment specific noise mitigation measures to reduce low frequency noise if local residents express concerns;
- take measures to reduce the impact of back-up beepers if local residents express concerns that can be addressed;
- maintain equipment in good working condition and mechanical repair;
- have appropriate dialogue with the local residents to alleviate any noise concerns where practical; and
- maintain a 10 m high earth berm at the northern portion of the north waste dump starting approximately in mining year 06.

E.7.4.2 Monitoring

In order to assess the effectiveness of mitigation measures, Coalspur will:

- conduct noise monitoring in compliance with the methods and procedures detailed in D38 if a noise complaint is raised.

E.7.5 Summary

Noise modelling indicated noise levels below the respective PSLs at all 26 of the modelled residential receptors and at the 39 theoretical 1,500 m receptors (1,500 m from the mine permit boundary) for each of the four mining years modelled (years 02, 05, 10, 15). The noise modelling indicated that low frequency tonal noise is possible for all of the residential receptors and some of the theoretical 1,500 m receptors due to diesel locomotives associated with the train loadout or the large distance between the noise sources and the receptor locations. The overall noise levels at these locations are still very low. Therefore, the possibility of a low frequency noise complaint is low.

E.8 SOCIO-ECONOMIC

E.8.1 Introduction and Terms of Reference

Coalspur conducted a Socio-Economic Impact Assessment (SEIA) for the proposed Project. The following section is a summary of the SEIA that was prepared by Nichols Applied Management and included as Consultants Report #8 (CR #8). For full details of the assessment, please refer to CR #8.

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the SEIA are provided in Section 7 of the ToR and are as follows:

7 SOCIO-ECONOMIC ASSESSMENT

7.1 Baseline Information

[A] Describe the existing socio-economic conditions in the region and in the communities in the region.

[B] Describe factors that may affect existing socio-economic conditions including:

- *a) population changes;*
- *b) the Proponent's policies and programs regarding the use of regional and Alberta goods and services;*
- *c) a project schedule and a general description of the overall engineering and contracting plan for the Project;*
- *d) workforce requirements for the Project, including a description of when peak activity periods will occur; and*
- *e) planned accommodations for the workforce for all stages of the Project.*

7.2 Impact Assessment

[A] Describe the socio-economic impacts of construction and operation of the Project, including:

- *a) impacts related to:*
  - *i) local training, employment and business opportunities,*
  - *ii) regional and provincial economic benefits,*
  - *iii) housing,*
  - *iv) recreational activities,*
  - *v) hunting, fishing, trapping and gathering, and*
  - *vi) impacts to First Nations and Métis (e.g., traditional land use and social and cultural implications);*
- *b) estimated total Project cost, including a breakdown for engineering and project management, equipment and materials, and labour for both construction and operation stages. Indicate the percentage of expenditures expected to occur in the region, Alberta, Canada outside of Alberta, and outside of Canada;*
- *c) impacts of the Project on the availability of affordable housing and the quality of health care services. Provide a summary of any discussions that have taken place with the local municipalities and the local environmental public health office of Alberta Health Services concerning housing availability and health care services respectively;*
- *d) discuss any impacts expected on primary and secondary highway systems and other regional roads caused by anticipated traffic changes;*
- *e) the impact on local and regional infrastructure and community services, including consideration of municipal "hard services", education/training services, social services, urban and regional recreation services, law enforcement and emergency services; and*

f) describe municipal growth pressures as they relate to the Project and the need for additional Crown land to meet these needs.

[B] Discuss plans to work with First Nation and Métis communities and groups, other local residents and businesses regarding employment, training needs and other economic development opportunities arising from the Project.

[C] Provide the estimated total Project cost, including a breakdown for engineering and project management, equipment and materials, and labour for both construction and operation stages. Indicate the percentage of expenditures expected to occur in the region, Alberta, Canada outside of Alberta, and outside of Canada.

The SEIA addresses the human environment with and without the Project. The key socio-economic issues considered in the analysis fall into the following categories:

- employment effects;
- regional and provincial economic benefits;
- population effects;
- effects on regional infrastructure and services; and
- traditional land use effects.

Key indicators used to assess the effects of the Project on communities in the RSA are:

- workforce;
- population change;
- income;
- effects of population changes on service providers and physical infrastructure;
- effects of increased traffic on the regional road network; and
- traditional land use and culture.

The key indicators used to assess the Project's income and taxation consequences for governments are:

- municipal taxes;
- provincial corporate tax and resource royalty income; and
- federal corporate tax income.

For the purpose of the socio-economic analysis, the RSA includes consists of Yellowhead County, the Town of Edson, and the Town of Hinton (CR #8, Figure 1).

E.8.2 Baseline Conditions

E.8.2.1 Labour Force

The economy of the RSA is driven primarily by the oil and gas, mining, and forestry sectors. The 2006 federal census reveals that 16% of the RSA labour force works in the mining and oil extraction sectors. Seven percent of the workforce engaged in the agriculture and forestry sectors. Tourism also contribute to the regional economy albeit in a less prominent fashion.

The percentage of the population holding an apprenticeship or trade certificate is above the provincial average. An estimated 31% of the RSA population over the age of 15 have not completed high school, slightly above the provincial average of 23% (Nichols Applied Management 2011, Statistics Canada 2006). Educational attainment within the aboriginal population resident in the RSA is below the provincial average for aboriginal persons, with 48% of the population over the age of 15 having not completed high school (Nichols Applied Management 2011, Statistics Canada 2006).

In general, the labour force participation rate is above and the unemployment rate below the provincial average for both the total and aboriginal working age populations.

E.8.2.2 Population

The 2011 population of the RSA is estimated to be 28,584 distributed throughout Yellowhead County (CR #8, Table 3.1). Hinton is closest and largest population centre to the Project with 34% of the RSA population. There are no First Nation Reserves located within the boundaries of the RSA; however, there is a large aboriginal contingent consisting of approximately 8.8% of the total population (Nichols Applied Management 2011, Statistics Canada 2006). The ten-year average annual growth rate within the RSA from 2001 to 2011 is 0.62%. The population of the RSA is expected to grow by an average rate of 0.63% between 2011 to 2021. The Town of Hinton (Hinton) has expressed a desire to grow and has established a target population of 12,000 by 2015.

There is a non-permanent population in the RSA that fluctuates with the level of industrial activity; in 2007 the estimate was in the order of 1,500 to 2,000 workers. These mobile workers are accommodated primarily in area hotels and motels, and to a lesser extent in camp-based accommodations in Yellowhead County. Permit data for Yellowhead County indicates a limited number of temporary camp facilities in the past few years.

E.8.2.3 Family Income

The favourable labour market conditions found in the RSA are reflected in family incomes, especially in the urban centres. Income data for Hinton and Edson indicates that median income for couple families and single persons are above the provincial median (CR#8, Table 3.2) while single parent families are below the provincial average. In the RSA, the median income for couple families is 2.8 times higher than for single-parent families.

E.8.2.4 Housing

The housing needed to accommodate base case population growth in the RSA is estimated at 741 units for the period between 2011 and 2021. If future housing development keeps pace with previous trends in new home construction within the RSA, there will be sufficient supply to meet the additional demand in 2021.

E.8.2.5 Social Infrastructure

Social infrastructure includes a diverse range of human services and infrastructure including health, education, social, recreation, policing and emergency services. Social infrastructure is important to a community as a means of:

- supporting the functioning of the community by sustaining the well-being of its residents and building social cohesion; and
- sustaining economic growth by making the community more attractive to those considering investing or relocating to the region.

The RSA has a well-developed social infrastructure system. The majority of infrastructure and services are located in the Towns of Hinton and Edson, which also service Yellowhead County residents. presents a high-level summary of social, health and emergency services and infrastructure in the RSA along with key issues identified through stakeholder interviews and a review of relevant planning documents, studies and reports is provided in CR #8, Table 7.1.

E.8.2.6 Municipal Infrastructure and Services

Each of the three municipalities within the RSA is responsible for the planning, construction, operations, and maintenance of municipal infrastructure within its boundaries. All three municipalities in the RSA are in relatively good shape in terms of their municipal financial position.

The three municipalities share a solid waste transfer station that is operated by Yellowhead County. It is estimated to have sufficient capacity to continue accepting waste for roughly 30 years.

Despite a number of favourable financial indicators, both Hinton and Edson report concerns regarding the cost of maintaining aging infrastructure as well as a $1 million unbudgeted cost requirement to meet upcoming revised AEW water and wastewater treatment standards.

Current and planned municipal infrastructure in Edson, Hinton, and Yellowhead County is sufficient to meet the level of service required by the anticipated population under the base case.

E.8.2.7 Transportation

Highway 16 spans the RSA from east to west and, as the main arterial road in the region, will be the road travelled by workers and material loads travelling to the Project site from both the east and west. There are existing rail lines in the region that allow for the movement of rail traffic from the study area and beyond to ports on Canada's west coast.

Traffic safety is a concern in the RSA as Highway 16 has, for several years, had collision rates above the provincial average for comparable roadways. Between 2002 and 2010, the volume of traffic travelling between Hinton and the Project and Edson and the Project has grown at an average annual rate of 1.3% and 1.7% respectively. Genivar estimates baseline traffic volumes on Highway 16 between Hinton and the Project access road to be 6,020 when the Project begins operations in 2015 and 8,290 at the end of the 20 year life of the Project (Genivar 2012).

E.8.2.8 Traditional Land Use

The external influences affecting Aboriginal communities in the RSA are similar to those impacting Aboriginal communities elsewhere in Canada. One external influence facing many Aboriginal communities is resource development. Examples include oil sands development in the Wood Buffalo region, diamond mining in the Northwest Territories, and, in the case of the RSA, coal mining and conventional oil and gas development. Resource development places pressure on the traditional lands of Aboriginal peoples in a number of different ways, including:

- making portions of land unavailable for traditional pursuits for a period of time, thereby reducing opportunities to carry out traditional activities and to transmit traditional culture and oral history while on the land;
- raising concerns among Aboriginal persons regarding the effect of pollutants on traditional lands and resources, thereby affecting how and where traditional practices are carried out; and

- offering opportunities for increased engagement in the wage economy which limits opportunities for carrying out traditional pursuits and transferring traditional knowledge to Aboriginal youth while on the land.

Information regarding TLU in the area is included in Section E.11 and CR #11.

E.8.3 Potential Impacts

E.8.3.1 Income Effects

Total initial capital expenditure for the Project is estimated at $872.7 million. Construction capital expenditures include wages and salaries paid to construction workers, engineering and environmental services, and the direct purchase of goods and services such as equipment modules and structural steel elements. Capital outlays will likely begin before the construction period for items such as engineering and purchases of long lead-time equipment.

For the construction phase approximately 65% of the total expenditure will accrue to the RSA and the rest of Alberta. An additional 12% will accrue to the rest of Canada and the balance to foreign suppliers. The expenditure accruing to foreign suppliers is related primarily to the purchase of materials and equipment. The annual operations and sustaining capital expenditure of the Project will average $198.1 million per year. An estimated 58% of the expenditures will accrue to Alberta, including the RSA, and an additional 6% to the rest of Canada.

For construction, the Project's direct, indirect and induced impact in terms of GDP and household income is approximately $844 million and $545 million respectively (Alberta Finance 2011). The direct, indirect and induced GDP impact of operating and sustaining capital expenditures is estimated at $350 million. The total labour income effect of the Project's operating and sustaining capital is estimated at $183 million. The estimates represent the average annual impact over the life of the Project and are based on published multipliers (Alberta Finance 2011).

Coalspur has policies in place to hire locally first and to use Alberta-based contractors as often as possible subject to labour availability, cost, and quality considerations. The Project will also offer increased contracting opportunities for qualified local Aboriginal businesses and employment opportunities for qualified local Aboriginal workers.

E.8.3.2 Fiscal Effects

The Project will contribute property taxes to Yellowhead County, coal royalties to the provincial government, and corporate taxes to the provincial and federal government.

Annual municipal tax payments are estimated at $1.4 million in 2015, the first full year of operations. The present value of the municipal taxes over the life of the Project is calculated to be $11.3 million in $2012 (at 8% discount rate).

Once fully operational, the Project will pay royalties to the provincial government. The Project is estimated to pay royalties with a net present value in 2012 of $123 million over the life of the Project.

Coalspur will also pay provincial and federal corporate income taxes on revenue derived from the Project. Coalspur will pay corporate income taxes of approximately $227 million (NPV 2012) over the life of the Project.

E.8.3.3 Employment Effects

The Project will create positive economic and fiscal effects on the socio-economic RSA consisting of Yellowhead County and the Towns of Hinton and Edson and Alberta.

Construction of the Project is expected to require approximately 970 person years of labour during the 2013 to 2014 period. An estimated 900 person years are expected to be on-site, with the balance in fabrication shops outside of the RSA.

In addition to the on- and off-site construction employment, the Project is expected to create an estimated 105 person years of engineering employment. The majority of this work will accrue to engineering firms outside of the RSA in Edmonton and Calgary.

Once fully operational, the Project will employ an annual average of 510 individuals. In addition to operations employment, the Project will create 25 person years annually of contractor employment for scheduled maintenance.

The Project will employ a broad range of construction trades during the on-site construction activities, the bulk of which will be heavy equipment operators, welders, millwrights, pipefitters, iron workers, and electricians. The operation of the Project is expected to require primarily heavy equipment operators, millwrights, and process operators.

E.8.3.4 Population Effects

The Project is expected to result in a net permanent population increase in the RSA comprised of in-migrants who re-locate to the RSA to fill many of the direct, indirect, and induced jobs created as a result of the Project. By 2021, an additional 1,220 persons are expected to have relocated to the region. The Town of Hinton (closest to the Project) is expected to experience an estimated 20.2% increase in permanent population in 2021 as a result of the Project. The effect in Edson and Yellowhead County will be 15.6% and 7.5% respectively. The Town of Hinton will approach its target population of 12,000 during the forecast period under the application case assumptions.

During peak construction activity, the Project may increase the number of mobile workers in the region by approximately 800 (average of 485). Mobile workers will add to the pressure on the health system, especially emergency department, police and emergency services, and transportation infrastructure (Nichols Applied Management 2007).

E.8.3.5 Housing Effects

The permanent housing need associated with the long-term population effect of the Project is estimated to be approximately 881 units above the base case levels for a total of 1,623 units. Of these, 682 of these will be in Hinton. Discussions with Yellowhead County, Hinton and Edson suggest that sufficient land is available to meet the demand for new housing under the application case assumptions.

Coalspur plans to house the mobile workers and most construction workers in the RSA for the construction of the Project in area hotels and motels. Capacity and occupancy data from Alberta Tourism, Parks, and Recreation indicates that there is sufficient hotel and motel room capacity in the region to accommodate the Project’s construction workforce. If drilling activity returns to the levels seen in 2006 and 2007, there may be a shortage of hotel and motel rooms in the RSA.

E.8.3.6 Social Infrastructure

Demand for social infrastructure is expected to increase in line with population effects. The increase in demand for social infrastructure will require additional facilities, programming and staffing (Table E.8.3.1). The social infrastructure requirements identified in Table E.8.3.1 are for the RSA as a whole but will largely fall on the town of Hinton where the majority of population effects are expected to occur.

Project construction will increase the mobile workforce in the region, placing temporary additional demands on regional social infrastructure, such as health and social services, and policing and emergency response services.

Table E.8.3.1 Additional Social Infrastructure Required by 2021

Assessment Cases	Police Services	Fire Services	Ambulance Services	Health Services	Education
	No. of RCMP Officers (FTEs)[1]	*No. of Staff (FTEs)*[1] */ No. of Volunteers*[2]	*(No. of Staff)*[2]	*(No. of Full-Registered Physicians)*[4]	*No. of Licensed Teachers (FTEs)*[1]
Base Case[3]	3.0	0.5 / 11.3	1.8	1.8	18.0
Application Case ***(Project Effect Only)***	3.5	0.6 / 13.5	2.2	2.1	21.4
Planned Development Case[4]	5.1	0.9 / 19.5	3.1	3.0	31.0
Total[5]	**11.6**	**2.0 / 44.4**	**7.1**	**6.9**	**70.3**

Notes:
1) FTEs = Full-Time Equivalents
2) Number of Emergency Medical Responders (EMRs), Emergency Medical Technicians (EMTs), and Emergency Medical Technician-Paramedics (EMT-P)
3) Additional social infrastructure required over and above existing levels
4) Additional social infrastructure required over and above Application Case assumptions by 2021
5) Total additional social infrastructure requirements by 2021

While service providers will likely face challenges in meeting increased demand, future growth can also help generate opportunities to address this increased demand by:

- leading to increased funding from the federal and provincial governments (*e.g*. per capita funding support for certain programs and services);
- increasing businesses in the area that can offer support for community programs and infrastructure used by residents;
- increasing the labour pool and volunteer base on which local service providers can draw; and
- increasing revenues to local government, which can be used to increase investment in public infrastructure and services.

Growth in a community can also help increase the breadth and nature of social infrastructure services available to local residents (*e.g*. specialized health services, broader educational offerings).

A number of service providers indicated that they are well positioned to plan for and address most, if not all, future growth forecasted under both base and application case assumptions. An exception was those providing social support services (*e.g*. FCSS, addictions and substance abuse services).

E.8.3.6 Municipal Infrastructure and Services

The Project will not tie in directly to municipal water or sewer lines in the region. The Project will make use of the regional waste transfer station operated by Yellowhead County.

The additional demand for municipal infrastructure requirements driven by the population increase estimated under the application case assumptions do not exceed the current and planned levels of municipal infrastructure in Hinton, Edson, or Yellowhead County.

E.8.3.7 Transportation

During peak construction activity, the Project is expected to contribute an estimated 900 average annual daily traffic (AADT) to traffic numbers between the Hinton and the Project and 600 AADT to the traffic between Edson and the Project. These volumes represent an increase of 16% and 8% above 2010 levels respectively.

During operations, Genivar estimates that the Project will generate approximately 145 AADTs, an increase of 2.4% above forecast 2015 levels. Based on the expected settlement pattern of in-migrants, operational Project AADTs will primarily travel the stretch of highway between Hinton and the Project access road. Genivar estimates that east and westbound traffic movements along Highway 16 near the Project will operate at the highest level of service (LOS A) over the operational life of the Project Traffic on the Project access road is expected to operate at a LOS of B or better (Genivar 2012).

E.8.3.8 Traditional Land Use and Aboriginal Culture

Additional land disturbance and population growth associated with resource development in the region, such as the Project, will place increasing pressure on traditional land use and Aboriginal culture. However, it will also enhance a number of benefits associated with development including increased wage opportunities, support for TLU and TEK studies, and support for specific community projects, where appropriate (CR #8, Table 9.1).

The culture of local Aboriginal peoples, like the culture of Aboriginal peoples across Canada, will not remain static over time. Culture will continue to respond and adapt to both external influences – such as resource development, government policy, education, and technology – and internal drivers, such as the desires and aspirations of Aboriginal peoples themselves. Effects on traditional land use and Aboriginal culture, along with the development of appropriate mitigation initiatives and engagement strategies, will remain an integral part of ongoing discussions between local Aboriginal peoples, industry and government.

E.8.4 Cumulative Effects

The PDC consists of all the economic activity assumed under the application case, plus those large industrial Projects that were disclosed as of December 1, 2011 including the Coalspur Vista Coal Mine Expansion Project. A complete listing of the projects included in the base case and PDC is included in Table D.2.4.2.

E.8.4.1 Population Effects

The proposed Project will increase the operations workforce from 510 to 1,255 by 2021. The RSA will likely experience population growth of approximately 3,190 people above the application case by 2021. The Town of Hinton will experience an estimated 42.2% increase in permanent population above baseline by 2021. The effect in Edson and Yellowhead County will be approximately 8.7% and 3.6% above baseline respectively. The Town of Hinton will likely achieve its target population of 12,000 sometime during late 2016.

The number of mobile workers in the region is expected to be slightly lower than the application case.

E.8.4.2 Housing Effects

The permanent population forecast for the PDC is estimated to generate housing demand for about 2,158 units above baseline (1,669 in Hinton) for a total of 2,899 units by 2021. The requirement for new housing will be well above the annual growth seen in recent years. This may lead to upward pressure in house prices unless the supply of new housing grows in line with the increased demand, particularly in the Town of Hinton between 2015 and 2021.

Most construction workers are similarly expected to be housed in hotels and motels under the PDC. The peak number of mobile workers under the PDC is expected to be slightly less than under the application case.

E.8.4.3 Social Infrastructure

Demand for social infrastructure is expected to increase in line with population effects. Table E.8.3.1 provides an overview of effects on selected social infrastructure indicators by 2021. Additional social infrastructure will be required even under the base case assumptions. The Project and PDC-induced population growth will require additional services (*i.e*. over and above social infrastructure required under the base case assumptions).

E.8.4.4 Municipal Infrastructure and Services

The additional demand for municipal infrastructure requirements driven by the population increase estimated under the PDC assumptions do not exceed the current and planned levels of municipal infrastructure in Edson and Yellowhead County. It is expected to exhaust the available capacity of the water and wastewater system in Hinton, thus requiring additional investment to accommodate growth beyond 2021. Although the impact of increased industrial activity is not expected to overwhelm municipal services, the long-term development and service plans of municipalities in the RSA may need to be revisited in order to reflect the in-migration forecast under PDC assumptions.

E.8.4.5 Transportation

Traffic volumes in the RSA may increase by as much as 240 (Genivar 2012) when the Projects in the PDC are fully operational. Genivar estimates that east and westbound traffic movements along Highway 16 near the Project will operate at a LOS of A under the PDC assumptions (Genivar 2012). Traffic on the Project access road is expected to operate at a LOS of C or better (Genivar 2012).

During full operations, Coalspur anticipates that the Project will produce sufficient clean coal product to fill approximately one train or 175 rail cars every 1.4 days. Canadian National Railway (CN) will be responsible for the construction and operation of the Project related rail spur which will be subject to its own regulatory application.

During both construction and operations, Coalspur and its contractors will use buses and multi-passenger vans to transport personnel to site in order to reduce the total number of vehicles traveling on local roads. Also, the use of a conveyor belt to transport clean coal across the highway will reduce the need for Project related traffic to cross the highway from the Project to the train load out and rail spur.

E.8.5 Mitigation and Monitoring

E.8.5.1 Mitigation

In order to ensure the local economy and people benefit from the Project, Coalspur will:

- continue with their local hire and procurement policy;
- continue to support community investment programs and initiatives;
- provide a bussing/ multi-passenger vans service to the Project to reduce the traffic impact on local roads;
- provide first responder medical capability on site during construction and operations;
- continue ongoing public engagement through the life of the Project;
- provide periodic updates regarding Project details (*e.g.* workforce size, Project approach) to municipalities in the region, other service providers (*e.g.* health and emergency services) , and provincial and municipal governments;
- work with local governments to facilitate the timely development of residential land and dwellings;
- continue to house construction workers in hotel and motel rooms throughout the region;
- develop and implement an emergency response plan;
- maintain explicit and enforced workplace policies with regards to the use of alcohol, drugs, and illegal activities; and
- provide employees with access to the company's confidential employee assistance plan.

In order to minimize the adverse effects of resource development on traditional land use and culture, Coalspur will:

- undertake progressive reclamation, giving consideration to traditional land use, where possible;
- provide access to trappers and traditional users across the Project area;
- compensate trappers directly affected by the Project, according to industry standards;
- promote cultural diversity awareness to Coalspur employees and contractors regarding respect for traditional resource users;
- support specific community projects, such as elder and youth programs, where appropriate; and
- continue working with Aboriginal communities in the region to ensure that their concerns with respect to traditional land use and culture are continually considered during Project planning and operation.

E.8.5.1 Monitoring

Coalspur will:

- continuously monitor Project effects and associated mitigation measures through Coalspur's engagement with regional and provincial stakeholders; and
- report results of monitoring as part of ongoing community consultation.

E.8.6 Summary

The Project will create positive economic and fiscal effects on the socio-economic RSA consisting of Yellowhead County and the Towns of Hinton and Edson, and Alberta. The Project is estimated to create:

- 105 person years of engineering employment before and during construction;
- 970 person years of on- and off-site employment related to the 2013-2014 construction of the plant, facilities and infrastructure for the mine; and
- 510 long-term operations positions to be hired between 2014 and 2016.

Once fully operational, the Project will add an estimated $1.4 million annually in property taxes to Yellowhead County, which over the life of the Project has a net present value (NPV) of approximately $14.1 million in 2012 dollars assuming no change in mill rates. The Project will also contribute an estimated $90.7 million (NPV 2012) and $136 million (NPV 2012) to provincial and federal corporate income taxes respectively as well as approximately $123 million (NPV 2012) in provincial royalties over the 20 year operating life of the Project, assuming a $122/tonne average real price of coal.

The population impact of the Project is expected to fall primarily on the Town of Hinton as it is the fully serviced urban municipality closest to the Project. The new jobs created by the Project are expected to be filled primarily by in-migrants to the region. By the year 2021, an estimated 2,200 people are expected to have re-located to the region, with the bulk of them finding a home in Hinton.

The effects on regional services and infrastructure will largely be in line with population effects, falling mainly on the Town of Hinton.

A number of service providers indicated that they are well positioned to plan for and address future growth forecasted under both baseline and application case assumptions. A notable exception was those providing social support services.

Growth of the scale predicted in the planned development case is generally not considered in the current plans of service providers in the region. The ability of local service providers to respond in a timely and appropriate manner to increased service demands will be contingent on the availability of increased resources to meet those demands. Many service providers are currently pursuing plans to boost resources and expand service offerings, but likely not to a level that may be required with population growth assumed under the PDC. Population growth anticipated under the PDC could also give rise to house price inflation if the supply of dwellings does not meet the anticipated needs. If so, service providers may experience both an increase in demand and challenges recruiting and retaining staff.

While service providers will likely face challenges in meeting increased demand, future growth can also help generate opportunities to address this increased demand by increasing revenues to government, increasing the labour and volunteer base, and increasing businesses that could support local programs and infrastructure. Growth in a community can also help increase the breadth and nature of infrastructure and services available to local residents (*e.g*. specialized health services, broader educational offerings).

E.9 SOIL AND TERRAIN

E.9.1 Introduction and Terms of Reference

Coalspur conducted a soil and terrain assessment for the proposed Project. The following section is a summary of the Baseline Soils and Terrain Survey and Effects Assessment that was prepared by Millennium EMS Solutions Ltd. and included as Consultants Report #9 (CR #9). For full details of the assessment please refer to CR #9.

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the soils and terrain assessment are provided in Section 3.9 of the ToR and are as follows:

3.9 TERRAIN AND SOILS

3.9.1 Baseline Information

[A] Provide descriptions and maps of the terrain and soils conditions, including:

- *a) surficial geology and topography;*
- *b) soil types and their distribution. Provide an ecological context to the soil resource by supplying a soil survey report and maps to Survey Intensity Level 2 for the Project Area;*
- *c) suitability and availability of soils within the Project Area for reclamation;*
- *d) soils that could be affected by the Project with emphasis on potential acidification (by soil type); and*
- *e) descriptions and locations of erosion sensitive soils.*

3.9.2 Impact Assessment

[A] Describe Project activities and other related issues that could affect soil quality (e.g., compaction, contaminants) and:

- *a) indicate the amount (ha) of surface disturbance from plant, mine, overburden disposal, reclamation material stockpiles, infrastructure (e.g., pipelines, power lines, access roads), aggregate and borrow sites, construction camps, waste disposal and other construction and operation activities;*
- *b) provide an inventory of the pre- and post-disturbance land capability classes for soils in both the Project Area and the Local Study Area and describe the impacts to land capability resulting from the Project. Indicate the size and location of soil types and land capability classes that will be disturbed;*
- *c) discuss the relevance of any changes for the local and regional landscapes, biodiversity, productivity, ecological integrity, aesthetics and future use resulting from disturbance during the life of the Project;*
- *d) describe potential sources of soil contamination;*
- *e) describe the impact of the Project on soil types and reclamation suitability and the approximate volume of soil materials for reclamation. Discuss any constraints or limitations to achieving vegetation/habitat reclamation based on anticipated soil conditions (e.g., compaction, contaminants, salinity, soil moisture, nutrient depletion, erosion, etc.); and*
- *f) discuss the potential for soil erosion during the life of the Project.*

[C] Discuss the potential impacts caused by the mulching and storage of woody debris considering, but not limited to vulnerability to fire, degradation of soil quality, increased footprint, etc.

The soil and terrain effects assessment report provides the soil and terrain inventory for the Project, an assessment of effects the Project might have on the soil and terrain resources based on the development and reclamation plan and soil conservation and reclamation recommendations to mitigate those effects.

The LSA for the Project includes lands within the existing and proposed Mine Permit areas that are expected to be disturbed during the life of the Project (CR #9, Figure 2). The RSA corresponds to the existing and proposed mine permit areas. The area selected as the RSA is deemed sufficient to evaluate cumulative effects as relating to direct disturbance of soil and terrain from other industries/operations within this selected area.

VECs related to soil and terrain include:

- soil quality (includes impacts related to soil disturbance, erosion, soil burial, and accidental releases);
- soil biodiversity and ecological integrity;
- terrain; and
- landscape capability (impact to potential capability of reclaimed soil and landscapes in comparison to baseline conditions).

E.9.2 Baseline Conditions

Soils were investigated at 1,021 soil inspection sites within or adjacent to the RSA with 45 soil profiles sampled (CR #9, Figure 4a-b). A soil intensity survey (SIL) 1 was achieved for all lands within the LSA and a SIL 2 was achieved for the RSA. The LSA and RSA boundaries for the Project are located primarily within soil correlation area 14 with a small portion in the southeast corner of the RSA located in SCA 13. Soils were classified based on the *Canadian System of Soil Classification – Third Edition* (SCWG 1998).

E.9.2.1 Soil Map Units

The soil map unit symbols used to describe the soil and terrain for the Project include a numerator and a denominator. The numerator describes the soil patterns; the patterns are based on the AGRASID Soil Model (ASIC 2001). The denominator describes the terrain in terms of slope class and slope length (see CR #9, Table 6 for list of map unit slope descriptors). The baseline soil and terrain map for the RSA is included in CR #9, Figures 6a-e. Table E.9.2.1 presents map unit summary information for the RSA and LSA. Descriptions of the soil map units are provided in CR #9, Table 7 and Appendix B.

Table E.9.2.1 Soil Map Unit Count and Area Calculations for the RSA and LSA

Soil Map Unit	Distribution within the RSA			Distribution within the LSA		
	Polygon Count	Area (ha)	Percent Cover (%)	Polygon Count	Area (ha)	Percent Cover (%)
BIL18/2-3m	2	85.2	1.4	-	-	-
BIL18/2-3s	1	2.9	0.05	-	-	-
BIL18/3-4m	2	20.3	0.3	3	17.1	0.6
BIL18/3-4s	2	13.3	0.2	2	13.3	0.5
BIL18/4-5l	1	41.3	0.7	3	7.5	0.3
BIL18/4-5s	9	91.6	1.5	6	45.5	1.7
ESF21/2-3m	7	97.7	1.6	4	40.6	1.5
FKE1m-G/1-2m	3	22.7	0.4	1	11.5	0.4
FKE1m-G/3-4m	6	130.1	2.2	7	111.2	4.2
FKE1m/1-2m	9	109.0	1.8	5	59.3	2.2
FKE1m/3-4m	**22**	**423.2**	7.1	14	163.1	6.2
FKE2m/1-2m	23	345.0	5.8	20	104.1	3.9
FKE2m/3-4m	20	318.7	5.3	20	155.4	5.9
FKE3/1-2m	10	192.6	3.2	7	88.9	3.4
FKE3/3-4m	2	113.6	1.9	4	28.5	1.1
HGDA2/2-3m	2	23.9	0.4	3	2.1	0.1
HGDA2/3-4l	2	28.6	0.5	4	1.3	0.04
HGDA2/4-5m	7	49.1	0.8	5	2.0	0.1
HGDA2/4-5s	1	10.8	0.2	1	1.4	0.1
HGDA2/5-6l	2	72.6	1.2	3	6.5	0.2
HGDA9/4-5l	1	8.0	0.1	2	1.5	0.1
HGDA9/4-5m	1	26.9	0.4	1	2.0	0.1
HGDA9/5-6l	6	95.8	1.6	5	8.1	0.3
HGDA9/6-7m	1	46.9	0.8	3	2.5	0.1
HGW12/6-7s	6	35.2	0.6	7	2.3	0.1
HSY9/2-3m	1	10.6	0.2	1	3.0	0.1
HSY9/4-5l	1	6.9	0.1	2	2.7	0.1
HSY9/4-5m	6	139.2	2.3	5	110.9	4.2
HSY9/4-5s	1	41.6	0.7	1	4.1	0.2
MPH9/2-3m	13	133.9	2.2	5	49.5	1.9
MPH9/2-3s	2	17.1	0.3	2	14.6	0.6
MPH9/3-4m	5	39.6	0.7	5	38.7	1.5
MPH9/3-4s	2	31.3	0.5	-	-	-
MPH9/4-5l	1	9.6	0.2	-	-	-
MPH9/4-5m	7	140.3	2.3	2	20.2	0.8
MPH9/4-5s	6	80.3	1.3	2	23.1	0.9
MPHS2/2-3m	7	121.3	2.0	5	20.0	0.8
MPHS2/2-3s	2	10.6	0.2	2	8.8	0.3
MPHS2/3-4l	2	29.1	0.5	2	25.8	1.0
MPHS2/3-4m	1	30.0	0.5	1	21.3	0.8
MPHS2/3-4s	2	6.2	0.1	1	4.6	0.2

Table E.9.2.1 Soil Map Unit Count and Area Calculations for the RSA and LSA

Soil Map Unit	Distribution within the RSA			Distribution within the LSA		
	Polygon Count	Area (ha)	Percent Cover (%)	Polygon Count	Area (ha)	Percent Cover (%)
MPHS2/4-5l	2	19.2	0.3	2	5.7	0.2
MPHS2/4-5s	5	57.0	1.0	1	7.1	0.3
MPHS6/4-5s	1	5.7	0.1	1	5.7	0.2
MPHS6/6-7m	3	283.4	4.7	-	-	-
MPHS9/2-3m	10	224.2	3.7	10	152.8	5.8
MPHS9/2-3s	3	19.6	0.3	1	5.1	0.2
MPHS9/3-4l	5	59.9	1.0	5	36.6	1.4
MPHS9/3-4m	5	166.5	2.8	4	154.0	5.8
MPHS9/3-4s	2	17.2	0.3	2	11.6	0.4
MPHS9/4-5m	**16**	**348.2**	5.8	**12**	**217.6**	8.2
MPHS9/4-5s	**14**	**404.7**	6.7	**15**	**250.4**	9.5
MPHSxl6/4-5m	2	68.9	1.1	2	21.6	0.8
MPHSxl6/4-5s	1	16.9	0.3	1	16.9	0.6
MPHSxl6/6-7m	4	126.2	2.1	4	105.6	4.0
MPHSxl9/3-4l	2	103.8	1.7	2	41.9	1.6
MPHSxl9/3-4s	1	19.2	0.3	1	6.3	0.2
MPHSxl9/4-5m	13	255.0	4.3	**11**	**243.6**	9.2
MPHSxl9/4-5s	4	160.2	2.7	3	74.5	2.8
MPZG12/4-5s	3	36.5	0.6	7	8.1	0.3
MPZG12/5-6s	3	24.1	0.4	1	8.5	0.3
MPZG12/6-7s	3	14.1	0.2	2	4.6	0.2
ZDL	8	116.5	1.9	12	42.4	1.6
ZGZR/4-5s	3	104.6	1.7	-	-	-
ZWA	11	91.8	1.5	2	5.2	0.2
TOTALS[1]	**331**	**5996**	**100**	**267**	**2649**	**100**

[1] Due to rounding of values, totals may not equal the sum of the individual values presented in the table.
BOLD – Bolded value (ha and %) represents the three largest areas.

E.9.2.2 Soil Layer Thickness

Estimating average profile layer thicknesses assists in determining suitable soil salvage and stockpiling and soil replacement requirements for reclamation purposes. All soil data collected was analyzed to determine average thicknesses of soil layers for the soil map units. Soil profiles were defined as surface litter/shallow organics, deep organics, topsoil, upper subsoil, and lower subsoil. The estimated horizon thicknesses per soil map unit are listed in Table E.9.2.2 and shown on CR #9, Figure 7. Soil thickness was used to estimate suitable soil salvage and stockpiling and soil replacement requirements for reclamation purposes. Soil volumes for the Project and various Project components are provided in the conceptual C&R Plan for the Project (Section F).

Table E.9.2.2 Baseline Soil Layer Thicknesses by Soil Model

Soil Model	Thickness (cm)				
	Surface Soil			Topsoil Lift Thickness[1]	Upper Subsoil (B Horizon)[2]
	Deep Organics	Litter / Shallow Organics	Topsoil (A horizon)		
BIL18	-	10	10	20	30
HGDA2	-	10	15	25	20
HGDA9	-	10	20	30	30
HGW12	-	10	20	30	20
ESF21	-	30	10	40	20
FKE1m/1-2m	75	-	-	-	-
FKE1m/3-4m	70	-	-	-	-
FKE1m-G/1-2m	55	-	-	-	20
FKE1m-G/3-4m	65	-	-	-	10
FKE2m/1-2m	130	-	-	-	-
FKE2m/3-4m	125	-	-	-	-
FKE3/1-2m	190	-	-	-	-
FK3/3-4m	210	-	-	-	-
HSY9	-	10	15	25	30
MPH9	-	10	10	20	35
MPHS2	-	15	15	30	30
MPHS6	-	10	10	20	30
MPHS9	-	15	15	30	30
MPHSxL6	-	5	15	20	30
MPHSxL9	-	10	15	25	30
MPZG12**	-	15	15	30	20
ZGZR	NR	NR	NR	NR	NR
ZDL	NR	NR	NR	NR	NR
ZWA	NR	NR	NR	NR	NR

[1] Topsoil Lift Thickness includes the mineral A horizon plus the litter/surface organic layer. In mineral soils this is the salvage depth for the topsoil material.
[2] Upper subsoil (B horizon), by AEW definition also may comprise a portion of "surface soil" that is to be replaced at reclamation.
NR – Not rated for soil thickness.

E.9.2.3 Reclamation Suitability Ratings

Soils in the RSA and LSA were rated for reclamation suitability following the *Soil Quality Criteria Relative to Disturbance and Reclamation Guidelines as specified for the Eastern Slopes Region of Alberta (SQCWG 1987 – Table 10)*. Map unit ratings are listed in Table E.9.2.3 and include ratings for deep organics, mineral topsoil, upper subsoil and lower subsoil materials. Ratings parameters include soil reaction (pH), salinity (measured by electrical conductivity (EC)), sodicity (measured by sodium adsorption ratio (SAR)), saturation percentage (sat %), coarse fragment (% volume), soil texture, consistency, and calcium carbonate equivalent (CCE). Ratings are divided into three categories (Good, Fair, Poor) and one category indicating that the soil material is unsuitable as a rooting medium. CR #9, Figure 8 displays suitability ratings for the topsoil and organic materials and CR #9, Figure 9 and Figure 10 display suitability ratings for upper and lower subsoil materials respectively.

Table E.9.2.3 Reclamation Suitability Ratings for Soil Models of the RSA

Soil Model	Amalgamated Reclamation Suitability Ratings				Comments/Limitations
	Deep Organic Material[1]	A Horizon (TS)[2]	B Horizon (US)[3]	C Horizon (LS)[4]	
BIL18	-	F-G	F	F-P	TS – alkaline & acidic pH, high saturation % US – alkaline & acidic pH, coarse texture & fragment content, CCE[5] LS – alkaline pH, coarse texture & coarse fragments, CCE[5]
HGDA2	-	F	F	F-P	TS – alkaline pH, elevated saturation %, US – alkaline pH LS – alkaline pH, CCE[5]
HGDA9	NR	F	F	F-P	TS – alkaline pH, slightly low saturation %, fine textures US – alkaline pH LS – alkaline pH CCE[5]
HGW12	NR	F-G	F	F-P	TS – alkaline pH, elevated saturation %, fine textures US – alkaline pH, fine textures LS – alkaline pH, CCE[5]
ESF21	F[6]	F-G	F	F	TS – alkaline pH US – alkaline pH, fine textures LS – alkaline pH, CCE[5]
FKE1m	F	NR	NR	F	Organic Material – slightly alkaline pH LS – underlying mineral material contains alkaline pH and elevated CCE[5]
FKE1m-G	F	NR	NR	F	Organic Material – slightly alkaline pH LS – underlying mineral material contains alkaline pH and elevated CCE[5], coarse or fine textures also limit material
FKE2m	F	NR	NR	F	Organic Material – slightly alkaline pH LS – underlying mineral material contains alkaline pH and elevated CCE[5], coarse or fine textures also limit material
FKE3	F	NR	NR	NR	Organic Material – slightly alkaline pH LS – no mineral contact recorded therefore no ratings
HSY9	NR	F	F	F	TS – alkaline or acidic pH, elevated saturation %, US – alkaline pH, high saturation %, coarse textures LS – alkaline pH, CCE[5], finer textures
MPH9	NR	F	F	F	TS – alkaline or acidic pH, elevated saturation %, US – alkaline pH, high saturation %, coarse textures LS – alkaline pH, CCE[5], finer textures
MPHS2	NR	F	F-G	F	TS – alkaline or acidic pH, elevated saturation %, US – alkaline pH, high saturation %, LS – alkaline pH, CCE[5], finer textures

Table E.9.2.3 Reclamation Suitability Ratings for Soil Models of the RSA

Soil Model	Amalgamated Reclamation Suitability Ratings				Comments/Limitations
	Deep Organic Material[1]	A Horizon (TS)[2]	B Horizon (US)[3]	C Horizon (LS)[4]	
MPHS6	NR	F	F-G	F	TS – alkaline or acidic pH, elevated saturation %, US – alkaline pH, coarse textures LS – alkaline pH, CCE[5], finer textures
MPHS9	NR	F	F	F	TS – alkaline or acidic pH, elevated saturation %, US – alkaline pH, coarse textures LS – alkaline pH, CCE[5], finer textures
MPHSxL6	NR	F	F	F-P	TS – alkaline or acidic pH, elevated saturation %, US – alkaline pH, coarse textures, coarse fragment content (for component soils) LS – alkaline pH, CCE[5], finer textures and lithic contact common
MPHSxL9	NR	F	F-G	F-P	TS – alkaline or acidic pH, elevated saturation %, US – alkaline pH, coarse textures, elevated saturation %, coarse fragment content (for various component soils) LS – alkaline pH, CCE[5], finer textures and lithic contact common
MPZG12	NR	F	F-G	F	TS – slightly alkaline pH and high sat % US – slightly alkaline pH, component soils have coarse textures LS – alkaline pH, CCE[5], finer textures
ZGZR	NR	NR	NR	NR	Limited soil data within the McPherson River Valley, not rated
ZDL	NR	NR	NR	NR	Disturbed Land
ZWA	NR	NR	NR	NR	Open Water

1 Organic Material ratings are provided for Deep Organic map units.
2 TS – Topsoil is defined as the A horizon material (Ahe, Ae, Aegj, Aeg, AB).
3 US – Upper subsoil is defined as the B horizons (Bm, Bt, Btgj, Btg, BA).
4 LS – Lower subsoil is defined as all BC and C horizons recorded within the profile (100 cm investigation depth).
5 CCE – Elevated calcium carbonate equivalency (as a %).
6 For the ESF21 map unit a notable average organic layer thickness was noted (30 cm) as such a rating is applied for organic material even though the map unit is considered a mineral map unit.
NR –Particular horizon not rated for reclamation suitability for various Soil Models.

Overall, topsoil and upper subsoil material are considered to be fair material for reclamation. With proper management and reclamation planning theses soils will provide a suitable growth media for reclamation and revegetation of the Project. Issues related to coarse fragment content in various localized areas are not seen as reclamation barriers for establishment of forested ecosystems and will likely provide for a wider range of microhabitats and moisture regimes post reclamation.

Evaluation of organic materials indicates that this material is suitable for use in reclamation.

E.9.2.4 Evaluation of Soil Erosion Potential

The rate of water erosion was estimated using the *Revised Universal Soil Loss Equation for Application in Canada* (RUSLEFAC) (Wall *et al*. 2002). The risk of water erosion for baseline conditions is typically very low as the soil surface is currently well protected by tree and understory cover resulting in minimal exposure of surface soil material to water throughout the RSA (CR #9, Table 11). When assessing water erosion, slope gradient is an important factor. As slope gradient increases, so does the potential risk for water erosion. If mineral soil is exposed, water erosion risk increases. The majority of upland soils within RSA occur on gentle to strong slopes and soils in these landscapes are highly susceptible to water erosion upon complete removal of all vegetation and debris.

Landscape conditions of special concern that are estimated to have a moderate to high erosion risk via water after the implementation of erosion control measures described above include:

- slope classes of 10-20% with slope lengths of >200 m (5-6 l); and
- slope classes of >20% with slope lengths of 100-200 m (6-7 m).

Mitigation measures that can reduce soil loss to acceptable levels for other soils within proposed disturbance area may be insufficient for reclaimed landscape types that contain slope steepness and slope lengths similar to the aforementioned cases.

Wind erosion risk ratings were modified from the *Wind Erosion Risk, Alberta* (Coote and Pettapiece 1989), Alberta Agriculture (1985) and United States department of Agriculture (USDA) (2012, Internet site). Wind erosion risk under current conditions is considered to be very low to negligible due to the vegetation cover in the RSA (CR #9, Table 12). The wind erosion ratings estimated for the Soil models are based on the assumption that vegetation has been removed and bare soil is exposed. Upland soil units in the Project would generally be at moderate risk of wind erosion (assuming no vegetative cover) due to their medium surface texture and increased exposure to wind as a result of the terrain types associated. Wetland and transitional soil models were classified as having low risk of wind erosion due to their normally wet soil moisture regime and estimated placement in lower slope to depressional areas where exposure to wind is less likely.

E.9.2.5 Potential Soil Acidification

Soil sensitivity to acid deposition is the most commonly used system to rate the ability of soils to offset acidic inputs from deposition. Within the soil and terrain RSA the maximum PAI values for each assessment case (not associated with point source data) are as follows:

- baseline case – 0.08 keq/ha/yr;
- application case – 0.1 keq/ha/yr; and
- cumulative case – 0.15 keq/ha/yr.

The provincial acid deposition management framework (AENV 1998) specifies that an exceedance of a critical load at a local scale (e.g. a project EIA) is not considered to be an exceedance of an environmental objective. There are no predicted exceedances of the critical load of 0.25 keq/ha/yr for the most sensitive ecosystems in the RSA in any assessment case and none of the maximum PAI isopleths in any assessment case exceed the monitoring threshold. Therefore, a baseline evaluation or impact assessment for acid deposition was not conducted.

E.9.2.6 Overburden Assessment

Overburden considered in this assessment is the material located below the soil profile (about 1 m depth) and above, between, and below the coal strata that are to be mined in the Project (Chernipeski and Knapik 2005). A total of 91 overburden samples were analyzed from 23 test holes logged throughout the Vista lease and mine permit boundaries (CR #9, Figure 11) and were sampled at various depths throughout the entire profile from the surface to >240 m (CR #9, Table 13). Various samples were analyzed for detailed salinity (pH, EC, SAR), saturation percentage, calcium carbonate equivalent, acid base counting, and trace metals as defined by Canadian Council of Ministers of the Environment (CCME 2011) (CR #9, Table 14).

The overburden material has the potential to become part of the lower rooting zone. Therefore, the overburden material was rated for reclamation suitability following the *Soil quality criteria relative to disturbance and reclamation guidelines*, as specified for the eastern slopes region of Alberta (SQCWG 1987) (CR #9, Table 14).

Texture

Textures of the overburden material included sand, loamy sand, sandy loam, loam, clay loam, sandy clay loam, silty clay loam and clay. The predominant texture was sandy loam, which was usually found in conjunction with surficial materials and underlying sandstone beds. Reclamation suitability of the surficial overburden material was rated good to fair, and no limitations due to texture are expected following reclamation. Blasting and handling of sandstone, siltstone and mudstones will result in mixing of materials during development and produces overburden fines (<2 mm in size) of variable texture that are expected to range from medium to moderately coarse in texture. Texture (of the resultant fines) is not expected to be a limiting factor for reclamation suitability of the bedrock overburden.

Overburden often became dense or hard with increasing depth (Appendix 7-4). However, in some cases, especially sand or silt layers, the density of the overburden material was recorded as loose or soft. Density was not a significant limiting factor in the suitability ratings of the overburden material because pH and SAR usually increased with depth to become the limiting factors.

The range of coarse fragment (percent by volume) was <1.0 to 39.5% and resultant reclamation suitability ratings ranged from good to fair to poor. Surficial overburden materials with modal textures of sandy loam or coarser were typically rated as fair to poor for coarse fragment content is not considered a limiting factor for reclamation suitability. Coarse fragment content of the bedrock overburden materials is also not expected to be a limiting factor for reclamation suitability.

EC and SAR

High SAR results in poor soil structure and reduces water uptake by vegetation in surficial soil materials, thus lowering overall productivity. The average SAR value for the surficial overburden materials is 0.8. All of the surficial overburden results indicate that this material is suitable overburden material as per AEW's definition. The average SAR values for bedrock overburden material is 22.5, which is rated as unsuitable (>12 SAR) for reclamation media. A majority of the bedrock overburden samples are considered unsuitable overburden material as per AEW's definition.

The concentration of soluble salts in soil is measured as electrical conductivity on a soil paste extract. EC values >4 dS/m indicate elevated soluble salts, and hence a saline soil. EC values averaged 1.1 dS/m (range 0.2 - 2.4 dS/m) for all overburden data (surficial and bedrock) reviewed, indicating that the overburden material is non-saline. With depth, EC values tended to mirror SAR values; in cases where the SAR values were relatively low (<4), EC values were also low. With respect to EC all of the overburden material (surficial and bedrock) is considered suitable overburden material as per AEW's definition.

Saturation percentage values also varied widely and were dependent on overburden texture and the amount of soluble salts present in the material. Saturation percentage was generally not considered a limiting factor for reclamation suitability of overburden material.

Soil pH

Soil pH can influence availability of plant nutrients, thus potentially affecting plant growth. The average pH value of the surficial overburden materials was 7.8 (range 6.1 to 8.6). Soil pH was the most limiting factor for a majority of the samples located within the surficial overburden materials; the resultant reclamation suitability rating was poor. A majority of the surficial overburden material is considered suitable overburden as per AEW's definition. The average pH value in the consolidated bedrock materials was 9.6 (range 7.8 to 10.3). Overall, the high pH of the bedrock overburden material was a limiting factor for reclamation suitability and pH values (coupled with elevated to high SAR values) render this material unsuitable overburden material as per AEW's definition. It is anticipated that the alkaline pH recorded in the overburden material will not result in effects on vegetation as the overburden material will not form a significant portion of the reclaimed rooting zone. It is expected that overburden material excavated during the mining process will be exposed to weathering elements (rainwater and oxygen) and a decrease in pH of this material is likely.

The lime ($CaCO_3$) content (measured as calcium carbonate equivalency (CCE)) of overburden material was assessed in 88 samples. Calcium carbonate equivalent (percent) expresses the lime content in soil. Calcium carbonate equivalent was analyzed 0.6 m from surface to a maximum depth of 240 m, and ranged from 0.9 - 20.4% in all the reviewed data. These values do not present limitations for reclamation suitability.

Acid Drainage

Acidic drainage from the replaced overburden can be an issue at surface mines. Oxidation of sulfide minerals in the overburden will cause sulfuric acid to form, and high concentrations of trace elements may become dissolved in solution resulting in acid rock drainage. All overburden samples analyzed for acid base counting (67 total) have a positive net neutralizing potential and a positive neutralizing potential ratio. The results show that acid rock drainage will not occur.

Trace Elements

A total of 15 trace elements were analyzed from samples collected to identify baseline concentrations in the overburden material. Mean values of the 15 trace metals (from 92 samples) are generally within *Canadian Soil Quality Guidelines* for parkland soils (CCME 2011). Arsenic (3 screening value exceedances), barium (1 screening value exceedance) and selenium (2 screening value exceedances) display elevated values at a few sample locations. These values are not considered to be of concern as this represents a screening exceedance range of 1.1 to 3.3% and the average maximum concentration for all the depths investigated for arsenic, selenium and barium is below the CCME guidelines. Nickel (Ni) is the only element to have concentrations above the conservative CCME guidelines with any regularity (13 sample locations). A summary of analytical results for baseline trace metals by depth increment is provided in CR #9, Table 16.

Selenium

The CCME screening value guideline for Selenium is 1.0 mg/kg. Selenium displayed values >1.0 mg/kg in only two of the 91 samples that were analyzed. One at 130-170 m depth (which had a total of 14 samples) that had a value of 1.70 mg/kg and one at 170-210 m depth (which had a total of 7 samples) that had a value of 1.47 mg/kg. Selenium concentrations in the overburden material are not considered to be of concern as only 2 of 91 samples had selenium levels marginally over the CCME screening guidelines.

E.9.3 Potential Impacts

Activities that may impact the soil resource and associated terrain as a result of the Project and existing, planned, and approved developments for the application and cumulative effects cases include:

- soil salvage and handling – salvage of all required soil materials in the proposed disturbance areas as well as soil handling related to direct placement or stockpiling. Construction on (padding over); or salvage of organic materials for use in reclamation processes may result in effects to soil quality;

- soil stockpiling – stockpiling of salvaged soil materials during the construction of the Project, both short term and long term, results in potential for soil erosion issues and effects to soil productivity;
- development of Project infrastructure – includes creation of roads, and all related Project infrastructure, will require soil removal and alteration of existing terrain;
- mining process – extraction of the coal will require removal of all soil – landscape patterns within the proposed mining pit as well as all overburden materials. Replacement of overburden materials at reclamation will result in terrain units different from baseline conditions and the potential for introduction of unsuitable overburden materials into the reclaimed soil profile;
- operational activities – day to day operations (*i.e.* equipment breakdowns, fuel releases from fuel stations) that may result in effects to soil through accidental releases; and
- progressive reclamation – activities related to re-contouring of reclaimed landscapes and soil handling and replacement, may result in effects to the reclaimed soil profiles and terrain. Inappropriate re-contouring and/or soil replacement activities may result in impacts to the reclaimed soil profile and a decrease in land capability for the desired end land uses or delay in achieving land capability.

E.9.3.1 Soil Quality

The analysis of soil quality considers changes that may occur in soil physical, chemical and biological properties and soil quantity due to soil profile disturbance (salvage activities, handling, and replacement), erosion, soil compaction, accidental releases, and stockpiling. Within the proposed Project footprint there is an estimated 3.5 million m^3 of topsoil (including litter and shallow surface organics), 8.2 million m^3 of organic soil and 5.3 million m^3 of upper sub-soil.

Soil Profile Disturbance

Disturbance of the soil profile during development of Project infrastructure, mining of the coal resource, and reclamation has potential to impact soil quality. Soil salvage, handling, storage (long term and short term stockpiles) and replacement may impact soil quality. Inadvertent admixing of upland surface soil (surface litter, A horizon and potentially portions of the B horizon) with lower subsoil material may occur due to the sub-metre variability of soil profiles, the size of the equipment used and the complex terrain within the RSA. Overall, soil quality within the A and B horizons and the blending of all or portions of these layers is not expected to be detrimental. In some instances soil quality is expected to improve as a medium for supporting forest ecosystems.

It is estimated that approximately 117 ha (4.4%) of the Vista Project footprint will not have soil materials salvaged due to steep terrain. The soil deficiencies created by the lack of salvage in these areas will be mitigated by salvaging additional materials in areas where soil quality is suitable.

Soil compaction is of particular concern during direct replacement activities when large equipment is traversing reclaimed profiles during progressive reclamation. Appropriate soil replacement strategies (*e.g.* limiting heavy traffic to certain areas) and soil de-compaction activities post-reclamation (*e.g.* tillage, deep ripping, rough mounding) will minimize impacts potentially associated with soil compaction.

Implementation of appropriate soil salvage techniques, in addition to field guidance by experienced professionals and pre-disturbance soil survey information, will result in minimal soil losses due to conventional salvage and handling methods and minimize impacts to soil quality. As reclaimed profiles evolve, it is expected that the soil profiles and resultant mine landscapes will support the desired end land use objectives.

With proper soil salvage, handling, storage and replacement the effects of soil profile disturbance for the application case are rated as a low impact (Table E.9.6.1).

Erosion

The potential impacts of wind and water erosion on soil quality are of concern throughout the life of the Project. The potential impacts to soil quality by erosion can occur by storage of soil materials in stockpile long term (20 years) and short term (<1 year) and soil material directly replaced for progressive reclamation.

Short term stockpiles will likely not be seeded if the material is expected to be redistributed in a short period of time (<6 months). This material will be monitored while in stockpile to ensure erosion is not occurring. The length of time that the long term stockpiled materials will remain exposed to erosion (*i.e.* lack significant vegetative cover) will be brief. The utilization of appropriate mitigative measures (Section E.9.5) and appropriate monitoring will reduce the risk of soil loss by erosion.

The risk of erosion remains relatively high in some reclaimed landscapes until a vegetative cover is established or other preventative actions taken (*e.g.* rough mounding, or material is added onto the replaced soil (*e.g.* tackifier)), particularly on slopes >20%. Landscapes with moderate to high water erosion risk may require additional monitoring post mitigation to ensure soil loss is minimized. All remaining reclaimed landscapes are expected to have a low risk of water erosion. The risk of soil loss by wind is possible during direct placement activities, however is expected to be minimal as the amount of litter material, coarse fragments and rough micro topography created at soil placement will decrease erosion potential. Upon establishment of a vegetative cover, soil loss by wind is expected to be negligible.

With appropriate revegetation and erosion control activities during the Project, it is expected that the soil loss due to erosion, will be minimal and have a low impact on the soil resource (Table E.9.6.1).

Accidental Releases

Impacts to soil quality caused by accidental releases and operational incidents (*e.g.* equipment breakdowns, releases at fuelling stations) have the potential to alter chemical and physical attributes of soils. With the appropriate environmental management plans in place, accidental releases and subsequent cleanup will result in a low impact on soil quality (Table E.9.6.1).

E.9.3.2 Soil Biodiversity & Ecological Integrity

The potential effect to soil biodiversity and resulting ecological integrity of vegetation communities will be discussed in terms of the effects of the Project on the spatial distribution of soil patterns and potential changes in soil diversity and ecological integrity post disturbance.

Common soils in the LSA and RSA include Luvisols and Brunisols in upland and mid slope positions, Gleyed Luvisols and Gleysols in transitional areas, and shallow to deep Organics in the poorly drained level landscapes or drainage channels (sloped organic landforms). The soil and terrain map for the Project indicate that there are no soil profiles or patterns found in the LSA that are not commonly found within the RSA.

Ecological integrity with respect to soil and landscapes is related to the vegetation communities and resultant habitats that are formed as a result of the relationship between soil and landscape patterns and corresponding moisture and nutrient regimes. The natural variability associated with the aforementioned soil and landscape patterns will be removed at the time of soil salvage and handling. Reclaimed soil - landscape patterns will be more homogenous than baseline conditions because reconstruction of the inherent variability associated with natural soil profiles is only achievable with time. Reclamation of soil and landscape patterns to provide similar drainage, aspect and moisture regimes will allow for the eventual formation of a range of suitable habitats that meet desired end land use objectives including, wildlife habitat, wetlands, and lands suitable for commercial forest production and recreation.

No change in soil diversity or ecological integrity with respect to soil types and landscape patterns is expected from a regional perspective, and the Project is expected to have a low impact (Table E.9.6.1).

E.9.3.3 Alteration of Terrain

Development of the Project results in disturbances to the terrain types within the LSA. Various terrain types will be removed as a result of Project development. After mining and reclamation of Project infrastructure there will be a permanent loss of organic and upland terrain. The natural variability and complexity of the existing terrain within the LSA will not be duplicated by creation of re-contoured landscapes. The reclaimed landscape will be more homogenous than current conditions. However, the reclaimed landscapes will contain characteristics similar to the existing upland terrain. A range of slopes, aspects and slope lengths will exist and reclaimed landscapes will include ridges, benches (plateaus) separated by terraces, valleys, and steep single slope inclines. A variety of wetland complexes and an end pit lake will also be created during the reclamation of the Project. It is expected that the creation of a range of terrain types, during contouring and reclamation will provide a reclaimed terrain that will tie into adjacent undisturbed lands, provide suitable landscapes for the development of a range of reclaimed soil types and functioning vegetation communities. The development of the Project is expected to have a low impact on terrain.

E.9.3.4 Land Capability Effects

Proper soil conservation, soil replacement, mine backfilling and re-contouring, soil placement and revegetation are all key to ensuring that the reclaimed landscape inclusive of reclaimed soil profiles and vegetation communities provide equivalent land capability. Reclamation success for the Project will be measured by the ability of the reclaimed landscape to achieve land capability equivalent to pre-disturbance conditions and meet the desired end land use objectives with normal land management practices. It is expected that land capability and end land uses post disturbance will not be exactly as the land capability distribution (spatially) that currently exists, however, the overall reclaimed landscape will provide similar ecological function and land capability as the pre-disturbance conditions. The analysis of equivalent capability is assessed by evaluation of soil and overburden materials comprising the root zone, loss of various land capabilities due to disturbance, and delay in achieving equivalent land capability post reclamation.

Reclaimed Overburden Materials

Overburden material will be used to backfill and re-contour completed mine blocks. It will be conditioned prior to replacement of prescribed soil materials, including upland soil. Reclaimed soil profiles will accommodate the rooting zone in the re-constructed landscapes.

In the overburden assessment, two specific types of overburden materials were evaluated; surficial overburden materials that are comprised of surficial deposits (unconsolidated materials – glacial till and glaciofluvial deposits) and bedrock overburden. Much of the *in situ* bedrock overburden assessed is considered unsuitable as rooting medium and a majority of the surficial overburden is considered suitable as a rooting medium for reclamation. As such, Coalspur will ensure that sufficient suitable surficial overburden material is salvaged for use in reclamation to ensure that at least 1.0 m of suitable overburden material is in place prior to soil placement in areas identified as having unsuitable overburden at surface.

Land Capability – Loss and Delays

The reclaimed landscape will contain reclaimed soil profiles and landforms similar to what existed prior to disturbance. There will be an end pit lake, wet land complexes, and various reclaimed drainage patterns reinstated to ensure appropriate surface water drainage post development. It is expected that end pit lakes and wetland complexes will account for approximately 478.5ha (18%) of the reclaimed landscape. These reclaimed features will provide enhanced diversity, and are considered appropriate landscape features for the desired end land use objectives for the Project.

E.9.4 Cumulative Effects

Existing and planned activities/projects expected to occur within the soils and terrain RSA that will likely result, or have resulted, in disturbance to soil and terrain and contribute to cumulative include:

- various oil and gas operations – existing and approved activities;
- West Fraser Mills Ltd. timber operations up to the year 2062 – planned activity and existing and approved; and
- Coalspur Vista Project – Phase 2 – potential planned activity.

E.9.4.1 Soil Quality

Soil Profile Disturbance

It is expected that existing and planned activities within the RSA that disturb (or have disturbed) the soil resource as a part of the development are (or will be) required to conserve topsoil and complete reclamation as per all regulatory and operating requirements to the standard of the day. Regulatory requirements for planning, construction, and reclamation of developments will minimize any impacts to soil quality and quantity (productivity).

With effective soil salvage and handling, reclamation, mitigation and monitoring, the impacts to the RSA as a result of development of the Project and existing current and future developments are expected to be low impact with respect to reclaimed soil profiles in the reclaimed landscapes. It is expected that desired end land uses and appropriate capability will be achieved.

Erosion

The resultant environmental effects pertaining to soil erosion for the cumulative effects case are anticipated to be equivalent to the application case. Minimization and mitigation of soil erosion is a regulatory requirement to ensure soil conservation and to protect water bodies. It is anticipated that similar mitigative measures and monitoring described to minimize erosion for the application case are currently being used for existing disturbances within the RSA and will be used in potential future projects as well as enhanced or updated erosion control methods as reclamation technologies develop. The resultant residual effects to the soil resource due to potential soil erosion for the cumulative effects case (RSA) are anticipated to be equivalent to the application case and will be low impact.

Accidental Releases

It is anticipated that type, frequency, severity, and potential methods of accidental releases for existing developments currently within the RSA are in some instances similar to the application case. With the appropriate environmental management plans in place, compliance with regulatory requirements related to project development, and materials containment accidental releases and subsequent cleanup will result in a low impact on soil quality.

The assessment of impacts to the soil resource as a result of accidental releases for the cumulative effects case is anticipated to be unique to the application case; however the impact is still considered to be low.

E.9.4.2 Soil Biodiversity & Ecological Integrity

In general, the soil types and distribution of soil and landscapes within the RSA are similar to that of the LSA. The assessment of impacts to soil biodiversity and ecological integrity for the cumulative effects case is anticipated to be equivalent to the application case.

Mitigative measures and monitoring described to enhance biodiversity and ecological integrity for the application case are based on regulatory requirements for reclamation and revegetation objectives, including achieving land capability and ecosystem diversity appropriate for the end land use objectives. Development of lands in the RSA that require soil disturbances will likely be required to address similar requirements with respect to the reclamation and revegetation of disturbed lands. Cumulatively, the impacts to soil biodiversity and ecological integrity for the cumulative effects case are the same as for the application case.

E.9.4.3 Alteration of Terrain

The soil and landscape patterns within the region, the RSA and LSA are similar. The expected impacts to terrain types disturbed by existing and future Projects in the RSA are negligible.

It is expected that existing and potential future developments within the RSA that disturb soil and terrain as a part of the development will be required to complete reclamation as per all regulatory and operating requirements. This includes appropriate re-contouring to ensure reclaimed landscapes blend with adjacent undisturbed lands and provide appropriate surface drainage across the reclaimed landscapes. Compliance with regulatory requirements for planning, construction, and reclamation of developments will minimize the impacts to terrain types in the RSA. The evaluation of the impact to altered terrain types is the same as for the application case.

E.9.4.4 Land Capability Effects

Reclaimed Overburden Materials

Within the RSA, the potential future expansion of the Vista Project would need to deal with any unsuitable overburden material. The impact assessment for the cumulative effects case is the same as the application case.

Land Capability – Loss and Delays

It is expected that existing and planned activities within the RSA that disturb (or have disturbed) the soil resource as a part of the development are required to adhere to regulations that require reclaimed lands to achieve equivalent capability or prove that reclaimed lands that are in a seral ecological state are trending toward the desired end land use objectives. Effective soil conservation, reclamation, revegetation, and mitigation and monitoring of developments or activities (existing or future) within the RSA will ensure that land capability will be achieved to meet desired end land uses.

The cumulative impacts to the RSA as a result of development of the Project and existing current and future developments are expected to be low impact with respect to impacts to equivalent land capability. The impact assessment for the cumulative effects case is the same as the application case.

E.9.5 Mitigation and Monitoring

E.9.5.1 Mitigation

In order to reduce the potential impacts of the Project on soil and terrain resources, Coalspur will:

- salvage upland surface soil and sufficient subsoil and suitable overburden materials for use in reclamation;
- salvage sufficient organic soil material for use in reclamation;
- ensure soil salvage, stockpiling, and placement of soil materials is supervised by a qualified individual;
- suspend soil handling activities under wet or windy conditions when there is potential for degradation of soil quality;
- store materials in a manner to minimize material loss or degradation of quality (*e.g.* wind and water erosion);
- locate stockpiles in areas that are accessible and retrievable;
- stockpile surface soil material separately from suitable subsoil materials and organic soils;
- ensure that at least 1.0 m of suitable overburden or subsoil material is in place prior to placement of surface soil in areas where unsuitable overburden is at surface;
- replace upland soils at varying thicknesses to assist in creating diversity in the reclaimed landscapes;
- place surface soil without decompaction or decompact the replaced materials where needed to reduce potential compaction as a result of soil replacement activities;
- seed topsoil stockpiles utilized as long-term storage (plant site and various other Vista Project infrastructure) with an Alberta Sustainable Resource Development (ASRD) approved, non-invasive, and weed free seed mix that establishes quickly, or rely on a combination of rough surface profile and natural recovery if research results support this practice;label stockpiled materials by material type;
- reseed reclaimed landscapes with a quick establishing, non-invasive cover that does not discourage natural recovery;
- implement soil erosion control measures (*i.e*., rough surface profile, check bales, silt fences, tackifiers, and/or mulch) on reclaimed landscapes that have a moderate to high water erosion risk; and
- use proper handling and containment of contaminating substances (operational-related chemicals, liquids, or solids).

E.9.5.2 Monitoring

In order to assess the effectiveness of mitigation measures, Coalspur will:

- monitor potential soil erosion on stockpiles or recently replaced soil material;
- monitor the effectiveness of erosion control processes implemented;
- monitor reclaimed areas for topsoil quality (*i.e.* admixing) and quantity (depths);
- monitor quality of overburden material; and
- monitor post reclamation landscapes for stability, drainage, and the interaction of the vegetation communities.

E.9.6 Summary

Table E.9.6.1 summarizes the potential impacts anticipated to affect soils and terrain VECs throughout the life of the Project. With mitigation, the Project is expected to have a low impact of soil and terrain resources.

Table E.9.6.1 Summary of Impact Ratings on Soil and Terrain Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Project Contribution[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
1. Soil Quality												
	Soil Profile Disturbance											
	Impact on soil quality - soil profile disturbance	Appropriate soil salvage, handling, storage, and reclamation	Application	LSA	Extended	Continuous, diminish with time	Reversible – long term	Moderate	Initially – Negative; Over time - Neutral	High	High	Low
	Impact on soil quality - soil profile disturbance	Soil salvage, handling, and reclamation as per regulatory requirements for Projects in the RSA	Cumulative Effects (Developments outside the LSA)	RSA	Extended	Continuous, diminish with time	Reversible – long term	Moderate	Initially – Negative; Over time - Neutral	Moderate	High	Low
	Erosion											
	Impact on soil quality – potential soil loss	Appropriate erosion control measures and monitoring throughout Project	Application	LSA	Short	Occasional (unplanned)	Irreversible	Initially - Moderate, Low - with veg. establishment	Negative	Moderate	High during salvage and replacement at reclamation decreasing to Low after veg. establishment	Low
	Impact on soil quality – potential soil loss	Appropriate erosion control measures as per regulatory requirements for all stages of Projects in the RSA	Cumulative Effects	RSA	Short	Occasional (unplanned)	Irreversible	Initially - Moderate, Low - with veg. establishment	Neutral	Moderate	High during salvage and replacement at reclamation decreasing to Low after veg. establishment	Low
	Accidental Releases											
	Impact on soil quality – soil loss or degradation of soil quality	Appropriate environmental management plans - spill containment and spill response plan	Application	LSA	Long	Occasional (unplanned)	Reversible – short term	Low	Neutral	High	Medium to Low	Low
	Impact on soil quality – soil loss or degradation of soil quality	Appropriate spill containment and spill response plan; compliant with regulatory requirements for	Cumulative Effects	RSA	Extended	Occasional (unplanned)	Reversible – short term	Low	Neutral	Moderate	Medium to High	Low

Table E.9.6.1 Summary of Impact Ratings on Soil and Terrain Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Project Contribution[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
		construction, operation, and reclamation of Projects in the RSA										
2. Soil Biodiversity & Ecological Integrity												
	Impact on soil diversity (distribution of soils) and ecological integrity	Appropriate soil salvage, site re-contouring effective soil replacement, revegetation, and monitoring	Application	LSA	Extended – diminish with time	Continuous	Partially Reversible – long term	Low	Negative	High	High	Low
	Impact on soil diversity (distribution of soils) and ecological integrity	Implementation of an appropriate C&R plan as per regulatory requirements for existing and planned future Projects in the RSA	Cumulative Effects	RSA	Extended – diminish with time	Continuous	Partially Reversible – long term	Low	Negative	High	High	Low
3. Alteration of Terrain												
	Removal of natural terrain and reconstruction of reclaimed terrain post development	Appropriate site construction practices and re-contouring at reclamation to meet end land use objectives	Application	LSA	Residual	Continuous	Irreversible	Moderate	Neutral	High	High	Low
	Removal of natural terrain and reconstruction of reclaimed terrain post development	Implementation of a C&R plan as per regulatory requirements for existing and planned future Projects in the RSA	Cumulative Effects	RSA	Residual	Continuous	Irreversible	Moderate	Neutral	High	High	Low
4.Land Capability Effects												
	Reclaimed Overburden Materials											
	Achievement of equivalent land capability delayed or hindered through unsuitable overburden in root zone	Ensure 1.0 m of suitable overburden is in place prior to surface soil placement in areas where unsuitable overburden is at surface	Application	LSA	Residual	Continuous, diminish with time	Reversible – long term	Low	Neutral	High	Low	Low
	Achievement of equivalent land capability	Compliance with regulatory requirements for	Cumulative Effects	RSA	Residual	Continuous, diminish with	Reversible – long term	Low	Neutral	High	Low	Low

Table E.9.6.1 Summary of Impact Ratings on Soil and Terrain Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Project Contribution[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
	delayed or hindered through unsuitable overburden in root zone – Planned Vista Phase 2	materials placement post mining				time						
	Land Capability – Loss and Delays											
	Project Development and subsequent materials placement on altered landscape may causes alteration land capability distribution and delay in achieving equivalent capability	Soil salvage, site re-contouring effective soil replacement, revegetation, and monitoring are designed to meet land use objectives for land capability	Application	LSA	Extended – diminish with time	Continuous	Irreversible	Moderate	Neutral	High	High	Low
	Existing and planned future development and subsequent materials placement on altered landscape may causes alteration land capability distribution and delay in achieving equivalent capability	Development and reclamation / revegetation of Projects within the RSA to ensure equivalent land capability is attained to meet end land use objectives	Cumulative Effects	RSA	Extended – diminish with time	Continuous	Irreversible	Moderate	Neutral	High	High	Low

1. Local, Regional, Provincial, National, Global
2. Short, Long, Extended, Residual
3. Continuous, Isolated, Periodic, Occasional
4. Reversible in short term, Reversible in long term, Irreversible – rare
5. Nil, Low, Moderate, High
6. Neutral, Positive, Negative
7. Low, Moderate, High
8. Low, Medium, High
9. No Impact, Low Impact, Moderate Impact, High Impact

E.10 SURFACE WATER QUALITY

E.10.1 Introduction and Terms of Reference

Coalspur conducted an assessment of surface water quality for the proposed Project. The following section is a summary of the Surface Water Quality Assessment that was prepared by Hatfield Consultants and is included as Consultants Report #10 (CR #10). For full details of the assessment please refer to CR #10.

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the surface water quality component are provided in Section 3.4 of the ToR and are as follows:

3.4 SURFACE WATER QUALITY

3.4.1 Baseline Information

[A] Describe the baseline water quality of watercourses and waterbodies. Discuss the effects of seasonal variations, flow and other factors on water quality.

[B] Describe the baseline channel embeddedness and percent fines in the essential habitats (i.e., spawning) in the receiving waters (i.e., McPherson Creek mainstem).

3.4.2 Impact Assessment

[A] Identify Project components that may influence or impact surface water quality.

[B] Describe the potential impacts of the Project on surface water quality:

- *a) discuss any changes in water quality resulting from the Project that may exceed the Surface Water Quality Guidelines for Use in Alberta or the Canadian Water Quality Guidelines;*
- *b) discuss the significance of any impacts on water quality and implications to aquatic resources (e.g., biota, biodiversity and habitat);*
- *c) discuss seasonal variation and potential impacts on surface water quality;*
- *d) assess the potential Project related and cumulative impacts of acidifying and other air emissions on surface water quality; and*
- *e) discuss the effect of changes in surface runoff or groundwater discharge on water quality in surface waterbodies.*

Surface water quality is the VEC considered in this assessment. Surface water quality issues to be considered in the assessment were obtained from traditional environmental knowledge (TEK) and traditional land use (TLU) information collected from Aboriginal groups (Section E.11), the scope and findings of the surface water quality impact assessment for the McLeod River Project environmental assessment, and issues identified from a review of the proposed Project Mine Plan (Section C).

Issues considered in the assessment of potential impacts to surface water quality include:

- sediments entering the stream through surface run-off;
- leaching of nitrates and selenium into surface waters;
- surface water run-off patterns, groundwater discharge, and water withdrawals;
- discharges of water from impoundments to natural watercourses;
- effects of end-pit lakes on surface water quality; and
- effects on surface water quality from acidifying emissions.

The LSA for the Project is defined by the drainage boundaries of a number of watercourses that begin within or run through the existing mine permit area that are downstream of proposed developments or the proposed mine permit area extension and drain into the McLeod or Athabasca rivers (CR #10, Figure 2).

The RSA for the Project is defined by the LSA plus the following watercourses (CR #10, Figure 2):

- McLeod River downstream of its confluence with McPherson Creek to approximately 14 km downstream; and
- Athabasca River downstream of its confluence with Trail Creek to the Obed Mine bridge crossing.

E.10.2 Baseline Conditions

Coalspur has measured surface water quality in numerous watercourses throughout the LSA and RSA. Samples were collected at 16 locations; 11 of which were in the LSA (CR #10, Table 5). A summary of surface water quality data used for characterizing baseline surface water quality conditions in the LSA and RSA is provided in CR #10, Table 8.

E.10.2.1 Surface Water Quality for the LSA

Water quality in the LSA is similar both geographically and temporally (across seasons) and is characteristic of clear-water systems. High levels of dissolved oxygen (>7 mg/L), low levels of dissolved organic carbon (DOC, median concentration of 7.25 mg/L), and low concentrations of total suspended solids (TSS, ranging from <3.0 mg/L – below laboratory detection limits – to 6 mg/L) were found. Watercourses in the LSA are alkaline with a median pH of 8.3 and have total dissolved solids (TDS) concentrations ranging from 171 mg/L to 341 mg/L. Water is classified as hard to very hard. The summer trophic status is oligotrophic. The ionic composition is dominated by bicarbonate and calcium. Similarities between surface water and groundwater indicate that there are hydrologic connections between surface waters and shallow groundwater at locations in the LSA (CR #10, Figure 3).

Most surface water quality variables are below their applicable detection limits, with concentrations of 54% of all combinations of measured water quality variables, seasons, and sampling locations being below detection limits. The frequency with which concentrations of water quality variables exceeded their applicable guideline ranged from 1% in the summer and winter to 2% in the fall (CR #10, Table 7). The cases where concentrations of water quality variables exceeded their guidelines in the LSA are attributable to phenols, sulphide, iron, and zinc.

E.10.2.2 Surface Water Quality for the RSA

Surface water quality in the RSA showed concentration differences for many water quality variables when compared geographically (Athabasca River vs. McLeod River). Concentrations and levels of conventional variables such as alkalinity, conductivity, dissolved and total organic carbon, hardness and TDS were all higher in McLeod River than in the Athabasca River. With the exception of TSS, concentrations of most conventional variables, general organics, major ions and nutrients were higher in the winter compared to summer and fall for both the Athabasca and McLeod rivers (CR #10, Table 8 and Table 9).

High levels of dissolved oxygen (>8 mg/L), low levels of dissolved organic carbon (median concentration of 2.6 mg/L), and variable concentrations of TSS ranging from <3 mg/L in the McLeod River to 129 mg/L in the Athabasca River were found. Watercourses in the RSA are alkaline with a median pH of 8.27 and TDS concentrations ranging from 130 mg/L in the Athabasca River (fall) to 290 mg/L in the McLeod River (winter). Water is moderately hard to hard. Summer trophic status was assessed as mesotrophic and oligotrophic for the Athabasca and the McLeod rivers, respectively. The ionic composition of RSA surface watercourses is dominated by bicarbonate and calcium with lesser proportions of chloride and sulphate.

Concentrations of a number of surface water quality variables in the RSA are below their applicable detection limits, with concentrations of 47% of all combinations of measured water quality variables, seasons, and sampling locations being below detection limits. Watercourses in the RSA had a low frequency of guideline exceedance, with concentrations of 4% of all combinations of water quality variables, seasons, and sampling locations above their applicable guideline. Water quality variables that exceeded their guideline value in RSA watercourses were phenols, sulphate, total phosphorus, and total aluminum, iron and selenium. The concentrations of total aluminum, phosphorus and iron exceeded guidelines only in the Athabasca River while concentrations of phenols and total selenium exceeded guidelines only in the McLeod River.

E.10.2.3 Acid sensitivity of Surface Aquatic Resources

Acid-sensitive lakes occur in areas with little or no capacity to neutralize acidic deposition. Chemical characteristics of three lakes within the air quality RSA are shown in CR #10, Table 10. Using the alkalinity-based classification system developed by Saffran and Trew (1996), these three lakes have low sensitivity to acidification. Baseline case PAI inputs for all three lakes are assessed as being below their corresponding critical load value.

E.10.3 Potential Impacts

E.10.3.1 Effects of Mine Construction Activities

There is potential to impact surface water quality during tree clearing, construction of haul roads, diversions, and settling ponds; area disturbances for borrow pits, tailings pond, waste and soil piles, and crusher and plant site construction; and constructing drainage controls, cleanouts/retention areas, borrow pits and watercourse crossings. With implementation of the mitigation measures summarized in Section E.10.5.1 and described in detail in the Project Reclamation Plan (Section F) potential effects of construction phase activities are predicted to be negligible in the LSA for the following reasons:

- impacts from construction activities which have been identified as potentially adverse are mitigable using standard engineering and environmental design applications;
- short-term impacts on surface water quality during watercourse crossing installations are inevitable but will be temporary and localized;
- potential adverse effects associated with sedimentation will be localized and confined to the immediate and downstream areas of construction activities; and
- potential effects on water quality associated with sediment input will be temporary, that is, they will occur mainly during the period of construction and until bank slopes are stabilized.

Because the potential effects of construction activities of the Project on surface water quality in the LSA are assessed as low, potential effects of construction activities of the Project on surface water quality in the RSA are also assessed as low.

E.10.3.2 Effects of Using Nitrogen-Based Explosives

Explosives containing ammonium nitrate will be used during mine operations. The use of explosives is restricted to breakup of the overburden material that needs to be moved. Broken rock and unconsolidated material will be deposited in piles or will be used to backfill previously-mined areas. These rock piles and backfilled areas are potential sources of leaching of nitrates into surface waters.

While increases in concentration of nitrogen compounds downstream of active mines has been documented in a number of cases, elevated concentrations have more often than not been below surface water quality guidelines (CR #10, Section 4.2.1.3). The residual (after mitigation) effects of the Project on surface water quality due to increases in nitrogen caused by the use of explosives containing ammonium nitrate are assessed as low in the LSA.

Because the potential effects of using nitrogen-based explosives on surface water quality in the LSA are assessed as low, potential effects of using nitrogen-based explosives on surface water quality in the RSA are also assessed as low.

E.10.3.3 Effects of Changes in Surface Runoff or Groundwater Discharge on Water Quality

Changes in surface runoff or groundwater discharge may potentially impact surface water quality through:

- changes in the water balance between surface water and groundwater;
- use of groundwater to meet Project water requirements. Groundwater will ultimately be discharged into watercourses;
- changes in water quality through loss of upstream surface runoff contributing to downstream water quality; and
- changes to water quality variables that are related to water quantity (*e.g.*, a decrease surface water volume can lead to an increase in downstream temperatures).

Changes to surface runoff or groundwater discharge and its effects on surface water quality can arise from:

- surface disturbance activities altering natural run-off and drainage patterns;
- surface water withdrawal activities required to meet water requirements of the Project; and
- changes in the amount of shallow groundwater migrating to surface water.

Surface water upstream of Project activities will be diverted around disturbance areas and returned to the downstream watercourse and reclamation activities will be phased such that they commence before the entire Project is developed. The Project requires only minor surface water withdrawals from water collected in the active pit, settling and stormwater retention ponds and the fresh water pond. Project affected waters will be diverted to a series of settling ponds and treated prior to downstream release. All water removed from the hydraulic network in the Coalspur area will eventually be returned to downstream areas. Stream flow augmentation will be undertaken in order to maintain minimum instream flow needs.

Only small changes in surface water runoff volumes are predicted as a result of surface disturbance activities (Section E.6, CR #6). While changes in the water chemistry balance in LSA watercourses are likely to occur, these changes are predicted to be minor and will dissipate in downstream areas as water is returned to the hydraulic network.

While it is predicted that groundwater from deeper units will be discharged to surface watercourses as a result of Project activities, the water quality of both systems (groundwater and surface water) are within CCME and AEW guidelines for the protection of aquatic life (CR #10, Table 6).

The residual (after mitigation) effects of the Project on surface water quality from changes to surface runoff and/or groundwater discharge are assessed as low in the LSA. Because the potential effects of the

Project on surface water quality from changes to surface runoff and/or groundwater discharge are assessed as low in the LSA, potential effects on surface water quality from changes to surface runoff and/or groundwater discharge in the RSA are also assessed as low.

E.10.3.4 Discharge from Impoundments to Natural Watercourses

Construction, operation and reclamation activities have the potential to impact water quality in the area. Each of these activities will potentially influence the natural drainage, infiltration, runoff, and soil erosion of the existing area which can influence surface water quality. Because of the potential influence of the mining activities on the surface water quality, water collection and a settling pond system (impoundments) will be used to attenuate the impacts of the mining activities on local water courses, including increased sediment loads and deposition of those sediments. The water from these ponds will be released into local streams once TSS levels are below guidelines outlined in the EPEA approval.

A detailed assessment of the potential effects of impoundment operation on surface water quality was conducted for the Mercoal West/Yellowhead Tower Mine project (Hatfield 2008). This indicated that there would be few effects of impoundments on water quality in LSA drainages under the extremely conservative assumption that low flow events (7Q10 summer flows and winter flows) would be "the norm" for baseline flows in natural watercourses and that any effects would be seasonal and largely undetectable in an effects monitoring program. In addition, these effects will terminate immediately once the impoundments are decommissioned. This assessment is applicable to the Vista Mine Project because:

- baseline surface water quality conditions in the LSA are similar to baseline surface water quality conditions in watercourses assessed in the Mercoal West/Yellowhead Tower Mine project application (Hatfield 2008); and
- Coalspur will employ a series of proven mitigation measures for the management of impoundment water as described above.

An adaptive management approach to water treatment has been used in existing mines and will be used for this Project as well. The water management system has been designed using best available technology (Appendix 7-1) which will generate significant increases in wastewater treatment efficiency. This will include recycling as much fine settling pond water back to the process plant as possible and utilizing pit water and surface runoff in the coal cleaning process wherever possible.

Release of water pollutants from the site such as oil and grease will be controlled. With the installation of oil booms on the impoundments and immediate containment of oil in the event of a spill, there is little danger of these materials contaminating surface waters. Components of the water handling system will be designed according to the governmental specification and the systems will be operated in accordance with regulatory approval requirements.

Elevated concentrations of selenium in surface waters is an important consideration with some coal mines and one that Coalspur considers important in the assessment, design, operation and monitoring of its mining operations. Mining of coal creates waste rock that when exposed to water and air, may accelerate the release of potentially toxic forms of selenium into the environment (Wayland and Crosley 2006), depending on the composition of the waste rock. A detailed assessment of overburden material to identify baseline metal concentrations was conducted for the Project (CR #9, Section E.9.1). Assessment results indicated that selenium concentrations in more than half of the samples (92 samples collected) were below the detection limit of 0.5 mg/kg and the median selenium concentration was 0.62 mg/kg. Selenium concentrations exceeded the 1.0 mg/kg CSQG in only two of the samples analyzed. Results of groundwater and surface water monitoring at other mines with similar geology have indicated low release potential for selenium into receiving streams. These results support the expectation that selenium leaching will not be an environmental issue.

The residual (after mitigation) effects of the Project on surface water quality from discharging from impoundments to natural watercourses are assessed as Low in the LSA. Because the potential effects of the Project on surface water quality from discharging from impoundments to natural watercourses are assessed as low in the LSA, potential effects on surface water quality from discharging from impoundments to natural watercourses in the RSA are also assessed as low.

E.10.3.5 Effect of End Pit Lake Characteristics on Water Quality

Analyses presented in End-Pit Lake Working Group (2004) suggest that the design, construction, and management of end-pit lakes influence their viability. One end-pit lake will be constructed as part of the reclamation landscape for the Project. This end-pit lake is predicted to have a lake area of approximately 318 ha, littoral zone area of 56 ha (17% of lake area) and a maximum and average depth of 155 m and 45.6 m, respectively. The expected dimensions of the proposed end-pit lake, coupled with differences in salinity of expected inflow of surface water and shallow groundwater (TDS from approximately 170 mg/L to 340 mg/L) as compared to inflows of deep groundwater (TDS from 376 mg/L to 1730 mg/L) are predicted to result in the end-pit lake being meromictic, with a well-defined epilimnion and hypolimnion. The influences of the design characteristics of the end-pit lake on the surface water quality of the lake are assessed as valid impact pathways.

Coalspur is committed to participating in initiatives by ASRD and AEW in updating the existing end-pit lake guidelines. The final design of the end-pit lake to be created at the end of the Project will incorporate important characteristics for developing and maintaining water quality that is suitable for aquatic life as described in End-Pit Lake Working Group (2004) and additional guidelines that may be developed under new ASRD and AEW initiatives, including: connection to the existing hydrologic network through inflows and outflows; enhancing lake flushing rate; and minimizing stagnant, stratified water by increasing mixing.

The residual (after mitigation) effects of the Project on surface water quality in the end-pit lakes as a result of their design, construction, and management are assessed as low. Because the potential effects of end-pit lake characteristics on the surface water quality of the proposed end-pit lake are assessed as low for the LSA, potential effects of end-pit lake characteristics on the surface water quality of the proposed end-pit lake are also assessed as low for the RSA.

E.10.3.6 Effects Surface Water Quality from Acidifying Emissions

The construction and operation of the Project, specifically the plant site, will result in the release of acidifying emissions as described in the air quality assessment (Section E.1). Predicted PAI values at all three lakes are below Alberta's Clean Air Strategic Alliance (CASA) target level of 0.25 keq H+/ha/yr (AEP 1997). The area within the air quality RSA, which is predicted to receive a PAI in excess of 0.25 keq H+/ha/yr, could not be determined as the area was too small to be determined by the current receptor spacing (CR #1).

The residual (after mitigation) local effects of the Project on surface water quality through acidifying emissions are assessed as low and regional effects are assessed as low.

E.10.4 Cumulative Effects

Because the potential effects of the Project on surface water quality in the LSA and RSA are assessed as low for the application case, potential effects of the Project on surface water quality are also assessed as low for the planned development case for both the LSA and RSA.

E.10.5 Mitigation and Monitoring

E.10.5.1 Mitigation

In order to reduce the potential impacts of the Project on surface water quality Coalspur will:

- divert clean water around areas to be disturbed where the terrain and flow rates warrant;
- minimize the time interval between clearing/grubbing and subsequent earthworks, particularly at or in the vicinity of watercourses or in areas susceptible to erosion;
- install surface runoff collection and treatment systems to control groundwater seepage from road cuts and surface runoff from disturbed areas;
- direct surface runoff to settling impoundments for removal of settleable solids;
- use chemical flocculants to enhance settling rates in licensed impoundments ;
- manage and monitor the use of chemical flocculants to ensure that concentrations are effective and ecologically protective;
- when necessary, augment stream flows using water from the fresh water pond;
- utilize slope grading and stabilization techniques including ditching above the cutslope to channel surface runoff away from the cutslope, leaving buffer (vegetation) strips between the construction site and a watercourse, and placing large rock riprap to stabilize slopes;
- utilize temporary measures to control erosion before a vegetation cover is re-established, including: diversion ditches, drainage control, check dams, sediment ponds, sumps and mulches;
- plan to undertake progressive reclamation to reduce the amount of disturbed area at any given time;
- whenever possible, carry out construction activities in close proximity to watercourses during periods of relatively low surface runoff from October to April and maintain a 30 m buffer (vegetation) strip between construction and mining areas and watercourses except at stream crossings and diversions;
- design and construct all stream crossings in compliance with the *Alberta Code of Practice for Watercourse Crossings* and associated guidelines;
- implement the use of explosives with minimal slurry to reduce the amount of nitrogen compounds released;
- conduct the blast-hole loading process to ensure that maximum detonation and combustion/oxidation of the ammonium nitrate occurs and that the minimum of blasting compound is used to effectively break the rock;
- minimize water contact with explosives by undertaking water control activities (dewatering of pit areas, use of diversion ditches and interceptor ditches) for drier conditions for mining and blasting operations;
- design water management to direct mine-affected water into settling impoundments for treatment prior to discharge of surface waters and from impoundments in accordance with conditions in the EPEA approval;
- recycle as much fine settling pond water as possible back to the process plant;
- utilize pit water and surface runoff in the coal cleaning process wherever possible;
- use competent gravel (rather than pit-run rock) on those sections of haul roads that are most sensitive to runoff adjacent to receiving streams; and
- construct haul road stream crossings such that surface runoff flows away from the stream towards a settling pond.

E.10.5.2 Monitoring

In order to assess the effectiveness of mitigation measures Coalspur will:

- conduct audits and associated surface water quality monitoring during sensitive construction periods;
- monitor impoundments as required in the EPEA approval;
- continue to monitor selenium in the routine analysis of impoundment discharge water; and
- monitor surface water quality both upstream and downstream of Project activities.

E.10.6 Summary

With mitigation and monitoring it is anticipated the Project will have a low impact on surface water quality within the LSA and RSA. A summary of the environmental impacts on surface water quality is provided in (Table E.10.6.1).

Table E.10.6.1 Summary of Impact Rating on Surface Water Quality Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Project Contribution (Direction)[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
Surface Water Quality												
	Changes in Surface Water Quality from Construction Activities	Section E.10.5	Application	Local	Short	Isolated	Reversible, Short-term	Low	Negative	High	High	Low
				Regional	Short	Isolated	Reversible, Short-term	Low	Negative	High	High	Low
			Planned Development	Local	Short	Isolated	Reversible, Short-term	Low	Negative	High	High	Low
				Regional	Short	Isolated	Reversible, Short-term	Low	Negative	High	High	Low
	Changes in Surface Water Quality from use of Nitrogen-Based Explosives	Section E.10.5	Application	Local	Long	Periodic	Reversible, Long-term	Low	Negative	Moderate - High	High	Low
				Regional	Long	Periodic	Reversible, Long-term	Low	Negative	Moderate - High	High	Low
			Planned Development	Local	Long	Periodic	Reversible, Long-term	Low	Negative	Moderate - High	High	Low
				Regional	Long	Periodic	Reversible, Long-term	Low	Negative	Moderate - High	High	Low
	Changes in Surface Water Quality from Changes in Surface Runoff and/or Grounder Availability	Section E.10.5	Application	Local	Extended	Isolated	Irreversible	Low	Neutral	Moderate - High	High	Low
			Planned Development	Regional	Extended	Isolated	Irreversible	Low	Neutral	Moderate - High	High	Low
	Changes in Surface Water Quality from Operation of Project Impoundments	Section E.10.5	Application	Local	Extended	Occasional	Reversible, Long-term	Low	Negative	Moderate - High	High	Low
				Regional	Extended	Occasional	Reversible, Long-term	Low	Negative	Moderate - High	High	Low
			Planned Development	Local	Extended	Occasional	Reversible, Long-term	Low	Negative	Moderate - High	High	Low
				Regional	Extended	Occasional	Reversible, Long-term	Low	Negative	Moderate - High	High	Low
	Water Quality of End-Pit Lakes	Section E.10.5	Application	Local	Residual	Continuous	Irreversible	Low	Neutral	High	High	Low
	Changes on	Section	Application	Local	Extended	Occasional	Reversible,	Low	Negative	Moderate	High	Low

Table E.10.6.1 Summary of Impact Rating on Surface Water Quality Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Project Contribution (Direction)[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
	Surface Water Quality from Acidifying Emissions	E.10.5					Long-term					
				Regional	Extended	Occasional	Reversible, Long-term	Low	Negative	Moderate	High	Low
			Planned Development	Local	Extended	Occasional	Reversible, Long-term	Low	Negative	Moderate	High	Low
				Regional	Extended	Occasional	Reversible, Long-term	Low	Negative	Moderate	High	Low

1 Local, Regional, Provincial, National, Global.
2 Short, Long, Extended, Residual.
3 Continuous, Isolated, Periodic, Occasional, Accidental, Seasonal.
4 Reversible in short term, Reversible in long term, Irreversible – rare.
5 Nil, Low, Moderate, High.
6 Neutral, Positive, Negative.
7 Low, Moderate, High.
8 Low, Medium, High.
9 Low, Moderate, High

E.11 TRADITIONAL LAND USE

E.11.1 Introduction and Terms of Reference

Coalspur conducted a Traditional Land Use/ Traditional Ecological Knowledge (TLU/TEK) assessment for the proposed Project. The following section is a summary of the TLU/TEK assessment that was prepared by Lifeways of Canada Limited and included as Consultants Report #11 (CR #11). For full details of the assessment please refer to CR #11.

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the TLU/TEK are provided in Section 5.0 of the ToR and are as follows:

5 TRADITIONAL ECOLOGICAL KNOWLEDGE AND LAND USE

[A] Provide:

- *a) a map and description of traditional land use areas including fishing, hunting, trapping and nutritional, medicinal or cultural plant harvesting by affected aboriginal peoples (if the aboriginal community or group is willing to have these locations disclosed);*
- *b) a map of cabin sites, spiritual sites, graves and other traditional use sites considered historic resources under the Historical Resources Act (if the aboriginal community or group is willing to have these locations disclosed), as well as traditional trails and resource activity patterns;*
- *c) a description of the extent of traditional use of land in both the Project Area and the Local Study Area, including fishing, hunting, trapping, nutritional or medicinal plant harvesting, and cultural use by affected aboriginal peoples; and*
- *d) a discussion of:*
  - *i) the availability of vegetation, fish and wildlife species for food, traditional, medicinal and cultural purposes in the identified traditional land use areas considering all Project related impacts,*
  - *ii) access to traditional lands in the Project Area during all stages of the Project; and*
  - *iii) aboriginal views on land reclamation.*

[B] Describe how TEK and TLU information was incorporated into the project designed and development, technical components of the EIA, the conservation and reclamation and, monitoring and mitigation.

People of Aboriginal heritage and their ancestors have made use of this Foothills area of Alberta for the last 10,000 years (CR#12, Section 2). Under Treaty with the Crown and the Government of Canada, the First Nations' uses were enshrined as the right to collect, hunt, fish, and trap for food on Crown land, as well as other traditional uses such as ceremonies and burials.

E.11.2 Scope of Assessment

As part of the current Environmental Assessment (EA) process for the proposed Project, communities have been and will be encouraged to undertake Traditional Use Studies (TUS) of the Project area to help gauge the effect of the development on members of their communities. Consultation and studies are in accordance with *The Government of Alberta's First Nations Consultation Guidelines on Land Management and Resource Development*. The Project's consultation program has also incorporated directives from the Canadian Environmental Assessment Agency (CEAA) or other Federal government agencies when and where required.

A number of Aboriginal communities have used the Hinton area historically and traditionally, continuing to this day. Many of these groups have strong social and blood ties with one another. The Project is located in the Treaty 6 area. The potentially affected Aboriginal groups included in this process were established through discussion with AEW and the Sustainable Resource and Environmental Management Aboriginal Affairs Branch (SAAB). Consultations are not limited to Treaty First Nations groups, as the area has also been used considerably by several non-Treaty Aboriginal groups in the region.

Consultation efforts for the Project started with Project notification occurring in December 2010 and have continued into 2012. Coalspur has been engaged in consultation and TUS with potentially affected Aboriginal groups for over a year. These consultation efforts became "official" on November 3, 2011 when the Aboriginal Consultation Plan and associated Plain Language Description were approved and finalized after discussions with SAAB (CR#15, Appendix A). The proposed ToR for the Project were produced and shared with Aboriginal groups in November 2011 and finalized in January 2012. Coalspur updated SAAB in January 2012 and March 2012 regarding the status of Aboriginal consultation and traditional use studies of the proposed Project.

Consultation for the Project has been undertaken and will continue with the Alexis Nakota Sioux Nation, Aseniwuche Winewak Nation, and the Mountain Cree Camp (Smallboy), officially members of the Ermineskin Cree Tribe. In addition, two societies representing non-treaty Aboriginal people in the area have been consulted including the Foothills Ojibway Society and Nakcowinewak Nation of Canada. Coalspur has engaged Métis groups.

E.11.3 Concerns Raised

To date, substantial contact regarding the Project has been made with all identified potentially affected Aboriginal groups. Consultation with each group is tailored to the needs of the group depending on development of their own consultation and traditional use programs and level of interest in the Project area. Communications have involved various mailouts, meetings, tours, and traditional field studies. In general, the Aboriginal groups are not opposed to the development but have noted concerns regarding environmental stewardship and proper reclamation using native species, the avoidance of important traditional use sites where necessary, and economic opportunities for the Aboriginal communities deriving from the Project.

The Alexis Nakota Sioux Nation, Aseniwuche Winewak Nation, Mountain Cree Camp (Ermineskin Tribe), and Nakcowinewak Nation have completed field visits and/or TEK studies of the Project area. Discussions are on-going with the Foothills Ojibway Society and Metis representatives regarding scope and scale of any necessary pre-development traditional studies. Groups that have undertaken field studies will communicate or share the sensitive data as they feel appropriate with Coalspur, SAAB, or ACCS. Discussions regarding Aboriginal concerns with the development and possible mitigation strategies are on-going and will be finalized on a group-by-group basis after the Project application submission date.

The aboriginal groups have inspected the Project area and identified resources used by their people. Table E.11.3.1 provides a list of plant and fungi species or classes (term not used in the Linnaean sense) observed by Aboriginal groups in the Project area that are used for a variety of medicinal or mundane purposes. A total of at least 86 species or classes of plant/fungi have been identified in the Project that are important to Aboriginal groups. As a generic statement, all Aboriginal groups consulted are concerned that Coalspur take steps to ensure that native plant species are included in reclamation plans rather than solely agronomic species as have been often utilized in the past.

Table E.11.3.1 Plants and Fungi in the Project Area Important to Aboriginal People.

Common Name	Latin Name
Alder	*Alnus spp.*
Alsike Clover	*Trifolium hybridum*
Arrowgrass	*Triglochin spp.*
Arrow-leafed Coltsfoot	*Petasites sagittatus*
Aspen	*Populus tremuloides*
Balsam fir	*Abies balsamea*
Bearberry (Kinnikinnik)	*Arctostaphylos uva-ursi*
Black Poplar	*Populus balsamifera*
Black Spruce	*Picea mariana*
Blue Clematis	*Clematis verticellaris/occidentalis*
Bog Cranberry (Lingonberry)	*Vaccinium vitis-idaea*
Bog Laurel	*Kalmia polifolia*
Bracted Honeysuckle	*Lonicera involucrate*
Bristly Black Currant	*Ribes lacustre*
Buffaloberry	*Shepherdia canadensis*
Bunchberry	*Cornus canadensis*
Club Spikemoss	*Lycopodium annotinum*
Common Dandelion	*Taraxacum officinale*
Common Blueberry	*Vaccinium myrtilloides*
Common Harebell	*Campanula rotundifolia*
Common Horsetail	*Equisetum arvense*
Common Plantain (White Man's Foot)	*Platago major*
Common Red Clover	*Trifolium pratense*
Common Scouring-Rush	*Equisetum hyemale*
Common Snowberry	*Symphoricarpos albus*
Common Sweetgrass	*Hierochloe odorata*
Common Yarrow	*Achillea millefolium*
Cow Parsnip	*Heracleum lanatum*
Creamy Peavine	*Lathyrus ochroleucus*
Dewberry	*Rubus pubescens*
Dwarf Blueberry	*Vaccinium caespitosum*
Fireweed	*Epilobium angustifolium*
Gooseberry	*Ribes oxyacanthoides*

Table E.11.3.1 Plants and Fungi in the Project Area Important to Aboriginal People.

Common Name	**Latin Name**
Green Alder	*Alnus crispa/viridis*
Green Wintergreen	*Pyrola virens*
Ground Juniper	*Juniper communis*
Indian Paint Brush	*Castilleja miniata*
Kidney-leaved Violet	*Viola renifolia*
Labrador Tea	*Ledum groenlandicum*
Lady Fern	*Athyrium filix-femina*
Larch (Tamarack)	*Larix laricina*
Leather-leaf	*Chamadaphne calyculata*
Lodgepole Pine	*Pinus contorta*
Low Bush-Cranberry	*Viburnum edule*
Meadow Horsetail	*Equisetum pratense*
Mint	*Menta arvenis*
Moss	Sphagnum spp.
Mushroom species, edible	unidentified
Northern Black Currant	*Ribes hudsoianum*
Northern Bluebell	*Mertensia paiculata*
Northern Comandra (Bastard Toadflax)	*Geocaulon lividum*
Onion	*Allium spp.*
Pink Pyrola (Pink Wintergreen)	*Pyrola asarifolia*
Prince's Pine	*Chimaphila umbellata*
Puffballs	*Lycoperdom spp.*
Red Osier Dogwood/Red Willow	*Cornus stolonifera*
Red Banded/Belted Polypore	*Fonitopsis pinicola*
Reindeer Lichen (Old Man's Beard)	*Cladina mitis*
River Willow	*Salix spp.*
Rocky Mountain Cow-lily	*Nuphuar lutea*
Rough-fruited Fairybell	*Disporum trachycarpum*
Saskatoonberry	*Amelanchier alnifolia*
Showy Aster	*Aster conspicuous*
Shrub, unidentified (possibly Bog Birch)	(possibly *Betula pumila)*
Small Bog Cranberry	*Oxycoccus microcarpus*
Sweet Coltsfoot	*Pedicitis palmatus*

Table E.11.3.1 Plants and Fungi in the Project Area Important to Aboriginal People.

Common Name	Latin Name
Sweet Flag	*Acorus calamus*
Sweet Vetch	*Hedysarum spp.*
Stinging or Common Nettle	*Urtica gracilis*
Swamp Horsetail or Water Horsetail	*Equisetum palustre* or *E. fluvitile*
Tall Bush Blueberry	*Vaccinium membranaceum*
Tobacco Root	*Valeriana edulis*
Twinflower	*Linnaea borealis*
Twining Honeysuckle	*Lonicera dioica*
Water Avens	*Geum rivale*
Western Mountain Ash	*Sorbus scopulina*
Western Sweet Cicely	*Osmorhiza depauperata*
Wheatgrass	*Agropyron spp.*
White Mushroom (non-specific)	*Agaricales spp.*
White Spruce	*Picea glauca*
Wild Licorice	*Glycyrrhiza lepidota*
Wild Raspberry	*Rubus idaeus*
Wild Sarsaparilla	*Aralia nudicaulis*
Wild Strawberry	*Fragaria virginiana*
Wildrose	*Rosia spp.*
Willow	*Salix spp.*

Most Aboriginal groups focused their traditional studies on the presence of important plants in the Project area. Discussion of concerns regarding animal species tended to occur in generic terms and typically revolved around hunting and trapping practices. Table E.11.3.2 presents a list of animals noted to date during consultations that Aboriginal groups have concern for in this region.

Table E.11.3.2 Animals in the Project Area Important to Aboriginal People.

Common Name	Latin Name
Beaver	*Castor canadensis*
Birds	various
Black Bear	*Ursus americanus*
Caribou	*Rangifer tarandus*
Cougar	*Puma concolor*

Table E.11.3.2 Animals in the Project Area Important to Aboriginal People.	
Common Name	**Latin Name**
Coyote	*Canis latrans*
Deer	*Odocoileus spp.*
Ducks	various
Eagle	*Aquila chrysaetos, Haliaeetus leucocephalus*
Elk	*Cervus canadensis*
Fish	various
Fisher	*Martes pennanti*
Grizzly Bear	*Ursus arctos horribilis*
Hawks	*Buteo spp., Accipiter spp., P. haliaetus*
Lynx	*Lynx canadensis*
Mink	*Neovison vison*
Moose	*Alces alces*
Porcupine	*Erethizon dorsatum*
Rabbit	*Sylvilagus sp., Lepus spp.*
Spruce Grouse	*Falcipennis canadensis*
Squirrels	*Sciurus spp.*
Weasel	*Mustela spp.*
Wild Horses	*Equus caballus*
Wolf	*Canis lupus spp.*

During discussions, open houses, and fieldwork with Aboriginal groups, several items of concern relating to the proposed Project and developments have been raised. Many of these concerns mirror general concerns of environmental impact from other stakeholders and the general public. A summary is as follows:

Water Quality & Preservation – Water quality is the most commonly raised issue for Aboriginal people. Their concern is how Coalspur will keep the water clean and how the water resources will be protected and impacts mitigated. Water quality concerns include surface water and groundwater. One group expressed concern as they still rely on natural spring water in the region for drinking. Clean water is critical for the communities and also for the well-being and balance of all animal and plant life in the region. One individual specifically asked if proper studies had been conducted to ensure mine wastewater was treated and questioned the effectiveness of settling ponds. Contamination of groundwater as a result of blasting operations was also identified as a concern.

Health of Wild Game – Aboriginal people have noted that with increased development in areas, particularly oil and gas, comes an increase in visibly diseased game animals. Sometimes the animals are inedible once killed and skinned if tainted or poisoned. They attribute the poor health of these animals to nearby developments and their effects on the environment. This results in a direct effect on the communities hunting rights and access as the wild game is being damaged. They questioned what the direct impact on the health of wild game will be once development begins.

Displacement of Wildlife – Many Aboriginal people rely heavily on hunting wild game as a regular part of their diet. Many mentioned that parts of the Project area are great moose habitat and saw clear signs and tracks of moose and elk in the area. Moose are culturally important and clearly among the most preferred game among many Aboriginal communities. There is concern that once development begins, there will be a loss of wildlife habitat causing the displacement or death of animals which would have a direct effect on hunting access. They questioned what the impact on game populations, particularly moose, will be. They also questioned what the overall wildlife displacement impact will be and how this will be mitigated.

Moose Licks/Salt Licks/Springs – Directly related to displacement of wildlife is the issue of moose or salt licks. These are important to the wildlife in the region and are also an important place for hunters to look for game. Clearly some of these will be removed during Project development. They questioned how the removal of salt licks and springs would affect wildlife in the area and their ability to hunt.

Bears – A number of Aboriginal people also mentioned the importance of bears, not only to the health of the wildlife in an area, but as a cultural symbol. Although not frequently hunted, bears are a powerful, well-respected and important animal. Concerns were raised over the destruction of bear habitat. Questions were raised on how Coalspur will protect bear dens and bear habitat, particularly grizzly bears.

Avoidance of Important Locales – Aboriginal groups have, or will have, identified to Coalspur the locations of known ceremonial sites, burials or other important locations in the proposed Project area. One individual inquired if Coalspur would have a protocol in place for previously unrecorded burials located during development operations. Discussions are underway with individual Aboriginal groups on appropriate avoidance or mitigation strategies on a case-by-case basis.

Impact to Medicinal and Food Plants – One of the most important concerns among Aboriginal Elders was the impact to medicinal, ceremonial, and food plants in the Project area. Some of these plants are noted as “rare” or “rare elsewhere,” whereas others are more common. Some plants were noted by Elders as being more abundant in this area and, in some cases, larger in size. Often these plants cannot simply be transplanted due to specific conditions required. Also, transplanting may impact the potency or efficacy of the medicines in some cases. Most of the Aboriginal groups consulted are interested in direct involvement in the reclamation process and the use of traditional knowledge and native plant species in the reclamation process.

Air Pollution – There was concern raised as to the air quality once mining operations take place. There is a concern about the creation of dust by the plant as some individuals live downwind of the plant. They also questioned if any smell will be produced.

Reclamation and Process – As already noted, the use of native species and traditional knowledge was highly emphasized by Aboriginal groups as important in the reclamation process. The communities urge Coalspur to take measures to ensure proper reclamation with the utilization of their ideas and knowledge. This includes suggestions such as the use of test-plotting to ensure native species grow back, use of “pucks” of native soil/seed to help establish native plants on the ground, use of a tree spade to transplant limited numbers of native shrubs/sod to help inoculate areas, and other restoration input that will be provided later. Some Aboriginal groups also emphasized the reclamation of certain plant species important to the communities and would like to see these particular species part of the process. In addition to many of the common berries, plants such as mountain ash, tobacco root, ground juniper, arrow-leafed coltsfoot, cow-lily, showy aster, pink wintergreen, red osier dogwood, common yarrow, and willows are among those of considerable value to Aboriginal groups. Questions were also raised regarding the anticipated length of time required for the re-growth of plants and for the restoration of the landscape.

Employment Opportunities – Many Aboriginal community members expressed interest in job opportunities when the mine is developed. Concerns have been expressed about past discrimination and the need for a high school diploma to obtain employment with some industries. The need for further training or certificates for certain positions was also brought up. Desire for the incorporation of Aboriginal youth into positions such as environmental monitors or to assist in reclamation was expressed. Some Aboriginal groups are concerned that skilled or unskilled labour will be brought into the region to fill new roles at the mine rather than training opportunities supplied to help local people acquire jobs.

Contracting Opportunities – Several Aboriginal groups inquired about contracting opportunities for Aboriginal-owned companies or affiliated corporations. These opportunities allow the development of further economic opportunity for the communities.

Agreements – A number of consulted Aboriginal groups have expressed their interest in solidifying their relationship to, or creating agreements with Coalspur, in long-term memoranda of understanding or similar written agreements.

E.11.4 Mitigation and Monitoring

In order to reduce potential impacts of the Project on TLU/TEK Coalspur will:

- continue to work with the Aboriginal groups on identifying traditional use areas and mitigation required to reduce potential impact to these areas;
- undertake mitigation measures identified by the environmental assessments conducted for the Project; and
- continue to discuss with Aboriginal groups on a case by case basis for the options for avoidance or re-establishment of ceremonial areas, specific plant species, graves, and other areas during construction and operation of the proposed Project.

E.11.5 Summary

Coalspur has provided capacity funding and other support to the numerous Aboriginal groups that have used the Project area in the past, continue to use it today, or are entitled to use the area. The capacity funding was used to undertake studies of traditional use and ecological knowledge of the proposed Project area. The results of some of the traditional studies indicate that although the patterns and intensity of use have been changing over time, Aboriginal people in the area continue to use the region for hunting, the collection of medicinal and food plants, camping, and ceremonial pursuits. Some of the Aboriginal groups have indicated that the Project will impact some of the resources they use but that, through appropriate measures, the impact to resources and areas important to them can be mitigated or avoided where need be. The traditional studies undertaken for the Project have collected and safeguarded important cultural information for several Aboriginal groups. These studies not only provide information important to the assessment of environmental impacts but help to ensure the transmission of cultural knowledge from the Elders to the young people. It has also resulted in an important positive extension of Coalspur's relationship with these peoples and their inclusion in the process of approvals for development in the region. Field studies for some of the Aboriginal groups are still awaiting completion and further discussion. Consultations with the Aboriginal groups will continue in the future as information is brought forward regarding specific impacts to traditional use areas.

E.12 VEGETATION, WETLANDS, RARE PLANTS

E.12.1 Introduction and Terms of Reference

Coalspur conducted a vegetation and wetlands resource assessment for the proposed Project. The following section is a summary of the Vegetation and Wetlands Resource Assessment Report that was prepared by Millennium EMS Solutions Ltd. and included as Consultants Report #12 (CR #12). For full details of the assessment please refer to CR #12.

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the Vegetation and Wetlands Resource Assessment are provided in Section 3.6 of the ToR and are as follows:

3.6 VEGETATION

3.6.1 Baseline Information

[A] Describe and map vegetation communities. Identify the occurrence, relative abundance and distribution and identify any species that are:

- *a) listed as "at Risk, May be at Risk and Sensitive" in The Status of Alberta Species (Alberta Sustainable Resource Development);*
- *b) listed in Schedule 1 of the federal Species at Risk Act; and*
- *c) listed as "at risk" by COSEWIC; and*
- *d) traditionally used species.*

[B] Describe and quantify the current extent of habitat fragmentation.

[C] Discuss the potential of each ecosite phase to support rare plant species, plants for traditional, medicinal and cultural purposes, old growth forests and communities of limited distribution. Consider their importance for local and regional habitat, sustained forest growth, rare plant habitat and the hydrologic regime.

[D] Describe the regional relevance of landscape units that are identified as rare.

[E] Provide Timber Productivity Ratings for both the Project Area and the Local Study Area, including identification of productive forested, non-productive forested and non-forested lands.

3.6.2 Impact Assessment

[A] Describe and assess the potential impacts of the Project on vegetation communities,

[B] Discuss any potential impacts the Project may have on rare plants or endangered species.

[C] Identify key vegetation indicators used to assess the Project impacts. Discuss the rationale for the indicator's selection.

[D] Discuss temporary (include timeframe) and permanent changes to vegetation and wetland communities and comment on:

- *a) the impacts and their implications for other environmental resources (e.g., habitat diversity and quantity, water quality and quantity, erosion potential);*
- *b) the impacts and their implications to recreation, aboriginal and other uses; and*
- *c) the sensitivity to disturbance (including acid deposition), as well as the techniques used to estimate sensitivity to disturbance and reclamation, of each vegetation community.*

[E] Describe the regional impact of any ecosite phase to be removed.

[A] Discuss from an ecological perspective, the expected timelines for establishment and recovery of vegetative communities and the expected differences in the resulting vegetative community structures.

[B] Provide a predicted Ecological Land Classification map that shows the reclaimed vegetation. Comment on the importance of the size, distribution and variety of the reclaimed landscape units from both a local and regional perspective.

[C] Discuss the impact of any loss of wetlands, including how the loss will affect land use.

[D] Discuss weeds and non-native invasive species and describe how these species will be assessed and controlled prior to and during operation and reclamation.

[E] Discuss at multiple spatial scales, the predicted changes to upland, riparian and wetland habitats resulting from increased fragmentation.

VECs were selected based on specific requirements outlined in the final ToR, regulatory requirements and guidelines, and issues historically and currently raised by stakeholders through the consultation process. The importance and rationale for selection of each VEC are included in CR #12, Section 5.0. Project VECs are:

- vegetation communities (ecosite phase);
- wetlands;
- rare plants;
- traditionally used vegetation;
- forest resources (timber damage assessment);
- old growth forests;
- biodiversity (includes assessment of fragmentation); and
- noxious or invasive vegetation (while not necessarily valued, this is assessed).

The LSA for the Project is within the limits of Coalspur's mine permit boundary for the proposed Project (CR #12, Figure 1-2). The RSA encompasses the town of Hinton, Hargwen, a segment of the McLeod River watershed, and a segment of McPherson Creek drainage basin. The vegetation RSA is defined to capture measurable Project and cumulative effects on valued vegetation and wetland resources resulting from activities within the LSA.

E.12.2 Baseline Conditions

E.12.2.1 Land Cover Classification

The majority of the RSA is situated within the Upper Foothills Natural Subregion of Alberta with a small portion occupying the Lower Foothills Natural Subregion. The Upper Foothills (UF) occur at higher elevations than the Lower Foothills (LF). Consequently, the climate of the UF is characterized by a stronger cordilleran influence compared to the more continental climate of the LF (Strong and Leggat 1992; Natural Regions Committee 2006). As elevation increases from LF to UF, more winter precipitation is received and the length of the growing season becomes shorter.

The vegetation RSA mapping was completed by developing 49 ecological land classification (ELC) cover classes originating from coarse raster satellite data (at pixels of 30 m x 30 m resolution) from the Foothills Research Institute (FRI 2009). The ten ELC land cover classes were further refined by adding crown closure, percent conifer, stand origin, and regeneration were added to the land cover dataset. The percent canopy closure dataset was then re-classified into four classes (open: 6 – 30; moderate: 31 – 50; dense: 51 – 70; and closed: 71 - 100). Following which, conifer, mixedwood, broadleaf, and regenerating forest stands were delineated. ELC classes in the RSA are listed in Table E.12.2.1 and shown in CR #12, Figure 4.10.

Table E.12.2.1 ELC Cover Classes in the RSA

ELC Class	Area (ha)	Proportion (%)
Open Regen Herb	4,563.7	5.53
Open Regen Shrub	20,873.6	25.28
Closed Regen Treed	24,595.6	29.78
Natural Shrubby	2,003.9	2.43
Natural Upland Herb	1,711.6	2.07
Open Wetland Herbaceous	474.3	0.57
Open Wetland Shrubby	295.8	0.36
Treed Wetland	2,219.3	2.69
Open Broadleaf Young Forest	1,035.6	1.25
Open Broadleaf Mature Forest	1,076.7	1.30
Open Broadleaf Old Forest	1,659.1	2.01
Open Mixed Young Forest	1.9	0.00
Open Mixed Mature Forest	1.6	0.00
Open Mixed Old Forest	1.1	0.00
Open Conifer Young Forest	0.1	0.00
Open Conifer Mature Forest	15.8	0.02
Open Conifer Old Forest	3.6	0.00
Moderate Broadleaf Young Forest	8.7	0.01
Moderate Broadleaf Mature Forest	36.0	0.04
Moderate Broadleaf Old Forest	0.8	0.00
Moderate Mixed Young Forest	0.8	0.00
Moderate Mixed Mature Forest	231.5	0.28
Moderate Mixed Old Forest	86.9	0.11
Moderate Conifer Mature Forest	146.5	0.18
Moderate Conifer Old Forest	11.6	0.01
Closed Broadleaf Young Forest	0.6	0.00
Closed Broadleaf Mature Forest	50.8	0.06
Closed Broadleaf Old Forest	29.4	0.04
Closed Mixed Young Forest	735.3	0.89
Closed Mixed Mature Forest	9,741.8	11.80
Closed Mixed Old Forest	2,043.6	2.47

Table E.12.2.1 ELC Cover Classes in the RSA

ELC Class	Area (ha)	Proportion (%)
Closed Conifer Mature Forest	3,437.3	4.16
Closed Conifer Old Forest	266.6	0.32
Dense Broadleaf Mature Forest	0.1	0.00
Dense Broadleaf Old Forest	11.6	0.01
Dense Mixed Young Forest	24.6	0.03
Dense Mixed Mature Forest	1,223.4	1.48
Dense Mixed Old Forest	1,557.1	1.89
Dense Conifer Mature Forest	116.4	0.14
Undifferentiated Conifer	1.5	0.00
Barren Land	325.1	0.39
Open Water	442.9	0.54
Settlement	1,028.3	1.25
Linear Disturbance	486.4	0.59
Total Vegetation RSA ELC Classes:	**82,578.8**	**100**

E.12.2.2 Ecological Land Classification

Vegetation is a key component in the diversity and functioning of natural ecosystems. The distribution and occurrence of vegetation species differs primarily with climate, topography and soil type and secondarily with disturbance type, severity and frequency.

The data collection protocols used for the vegetation survey followed the guidelines outlined in the *Ecological Land Survey Site Description Manual* (Alberta Environmental Protection 1994). A total of 344 vegetation species were observed and documented within the LSA during field sampling surveys in 2011. Of these, 247 were vascular and included 9 trees, 47 shrubs, 136 forbs and 55 grasses. The remaining 97 species were non-vascular and included 82 bryophytes, 6 ground lichens and 9 epiphytic lichens. A complete listing of the flora identified in the LSA is presented in CR #12, Appendix III.

The *Field Guide to Ecosites of West-Central Alberta (*Beckingham *et al*. 1996) ecological land classification system was used to further delineate ELC. Twenty- seven upper foothills (UF) ecosite phases and nineteen lower foothills (LF) ecosite phases were mapped within the LSA and encompass 5995.6 ha (Table E.12.2.2; CR #12, Figure 4.1). As well, open and closed regenerating forest harvested cutblocks, human disturbance areas, large water bodies and large water courses were also mapped.

Ecosite phases which were found to be limited in distribution (<1%) in the LSA for UF are b1, c1, c2, e4, f1, f2, f3, f4, f5, g1, g2, j1, k1, l2, l3, m1, m2, m3 and Marsh. Ecosite phases which were found to be limited in distribution (<1%) in the LSA for the LF are c1, c3, d1, f1, f2, m2 and m3 (CR #12, Table 4.1). UF ecosite phases f2, f5, g2, k1, l3, m1, m2, Marsh and LF ecosite phases c1, g1, g2 and m3 are limited in distribution regionally (Beckingham *et al*. 1996).

Table E.12.2.2 Baseline Ecosite Phases in the LSA and Project Footprint

Ecosite	Descriptions	LSA		Project Footprint	
		Area (ha)	Proportion (%)	Area (ha)	Proportion (%)
b1	subxeric/poor-bearberry/lichen Pl	2.1	0.0	1.2	0.0
c1	submesic/medium-hairy wild rye Pl	32.2	0.5	22.8	0.4
c2	submesic/medium hairy wild rye Aw	3.5	0.1	3.5	0.1
c3	submesic/medium hairy wild rye Aw-Sw-Pl	74.9	1.2	60.5	1.0
d1	mesic/poor Labrador tea-Pl-Sb	590.7	9.9	311.4	5.2
e1	mesic/medium tall bilberry/arnica Pl (UF) mesic/medium - low bush cranberry Pl (LF)	404.3	6.7	208.2	3.5
e2	mesic/medium tall bilberry/arnica Aw-Sw-Pl (UF) mesic/medium low bush cranberry Aw (LF)	646.3	10.8	334.7	5.6
e3	mesic/medium tall bilberry/arnica Sw (UF) mesic/medium low bush cranberry Aw-Sw-Pl (LF)	174.1	2.9	18.5	0.3
e4	mesic/medium tall bilberry/arnica Fa (UF) mesic/medium low bush cranberry Sw (LF)	48.5	0.8	0.6	0.0
f1	subhygric/rich-bracted honeysuckle Pl	9.9	0.2		0.0
f2	subhygric/rich-bracted honeysuckle Pb (UF) subhygric/rich-bracted honeysuckle Aw-Pb (LF)	6.2	0.1	0.2	0.0
f3	subhygric/rich-bracted honeysuckle Pb-Sw-Pl	83.9	1.4	8.1	0.1
f4	subhygric/rich-bracted honeysuckle Sw	62.9	1.0		0.0
f5	subhygric/rich-bracted honeysuckle Fa	0.9	0.0	0.6	0.0
g1	subhygric/very rich-shrubby meadow	34.5	0.6	0.4	0.0
g2	subhygric/very rich-forb meadow	12.9	0.2	0.1	0.0
h1	subhygric/poor-Labrador tea-Sb-Pl	860.2	14.3	375.2	6.3
i1	hygric/medium-Labrador tea/horsetail Sb-Sw	247.4	4.1	120.6	2.0
j1	hygric/rich-horsetail Sw	23.8	0.4	1.3	0.0
j1	hygric/medium-Labrador tea/horsetail Sb-Sw		0.0		0.0
k1	subhydric/poor-treed bog	2.1	0.0		0.0
l1	subhydric/medium-treed poor fen	1000.8	16.7	513.4	8.6
l2	subhydric/medium - shrubby poor fen	47.6	0.8	16.2	0.3
l3	subhydric/medium-graminoid poor fen	21.0	0.4	5	0.1
m1	subhydric/rich-treed rich fen	22.6	0.4	3.1	0.1
m2	subhydric/rich shrubby rich fen	20.0	0.3	4.8	0.1
m3	subhydric/rich-graminoid rich fen	21.8	0.4	5.3	0.1

Table E.12.2.2 Baseline Ecosite Phases in the LSA and Project Footprint					
Ecosite	**Descriptions**	**LSA**		**Project Footprint**	
		Area (ha)	**Proportion (%)**	**Area (ha)**	**Proportion (%)**
Marsh		2.6	0.0		0.0
NMR	Rock - barren	0.4	0.0		0.0
NMS	Mineral - sand	6.3	0.1		0.0
	Anthropogenic	172.6	2.9	80	1.3
	Water - Natural lakes and rivers	46.7	0.8	3.5	0.1
	Open and closed regenerating	1311.9	21.9	549.7	9.2
Total		**5995.6**	**100.0**	**2648.9**	**44.2**

E.12.2.3 Distribution of Wetland Types

Wetlands are defined by the National Wetlands Working Group (NWWG 1988) as "*land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment.*"

Wetlands within the LSA are classified using the *Canadian Wetland Classification System* (National Wetlands Working Group 1997), the *Alberta Wetland Inventory Classification Standards* (Halsey *et al.* 2004), and the appropriate field guide to ecosites of Alberta (Beckingham *et al* 1996; Beckingham and Archibald 1996). Wetlands constitute 19.9% (1,195.46 ha) of the LSA (Table E.12.2.3). Non-patterned, treed fens with no internal lawns (FTNN) are the most dominant wetland type (17.4%; 1,042.0 ha). Wetlands of limited distribution in the LSA are BTNN, FONG, FONS, FOPN, MONG, STNN, and WONN, all of which encompass <1% of the LSA. The locations of the wetland types observed and documented within the LSA are shown on CR # 12, Figure 4.6a.

Four sensitive wetlands (a patterned fen, a graminoid saline fen, a marsh and a mineral lick) were observed and documented within the LSA and are shown on CR #12, Figure 4.6b. These are considered unique (limited at the regional scale) for the UF natural sub-region.

Wetlands occupy 3.62% of the RSA, with treed wetlands the most common (CR #12, Table 4.20).

Table E.12.2.3 Wetlands within the LSA and Project Footprint				
Wetland Classification	**LSA**		**Project Footprint**	
	Area (ha)	**Proportion (%)**	**Area (ha)**	**Proportion (%)**
BTNN - Wooded bogs without internal lawns, patterning or permafrost	2.1	0.04		
FONG - Open graminoid fens without patterning or permafrost	39.5	0.66	8.9	0.15%
FONS - Open shrubby fens without patterning or permafrost	50.6	0.84	15.8	0.26%

Table E.12.2.3 Wetlands within the LSA and Project Footprint

Wetland Classification	LSA		Project Footprint	
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)
FOPN - *Open fen with patterning and no internal* lawns	8.5	0.14	1.4	0.02
FTNN - Wooded fens without internal lawns, patterning or permafrost	1,042.0	17.38	527.2	8.79
MONG - Marsh	0.3	0.00	0	0
STNN - Wooded swamp without internal lawns, patterning or permafrost	31.5	0.53	22.5	0.38
WONN - Open water	19.8	0.33	3.5	0.06
ZONG - Non-typical Wetland	1.1	0.02	1.1	0.02
Total	**1,195.5**	**19.94**	**580.4**	**9.68**
Total Area in LSA (ha)	**5,995.60**			

E.12.2.4 Rare Plants, Rare Plant Potential, and Rare Plant Communities

In Alberta, a rare plant is defined by the Alberta Native Plant Council (ANPC) as "*any native vascular or non-vascular (mosses, hornworts, liverworts) plant that, because of its biological characteristics or for some other reason, exists in low numbers or in very restricted areas in Alberta*" (ANPC 2000a). A rare plant community is any native plant community that is uncommon, of limited extent, or locally significant. In Alberta, the Alberta Conservation Information Management System (ACIMS) ranks, maps, and tracks rare vegetation species and plant communities (each one called a tracked element).

A list of rare plants and rare plant communities that are likely to occur in the LSA was compiled from the *Alberta Rare Native Vascular Plants* (Kershaw *et al*. 2001) and the Alberta Conservation Information Monitoring System (ACIMS 2011). The list was then compared to all observed and documented occurrences of rare plants and rare plant communities in the LSA and RSA derived from field sampling for this environmental assessment.

Within the LSA, seven vegetation species documented during field surveys are on the Alberta Rare Plant Tracking and Watch Lists (ACIMS 2011). Of these, three are forbs, one is a graminoid, two are liverworts - bryophytes, and one is lichen. A summary of the species, the habitat(s), and the provincial and federal status in which they occur is presented in Table E.12.2.4 and the species distribution is shown on CR #12, Figure 4.7. There were no rare plant communities sampled in the LSA to date.

Ecosite phases in the UF with high rare plant potential are e1, f3, f4, g1, h1, j1, l1 and l2 (CR #12, Table 4.11). Ecosite phases with high rare plant potential in the LF are i1 and j1. CR # 12, Figure 4.8 displays the high rare plant potential location within the LSA.

Table E.12.2.4 Documented Rare Plant Occurrences in the LSA

Occurrences in LSA	Plant Community	Scientific Name (ACIMS)	Common Name	Vegetation Type	SRANK	GRANK	Track
3	e.3.4	*Anastrophyllum helleranum*	Heller's anastrophyllum	Liverwort	S2	G5	Y
1	g.1.2	*Calamagrostis lapponica*	Lapland reed grass	Graminoid	S1	G5	Y
1	m.3.1	*Chrysosplenium iowense*	golden saxifrage	Forb	S3?	G3?	Y
1	h.1.2	*Cladonia stygia*	black footed reindeer lichen	Lichen	S2	G5	Y
1	l.1.1	*Coptis trifolia*	goldthread	Forb	S3	G5	W
1	m.1.1	*Lophozia excisa*	no common name	Liverwort	S1	G5	Y
7	c.3.1	*Penstemon albertinus*	blue beardtongue	Forb	S3	G4G5	W

W is designated "watched" in Alberta.

E.12.2.5 Traditional Ecological Knowledge (TEK) Vegetation

Many Aboriginal groups consulted have inspected the LSA and identified vegetation resources used by Aboriginal groups in the region. The Aboriginal groups compiled a list of vegetation (including fungi, and lichen and bryophyte) species valued and used. A total of 83 different TEK vegetation species were observed and documented during field sampling of the LSA (CR #12, Appendix V). Numerous TEK studies were completed and the results are provided in CR #11.

Of the TEK vegetation documented, seven are used for critical medicinal purposes, 18 are used for food and 58 are used for other uses. Critical medicinal use vegetation was found in ecosite phases c3, d1, e1, e2, e3, f2, f3, g1, h1, i1, j1, l1, l2, l3, m1, and m3. Vegetation used for food was found in b1, c1, c3, d1, e1, e2, e3, f2, f3, f5, g1, h1, i1, j1, l1, l2, l3, m1, and m3 (CR #12, Table 4.7). Ecosite phases with the greatest propensity to support critical use vegetation are c3, d1, e2, e4, f3, g1, h1, i1, l1, l2, m1 and m3. Ecosite phases with the greatest propensity to support food vegetation are c1, c3, d1, e1, e2, e3, f3, f5, g1, h1,i1, j1 and l1.

TEK vegetation has a very high potential to occur in ecosite phases c3, d1, and i1 and a high potential to occur in e2, e3, and f3 (CR #12, Table 4.8; Figure 4.5) in the UF and LF natural region.

E.12.2.6 Forestry Resources

Approximately 67% of the LSA is forested (CR #12, Table 4.2) and has an estimated 380,576.6 m^3 of merchantable timber. The following provides a distribution of forest productivity in the LSA:

- good productive forest has an estimated 37,941.3 m^3 merchantable timber;
- moderate productive forest has an estimated 278,037.5 m^3 merchantable timber;
- fair productive forest has an estimated 27,878.1 m^3 of merchantable timber;
- unproductive forest has an estimated 36,719.7 m^3 of timber; and

- non-forested (no timber) land occupies the remainder of the LSA (32.9%) and is a combination of anthropogenic features (including regenerating cutblocks), lakes, rivers, shrubby and graminoid wetlands, natural meadows and barren land.

The leading tree type within the LSA is pine (180,018.4 m^3), followed by black spruce (96,519.3 m^3), white spruce (56,885.7 m^3), aspen (36,831.4 m^3), larch (7,575.1 m^3) and balsam poplar (2,746.7 m^3) (CR #12, Table 4.4).

ELC cover classes for the RSA are provided in Table E.12.2.1. The most common type of land class in the RSA is regenerating cutblocks (50,032.9 ha; 60.59%) followed by mature forests (23,558.3 ha; 28.53%). Mixed forest occupies 15,649.6 ha (18.95%) of the RSA followed by coniferous forests (3,999.4 ha; 4.84%), broadleaf forest (3,909.3 ha; 4.73%) and moderate forest (522.7 ha; 0.63%).

E.12.2.7 Old Growth Forests

Old growth forest is defined according to criteria outlined in Schneider (2002). Approximately 502.5 ha or 8.38% of the LSA is old growth forest (Table E.12.2.5; CR #12, Figure 4.3). Mixed pine leading stands are the most dominant type of old growth forest (148.1 ha; 2.47%) followed by mixed stands of white spruce (80.4 ha; 1.34%). Mixed wood stands include both coniferous leading and deciduous leading stands.

Most of the vegetated areas in the LSA are in early succession stages due to active logging. Consequently, the amount of old growth forest is low. The oldest forests have been found in remote, small valleys as a result of fire disturbance patterns. The assessment of old growth potential in the foothills forests takes into account future forest harvesting which is a significant anthropogenic disturbance in the region.

Table E.12.2.5 Old Growth Forest within the Footprint

Pure or Mixed Stands	LSA		Project Footprint	
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)
Mixed:				
Populus tremuloides (aspen) leading:	57.8	0.96	45	0.75
Populus balsamifera (poplar) leading:	12.3	0.21	0	0.00
Pinus contorta latifolia (pine) leading:	148.1	2.47	16	0.27
Picea mariana (black spruce) leading:	63.7	1.06	34.4	0.57
Picea glauca (white spruce) leading:	80.4	1.34	4.2	0.07
Pure:				
Populus tremuloides (aspen):	15.8	0.26	2.5	0.04
Pinus contorta latifolia (pine):	16.2	0.27	3.9	0.07
Picea mariana (black spruce):	46.4	0.77	31.3	0.52
Picea glauca (white spruce):	61.8	1.03	0	0.00
Total Old Growth:	**502.5**	**8.38**	**137.3**	**2.29**
Total Area of LSA:	**5,995.6**			

E.12.2.8 Biodiversity

Biodiversity is a measure of the health of an ecosystem and defines the degree of variation among living organisms within an ecosystem. A key influence on biodiversity is the effects of fragmentation. Ecosystem fragmentation refers to the break-up of habitat expanses into smaller and more isolated units. Increased ecosystem fragmentation may result in a wide range of threats to biodiversity such as an increase in invasive and non-native species, reduction or restriction of wildlife movement, reduction of genetic diversity and population viability, loss of resilience, alteration of natural disturbance patterns, and interruption of succession. Fragmentation and biodiversity are inversely co-dependent, in that, as fragmentation of natural landscapes increases, biodiversity decreases.

Biodiversity exists at several scales or levels including genetic (species), community, and landscape-level. The biodiversity indicators that were used to characterize baseline biodiversity and assess the effects of the Project on biodiversity in the LSA and the RSA are listed in CR #12, Table 3.8.

Species Level Biodiversity

In total, 344 vegetation species were observed and documented within the LSA. Of these, 247 were vascular and included nine trees, 47 shrubs, 136 forbs and 55 grasses. Ninety-seven were non-vascular and included 82 bryophytes, six ground lichens and nine epiphytic lichens. The highest mean species richness and diversity was found in ecosite phase LF- h1 (mean 49.0 and 4.2, respectively; CR #12, Table 4.12) which has a subhygric moisture regime and poor nutrient regime. The lowest mean species richness value was observed in UF- m2 (mean 14.0) and the lowest diversity was found in UF- b1 (mean 2.1).

A ranking metric was used to determine the biodiversity potential of each ecosite phase (CR #12, Table 4.14). The final biodiversity potential of each ecosite phase for the LSA is given in CR #12, Table 4.15 and is presented in CR #12, Figure 4.9.

Community Level Biodiversity

Unlike the species level assessment that focuses on species within each ecosite phase, the community level assessment focused on number of ecosite phases within the LSA and the biodiversity potential of each ecosite phase. Biodiversity potential describes the potential of each ecosite phase or community to support a variety of self-sustaining plant and animal populations. It incorporates the structure and composition of each ecosite phase as well as the rarity of the ecosite phase at a landscape level.

A ranking metric was used to determine the biodiversity potential of each ecosite phase in the LSA (CR #13, Table 3.9). Ecosite phases were ranked as very low, low, moderate, high and very high. All disturbed and anthropogenic classes were not ranked for biodiversity. Table E.12.2.6 shows the total area of all ecosite phases combined for each of the five biodiversity classes.

Table E.12.2.6 Biodiversity Potential in the LSA and Project Footprint

Potential	Ecosite Phases	LSA		Project Footprint	
		Area (ha)	Proportion* (%)	Area (ha)	Proportion* (%)
Very High	none				
High	UF: c3, f3, f5, g1, i1, m1 LF: e3, h1	525.9	8.77	221.0	3.69
Moderate	UF: b1, d1, e1, e2, e3, f2, h1, l1, l2, l3, m2, m3 LF: c1, j1	3,607.8	60.17	1795.9	29.95
Low	LF: d1	3.2	0.05	0	0
Very Low	None	0	0	0	0

* Proportion of LSA

Landscape Level Biodiversity

Biodiversity at a landscape level refers to the assemblage of plant communities in relation to one another in a mosaic of patches, corridors, and matrices. Landscape level biodiversity is presented as the number of ecosite phases in the LSA and land cover classes in the RSA. Landscape level biodiversity is also presented as the level of fragmentation of mapped land units in the LSA and RSA.

Within the LSA, 27 UF ecosite phases, 18 LF ecosite phases, two water classes (lakes and rivers), two forest regenerating classes (open and closed), and four anthropogenic disturbance types (*i.e.* linear disturbances and wellsites) were mapped. As well, two natural non-vegetated cover classes (barren sand and rock) and one settlement type was mapped in the LF. Mapping also included eight wetlands and a mineral lick. Anthropogenic features constitute 24.8% (1,485.5 ha) of the LSA with the largest patches being regenerating forest harvested cutblocks.

In the RSA, there are 45 ELC classes: 37 are natural, two are other (barren and water), three are regenerating forest cutblocks (open herbaceous, closed shrubby and treed), two are other types of anthropogenic disturbance (settlement and linear disturbance) and one is undetermined (cloud, ice, shadow). The ELC classes mapped in the vegetation RSA, ELC types (amalgamated similar classes), and their abundance (habitat richness) rankings are presented in CR #12, Table 4.21.

Baseline fragmentation for the LSA and RSA was described using the following parameters and metrics:

- number of patches (by type);
- mean patch size (hectares);
- total area of each patch type (hectares);
- total length of edge (metres);
- mean perimeter to area ratio (index);
- mean distance to nearest neighbour (metres); and at the landscape level;
- mean patch density (# of patches/100 ha).

Total edge or perimeter length is a function of the amount of border of different patches and is related to the average patch size and shape. Most adverse effects of forest fragmentation on organisms seem to be directly or indirectly related to edge effect differences (McGarigal and Marks 1994). A shorter distance between each patch type is preferential for wildlife movement between critical resources such as forest cover.

CR #12, Table 17 provides baseline fragmentation information for the LSA. Highlights are as follows:

- the total patch area is 5991.6 ha;
- the largest patch types for the UF and LF natural subregion are closed regenerating cutblocks (mean patch size of 13.5 ha and 21.3 ha respectively);
- the smallest patch for UF and LF are ecosite phases mostly of limited distribution (b1 and Marsh in UF; E1 and m2 (limited distribution));
- mean patch size for ecosite phases is 10.6 ha; and
- mean patch size for anthropogenic disturbance in the LSA is 14.4 ha;
- largest perimeter length is the l1 ecosite phase in the UF;
- the ecosite phase patch type with the highest perimeter to area ratio in the UF is g1, which is a sub-hygric, very rich shrubby meadow vegetation community, usually occurring adjacent to streams. These communities often have elongated shapes that follow areas of low topography such as riparian margins and are frequented by wildlife;
- linear anthropogenic features such as pipelines (CIP), roads, and highways (AIH) have a high perimeter to area ratios in the LF; and
- only one ecosite phase in the UF and five ecosite phases in the LF were less than 100 m in length between patches.

Overall, the mean patch area is 8.2 ha, mean nearest neighbor is 327.7 m, and the patch density per 100^2 ha is 12.2 (CR #12, Table 18). The baseline fragmentation results for the LSA indicate that the area is moderately fragmented.

CR #12, Table 4.22 provides baseline fragmentation information for the RSA. Highlights are as follows:

- the total patch area is 82,578.2 ha;
- the largest area is closed (24,595.5 ha; 29.8%) and open regenerating (20,872.5 ha; 25.3%) harvest cutblocks;
- largest perimeter length is open regenerating shrub (3,966,820 m);
- the smallest perimeter length is found in dense broadleaf mature forest (120 m) and open conifer young forest (180 m); and
- the closest vegetated mean nearest neighbor is open herbaceous regenerating cutblocks (22.6 m) while the farthest is closed broadleaf young forest (10,257.2 m).

The baseline fragmentation results for the RSA indicate that the area is moderately fragmented.

E.12.2.9 Noxious and Invasive Species

Baseline field surveys identified two noxious and six invasive vegetation species within the LSA (CR #12, Figure 4.2). The invasive vegetation species are non-regulated species which may be considered invasive by one or more authorities (*i.e.* Municipalities or Counties) in Alberta. Most of the noxious and invasive species were observed in areas associated with existing development (pipelines, well sites) and reclaimed areas (cutblocks). The noxious and invasive species are:

- noxious: *Chrysanthemum leucanthemum*; and, *Ranunculus acris*; and
- invasive: *Festuca rubra; Phleum pratense; Poa pratensis; Trifolium hybridum; Trifolium pratense, and Trifolium repens.*

E.12.3 Potential Impacts

The overall potential Project effects to vegetation and wetlands are related to removing natural vegetation and disturbing soils within the Project footprint area. Removing native vegetation will impact vegetation and wetlands directly through the removal of biomass and reduction of plant communities and indirectly through changes to hydrology, soils, topography, biodiversity, and habitat fragmentation.

E.12.3.1 Ecological Land Classification

The Project footprint is predicted to cover 2,648.7 ha which represents the removal of 44.18% of the LSA. Construction and operation of the Project will result in the removal of all natural vegetation and wetlands within the Project footprint. Ecosite phases to be removed by the Project footprint encompass 2,015.5 ha (33.62% of the LSA). As well, 3.5 ha (0.06%) of lake, 80 ha (1.33%) of anthropogenic disturbance, and 549.7 ha (9.17%) of regenerating forest harvesting cutblocks will be removed (Table E.12.2.2). Ecosite phases with limited distribution in the LSA and regionally that will be affected by the Project include b1, c1, c2, e4, f2, f5, g1, g2, j1, l2, l3, m1, m2, and m3.

Within the RSA, in order to assess the Project vegetation effects, ELC succession stages at 5 (T5, 2020-2024), 10 (T10, 2025-2034), 20 (T20, 2035-2039), and 25 (T25, 2040-2045) years were modeled with T25 representing Project areas at closure. At T5, where the most substantial differences are starting to appear related to the Project and forest harvesting, there is a decrease in open regenerating herbaceous, open regenerating shrub, closed regenerating treed, and closed mixed and mature conifer forests. At T25 the Project footprint has been re-claimed and re-vegetated and open regenerating herb, open regenerating shrub, closed regenerating treed, and open mixed young forest have increased by 1,157.8 ha, 520.1 ha, 58.1 ha, and 319.9 ha respectively. Increases to open herbaceous is a result of forest harvesting between 2028 and 2057. Increases to closed regenerating treed and open mixed young forest are a result of replanting of cutblocks from forest harvesting in 2023 and 2013 respectively. Changes in ELC cover classes for each modeling scenario are presented in CR #12, Table 5.2 and Figure 5.1.

Potential effects to vegetation and wetlands as a result of the Project will be mitigated through the revegetation activities. The re-vegetation activities will be aimed at the long term establishment of equivalent vegetation communities and wetlands that existed within the Project area prior to the Project. Vegetation communities are defined by the combination of site conditions (moisture and nutrient regimes), regional climate, surficial geologic conditions, and dominant vegetation species. Areas re-vegetated to vegetation communities are expected to progress through successional stages over time (>65 years). Contingent upon normal environmental conditions in the area (*e.g.* lacking stochastic events), revegetated sites are expected to resemble pre-disturbance conditions.

With implementation of appropriate mitigation measures the residual impacts to vegetation communities is rated as Low.

E.12.3.2 Wetlands

The area of wetlands that will be within the Project footprint is 580.4 ha which equates to 9.7% of the LSA (Table E.12.2.3). Wetlands which are limited in distribution within the Project footprint are marsh and mineral lick (totalling 53.2 ha). The wetland type with the greatest area within the Project footprint is a treed fen (FTNN) which encompasses 17.38 % (1,042 ha) of the LSA and 8.79% (527.2 ha) of the

Project footprint. A portion (1.4 ha) of one patterned fen that is considered unique for the Foothills Natural Sub-Regions, will be removed by the Project footprint.

Based on topography, mineral soil wetlands will be created to act as a transition zone between open water and re-vegetated vegetation communities. Vegetation typical of these wetland plant communities are expected to establish on the mineral soil along the margins of the open water where mineral soil is placed. In addition, at least a 3 m emergent zone (less than 1 m deep) will be planted with emergent vegetation species. As well, creation of an end pit lake in the reclaimed landscape that will have numerous wetland functions.

The final impact rating for wetlands is Moderate given the low success rate of re-establishing organic soil wetlands and the difficulty in establishing some mineral soil wetlands (Moreno-Mateos *et al.* 2012; Raab and Bayley 2012; Ballantine and Schneider 2009; Mitsch & Gosselink 2007; Price *et al.* 2003).

E.12.3.3 Rare Plants and Rare Plant Potential

Construction and operation of the Project will impact four rare plant species. These species include: *Penstemon albertinus (7)*; and *Coptis trifolia* (1); *Anastrophyllum helleranum* (2) and *Lophozia excise* (1) (CR #12, Table 5.3). Approximately 2,004.7 ha of Upper Foothills natural sub-region (33.44% of the LSA) and 12.2 ha of Lower Foothills natural sub-region (0.20% of the LSA) with rare plant potential will be impacted by the Project footprint.

Vegetation species ranking in Alberta is largely determined by the number of times a species is detected in the province. Given this system, low profile and hard to identify species are more likely to be listed as rare (ABMI 2007). Consequently, it is difficult to determine if some species are in fact rare, if they are at the edge of their natural range and only appear to be rare, or if they are taxonomically uncertain and have been misidentified or described as subspecies.

There were no vascular species with a provincial ranking of S1 – S3 and a global rank of less than G4 documented during field sampling for this assessment. In the event a vascular species is found prior to disturbance, avoidance of rare plant vegetation species ranked between S1 and S3 is the most certain option. Where avoidance is not an option, vascular plants (with a global ranking of < G4) are to be transplanted to a suitable plant community to aid in the dispersal of propagules. Transplanting has a low rate of success for rare vascular vegetation (Howald *et al.* 1996; Allen 1994). Non-vascular lichen and bryophyte species often have specific and microclimate requirements and/or symbiotic relationships. Consequently, transplanting is not a viable option for these species. No mitigation for lichen and bryophyte species is recommended. All rare plants documented will be reported to Alberta Conservation Information Management (ACIMS).

At Project closure, ecosite phases with high and very high rare plant potential will be established. Over time, revegetated ecosite phases should begin to function like mature ecosite phases and it is expected that the potential for these vegetation communities to support rare plants will return. The re-occurrence of natural disturbances, particularly fire, would enhance restoration of natural composition, structure and functioning, including enhanced rare plant potential. There were no rare (tracked) plant communities observed in the LSA.

The residual Project effect is Moderate due to the low rate of success for transplantation of vegetation (Howard *et al.* 1996; Allen 1994).

E.12.3.4 Traditional Ecological Knowledge Vegetation

TEK vegetation has a very high potential to occur in ecosite phases c3, d1, and i1, and a high potential to occur in e2, e3, and f3 in the Foothills Natural Sub-regions (CR #12, Table 4.7). In total 2,005.9 ha (33.44% of the LSA) of ecosite phases that support TEK vegetation potential are within the Project footprint (CR #12, Table 5.11) with 491.0 ha (8.19%) having a very high TEK potential and 367.6 ha (6.13%) having a high TEK potential. Ecosite phases (c3, d1, e2, e3, f3, g1, i1, l1, l2 and m1) which support critical medicinal use TEK vegetation cover 1,434.3 ha within the Project footprint (CR #12, Table 4.8) and are limited in distribution both locally and regionally.

Harvesting of forests, removal of old growth forests and removal of fens and bogs can all impact sustainable populations of TEK vegetation. The greatest impact in regard to TEK vegetation may be removing ecosite phases in the LSA which support critical medicinal use TEK vegetation. The best means of sustaining medicinal vegetation is to ensure that populations of vegetation species continue to grow and evolve in their intact native habitat (WHO 1986:24).

The distribution of ecosite phases (plant communities) which support TEK vegetation are expected to be available and accessible in the region (RSA) following removal of ecosite phases in the Project footprint. With mitigation and monitoring, the residual impact is expected to be Low.

E.12.3.5 Forest Resources

The Project will result in the removal of 184,795.8 m^3 (48%) of the timber volume from the LSA. Of that, 20,849.2 m^3 is considered good timber productivity and 135,653.6 m^3 is considered moderate (CR # 12, Table 5.5). Project effects on annual allowable cut (AAC) will be minimal because all merchantable timber salvaged from the Project will be made available to the FMA holder.

With mitigation, the impact rating for forest resources is Low given forest resources salvaged from the Project footprint will be made available to the FMA holder.

E.12.3.6 Old Growth Forest

Old growth forests are unique in terms of their composition, structure and functioning. Consequently, the maintenance of old growth forests is critical to supporting biodiversity. Within the Project footprint, approximately 137.3 ha (2.29% of the LSA) is old growth forest comprised of mostly pure aspen (45 ha) followed by pure black spruce (34.4 ha) (CR # 12, Table 5.7).

Approximately 2,016.9 ha (33.64% of the LSA) of the ecosite phases with potential to support old growth are within the Project footprint (CR # 12, Table 5.8). Of this, approximately 1,167.4 ha (19.47% of the LSA) of ecosite phases have a moderate potential to support old growth. Planned harvesting activities in the Project footprint will remove much of the old growth forest potential before it reaches its potential. Consequently, there are no areas within the LSA which are rated as having either high, or very high old growth potential and the highest rating is moderate.

With mitigation, the residual Project effect on old growth forests is low.

E.12.3.7 Biodiversity

Species Level Biodiversity

Construction and operation of the Project will result in the removal of all vegetation from the Project footprint and a reduction of native species level biodiversity will occur in the LSA.

Very high species richness was found in ecosite phases c3, e2, e3, f2, f3, f5, g1, h1, i1, l1 and m1 in the UF, and e3 and h1 in the LF. Higher species richness in c3, e2, e3, f2, f3, f5, g1 and h1 is indicative of the higher vascular vegetation (*i.e*. forbs and graminoids) species richness, but ecosite phases i1 and l1 are indicative of higher non-vascular vegetation (*i.e*. bryophytes and lichens) species richness. After closure, native species richness is expected to be lower than intact naturally developed ecosites in the LSA (CR #12, Section 5.6.3).

Community Level Biodiversity

In total, construction and operation of the Project will result in the removal of 2,004.7 ha of ecosite phases with moderate to high biodiversity potential in the UF natural sub-region footprint, and 12.2 ha of ecosite phases with moderate to high biodiversity potential in the LF natural sub-region footprint (Table E.12.2.6). Ecosite phases with high biodiversity potential ranking in the UF natural sub-region total 204.6 ha (33.44% of the LSA), and in the LF total 5.8 ha (0.20% of the LSA) (CR #12, Table 5.12, Figure 4.6). Ecosite phases g1 and m1 of the UF are limited in distribution at the landscape level so the impact to biodiversity will be the greatest for these ecosite phases.

Landscape Level Biodiversity

The Project will result in a decrease in the number of natural (ecosite phases) patches (576 to 543), a decrease in mean patch area of ecosite phases (7.2 ha to 4.6 ha), and a decrease in total perimeter (edge) length (1,639,615 m to 1,042,010 m) in the LSA (CR #12, Table 5.13). The decrease in the number of natural patches in the LSA at application is a result of broad level clearing for the Project into one large patch from multiple smaller natural patches. The decrease in mean patch area of ecosite phases is indicative of fragmentation from human disturbance. The decrease in total edge length is a reflection of many smaller natural (and some anthropogenic) patches being cleared for the Project. One very large (2,648.7 ha) patch, like the Project footprint, has a smaller total edge length than the total of multiple variable size and shape patches.

At application, landscape level fragmentation metrics demonstrate a reduction in the number of patches which is indicative of clearing one large area (patch) for the Project footprint versus the many smaller patches which existed at baseline in the same area. Mean patch area increases from 8.2 ha to 8.6 ha for the same reason. The total perimeter was also considerably reduced (299,802.5 m) as many of the patches within the Project footprint (with edge), will be cleared for construction and operations (Table E.12.3.1). Overall, a greater amount of patches will have a longer total edge, than just a few large patches. Mean perimeter to area ratio has increased indicating that the shape of the patches; overall, has changed to longer and narrower patches.

Table E.12.3.1 Baseline Landscape Level Fragmentation in the LSA

Time Period	Number of Patches (#)	Total Patch Area (ha)	Mean Patch Area (ha)	Patch Density (#/100 ha)	Total Perimeter Edge (m)	Mean Perimeter to Area Ratio	Mean of Nearest Neighbour Patch (m)
Baseline (2011)	734.0	5,995.8	8.2	12.2	820,807.5	884.1	327.7
Application (2015-19)	694.0	5,995.8	8.6	11.6	521,005.0	1,425.9	303.9
Difference	-40.0	0.0	0.5	-0.7	-299,802.5	541.8	-23.8

During the T0 time period (2015-2019), 2,648.7 ha (3.21% of the vegetation RSA) are being cleared for the Project footprint resulting in the mean patch size changing from 12.8 ha at baseline to 36.8 ha at T0 (2015-2019) which is a reflection of the Project (Table E.12.3.1). Over time, the mean patch area with the Project decreases in size to 19.3 ha at T5 (2020-2024) which is a result of the Project reclamation. At T45 (2046-2060) the weighted mean patch size slightly decreases again (16.9 ha) due to the Project being completely reclaimed.

Landscape level fragmentation in the RSA at T0 - *Application worst case scenario* demonstrates that the reduction (from 6.8 ha to 5.4 ha) in mean patch area is a result of the Project (Table E.12.3.2). However, at T45, when there is a significant amount of forest harvesting occurring at the median date of 2043, mean patch area decreases even further to 3.9. This indicates that the forest logging in the region has a significant impact on fragmentation. Similarly, the total number of patches on the landscape increased the most (8,426) between Baseline and T45 versus Baseline and T0 (2,998). As well, patch density (# of patches/100 ha) increased from 14.8 to 18.4 from Baseline to T0 and from 14.8 to 25.0 from Baseline to T45 (when the greatest harvesting takes place).

Table E.12.3.2 Landscape Level Fragmentation in the Vegetation RSA for Application

	Total Patch Area (ha)	Number of Patches (#)	Mean Patch Density (#/100ha)	Total Edge Distance (m)	Mean Patch Area (ha)	Mean Perimeter to Area Ratio	Mean Nearest Neighbour Distance (m)
Baseline (2011)	82,578.2	12,232	14.8	7,763,800	6.8	3,147.9	134.9
T0 (2015-19)	82,578.2	15,230	18.4	8,361,880	5.4	3,472.2	115.3
T5 (2020-24)	82,578.2	16,153	19.6	8,772,635	5.1	3,509.9	112.6
T10 (2025-34)	82,578.2	16,165	19.6	8,812,370	5.1	3,508.2	112.6
T25 (2040-45)	82,578.2	20,673	25.0	10,188,870	3.9	3,776.3	95.4
T45 (2046-60)	82,578.2	20,658	25.0	10,149,430	3.9	3,777.8	95.2
Difference (Baseline to Closing)	0.0	8,426	10.2	2,385,630	-2.9	629.9	-39.7

The Project footprint will be progressively re-vegetated which is expected to result in plant communities returning to pre-disturbance conditions. While the Project is expected to have a measurable impact on the landscape, over the long term (>60 years) the Project footprint is predicted to resemble early to mid succession vegetation communities if recommended mitigation and monitoring measures are implemented.

With the increased fragmentation of the LSA, it is expected that biodiversity will decrease. It is anticipated that populations of most native vegetation species will recover, given time, to near-baseline levels and that re-vegetated habitat is structurally and compositionally similar to that existing at baseline. With mitigation, the residual Project effect on biodiversity is low.

E.12.3.8 Noxious and Invasive Vegetation

Six noxious and invasive vegetation species (*Trifolium repens, Trifolium hybridum, Trifolium pratense, Phleum pratense, Poa pratensis and Ranunculus acris*) were noted in the Project footprint (CR #12, Figure 4.2). Occurrences of noxious and invasive species were mostly recorded only along existing disturbance. It will be particularly critical to control or eliminate weed populations to prevent the spread and re-establishment of weeds throughout the mine.

Through the lifetime of the Project, ongoing inspections will be conducted during each growing season to identify the presence of prohibited noxious and noxious weeds listed under the *Weed Control Act* and Regulation (Government of Alberta 2010). Should any prohibited noxious or noxious weeds be found, timely measures will be taken to control or eliminate the population. Methods for controlling weed populations include hand-pulling, cultivation and/or spot-spraying of herbicide and may be species dependant.

Non-native agronomic species observed within the LSA include timothy (*Phleum pretense*), Kentucky bluegrass (*Poa pratensis*), creeping red fescue (*Festuca rubra*), redtop (*Agrostis stolonifera*), smooth brome (*Bromus inermis*), alsike clover (*Trifolium hybridum*), red clover (*Trifolium pratense*), and white clover (*Trifolium repens*). These species are productive and quick to establish and they have the potential to become invasive in areas where the existing vegetation and soil has been disturbed. The best approach to limit or prevent dominance of these agronomic plants is to ensure timely reclamation and re-vegetation with suitable species that have the ability to establish cover and provide sufficient competition.

Other non-native species recorded within the LSA include hemp-nettle (*Galeopsis tetrahit*), common plantain (*Plantago major*), and dandelion (*Taraxacum officinale*). These forbs do not present an invasive threat but are more of a minor nuisance. As a result, no control measures are required for these species.

With mitigation and monitoring, the Project effect for noxious and invasive vegetation species is low.

E.12.3.9 Potential Acid Input

Regional air emissions modeling for the Project (including adjacent existing, approved and future Projects) indicate that the H^+ emissions are less than the threshold of 0.175 t/d. Therefore, according to the Acid Deposition Management Framework, a potential acid deposition input (PAI) assessment is not required for the Project (AENV 2008).

E.12.4 Cumulative Effects

The planned development case (Cumulative Effects Assessment) was used to assess the effect of the Project in combination with other future projects in the region. The planned development case assessment focussed on vegetation and biodiversity in the RSA.

E.12.4.1 Vegetation in the RSA

In order to assess the cumulative effects on vegetation within the RSA, modeling was carried out to predict the state of vegetation and wetland conditions at zero (T0, 2015-2019), 5 (T5, 2020-2024), 10 (T10, 2025-2034), 20 (T20, 2035-2039), 25 (T25, 2040-2045) and 45(T45, 2046-2060) years into the future. T25 is the anticipated worse-case scenario and T45 is the residual effects within the RSA. The greatest impact to the vegetation RSA is between 2028 and 2057 when 13,290.2 ha of forest will be logged. After 45 years (T45), closed regen treed and open mixed young forest increases by 1,157.8 ha and 1,421.1 ha respectively (CR #12; Table 5.3 and Figure 5.6). These increases are in the Project footprint are predicted and are based on mitigation measures being implemented.

Potential effects to vegetation and wetlands as a result of the Project will be mitigated through the re-vegetation activities. The re-vegetation activities will be aimed at the long term establishment of equivalent vegetation communities and wetlands that existed within the Project area prior to the Project. The final PDC assessment assumes that the effects from the identified development within the RSA, and close to the Project, will be mitigated in a similar manner as this Project given other projects fall under the same federal and provincial regulatory legislation and guidelines.

With mitigation, the residual impacts are rated as low.

E.12.4.2 Biodiversity

The Project, in combination with other projects in the RSA, will contribute cumulatively to fragmentation which in turn influences loss of biodiversity. Habitat fragmentation will increase with the addition of the Project in combination with other existing and approved future projects (*e.g.* Robb Trend) and planned forest harvesting in the RSA. Spatial patterns which are indicative of fragmentation are: an increase in patch density, inter-patch distance, and edge length; and a decrease in patch size, connectivity, interior to edge ratio and total interior area (Forman 1995:413).

Because much of the RSA at baseline is dominated by forest harvested cutblocks, natural succession will progressively increase in some of those areas that are mapped as open or closed regenerating. Concomitantly, most of the number of patches of natural dense conifer, natural closed regenerating and natural moderate conifer cover classes will increase as previously harvested stands mature. The Project and planned future forest harvesting (HWP 2010) will cumulatively result in those and other ELC classes being reduced while the Project area and forest cutblocks increase (CR #12, Table 5.17). The results for community level (ELC) fragmentation indicate that the number of patches will increase by 3,453 (from 16,153 at T5 to 19,606 at T45) while the mean area of individual patches will decrease by 1.9 ha (from 19.3 ha to 17.4 ha at T45).

Landscape level fragmentation at T5 demonstrates that the reduction in mean patch area (from 6.8 ha to 5.1 ha) is a result of the Project in combination with forest harvesting from 2023 and a portion of the area of the Coal Valley – Robb Trend project (CR #12, Table 5.18). At T45, when considerable forest harvesting is planned (13,393 ha), mean patch area decreases even further to 3.9. Similarly the total number of patches on the landscape increased the most between baseline and T45. As well, patch density increased from 14.8 to 19.6 from baseline to T5 and from 14.8 to 25 from baseline to T45. While the cumulative effects of the Project in combination with other human disturbance is expected to initially have an impact on fragmentation in the RSA, over the long term (>60 years) the Project footprint is predicted to be early to mid succession stage vegetation communities.

The removal of vegetation in the Project footprint will reduce species richness, habitat richness and diversity (some ecosite phases and land cover classes will either be completely removed or significantly reduced in extent) and increase habitat fragmentation. Responses of vegetation species populations to changes in habitat area and fragmentation are variable among species. Studies which have examined correlations between vegetation species richness and patch size have consistently indicated that larger patches support greater diversity of native vegetation and wildlife species than smaller patches (Forman 1995; Webb & Vermaat 1990; Peterken & Game 1984; Simberloff & Gotelli 1984; Weaver & Kellman 1981). The fragmentation results for this assessment are that patch number will increase, patch size will decrease and patch edge will increase.

With the increased fragmentation, it is expected that biodiversity will decrease. It is anticipated that populations of most native vegetation species will recover, given time, to near-baseline levels and that re-vegetated habitat is structurally and compositionally similar to that existing at baseline. With mitigation, the residual Project effect on biodiversity is low.

E.12.5 Mitigation and Monitoring

E.12.5.1 Mitigation

In order to reduce potential impacts of the Project on vegetation and wetland resources, Coalspur will:

- implement a revegetation program which aims at the establishment of equivalent vegetation communities and wetlands that existed within the Project area prior to the Project with consideration of those which are locally and regionally limited in distribution;
- minimize the area required for construction and operation of the Project to preserve adjacent vegetation communities;
- provide an appropriate soil substrate where revegetated areas can establish;
- seed stockpiled topsoil with suitable vegetation species mixes;
- use a certified seed-mix for erosion control, and use revegetation species that are compatible with the target vegetation communities;
- use coarse woody debris and forest floor (LFH) from adjacent areas yet to be disturbed to augment soils with mycorrhizal and microbial inoculums;
- use adjacent forest floor (of areas yet to be disturbed) for provision of propagules to enhance opportunity for re-establishment of native species composition;
- plant multi layers of native vegetation species (*e.g*. shrubs) to provide initial structure for wildlife habitat and to enhance biodiversity;
- develop strategies for avoiding herbaceous competition;
- if found, avoid areas of rare plant vegetation species ranked between S1 and S3 where possible;
- if found, transplant vascular plants with a provincial ranking of between S1 and S3 and with a global ranking of less than G4 where avoidance is not possible;
- report all rare plants documented to Alberta Conservation Information Management (ACIMS);
- use best practices to maintain the hydrologic regime of organic soil wetlands;
- create organic soil wetland “transition areas” between re-vegetated ecosite phases, where it is appropriate to do so;
- revegetate appropriate depression wetland areas to mineral soil wetlands, where possible;
- conduct revegetation of mineral soil wetlands with wetland riparian, emergent and sub-mergent vegetation species;
- salvage peat (organic soil) and propagule materials and store for replacement during wetland reclamation/reconstruction activities;
- direct place peat materials (organic soils and propagules) from adjacent organic wetlands to provide a living peat substrate and a propagule source for organic soil wetlands;
- maintain water flow (culverts) between wetlands divided by access roads;
- maintain drainage control structures to ensure water flow and flow patterns are maintained in wetlands adjacent to the Project footprint during the construction, operation, and closure phases of the Project;
- reclaim and revegetate bare ground progressively upon completion of mining;
- using recommended revegetation techniques and species that will limit the establishment and spread of noxious and invasive species;
- control any non-native and invasive vegetation species occurrences that are identified during inspections (monitoring);

- cleaning equipment arriving from offsite to remove soil and vegetative material before accessing the study area; and
- invite Aboriginal groups to participate in a mitigation monitoring program to assess the efficacy of mitigation and re-vegetation efforts.

E.12.5.2 Monitoring

In order to assess the effectiveness of the mitigation measures, Coalspur will:

- assess the composition, structure, ecological succession and biodiversity targets which aim at establishment of equivalent vegetation communities;
- perform survival, growth and health assessments of revegetated areas;
- monitor drainage control structures regularly to ensure water flow and flow patterns are maintained in wetlands adjacent to the Project footprint during the construction, operation, and closure phases of the Project;
- monitor road removal at Project closure to ensure restoration of the hydrologic regime;
- monitor reclaimed wetlands for a minimum of ten years to ensure the composition and structure, and key wetland functions are consistent with wetlands in the LSA;
- conduct regular site inspections during the life of the Project (construction and operation to closure) to identify if non-native and invasive species distribution, spread and establishment; and
- conduct multi-year monitoring of vegetation communities following Project closure.

E.12.6 Summary

Environmental effects on vegetation and wetland resources were assessed after accounting for relevant mitigation measures. These methods will be implemented in conjunction with the Project Reclamation Plan (Section F). Table E.12.6.1 summarizes the impacts to vegetation, wetlands, and rare plants.

Table E.12.6.1 Summary of Impact Ratings on Vegetation and Wetlands Resources Valued Environmental Components (VECs)

Nature of Potential Impact or Effect	Mitigation / Protection Plan	Type of Impact or Effect	Geographical Extent of Impact or Effect[1]	Duration of Impact or Effect[2]	Frequency of Impact or Effect[3]	Ability for Recovery from Impact or Effect[4]	Magnitude of Impact or Effect[5]	Project Contribution[6]	Confidence Rating[7]	Probability of Impact or Effect Occurrence[8]	Residual Impact Rating[9]
1. Terrestrial Vegetation/Plant Communities or Ecosite Phases											
Reduction in Plant Community Types & Area	Section E.12.5	Application	Local	Extended	Continuous	Reversible Long Term	High	Neutral	High	High	Low
		Cumulative	Local	Extended	Continuous	Reversible Long Term	High	Neutral	High	High	Low
2. Rare Plants, Rare Plant Communities and Rare Plant Potential											
Removal of Rare Species, Communities & Potential	Section E.12.5	Application	Local	Extended	Continuous	Reversible Long Term	High	Neutral	Low	High	Moderate
		Cumulative	Local	Extended	Continuous	Reversible Long Term	High	Neutral	Low	High	Low
3. Forest Resources											
Removal of Forests	Section E.12.5	Application	Local	Extended	Isolated	Reversible Long Term	Moderate	Neutral	High	High	Low
		Cumulative	Local	Extended	Isolated	Reversible Long Term	Moderate	Neutral	High	High	Low
4. Wetlands											
Reduction in Types & Area	Section E.12.5	Application	Local	Extended	Continuous	Reversible Long Term	High	Neutral	Low	High	Moderate
		Cumulative	Local	Extended	Continuous	Reversible Long Term	High	Neutral	Low	High	Low
5. Old Growth Forests											
Removal of Old Growth Forests	Section E.12.5	Application	Local	Extended	Isolated	Reversible Long Term	High	Neutral	High	High	Low
		Cumulative	Local	Extended	Isolated	Reversible Long Term	High	Neutral	High	High	Low

Table E.12.6.1 Summary of Impact Ratings on Vegetation and Wetlands Resources Valued Environmental Components (VECs)

Nature of Potential Impact or Effect	Mitigation / Protection Plan	Type of Impact or Effect	Geographical Extent of Impact or Effect[1]	Duration of Impact or Effect[2]	Frequency of Impact or Effect[3]	Ability for Recovery from Impact or Effect[4]	Magnitude of Impact or Effect[5]	Project Contribution[6]	Confidence Rating[7]	Probability of Impact or Effect Occurrence[8]	Residual Impact Rating[9]
6. Noxious Vegetation Species											
Spread of Invasive & Noxious Species	Section E.12.5	Application	Local	Extended	Periodic	Reversible Long Term	Low	Neutral	High	High	Low
		Cumulative	Local	Extended	Periodic	Reversible Long Term	Low	Neutral	High	High	Low
7. Traditionally Used Plants											
Removed from Footprint	Section E.12.5	Application	Local	Extended	Continuous	Reversible Long Term	Moderate	Neutral	High	High	Low
		Cumulative	Local	Extended	Continuous	Reversible Long Term	Moderate	Neutral	High	High	Low
8. Biodiversity											
Reduction in Genetic-Species Diversity	Section E.12.5	Application	Local	Extended	Continuous	Reversible Long Term	Moderate	Neutral	Moderate	High	Low
		Cumulative	Local	Extended	Continuous	Reversible Long Term	Moderate	Neutral	Moderate	High	Low
Reduction of Community Diversity	Section E.12.5	Application	Local	Extended	Continuous	Reversible Long Term	Moderate	Neutral	Moderate	High	Low
		Cumulative	Local	Extended	Continuous	Reversible Long Term	Moderate	Neutral	Moderate	High	Low
Reduction of Landscape Diversity	Section E.12.5	Application	Local	Extended	Continuous	Reversible Long Term	Moderate	Neutral	Moderate	High	Low
		Cumulative	Local	Extended	Continuous	Reversible Long Term	Moderate	Neutral	Moderate	High	Low

1. Local, Regional, Provincial, National, Global; 2. Short, Long, Extended, Residual; 3. Continuous, Isolated, Periodic, Occasional, Accidental, Seasonal; 4. Reversible in short term, Reversible in long term, Irreversible – rare; 5. No Impact, Low Impact, Moderate Impact, High Impact; 6. Neutral, Positive, Negative; 7. Low, Moderate, High; 8. Low, Medium, High; and, 9. No Impact, Low Impact, Moderate Impact, High Impact.

E.13 WILDLIFE

E.13.1 Introduction and Terms of Reference

Coalspur conducted an assessment of wildlife resources for the proposed Project. The following section is a summary of the Wildlife Impact Statement that was prepared by HAB-TECH Environmental Ltd. and is included as Consultant Report #13 (CR#13). For full details of the assessment please refer to CR #13.

AEW issued the ToR for the Project on January 24, 2012. The specific requirements for the hydrology component are provided in Section 3.7 of the ToR and are as follows:

3.7 WILDLIFE

3.7.1 Baseline Information

[A] Describe and map existing wildlife resources (amphibians, reptiles, birds and terrestrial and aquatic mammals). Describe species composition, distribution, relative abundance, seasonal movements, movement corridors, habitat requirements, key habitat areas, general life history including habitat disturbances and their use and potential use of habitats. Also identify any species that are:

- *a) listed as "at Risk, May be at Risk and Sensitive" in The Status of Alberta Species (Alberta Sustainable Resource Development);*
- *b) listed in Schedule 1 of the federal Species at Risk Act; and*
- *c) listed as "at risk" by COSEWIC.*

[B] Describe, quantify and map all existing habitat disturbance (including exploration activities) and identify those habitat disturbances that are related to existing and approved Project operations.

3.7.2 Impact Assessment

[A] Describe and assess the potential impacts of the Project to wildlife populations and wildlife habitats, considering:

- *a) how the Project will affect wildlife relative abundance, movement patterns, distribution and recruitment into regional populations for all stages of the Project;*
- *b) how improved or altered access may affect wildlife including potential obstruction of daily and seasonal movements, increased vehicle-wildlife collisions, and increased hunting pressures;*
- *c) how increased habitat fragmentation may affect wildlife considering edge effects, the availability of core habitat, and the influence of linear features and infrastructure on wildlife movements and other population parameters;*
- *d) the spatial and temporal changes to habitat availability and habitat effectiveness (types, quality, quantity, diversity and distribution);*
- *e) potential impacts on wildlife resulting from changes to air and water quality, including both acute and chronic effects to animal health;*
- *f) the resilience and recovery capabilities of wildlife populations and habitats to disturbance; and*
- *g) the potential for the Project Area to be returned to its existing state with respect to wildlife populations and their habitats.*

[B] Identify key indicator species and discuss the rationale for their selection.

[C] Comment on the availability of species for traditional use considering habitat loss, habitat avoidance, vehicle-wildlife collisions, increased non-aboriginal hunting pressure and other Project related impacts on wildlife populations

Based on known distributional range and habitat preferences, the mine permit area has potential to harbor as many as 243 vertebrate wildlife species including 184 birds, 52 mammals, five amphibians and two reptiles (CR #13, Appendix 1). Sixty (60) of the 243 potential species are listed as species at risk by either provincial or federal authorities, including 45 birds, 10 mammals, three amphibians and two reptiles. It is not feasible or necessary however to assess impacts on all 243 species with potential to occur in the study area. Eleven species/groups were selected as valued environmental components (VECs) for the assessment of Project and cumulative impacts on wildlife including:

- Moose;
- Elk;
- Marten;
- Lynx;
- Grizzly Bear;
- Northern Myotis;
- Cricetid Rodents and Shrews;
- Northern Goshawk;
- Brown Creeper;
- Western Toad; and
- Long-toed Salamander.

Three nested study areas were used to assess Project-specific and cumulative impacts on wildlife VECs (CR #13, Figure 1). The LSA includes the entire mine permit area and transportation/conveyor belt corridor boundaries. The RSA includes the sub-watersheds and ecodistricts surrounding the LSA and was used to provide regional context for assessing all VECs other than grizzly bear. The Grizzly Bear Regional Study Area (GRSA) is the same as cumulative effects assessment (CEA) study area and is based on sub-watersheds/Bear Management Units (BMU).

E.13.2 Baseline Conditions

The 74,495 ha wildlife RSA occurs in a transition zone including the Upper Foothills and Lower Foothills Natural Subregions of the Foothills Natural Region of Alberta (CR #13, Figure 2). Three ecodistricts dominate the RSA including the Wolf Lake Upland (44.5%), Obed Upland (38.2%) and the Ram River Foothills (17.3%). The LSA occurs mainly (87.2%) within the Wolf lake Upland ecodistrict of the Upper Foothills subregion. A smaller portion (12.8%) occurs in the Obed Upland ecodistrict of the Lower Foothills subregion.

E.13.2.1 Field Surveys

Baseline field surveys conducted as part of the assessment included:

- winter tracking field surveys;
- spring ungulate pellet group/browse surveys;
- wildlife hiding cover measures;
- breeding songbird survey;

- Pileated woodpecker call playback survey;
- amphibian call survey;
- owl call playback;
- raptor call playback; and
- bat mist net and ultrasonic detection survey.

Results of the field surveys are discussed in CR #13, Section 2.4.2. Baseline conditions for each of the VECs are discussed in detail in CR #13, Section 3.0.

E.13.2.2 Habitat Suitability

A land/vegetation cover mapping framework of appropriate scale was required to assess the effects of the project on existing VEC habitat supply in a regional context. Habitat mapping was derived from raster satellite data with pixels of 30 m x 30 m resolution. The mapping involved modifying the original 10 class land classification raster coverage provided by the Foothills Research Institute (FRI) with ancillary data including: percent conifer, crown closure and forest regeneration variables (Section E.12 and CR #12). Vegetation cover types were further broken into three age classes (young, mature and old seral stages) using forest origin year available from the FRI. Open and closed regenerating cover types were sub-divided into herbaceous, shrubby and treed based on age of origin. From this, a total of 44 land cover classes were mapped for wildlife assessment purposes.

The RSA is dominated by regenerating herbaceous, shrubby and forest which comprise 60.6% of the area (CR #13, Table 4). Approximately half of the regenerating forest in the RSA is from timber harvesting since about 1950. Older upland forests occupy 29.2% of the RSA. The most common forest cover type is mixedwood forest (19.7%), of which, closed, mature stands are most abundant. Non-harvested coniferous forests occupy 5.1% of the RSA, of which, closed, mature stands are also most common. Deciduous (broadleaf) forest stands comprise 4.4% of the RSA. Other common land cover types in the RSA include: natural shrubland (2.6%), treed wetland (2.6%), and natural upland herbaceous (2.0%).

With reference to regionally pertinent literature; 2006, 2007, 2009 and 2011 field studies; past regional field studies; and knowledge of wildlife-habitat relationships in the Rocky Mountains and Foothills, the suitability of each of the 44 vegetation cover types was assessed for eight of the 11 VECs (Table E.13.2.2). Grizzly bear habitat mapping was obtained from the Foothills Research Institute (2010 Deliverables). Mapping of habitat suitability for long-toed salamanders was not done at the land cover class level because of the localized nature of this animal's habitat use.

Table E.13.2.2 Habitat Suitability Ratings for Eight VECs

Land Cover Class	Moose	Elk	Marten	Lynx	Goshawk	Northern Myotis	Western Toad	Brown Creeper
Barren Land	VL	L	VL	VL	VL	VL	VL	VL
Closed Broadleaf Mature Forest	M	L	L	L	L	M	L	L
Closed Broadleaf Old Forest	H	L	H	L	H	VH	L	H
Closed Broadleaf Young Forest	H	L	L	L	L	L	M	L
Closed Conifer Mature Forest	L	L	H	M	L	M	L	M
Closed Conifer Old Forest	M	L	VH	H	M	H	L	VH
Closed Mixed Mature Forest	H	M	M	H	H	H	L	M

Table E.13.2.2 Habitat Suitability Ratings for Eight VECs

Land Cover Class	Moose	Elk	Marten	Lynx	Goshawk	Northern Myotis	Western Toad	Brown Creeper
Closed Mixed Old Forest	M	H	H	H	VH	VH	L	VH
Closed Mixed Young Forest	H	L	L	H	L	L	M	L
Closed Regen Treed	H	M	M	H	L	L	M	L
Dense Broadleaf Mature Forest	M	L	L	M	M	H	L	L
Dense Broadleaf Old Forest	M	L	H	M	H	VH	L	H
Dense Conifer Mature Forest	L	L	M	H	L	M	L	H
Dense Mixed Mature Forest	L	M	M	H	H	H	L	H
Dense Mixed Old Forest	L	M	H	M	VH	VH	L	VH
Dense Mixed Young Forest	M	L	L	H	L	L	L	L
Hinton - Settlement	VL	VL	VL	VL	VL	VL	VL	VL
Linear Disturbance	VL	L	VL	VL	VL	VL	VL	VL
Moderate Broadleaf Mature Forest	M	L	M	L	M	H	L	L
Moderate Broadleaf Old Forest	H	L	H	L	H	VH	L	M
Moderate Broadleaf Young Forest	H	L	L	M	L	L	L	L
Moderate Conifer Mature Forest	L	L	H	L	L	M	L	M
Moderate Conifer Old Forest	L	L	VH	H	M	H	L	VH
Moderate Mixed Mature Forest	L	M	M	M	M	H	L	M
Moderate Mixed Old Forest	L	H	H	M	H	VH	L	VH
Moderate Mixed Young Forest	L	L	L	M	L	L	M	L
Natural Shrubby	VH	M	M	M	L	VL	H	L
Natural Upland Herb	L	VH	L	L	VL	VL	L	VL
Open Water	H	L	L	VL	VL	VL	VH	L
Open Wetland Herbaceous	H	H	L	L	VL	VL	VH	L
Open Wetland Shrubby	VH	H	L	L	L	VL	VH	L
Open Broadleaf Mature Forest	H	M	L	M	L	L	M	L
Open Broadleaf Old Forest	H	M	M	M	M	M	M	H
Open Broadleaf Young Forest	VH	M	L	H	L	L	M	L
Open Conifer Mature Forest	M	M	H	L	L	L	M	M
Open Conifer Old Forest	M	M	VH	L	M	H	M	VH
Open Conifer Young Forest	H	M	M	M	L	L	M	VH
Open Mixed Mature Forest	M	H	L	M	M	L	M	H
Open Mixed Old Forest	H	H	H	M	H	H	M	VH

Table E.13.2.2 Habitat Suitability Ratings for Eight VECs

Land Cover Class	Moose	Elk	Marten	Lynx	Goshawk	Northern Myotis	Western Toad	Brown Creeper
Open Mixed Young Forest	H	M	L	M	L	L	M	L
Open Regen Herb	L	M	VL	L	VL	VL	L	L
Open Regen Shrub	H	M	L	H	L	VL	H	L
Treed Wetland	M	M	M	M	L	M	H	L
Undifferentiated Conifer	M	L	M	L	L	L	L	L

E.13.3 Potential Impacts

The wildlife assessment describes the nature of five potential effects on VEC habitat and populations:

- habitat alteration;
- sensory disturbance and effective habitat loss;
- habitat fragmentation;
- direct mortality; and
- barriers to movement.

E.13.3.1 Project Effects

Habitat Alteration

Habitat alteration is the physical change, loss or gain of habitats that are potentially useful to a wildlife species for feeding, denning, security and reproduction. For the proposed Project, the majority of habitat alteration will result from land clearing, surface mining, road building and other infrastructure developments. In the short-term, mining activities will generally change lands in the Project areas from natural forest/shrub to barren land and herb-dominated vegetation communities. Reclamation and natural succession will yield a range of vegetation conditions over time on a given site from herbaceous, to low shrub, to tall shrub/juvenile forest and eventually to mature forest (Walker et al., 2007). Each stage of natural succession will offer different habitat values to different wildlife species.

Using wildlife habitat suitability ratings for regional land cover types, changes in baseline supply of wildlife habitat were predicted for five time intervals (5, 10, 20, 25 and 45 years) after mining (Table E.13.3.1).

Table E.13.3.1 Projected Changes in Supply of Habitat Suitability by VEC - Application Scenario

VEC	Baseline					T05 (2020-2024)					T10 (2025 - 2034)					T20 (2035 - 2039)					T25 (2040 - 2045)					T45 (2046 - 2060)				
	VL	L	M	H	VH	VL	L	M	H	VH	VL	L	M	H	VH	VL	L	M	H	VH	VL	L	M	H	VH	VL	L	M	H	VH
Moose	6.1	14	5.6	70.7	3.9	8.8	13.8	5.2	68.7	3.4	8.0	14.2	5.2	69.1	3.4	7.2	10.9	7.1	71.3	3.4	5.9	24.6	5.4	61.0	3.1	5.3	8.0	9.4	74.1	3.1
Elk	2.3	7.7	81.9	6.8	1.3	5.4	6.5	80.6	6.3	1.2	4.6	6.5	81.4	6.3	1.2	3.9	7.4	81.2	6.2	1.2	2.2	6.0	85.1	5.6	2.2	2.2	6.5	84.9	5.3	1.1
Marten	9.3	36.1	45.2	9.2	0.3	13.3	41.8	36.7	7.9	0.2	12.9	42.3	36.7	7.9	0.2	9.0	38.8	44.0	7.9	0.2	23.5	41.8	27.9	6.5	0.2	6.3	50.8	36.2	6.5	0.2
Lynx	2.8	10.3	14.5	72.4	0.0	5.8	11.1	12.4	70.7	0.0	5.1	11.4	12.4	71.1	0.0	4.4	8.3	12.4	74.9	0.0	2.8	24.1	19.7	53.4	0.0	2.8	7.2	24.1	65.9	0.0
Northern Myotis	39.1	32.8	9.2	14.2	4.7	50.3	25.4	7.7	12.1	4.5	50.3	25.4	7.7	12.1	4.5	40.8	35.0	7.7	12.1	4.5	51.6	30.2	6.6	7.9	3.7	33.7	48.1	6.6	7.9	3.7
Northern Goshawk	11.2	67.8	2.7	13.8	4.6	15.1	66.7	2.1	11.7	4.4	14.6	67.2	2.1	11.7	4.4	10.8	71.0	2.1	11.7	4.4	25.0	61.8	2.0	7.7	3.6	7.8	79.0	2.0	7.7	3.6
Brown Creeper	4.2	70.2	16.6	3.9	5.0	7.2	71.1	13.8	3.2	4.7	6.4	71.8	13.8	3.2	4.7	5.7	72.5	13.8	3.2	4.7	3.9	80.2	9.9	2.3	3.9	3.9	80.2	9.9	2.3	3.9
Western Toad	2.3	32.6	34.8	28.8	1.5	5.3	30.1	27.1	36.0	1.5	4.5	30.5	27.1	36.4	1.5	3.8	27.2	36.6	31.0	1.5	2.3	36.7	31.8	27.4	1.8	2.2	20.1	49.4	26.7	1.5

Sensory (Effective) Habitat Loss

Human activities generate sensory stimuli (e.g., noise, visual presence) that have potential to affect wildlife species negatively, positively or neutrally. The main potential negative effects of human sensory disturbance on wildlife are habitat loss through avoidance and behaviors resulting in elevated and damaging levels of stress or susceptibility to predation (Whittaker and Knight 1998, Wasser *et al*. 2011). Wildlife may avoid using habitat that is floristically and structurally intact because of the presence of human activity and associated sensory disturbance. This can result in "effective habitat loss" (Weaver *et al.* 1987, Gibeau *et al.* 1996). The duration and magnitude of the human use and the behavioural response of the species in question determine whether the extent of the habitat loss will be complete, partial, temporary or permanent (Bromley 1985).

Habitat Fragmentation

Fragmentation occurs when continuous tracts of habitat are separated by habitat loss into dispersed and usually smaller patches of habitat (Fahrig 2003). Land uses such as agriculture, logging, mining and major transportation development contribute most to wildlife habitat fragmentation. Not only does fragmentation reduce the total amount of available habitat, it reduces the remaining habitat into smaller, more isolated patches (Meffe and Carroll 1997). Fragmentation increases the amount of edge habitat, decreases the amount of interior habitat, and increases the distance between habitat patches. Fragmentation generally has a negative effect on species that require extensive tracts of habitat such as interior-nesting birds and some large carnivores. The primary potential sources of habitat fragmentation associated with the Vista Project are the modification of landforms and the clearing of vegetation and habitat.

Increased Mortality

Increased mortality can occur directly or indirectly. Direct mortality involves human actions that immediately result in a dead animal. For this assessment, primary sources of direct mortality include legal and illegal hunting, fur harvest, defense-of-life and/or property, vehicle collisions, and government-sanctioned problem wildlife kills. Indirect mortality is more subtle and difficult to detect and assess. Although the impact itself does not cause the mortality, it can contribute to it. The establishment of new roads into inaccessible areas is one example. Building a new road is seldom the direct cause of an animal death but the new road can indirectly cause increased species mortality by providing hunters or trappers with easier access and enhanced kill success rates. Indirect mortality can also theoretically occur as a result of habitat loss. Increased mortality, whether caused directly or indirectly, is a particular concern for species such as grizzly bears which have low reproductive rates and are inherently dangerous when in contact with humans. In contrast, increased mortality is less of a concern for species such as western toad, brown creeper, marten, or lynx. These species have ample starting population sizes and high fecundity which enhance compensation for population losses.

Barriers to Movement

Daily and seasonal movements, dispersal and long-distance range shifts facilitate access to necessary resources, provide escape routes from natural and artificial catastrophes and promote the exchange of genetic material. Free movement of individuals dispersing from high quality habitat supporting source populations is a key to long-term persistence of meta-populations (Noss and Harris 1986). Some human activities have the potential to act as either filters or barriers to wildlife movement. Certain wary wildlife species are often reluctant to cross open areas lacking hiding cover, especially if there is noticeable human presence. Disruption of movement between patches of high quality habitat can lead to reduced optimization of food and reproductive resources. Under certain circumstances and over extended time frames this could result in blocked gene flow. Potential barriers to movement associated with the project are: 1) the removal of vegetation hiding cover by mining and road development; 2) traffic activity associated with hauling coal; and 3) the conveyor belt infrastructure, noise and associated road.

E.13.3.2 Moose

Moose is listed provincially as *Secure* (AFWD 2010) and is also considered to be secure at a national level. Moose are a popular and sought after big game animal in west-central Alberta. They are a common in the LSA and RSA but appear to have decreased in numbers in the last 10 to 15 years.

Increased Mortality

Sources of mortality of moose include predation, hunting/poaching, starvation, vehicle collision, drowning, parasitism, and disease (Schwartz and Franzmann 1997). The main sources of mortality are hunting and predation.

Potential sources of direct mortality of moose from the Project include vehicle collisions and increased traditional resource and regulated hunting success from additional access. Minimal new road construction is planned as part of the Project. As such, increases in hunting mortality from access are likely to be negligible. Hunting is not allowed on mines while they are under Mineral Surface Lease and public access is limited. Vehicle collisions will be very rare because of established speed limits (<70 kph), inherently slow speed of coal haul trucks, and hauling of most coal by conveyor belt.

Habitat Alteration

Moose are “selective generalists” in that they use a wide range of habitats throughout their home range but are adept at selecting optimum habitats seasonally (Peek 1997). Forage availability is the primary factor influencing moose use of landscape. Table E.13.3.1 shows projected changes in the supply of combined high and very high suitability moose habitat attributable to the Project after immediate construction. Combined high/very high suitability moose habitat in the LSA increases by 3.5% by T45 after a decrease by 14.1% at T25. The amount of high/very high suitability moose habitat at 45 years post construction is estimated to be 3.5% more than at baseline. After the immediate maximum effect of mining, the losses of moose habitat are ameliorated over time by early seral natural aging (‘succession’) of forests.

Sensory Disturbance

Effects of human activity and noise on moose are generally poorly understood. Moose will avoid active mining areas during construction and operations but will re-colonize after hiding cover is sufficient for security and construction related activities have ceased. Avoidance will occur as much because of lack of habitat and movement obstruction as because of sensory disturbance.

Movement Obstruction

The Project has potential to block moose movements from north to south across the mine permit area, northeast to southwest across the conveyor and east to west along McPherson Creek. Moose will be displaced by active mining as they will not be able to cross the pit disturbances. This displacement will occur until after reclamation and sufficient forage and security cover is established. A buffer of 200 to 400 m will be left along McPherson Creek which is of sufficient width to maintain moose movement from east to west.

Linear features such as secondary roads and seismic lines are not generally a major impediment to moose movement. The planned conveyor belt route for the Project will include six natural and four man-made crossing points where the clearance for wildlife movement will be 3 m or more. Remaining areas will offer one metre of clearance. Typical wildlife crossing designs are provided in Figures C.5.1.1 to C.5.1.7.

Moose will regularly cross the 10 combined man-made and natural crossing features but will not likely cross where it is only one metre high areas unless highly motivated or under duress. Three replicates of conveyor route baseline monitoring data are available (CR #13, Section 2.4.2.1) and on-going monitoring is recommended to determine moose crossing behavioral responses and frequencies.

Habitat Fragmentation

Mining, road building, and conveyor construction/operation are the main potential causes of fragmentation of moose habitat in the LSA. These development activities have potential to break up extensive habitats into smaller isolated patches, alter movements of moose and/or enhance efficiency of predators of moose, including humans.

A study of moose population densities in Alberta by Schneider and Wasel (2000) indicated an inherently strong resilience of moose to habitat fragmentation effects. They observed that moose population densities from systematic aerial surveys conducted in the early 1990s were higher in the settled White Zone (67 towns and 37% of land converted to cropland and cattle pasture) than in the Green Zone (minimal human activity). They postulated that the fragmented nature of the White Zone lands increased the overall carrying capacity for moose through increased early successional edge habitat. Based on available studies the overall effect of the Project on moose habitat fragmentation is rated as low.

E.13.3.3 Elk

Elk is listed provincially as *Secure* (AFWD 2010). It is not listed by COSEWIC (2012) and as such elk populations are considered to be secure at a national level. Elk occur in the RSA and LSA but sporadically and in low abundance. Based on well documented history in the Coal Branch (Bighorn Environmental Design Ltd. 1995; Bighorn Environmental Design Ltd. 1999; Bighorn Wildlife Technologies 2008), elk have considerable potential to colonize and thrive on the reclaimed mine in spite of current low levels of occurrence.

Increased Mortality

Based on experience from nearby mines it is likely that elk will colonize the reclaimed portions of the Vista mine approximately 10 years after the first successful reclamation (Bighorn Wildlife Technologies 2008). This colonization could occur while other portions of the lease are being mined. Regional elk populations will likely increase from their current level in the LSA and RSA as a result of limitations to hunting on the mine MSL and increased reproductive fitness from heightened forage/habitat quantity and quality. The Vista Coal Project will not result in increased mortality or result in local population declines.

Habitat Alteration

The Project will increase regional elk habitat suitability for winter forage by Years 15 to 20 at which time elk are expected to colonize this new habitat resulting in a potential increase in the regional elk population. Minor decreases in high/very high suitability elk habitat in the entire RSA will occur from baseline to T25 because of aging of regenerating herbaceous cutblocks. Once reclamation is complete on the mine, positive habitat effects should last 25-50 years at which time, at Year 50, elk habitat suitability will be reduced by just over 20% in the RSA.

Sensory Disturbance

Monitoring of elk response to surface coal mining on other mines in the area strongly suggests that sensory disturbance from mining activities is a temporary effect of approximately 10 years. Documented recolonization of these mines in spite of on-going mining activity indicates that sensory disturbance occurs only during early mining and is offset by attraction to high quality early succession habitats after reclamation.

Movement Obstruction

Field surveys during 2011 and 2012 indicate sporadic occurrence in the LSA and surrounding RSA. Precise timing and location of movements of the limited number of elk currently using the Vista LSA and RSA are unknown. Based on past studies (Techman Engineering Ltd. 1982; Bighorn Wildlife Technologies 2008) elk utilize the McLeod River valley for wintering and for local movements between high quality habitat patches. Active mining will limit any elk movement across the mine lease. Approximately 10 years after reclamation elk will move freely across portions of the mine to seek high quality forage, in spite of the effects of mining. The conveyor and associated road have potential to obstruct southwest to northeast movement of elk. This effect is expected to be minor as very few elk trails were observed in three tracking bouts in 2012 in the conveyor area.

Habitat Fragmentation

Surface mining will alter landforms and vegetation markedly for a large portion of the LSA and this alteration will affect elk negatively for approximately 10 years. This effect is expected to be minor because of the limited baseline occurrence of elk in the area. There is strong evidence that elk will colonize the mine reclaim areas in spite of local and regional fragmentation effects. Because elk is an early seral species that favours grassland/herbaceous openings, the effects of fragmentation will be minimal.

E.13.3.4 Marten

Marten is listed as Secure by the Alberta Fish and Wildlife Division (2010). It is not listed by COSEWIC (2012) and as such marten populations are considered to be secure at a national level. They are a commonly trapped carnivore in the local/regional study areas and are an important species to registered fur trappers. They are a common species in the LSA and RSA. Trail densities in winters of 2011 and 2012 indicate above-average population levels.

Increased Mortality

Local extirpations of marten can occur as a result of over-trapping (Thompson 1991). Although current trapping levels are unknown, with chronically suppressed fur prices, it is unlikely that over-trapping is or will be occurring. Trapping access will not improve materially as a result of the development of the proposed mine as limited new open roads will be built. The development of the Project is unlikely to cause a material increase in direct marten mortality.

Habitat Alteration

High and very high suitability marten habitat in the RSA was considered to be comprised of moderate to dense canopy mature and old growth conifer forest, open old growth conifer and old growth mixedwood forest (Table E.13.2.2). At baseline, such habitats comprise 9.5% of the RSA. High/very high suitability marten habitat is projected to decrease by 14.7% by T05, T10 and T20 and then by an additional 14.3% by T25 and T45 (Table E.13.3.1). In the absence of fire, some mature stands will become very high quality old growth stands. This will ameliorate calculated marten habitat loss by an unknown extent.

Sensory Disturbance

Marten are not known to be seriously affected by human presence unless excessive trapping and /or extensive forest fragmentation occurs (Buskirk and Ruggiero 1994). Marten will possibly avoid some high quality habitat during blasting and coal hauling during active mining but this will be a short to medium-term effect with limited demographic consequences.

Movement Obstruction

Marten move across the landscape in a manner that optimizes food resources within their home range and minimizes predation risk (Buskirk and Ruggiero 1994; Cushman et a. 2011). Open areas that have no tree or tall shrub overstory are generally avoided (Spencer et al. 1983, Hargis and McCullough 1984, Buskirk and Powell 1994; Godbout and Ouellet 2010; Cushman et al. 2011). Marten movements can be enhanced by linking open areas between forest stands with islands of forest cover and coarse woody debris (Soutiere 1979, Steventon and Major 1982).

Marten movements will be limited on the mine site until regenerating forest cover re-establishes, likely sometime between 15 and 30 years post-reclamation. Retention of residual tree islands or riparian buffers at narrow portions of the mine will enhance marten movement in the interim. The movement obstruction effect will not differ significantly from a clearcut or an intense fire especially if direct placement of soil and slash is conducted and shrubs are planted.

Habitat Fragmentation

Marten are adapted to and can tolerate a degree of habitat fragmentation within their home range. The current percentage of regenerating clearcuts in the LSA is less than published thresholds but in the RSA is greater. The proposed Project will initially add another 3.5% of recently cleared forest to the RSA and will clear almost half (44%) of the LSA. This amount of incremental regenerating forest leaves the LSA and RSA above thresholds for habitat fragmentation conducive to marten residence (i.e. from 20% to 50%). It is clear from winter tracking surveys however that marten trail densities are at normal to above normal levels in spite of current levels of fragmentation in the RSA.

E.13.3.5 Lynx

Lynx is listed as a *Sensitive* by the Alberta Fish and Wildlife Division (2010), meaning that it is a species not at risk of extinction or extirpation but that may require special attention to protect it from becoming at risk. Lynx are widely distributed but uncommon in the LSA and RSA. Winter tracking inventories in 2011 to 2012 recorded a total of 69 lynx trails for an overall density of 0.23 trails per km-day in the RSA. Based on comparison to other tracking studies in the region and province, lynx were near the top of their population cycle in 2011/12.

Increased Mortality

The main potential causes of lynx mortality arising from the Vista Project are: 1) vehicle collisions from coal haul; and, 2) increased fur harvest resulting from new access. Unlike cougars, lynx are not a big game species in Alberta. Therefore, increased legal hunting pressure due to improved human access will not likely occur. Trapping of lynx is quota-based and recent lynx harvest has not been excessive (< 0.5 lynx per year per trapline). Trapping access will not improve materially as a result of the development of the Vista Project. Vehicle speeds are reduced on mines to <70 kph further reducing the likelihood of vehicle collisions. Overall, it is predicted that development of the Vista Project is unlikely to cause an increase in direct lynx mortality outside of the range of natural variability.

Habitat Alteration

As is the case for most boreal wildlife species, lynx have evolved and survived in the face of dynamic and unpredictably changing habitat structure and composition. Habitats rated as high and very high suitability for lynx included: closed and dense canopy coniferous and mixedwood forests, and shrubby and treed regenerating clearcuts (Table E.13.2.2). At baseline, such habitats comprise 72.4% of the RSA. High/very high suitability lynx habitat is projected to increase by 3.5% by T20 and then decrease by 9.0% from baseline by T45 (Table E.13.3.1). The amount of habitat change lies well within the natural variability of boreal fire events.

Sensory Disturbance

Lynx are generally tolerant of human presence and activity (Staples 1995). Lynx will likely temporarily avoid areas within the mine permit adjacent to active mining (blasting and active hauling). This effect will be short-term and based on the above evidence will not likely persist beyond the actual period of the effect (i.e. active mining).

Movement Obstruction

Free movement of individual lynx is necessary to access high quality food and security cover, provide escape routes from natural and anthropogenic catastrophes, and to promote exchange of genetic materials. Lynx are effective dispersers and their movement does not appear to be significantly affected by roads, trails, seismic lines, large rivers or lakes. Lynx movements will be limited on the mine site until medium to tall shrub or forest cover re-establishes, likely sometime between 10 and 25 years post-construction. Retention of residual tree islands or riparian buffers at narrow portions of the mine will enhance lynx movement. This effect will not differ significantly however from an intense fire especially if direct placement of soil and slash is conducted.

Habitat Fragmentation

Potential effects of fragmentation on lynx that are of most concern to biologists include:

- reduction of area and patch size of late-successional forest and of optimal snowshoe hare habitat;
- alteration of the amounts and structural complexity of seral forest stands;
- creation of early-seral openings that facilitate access by competing predators (e.g. coyote);
- increased densities of edges between early successional and older forest types; and,
- reduction or blockage of movement of lynx to and from high quality habitat patches.

There is some evidence to suggest that competition with coyotes can result in negative consequences for lynx (Buskirk et al. 2000). The ratio of lynx trail density (0.31 trails/km-day) to coyote trail density (0.21 trails/km-day) in the RSA does not indicate that coyote populations are at abnormally high levels in the region and that the lynx population is being affected.

Lynx move freely on the landscape in spite of roads, trails, seismic lines and cutblocks. The mine will limit lynx movement temporarily. Once shrub cover reaches over a metre tall (in 10 to 15 years) lynx will return to reclaimed mine areas to travel and hunt. Lynx trail densities suggest a population at or above normal levels, this in spite of relatively high levels of forest fragmentation.

E.13.3.6 Grizzly Bear

Grizzly bear is listed as *Special Concern* nationally by COSEWIC (2012). In Alberta, the grizzly bear is listed as *At Risk* under the 2010 General Status evaluation and *Threatened* under the *Wildlife Act* (AFWD 2010). Grizzly bears occur throughout the Coal Branch region with decreasing likelihood of occurrence from higher elevations in the west to lower elevations in the east (Boulanger and Stenhouse 2010). All of the LSA and 55% of the grizzly bear RSA occurs within core grizzly range as mapped by ASRD. Twenty three different radio-collared grizzly bears spent time in the 2825 km^2 GRSA from 1999 to 2006, while eight different bears frequented the 59 km^2 LSA. A considerable amount of empirical research information related to the ecology and response to human land use of this species is available in the region. This region-specific information is used extensively to assess Project and cumulative impacts.

Increased Mortality

Direct human caused mortality, primarily licensed hunting and illegal and self-defence kills, is the factor most responsible for grizzly bear population declines in Alberta and elsewhere in North America (Servheen 1990, Mattson 1993, Alberta Grizzly Bear Recovery Team 2005, ASRD and ACA 2010).

Records of 93 grizzly bear mortalities from the Yellowhead region (WMUs 326, 328, 330, 339, 340, 342, 344, 346, 347, 349, 350, 352, 429, 430, 432, 434, 436, 437 and 438) from 1999 to 2011 showed the following sources of death:

- legal hunting (45);
- illegal or suspected illegal (21);
- self-defense (8);
- research accidents (4);
- unknown (4);
- vehicle collision (3);
- found dead (3);
- natural (2);
- Treaty (2); and
- problem wildlife (1).

Direct mortality of grizzly bears from the proposed Vista mine is unlikely. Neither legal hunting nor firearms are allowed on mine permit areas. There are no records of grizzly bear deaths (radio-collared or otherwise) on mine lands in the last 40+ years of active mining in the Coal Branch (Symbaluk 2008). This lack of mortalities on mine permit lands is likely the result of firearm restrictions and high levels of construction and operation activity dissuading illegal actions. Death of grizzly/brown bears from vehicle collisions normally occurs on high speed roads (>90 kph) (Gunther et al. 1998, Servheen et al. 1998, Clevenger et al. 2002, Kaczensky et al. 2003). Speed limits on coal haul roads are less than 70 kph and the majority of coal haul will be via conveyor belt. Sources of garbage at the mines are incinerated or removed promptly from the mine. Problem bear actions at mines in the Coal Branch region are of extremely limited occurrence.

Upon closure and decommissioning, reclaimed mined lands once again revert to the Province of Alberta. Symbaluk (2008) and Kansas and Symbaluk (2011) noted that it is after mine closure that grizzly bears are most vulnerable to potential increases in mortality associated with public access (e.g., mistaken identity kills, defense of life and property, illegal hunting). Without careful land planning and management, an attractive source for grizzly bears has potential to quickly become a mortality sink.

Habitat **Alteration**

Observations at existing mines in the Coal Branch area can be used to assess the potential impacts of the Project. Mining and subsequent reclamation of the existing Coal Valley Mine (40 km southwest of the LSA) has significantly changed landscape structure, composition and food production in the permit area for grizzly bears. Mining and reclamation in the Coal Valley Mine has resulted in removal of tree canopies, leading to increases in availability of high energy herbaceous plant material (clover, thistles, legumes) and an increase in ungulates (elk, deer) responding to increased forage and edge habitat. There is strong evidence to suggest that ungulates and plants used for reclamation are sought and used extensively by grizzly bears occurring in the vicinity of the Coal Valley Mine area (Kansas and Charlebois 2008). Similar findings were observed in the existing Luscar and Gregg River mines (Stevens and Duval 2005; Kansas and Symbaluk 2011). Bears using the reclaimed Luscar and Gregg River mine lands were on average larger than bears in an adjacent un-mined Subalpine and the Gregg/Luscar permit block was considered to be an attractive habitat for grizzly bears and a source for enhanced cub production (Kansas 2005). If similar reclamation measures are used on the Vista mine, then impacts on grizzly bears from a habitat alteration perspective will likely be positive within 10 years post construction.

Sensory Disturbance/Movement Obstruction

BIOS (1996) considered the interruption/alteration of movement corridors to be "…one of the most serious consequences of the Cheviot Project" for carnivores. They rated effects of movement obstruction on grizzly bears as adverse and non-mitigable after 20 (short-term) and 100 (long-term) years. One of the primary reasons for these ratings was that bears would require trees as hiding cover for crossing the mine and that such cover would probably not occur on the mine site over the long-term. Kansas and Collister (1999) also rated project-specific (local) impacts of the Cheviot mine on grizzly bear movement to be significant. Cumulative (regional) effects to the year 2025 were however rated as low impact primarily because post-mining reclamation and abandonment was predicted to result in grizzly bear movement across the mine sites.

Subsequent analysis of extensive radio-telemetry locations collected by the FMFGRP from 1999 to 2003 indicates that grizzly bears generally move freely across areas of dispersed as well as concentrated human use in the Yellowhead region (Stenhouse and Graham 2005). Analysis of road crossings showed no evidence that roads with high volume traffic (>100 vehicle passes per day) acted as barriers to grizzly bear movements (Graham et al. 2005).

Grizzly bears routinely used the mine permit footprint areas of the existing Coal Valley Mine between 1999 and 2005 (Kansas and Charlebois 2008). A total of 16 grizzly bears (960 locations) occurred within the Coal Valley mine permit area between 1999 and 2005. Eight of these animals spent time in the permit area for more than one year with one bear spending four years, two bears for three years and five bears for two years. The Coal Valley Mine Permit area supported one of the highest number of grizzly bear locations (6.2) per km^2 and was utilized by a large number of different bears relative to its small size (Kansas and Charlebois 2008). Of the 16 bears and 960 locations recorded within the Coal Valley mine permit area 13 bears spent time (170 locations) within the boundaries of the mine footprint – most of this in the reclaimed areas (Kansas and Charlebois 2008).

Grizzly bears will likely be displaced from portions of the LSA during the active mining period. Displacement will result in part from construction noise and blasting. At some point shortly after reclamation grizzly bears will be attracted to the herbaceous forage and ungulates on the mine footprint as was observed on the Luscar, Gregg River and Coal Valley Mine reclaimed mine areas. The mined lands will not act as a serious barrier to grizzly bear movements, with the possible exception of during active blasting and hauling.

E.13.3.7 Northern Myotis

The northern myotis is listed as *May be at Risk* in Alberta. In February 2012, an emergency assessment subcommittee of COSEWIC assessed the status of northern myotis as *Endangered*. Baseline inventory data for northern myotis in Alberta is very limited and, as a result, insufficient inventory is available to assess or report on local or regional population trend. Two bats were captured at eight trapping locations (2 in the LSA and 6 in the RSA), of which, one was confirmed to be northern myotis and one a little brown bat (*Myotis lucifugus*). Neither capture was in the LSA. Bats of the genus Myotis were detected at 12 sites (54.5%) in the RSA and 9 sites (22.5%) in the LSA. These detections were attributed to northern myotis or little brown bat. If it assumed that half of the detections were of northern myotis then it is apparent that this species is relatively common in the RSA and somewhat less common in the LSA.

Increased Mortality

The main factor currently limiting northern myotis in Canada is White Nose Syndrome a fungus that propagates in bat tissue when they are in torpor in winter hibernacula. The Vista Project will not contribute to this source of mortality as it is located over 40 km from the winter hibernacula near Cadomin.

Habitat Alteration

One of the limiting factors of northern myotis in Alberta is the availability of roosting habitat (Lausen 2009). For the purposes of habitat projections very high suitability land cover classes for northern myotis included dense, closed and moderate canopy old growth deciduous and mixedwood forests (Table E.13.2.2). At baseline, high/very high suitability habitats for northern myotis occupy 18.9% of the Vista RSA. High/very high suitability northern myotis habitat is projected to decrease by 12.2% by T20 and then decrease by 38.6% from baseline by T45 (Table E.13.3.1). In the absence of fire, some younger forest stands will become very high quality old growth stands for northern myotis. This will ameliorate calculated northern myotis habitat loss by an unknown extent.

Sensory Disturbance

Bats, including northern myotis are particularly sensitive to sensory disturbance at their winter hibernacula (Lausen 2009, Olson et al. 2011). The Project will not contribute to sensory disturbance at hibernacula as it is located over 40 km from the winter hibernacula.

Movement Obstruction

Northern myotis is an interior forest species that generally avoids open, non-forested areas (Hogberg 2002, Patriquin and Barclay 2003, Henderson and Broders 2008). It is not likely that northern myotis will travel across wide stretches of the mine site (>75 m) for several decades after mining although foraging and commuting along edges of the mine is likely to occur.

Habitat Fragmentation

Being a boreal forest species, northern myotis clearly evolved in a spatially and temporally complex and fragmented landscape. Studies have shown that although northern myotis roost in fragmented forest environments (Lausen 2009), movement and home range sizes are reduced as fragmentation levels increase (Broders et al. 2006). The effect that these changes in movement rates and home ranges have on population viability, are currently unknown. It is clear from baseline inventory for this Project that northern bats are relatively common residents in a region that has experienced first-pass and early second pass timber harvest. The extent to which further fragmentation from the Vista mine will affect regional northern bat populations is unclear, primarily because of limited population research information.

E.13.3.8 Small Mammals

A variety of mice, voles and shrews occur in the Coal Branch region. Although no project-specific inventory was completed for this project, previous surveys in the region indicate that small mammal species most likely to occur in the LSA at baseline include: Southern red-backed vole; Meadow Vole; Arctic Shrew; Dusky Shrew; Deer Mouse; and Western Jumping Mouse. None of these species are listed as at risk provincially or nationally. High numbers and small home range size allows populations of most species of small mammals to remain stable and viable.

Increased Mortality

Surface mining will initially result in increased mortality of all small mammal species. It is expected that most species will recolonize the reclaimed mine surface as natural succession progresses.

Habitat Alteration

Different species of small mammals utilize different habitats and exploit different seral stages (e.g. ruderal grasslands versus older forests). Peles and Barrett (1996) found that standing vegetation and litter abundance are key components in habitat selection for meadow voles and suggest that providing a well-developed shrub layer with substantial litter cover (often achieved through the presence of graminoids) would be a useful strategy for reclamation for this species. To provide adequate reclamation for a variety of shrew species it is important to provide interspersed wet habitats, such as fens and riparian areas. Creating habitats with a combination of graminoid cover, shrub cover, and moss will provide essential habitat for a variety of shrew species. Deer mice are an early succession species often found in open areas with abundant bare ground. They occur early in the reclamation sequence in boreal mines (Bighorn Environmental Design 1995).

Sensory Disturbance

Sensory disturbance is not an issue affecting small mammal populations.

Movement Obstruction

Movement obstruction will occur during mining but is not an issue once hiding cover occurs.

Habitat Fragmentation

The mine will markedly alter vegetation supply and distribution in time and space. This will in turn alter small mammal composition, diversity and abundance.

E.13.3.9 Northern Goshawk

The northern goshawk is classified as Sensitive in Alberta according to the current *General Status of Alberta Wild Species* report. Primary conservation concern for this species is that human encroachment and specifically industrial development on nesting habitat may be reducing boreal forest populations. The northern goshawk is an uncommon year-round resident in the Coal Branch region. A single northern goshawk was heard in the LSA during raptor call playback surveys in spring of 2011. The current population status and trend of this species is unknown in the Vista RSA.

Increased Mortality

The main source of northern goshawk mortality in North America is natural predation of eggs and nestlings by species such as Great Horned Owl, marten and fisher (Cooper and Stevens 2000). Great horned owl were not observed during owl surveys in 2011 indicating that habitat fragmentation is not at the level that would promote great horned owl occupancy. The Vista Project is not likely to result in increased mortality of northern goshawk.

Habitat Alteration

Breeding habitat loss and alteration is the largest single threat to northern goshawk populations in North America (Cooper and Stevens 2000, Bush 2006). Very high suitability northern goshawk habitat in the RSA includes dense and closed old growth mixedwood forest. Habitats rated as high suitability included: moderate canopy old mixedwood, moderate and dense old growth broadleaf forest, open mixedwood old growth forest, and closed mature mixedwood forest (Table E.13.2.2). At baseline, such habitats comprise 18.4% of the RSA. High/very high suitability northern goshawk habitat is projected to decrease by 12.5% by T05, T10 and T20 and by 38.6% by T25 and T45 (Table E.13.3.1). In the absence of fire, some mature stands will become very high quality old growth stands. This will ameliorate calculated northern goshawk habitat loss by an unknown extent.

Sensory Disturbance

There is some evidence that northern goshawks may abandon nests because of human disturbance (noise, industrial activity, roads etc.). This has not, however, been identified as a major limiting factor for this species (Cooper and Stevens 2000).

Movement Obstruction

The volant nature of this species will limit movement obstruction effects of the mine. Avoidance of the mined lands will be related more to lack of nesting habitat.

Habitat Fragmentation

Northern goshawks in the boreal forest are resilient to certain levels of fragmentation from forest clearing as would be expected given that they evolved in fire-driven landscapes (Penteriani and Faivre 2001; Mahon and Doyle 2005, Bush 2006). Threshold levels of timber harvest and land clearing to maintain northern goshawks in Alberta have not been determined. Mahon and Doyle (2005) found that removal of up to 50% of nest area forest stand did not result in reduced reoccupation or fledging rates.

E.13.3.10 Brown Creeper

Brown creeper is a mature/old forest-dependent species that is potentially vulnerable to forest fragmentation (ASRD 2003). This species is classified as Sensitive in Alberta according to the current *General Status of Alberta Wild Species* report. Brown creeper is not listed as at risk nationally. Four brown creepers were detected in the RSA during breeding bird point count surveys in June 2011. One of these was recorded in the LSA and three in the RSA.

Increased Mortality

Mine construction has potential to cause mortality of birds at nest sites. Completing land clearing activities outside of the nesting/fledging period will significantly reduce this risk.

Habitat Alteration

Brown creepers require large diameter trees to forage and nest and as such are directly affected by removal of mature and old forests either through natural fire or timber harvest (Farr 1995, Poulin *et al*. 2008). Such findings notwithstanding there is some indication that breeding birds in the boreal forest that have evolved with frequent small- and large-scale natural disturbances, may be somewhat resilient to lesser human-induced habitat changes, such as timber harvest. (Schmiegelow *et al.* 1997).

Very high suitability brown creeper habitat in the RSA includes open, moderate, closed and dense canopy old conifer and mixedwood forest. Habitats rated as high suitability included: open canopy old broadleaf forest and dense canopy mature conifer forest (Table E.13.2.2). At baseline, such habitats comprise 8.9% of the RSA. High/very high suitability brown creeper habitat is projected to decrease by 11.2% by T05, T10 and T20 and by 30.3% by T25 and T45 (Table E.13.3.1). In the absence of fire, some mature stands will become very high quality old growth stands. This will ameliorate calculated brown creeper habitat loss by an unknown extent.

Sensory Disturbance

There is limited evidence that brown creeper may be sensitive to human disturbance at nest sites (ASRD 2003) but no linkages to population level effects have been reported.

Movement Obstruction

The volant nature of this species will limit movement obstruction effects of the mine. Avoidance of the mine will be related more to lack of nesting habitat.

Habitat Fragmentation

Mine development will temporarily remove habitat at the local scale and will fragment habitat at the regional scale. The scale of fragmentation from the mine is minor in comparison to large or even medium scale boreal fire events (Andison 1998). Brown Creeper prefers a continuous area of at least 3 ha of mature to old forest around the nest site (Doyon et al. 2000, Keller and Anderson 1992).

E.13.3.11 Western Toad

The western toad is listed as Special Concern nationally and as sensitive in Alberta. It is a Schedule 1 SARA species. It is the only Canadian amphibian on the International Union for the Conservation of Nature Red list. Call count surveys conducted in spring 2011 found western toads to be relatively abundant, being recorded in 50% (19/38) of sampling points.

Increased Mortality

Direct mortality of western toads from the Vista Project could occur as a result of: 1) land clearing of breeding sites during construction; and, 2) vehicle collisions during construction and operations. Ward and Chapman (1995) noted that direct toad mortality from timber harvesting may be reduced because harvesting occurs in winter. Minimizing clearing during spring and mid-summer months would reduce toad mortality. The public access road associated with the conveyor has potential to result in mortality of toads.

Habitat Alteration

The primary concern for western toads related to development projects is removal of breeding habitat. Habitats rated as very high suitability for western toads included: open water, open wetland-herbaceous and open wetland-shrubby (Table E.13.2.2). Land cover classes rated as high quality were treed wetland, natural shrubby and open regeneration-shrubby. At baseline, combined high/very high suitability habitats comprise 30.3% of the Vista RSA. High/very high suitability toad habitat is projected to increase by from 7.2% to 25.1% from baseline by T20 and then decrease by 6.9% from baseline by T45 (Table E.13.3.1). The amount of habitat change lies well within the natural variability of boreal fire events.

Sensory Disturbance

Sensory disturbance is not a significant limiting factor of western toad populations.

Movement Obstruction

Western toads require wetland and upland habitat and movement corridors between these areas. Western toads migrate from 300 m to 5 km each spring from their winter terrestrial hibernation sites to aquatic breeding sites. They then travel to terrestrial feeding sites during the summer. Wind and Dupuis (2002) observed that habitat corridors between wetlands would likely be beneficial but the extent of protection they would offer and the details for optimal design were unknown. Rescan Tahltan Environmental Consultants (2008) noted that roads have potential to create a significant barrier to amphibian movement (Carr and Fahrig, 2001).

Habitat Fragmentation

Western toads appear to be resilient to the fragmentation effects of clearcut timber harvest. This is indicated by the high proportion (50%) of occurrences of western toad calls at amphibian survey counts in the LSA/RSA, which currently supports greater than 30% of recent clearcuts. The proposed Vista Project will add to the existing fragmentation from clearcut timber harvest but will comprise a small percentage (<10%) of the total fragmentation in the RSA.

E.13.3.12 Long-toed Salamander

Coalspur conducted a survey of long-toed salamander in the Project area. The assessment Bighorn Wildlife Technologies Ltd. (2012) entitled: "*The Long-toed Salamander and Columbia Spotted Frog Vista Coal Project"* is included in CR #13 as Appendix 4. The following information is based on the assessment conducted by Bighorn Wildlife Technologies Ltd. (2012).

The long-toed Salamander is listed as a "Species of Special Concern" in Alberta (AFWD 2010). It occurs in a few, patchy disjunct populations in mountain riparian areas and its distribution may be declining. It is considered to be vulnerable to habitat destruction/alteration associated with industrial, recreational and transportation development. In the Hinton area Long-toed Salamander population groupings are found in the Montane valley of the Athabasca River in the vicinity of Kinky Lake and in an area southwest of Hinton. Population groupings are also found in Upper Foothills habitat east of Hinton along the Robb Road and in the McPherson Creek area where the Vista Project is located. The precise population size and trend in long-toed salamander population in the Hinton areas is currently not known.

Increased Mortality

Adult long-toed salamanders residing in upland vegetation within the vicinity of the breeding ponds will be impacted by mining during removal of waste rock and creation of rock dumps. High traffic roads may increase adult and immature salamander mortality. Depending on when dewatering takes place, any larvae in the breeding ponds located within the disturbance boundary will be lost.

Habitat Alteration

Two ponds known to be used by long-toed salamanders are located within the Vista Coal Project footprint and will be removed by mining. Two additional ponds used by long-toed salamanders are located within the mine permit boundary. The loss of the two ponds and associated upland habitat may reduce adult migration during the breeding season to the nearby ponds within the permit area. Upland vegetation used by adult and immature long-toed salamanders in the vicinity of breeding ponds will also be removed.

Sensory Disturbance

Sensory disturbance is not a major limiting factor of long-toed salamander populations with the possible exception of in highly populated areas.

Movement Obstruction

Due to the limited vagility of long-toed salamanders, home range sizes are relatively small. Pit development may obstruct seasonal movement of long-toed salamanders to adjacent undisturbed ponds, thereby affecting the local population in the McPherson watershed.

Habitat Fragmentation

Little mention of habitat fragmentation effects on long-toed salamander were found in the scientific literature. This may be because the very small home range sizes of long-toed salamander make them more susceptible to direct habitat loss than fragmentation.

E.13.4 Cumulative Effects

The habitat supply for eight VECs was projected into the future taking into account the effects of the Project and other land uses in the RSA (CR #13, Figures 31 to 38). Table E.13.4.1 provides the proportion of total land area in the RSA for each of the five habitat suitability classes for the different time stamps. This futures projection provided a means of screening the potential cumulative effects on VECs. Based on this screening, the wildlife VECs chosen for assessment of cumulative effects include: marten, northern myotis, northern goshawk, brown creeper and grizzly bear. Marten, northern myotis, northern goshawk and brown creeper show large (<30%) projected decreases in high and very high suitability habitat at T45 and are all know to be affected to some degree by habitat fragmentation. Grizzly bear is susceptible to increased mortality resulting from regional access proliferation. Impacts of the Project on long-toed salamander are localized and specific to the Project`s proposed mining activities and as such this species was not considered to be as prone to widespread cumulative land uses. Moose, elk, and lynx favour early seral habitat types and will likely benefit from combined mining and timber harvest activities as long as harvest is regulated accordingly. Western toad prefers early seral shrublands and its current population status indicates resilience to existing landscapes fragmented by timber harvest.

Table E.13.4.1 Projected Changes in Supply of Habitat Suitability by VEC - Cumulative Effects

	Scenario																													
VEC	**Baseline**					**T05 (2020-2024)**					**T10 (2025 - 2034)**					**T20 (2035 - 2039)**					**T25 (2040 - 2045)**					**T45 (2046 - 2060)**				
	VL	L	M	H	VH	VL	L	M	H	VH	VL	L	M	H	VH	VL	L	M	H	VH	VL	L	M	H	VH	VL	L	M	H	VH
Moose	6.1	13.7	5.6	70.7	3.9	8.8	13.8	5.2	68.7	13.8	8.0	14.2	5.2	69.1	3.4	7.2	10.9	7.1	71.3	3.4	5.9	23.1	5.6	62.3	3.1	5.3	8.0	9.4	74.2	3.1
Elk	2.3	7.7	81.9	6.8	1.3	5.4	6.5	80.6	6.3	1.2	4.6	6.5	81.4	6.3	1.2	3.9	7.4	81.2	6.2	1.2	2.2	6.0	85.2	5.5	1.1	2.2	6.5	84.9	5.2	1.1
Marten	9.3	36.1	45.2	9.2	0.3	13.4	41.8	36.6	7.9	0.2	12.9	42.3	36.6	7.9	0.2	9.1	38.8	44.0	7.9	0.2	22.0	42.9	28.3	6.5	0.2	6.3	50.7	36.3	6.5	0.2
Lynx	2.8	10.3	14.5	72.4	0.0	5.8	11.0	12.3	70.2	0.0	5.1	11.4	12.4	71.1	0.0	4.4	8.3	12.4	74.9	0.0	2.8	22.6	19.7	55.0	0.0	2.8	7.1	24.1	65.9	0.0
Northern Myotis	39.1	32.8	9.2	14.2	4.7	50.3	25.4	7.7	12.1	4.5	50.3	25.4	7.7	12.1	4.5	40.8	35.0	7.7	12.1	4.5	50.9	30.9	6.6	7.9	3.7	33.6	48.2	6.6	7.9	3.7
Northern Goshawk	11.2	67.8	2.7	13.8	4.6	15.1	66.7	2.1	11.7	4.4	14.6	67.2	2.1	11.7	4.4	10.8	71.0	2.1	11.7	4.4	23.5	63.2	2.0	7.7	3.6	7.8	79.0	2.0	7.7	3.6
Brown Creeper	4.2	70.2	16.6	3.9	5.0	7.2	71.1	13.8	3.3	4.7	6.4	71.8	13.8	3.3	4.7	5.7	72.5	13.8	3.3	4.7	3.9	80.2	9.9	2.3	3.9	3.9	80.2	9.9	2.3	3.9
Western Toad	2.3	32.6	34.8	28.8	1.5	5.3	30.1	27.1	36.0	1.5	4.5	30.5	27.1	36.4	1.5	3.8	27.2	36.6	31.0	1.5	2.3	35.3	32.5	28.2	1.7	2.2	20.1	49.5	26.7	1.5

E.13.4.1 Marten

Table E.13.4.2 shows the relative susceptibility of marten to various existing and proposed land uses in the region, according to effect type (e.g. habitat alteration *vs.* increased mortality). Marten are not highly susceptible to sensory disturbance or movement obstruction. Sensory disturbance effects are generally short-lived and marten readily use regenerating forest cover for movement, just as they have evolved to use regenerating forests following large fire events.

Fur harvest and large-scale habitat alteration and fragmentation are the effects most likely to result in marten population decline (Table E.13.4.2). The combined effects of the Project and past, present and future land actions on marten populations are rated as Low for everything except habitat fragmentation and alteration.

Table E.13.4.2 Relative Susceptibility of Marten to Existing/Proposed Land Uses - by effect type

Existing/proposed land use	Effect Type				
	Increased Mortality	**Habitat Alteration**	**Sensory Disturbance**	**Movement Obstruction**	**Habitat Fragmentation**
Clearcut Timber harvest	L	H	L	L	M
Mountain Pine Beetle and harvest	L	H	L	L	M
Surface coal mining	L	M	M	L	M
Oil and Gas development	M	L	L	L	L
Fur harvest	H	L	L	L	L
Legal/Illegal Hunting	L	L	L	L	L
Roads and recreational use	M	L	L	L	L

E.13.4.2 Grizzly Bear

Table E.13.4.3 shows the relative susceptibility of grizzly bears to various existing and proposed land uses in the region, according to effect type (e.g. habitat alteration *vs.* increased mortality). The greatest threat to regional grizzly bear populations is human-caused mortality caused by illegal hunting, self defense kills by ungulate hunters, and vehicle/train collisions. Any land use that results in increased access or use of access by individuals carrying firearms is a threat to grizzly bear population persistence. Any roads with vehicle speeds greater than 70 kph also have potential to result in increased grizzly bear mortality.

Table E.13.4.3 Relative susceptibility of grizzly bears to existing/proposed land uses - by effect type

Existing/proposed land use	Effect Type				
	Increased Mortality	*Habitat Alteration*	*Sensory Disturbance*	*Movement Obstruction*	*Habitat Fragmentation*
Clearcut Timber harvest	H	L	L	L	L
Mountain Pine Beetle and harvest	H	L	L	L	L
Surface coal mining	M	L	L	L	L
Oil and Gas development	H	L	L	L	L
Fur harvest	M	L	L	L	L
Legal/Illegal Hunting	H	L	L	L	L
Roads and recreational use	H	L	L	L	L

The causes and pathways of cumulative effects on grizzly bear mortality are both compounding and synergistic. Increasing open motorized road access is being used by humans leading to increasing probability of contact with grizzly bears. Such contacts are resulting in death of bears as indicated by the high percentage of radio-collared bears being killed.

In the case of regional and cumulative grizzly bear mortality, the proposed Project is unlikely to add significantly to regional mortality. This assertion is based on the fact that carrying of firearms in not permitted on mine permit areas and traffic speed control is practiced. It is further supported by the fact that no grizzly bear mortalities have occurred on mine permit areas in 40+ years in the Coal Branch region (Symbaluk 2008). This does not diminish the seriousness of cumulative effects on grizzly bear mortality in the RSA and broader Yellowhead region.

The combined effects of the Project and past, present and future land actions on grizzly bear populations are rated as Low for everything except for increased mortality.

E.13.4.3 Northern Myotis

Table E.13.4.4 shows the relative susceptibility of northern myotis to various existing and proposed land uses in the region, according to effect type (e.g. habitat alteration *vs.* increased mortality).

Although research is relatively scant on this species it is apparent that the most important limiting factors are large scale forest clearing that removes older mixedwood forests and snags and results in large open areas.

Table E.13.4.4 Relative susceptibility of northern myotis to existing/proposed land uses - by effect type

Existing/proposed land use	Effect Type				
	Increased Mortality	*Habitat Alteration*	*Sensory Disturbance*	*Movement Obstruction*	*Habitat Fragmentation*
Clearcut Timber harvest	M	H	L	L	H
Mountain Pine Beetle and harvest	L	M	L	L	M
Surface coal mining	M	H	L	L	M
Oil and Gas development	L	L	L	L	L
Legal/Illegal Hunting	L	L	L	L	L
Roads and recreational use	L	L	L	L	L

There is growing evidence that this species will roost and forage in fragmented landscapes, although recruitment and survivorship in these habitats is unknown. Being a boreal species, northern myotis has evolved in a patchy landscape with sparsely distributed patches of old forest. The limited knowledge and uncertainty of habitat use and response to large scale fragmentation in the boreal forest for this species should trigger a cautious supported by monitoring and research. Mixedwood forests offer habitat attributes for both male and female northern myotis (Lausen 2009). Silviculture and mine reclamation measures that maintain mixedwood stands should be a long-term regional objective for this species.

The combined effects of the Project and past, present and future land actions on Northern Myotis populations are rated as Low for everything except habitat fragmentation and alteration.

E.13.4.4 Northern Goshawk

Table E.13.4.5 shows the relative susceptibility of northern goshawks to various existing and proposed land uses in the region, according to effect type (e.g. habitat alteration *vs.* increased mortality).

Goshawks avoid early successional stages and immature forests for nesting and foraging. Breeding habitat loss or fragmentation is the most significant threat to the long-term viability of the Northern Goshawk and can result in local extirpation at high levels of loss/fragmentation (Crocker-Bedford 1998; Cooper and Stevens 2000). This species is most susceptible to large scale forest clearing from clearcut timber harvest and surface coal mining.

Table E.13.4.5 Relative susceptibility of northern goshawk to existing/proposed land uses - by effect type

Existing/proposed land use	Effect Type				
	Increased Mortality	*Habitat Alteration*	*Sensory Disturbance*	*Movement Obstruction*	*Habitat Fragmentation*
Clearcut Timber harvest	L	H	M	L	H
Mountain Pine Beetle and harvest	L	L	L	L	L
Surface coal mining	M	H	M	L	M
Oil and Gas development	L	L	M	L	L
Legal/Illegal Hunting	L	L	L	L	L
Roads and recreational use	L	L	L	L	L

Threshold levels of forest clearing from timber harvest and/or surface coal mining beyond which northern goshawk populations might decline precipitously or become extirpated are not known. The Planned Development Case projection for the Vista Project indicates that vegetation clearing associated with timber harvest is 10 times greater than clearing from surface coal mining.

The combined effects of the Project and past, present and future land actions on Northern Goshawk populations are rated as Low for everything except habitat fragmentation and alteration.

E.13.4.5 Brown Creeper

Table E.13.4.6 shows the relative susceptibility of brown creeper to various existing and proposed land uses in the region, according to effect type (e.g. habitat alteration *vs.* increased mortality). Brown creepers require large diameter trees to forage and nest and as such are directly affected by removal of mature and old forests either through natural fire or timber harvest (Farr 1995, Poulin et al. 2008). This species is especially sensitive to forestry because they nest on snags with peeling bark and forage primarily on large-diameter trees. This species is most susceptible to forest clearing from clearcut timber harvest and surface coal mining.

Table E.13.4.5 Relative Susceptibility of Brown Creeper to Existing/Proposed Land Uses - by Effect Type

Existing/proposed land use	Effect Type				
	Increased Mortality	*Habitat Alteration*	*Sensory Disturbance*	*Movement Obstruction*	*Habitat Fragmentation*
Clearcut Timber harvest	L	H	L	L	H
Mountain Pine Beetle and harvest	L	M	L	L	M
Surface coal mining	M	H	L	L	H
Oil and Gas development	L	L	L	L	L
Legal/Illegal Hunting	L	L	L	L	L
Roads and recreational use	L	L	L	L	L

The amount of cumulative vegetation clearing that would result in irreversible population declines of brown creep is poorly understood. Given that brown creeper is a boreal forest bird that has evolved with major fire events, it is unlikely that current or planned levels of timber harvest and surface mining would lead to irreversible declines. However, given its specialized habitat needs and known sensitivity to habitat fragmentation, its population status and trend in the RSA should be monitored.

Based on the above information, the combined effects of the Project and past, present and future land actions on Brown Creeper populations are rated as Low for everything except habitat fragmentation and alteration.

E.13.5 Mitigation and Monitoring

E.13.5.1 Mitigation

In order to reduce potential impacts of the Project on wildlife Coalspur will:

- establish and enforce a maximum speed of 70 kph along the road adjacent to the conveyor belt, establish and implement a vehicle/wildlife collision reporting program and place warning signs in strategic areas (e.g. blind corners, areas of known wildlife crossing) to limit vehicle speed;
- utilize direct placement of topsoil as much as is possible;
- plant favored moose deciduous browse shrubs in the understory of reclaimed sites including willow (spp.), red-osier dogwood, alder, bracted honeysuckle, low bush cranberry, balsam poplar, aspen, and white birch;
- maximize the width of retained riparian habitat along McPherson Creek;
- limit human use along the McPherson Creek riparian buffer;
- design reclamation is such a way that remnant tree islands within the mine areas are connected and leave slash and stumps on site especially in narrow portions of the mine footprint;
- plant shrubs (alder and willow) early in the reclamation phase;
- minimize traffic on the public access road along the conveyor belt route to the extent possible;
- construct a minimum of 10 crossing locations including four 3 m high crossing points evenly spaced along the conveyor route;
- restrict hunting and public access on the Vista MSL for the life of the mine;
- during reclamation initially establish a cover crop of grasses and legumes to prevent erosion and initiate soil development;
- increase marten habitat suitability and use of reclaimed lands by promoting dense shrub and coniferous generation, maximizing downed woody debris through direct placement of topsoil and associated slash and stumps and leave as many residual forest patches as possible;
- increase lynx habitat suitability and use of reclaimed lands by planting native shrubs and trees, and maintaining 10% cover of downed woody debris and slash and incorporate slash into salvaged soil;
- maintain hunting and firearm restrictions on the reclaimed mine including after mining has ceased and until hiding cover on the mines is equivalent to that of natural closed forest cover types;
- plant coniferous trees at a density that will hide a grizzly bear from an open road or mine edge at 30 metres;
- use native plants for reclamation that are favoured as forage by grizzly bears;
- maintain a minimum 30 metre buffer zone of undisturbed natural habitat along well developed riparian corridors;

- work with SRD to undertake formal end land use closure discussions very early in the mine planning process to minimize potential grizzly bear mortality associated with land use changes at closure;
- minimize alteration of old growth mixedwood forests to the extent possible. Conduct further inventory to identify high quality northern myotis habitat;
- in areas without direct placement use a reclamation seed mix that includes multiple grass species and legumes that stabilize soils and offer dense cover and diverse forage for recolonizing small mammals;
- integrate diverse native shrubs and deciduous trees into understory planting early in the reclamation sequence. Avoid planting homogeneous areas of conifer trees with limited shrub understory;
- optimize coarse woody debris placement and soil surface roughness;
- intersperse wetland and riparian reclamation areas to encourage shrew recolonization;
- conduct Pre Disturbance surveys in future footprint areas to determine northern goshawk nesting status and avoid clearing vegetation in the nesting/fledging period;
- avoid land clearing during the breeding bird nesting and fledging period (May to August) and conduct a nest survey of areas where clearing occurs during that restriction period;
- identify western toad breeding ponds prior to clearing of mine footprint then capture toads from targeted breeding ponds and remove to appropriate undisturbed habitat;
- conduct Pre-Disturbance surveys for breeding western toad habitat prior to clearing land for mining and construct breeding ponds to replace those removed from footprint;
- implement a salamander capture program prior to vegetation clearing which generally occurs in the fall or winter and move to the riparian edge of suitable existing or reconstructed ponds;
- avoid disturbing wetland habitats and compacting upland soils as much as possible particularly during haul road placement;
- design waste dumps to avoid salamander breeding ponds where possible; and
- avoid using pesticides, herbicides, and fungicides within 100 m of salamander breeding ponds.

E.13.5.2 Monitoring

In order to monitor the effectiveness of mitigation Coalspur will:

- monitor the presence / absence of long-toed salamanders and Columbia spotted frogs in all waterbodies within and adjacent the Project mine permit starting in the spring 2012 using monitoring procedures will be developed using protocols outlined by the RANA (Researching Amphibian Numbers in Alberta) program (Pretzlaw et al. 2002) and in consultation with Alberta Fish and Wildlife;
- implement a monitoring program of the reclaimed ponds to assess hatching success and subsequent use by long-toed salamanders;
- implement a monitoring program to assess the use of reconstructed breeding ponds in reclaimed areas by long-toed salamanders;
- consider cooperative monitoring of old growth dependant species population status and trend in the RSA;
- monitor the effectiveness of measures designed to increase understory cover (downed woody debris, shrubs, tree density) on reclaimed mine lands for small mammals, marten, and lynx;

- monitor the effectiveness of establishing and maintaining hiding cover for grizzly bears near mine edges and adjacent to main roads;
- measure and monitor human use levels of linear features during summer, winter and fall (hunting) seasons and use this data to design road closure plans;
- monitor the effectiveness of voluntary and enforced road closures including gating;
- continue long-term, multi-species winter inventory/monitoring of mammals (carnivores and prey) to regional habitat fragmentation using the tracking data conducted in 2011 and 2012 as a baseline;
- conduct further pre-impact monitoring of winter wildlife occurrence along the conveyor belt route; and
- monitor post-construction response of winter wildlife species to the conveyor belt and associated road to assess the effectiveness of the crossing sites.

E.13.6 Summary

Table E.13.6.1 summarizes ratings for impact types and VECs. None of the Project-specific impacts on VECs were rated as high (i.e. irreversible changes to the sustainability or integrity of a wildlife VEC). Several VEC/impact type combinations were considered to be moderate impacts (i.e. effects exceed natural variability but recovery or restoration is considered feasible). These included the following:

- Grizzly Bear - Increased Mortality
- Northern Myotis - Habitat Alteration
- Northern Goshawk - Habitat Alteration, Habitat Fragmentation
- Brown Creeper - Habitat Alteration, Habitat Fragmentation
- Long-toed Salamander - Increased Mortality, Habitat Alteration, Movement Obstruction

The reasons for higher impact ratings for the above species are one or more of the following:

- limited resilience to the impact type (*e.g.* low reproductive rate of grizzly bears);
- specialized habitat preference in habitats of limited regional supply (*e.g.* brown creeper) and which are directly affected by the Project;
- project impacts directly affect a high proportion of key regional breeding habitat (*e.g.* long-toed salamander); and
- limited understanding of impacts combined with limited supply of key breeding habitat (*e.g.* northern myotis, northern goshawk).

Table E.13.6.1 Summary of Impact Ratings on Wildlife Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Project Contribution (Direction)[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
1. Moose												
	Increased Mortality	Section E.13.5	Application	Local	Extended	Occasional	Reversible-Long Term	Low	Negative	High	Medium	Low
			Cumulative									
	Habitat Alteration		Application	Local	Residual	Continuous	Reversible-Long Term	Low	Negative	Moderate	Medium	Low
			Cumulative									
	Sensory Disturbance		Application	Regional	Long	Isolated	Reversible-Short Term	Moderate	Negative	Moderate	Medium	Low
			Cumulative									
	Movement Obstruction		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Negative	Moderate	Medium	Low
			Cumulative									
	Habitat Fragmentation		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Negative	Moderate	Medium	Low
			Cumulative									
2. Elk												
	Increased Mortality	Section E.13.5	Application	Local	Extended	Occasional	Reversible-Long Term	Low	Positive	High	Medium	Low
			Cumulative									
	Habitat Alteration		Application	Local	Residual	Continuous	Reversible-Long Term	Low	Positive	High	Medium	Low
			Cumulative									
	Sensory Disturbance		Application	Regional	Long	Isolated	Reversible-Short Term	Moderate	Negative	Moderate	Medium	Low
			Cumulative									
	Movement Obstruction		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Negative	Moderate	Medium	Low
			Cumulative									
	Habitat Fragmentation		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Negative	Moderate	Medium	Low
			Cumulative									

Table E.13.6.1 Summary of Impact Ratings on Wildlife Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Project Contribution (Direction)[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
3. Marten												
	Increased Mortality	Section E.13.5	Application	Local	Extended	Occasional	Reversible-Long Term	Low	Negative	High	Medium	Low
			Cumulative	Regional	Extended	Occasional	Reversible-Long Term	Low	Negative	High	Medium	Low
	Habitat Alteration		Application	Local	Residual	Continuous	Reversible-Long Term	Moderate	Negative	High	High	Low
			Cumulative	Regional	Extended	Continuous	Reversible-Long Term	High	Negative	High	High	Moderate
	Sensory Disturbance		Application	Regional	Long	Isolated	Reversible-Short Term	Low	Negative	Moderate	High	Low
			Cumulative	Regional	Extended	Periodic	Reversible-Short Term	Low	Negative	Moderate	High	Low
	Movement Obstruction		Application	Local	Extended	Continuous	Reversible-Long Term	Moderate	Negative	High	High	Low
			Cumulative	Regional	Extended	Continuous	Reversible-Long Term	Moderate	Negative	High	High	Low
	Habitat Fragmentation		Application	Local	Extended	Continuous	Reversible-Long Term	Moderate	Negative	High	High	Low
			Cumulative	Regional	Extended	Continuous	Reversible-Long Term	High	Negative	High	High	Moderate
4. Canada Lynx												
	Increased Mortality	Section E.13.5	Application	Local	Extended	Occasional	Reversible-Long Term	Low	Negative	High	Medium	Low
			Cumulative									
	Habitat Alteration		Application	Local	Residual	Continuous	Reversible-Long Term	Low	Negative	Moderate	High	Low
			Cumulative									
	Sensory Disturbance		Application	Regional	Long	Isolated	Reversible-Short Term	Low	Negative	Moderate	High	Low
			Cumulative									
	Movement Obstruction		Application	Local	Extended	Continuous	Reversible-Long Term	Moderate	Negative	High	High	Low
			Cumulative									
	Habitat		Application	Local	Extended	Continuous	Reversible-Long	Moderate	Negative	High	High	Low

Table E.13.6.1 Summary of Impact Ratings on Wildlife Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Project Contribution (Direction)[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
	Fragmentation						Term					
			Cumulative									
5. Grizzly Bear												
	Increased Mortality	Section E.13.5	Application	Local	Residual	Occasional	Reversible-Long Term	Low	Negative	High	Medium	Moderate
			Cumulative	Regional	Extended	Occasional	Reversible-Long Term	High	Negative	High	Medium	Moderate
	Habitat Alteration		Application	Local	Residual	Continuous	Reversible-Long Term	Low	Positive	High	Medium	Low
			Cumulative	Regional	Extended	Continuous	Reversible-Long Term	Moderate	Positive	High	High	Low
	Sensory Disturbance		Application	Regional	Long	Isolated	Reversible-Short Term	Low	Negative	High	Medium	Low
			Cumulative	Regional	Extended	Periodic	Reversible-Short Term	Low	Negative	High	Low	Low
	Movement Obstruction		Application	Local	Long	Isolated	Reversible-Long Term	Low	Negative	High	Medium	Low
			Cumulative	Regional	Extended	Continuous	Reversible-Long Term	Low	Negative	High	Low	Low
	Habitat Fragmentation		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Negative	High	Medium	Low
			Cumulative	Regional	Extended	Continuous	Reversible-Long Term	Low	Negative	High	Low	Low
6. Northern Myotis												
	Increased Mortality	Section E.13.5	Application	Local	Short	Isolated	Reversible-Short Term	Low	Negative	High	Medium	Low
			Cumulative	Regional	Short	Occasional	Reversible-Short Term	Low	Negative	High	Medium	Low
	Habitat Alteration		Application	Local	Residual	Continuous	Reversible-Long Term	Moderate	Negative	Low	Medium	Moderate
			Cumulative	Regional	Residual	Continuous	Reversible-Long Term	Moderate	Negative	Low	Low	Moderate
	Sensory Disturbance		Application	Local	Long	Isolated	Reversible-Long Term	Low	Negative	High	Medium	Low
			Cumulative	Regional	Short	Periodic	Reversible-Long Term	Low	Negative	High	Medium	Low

Table E.13.6.1 Summary of Impact Ratings on Wildlife Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Project Contribution (Direction)[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
	Movement Obstruction		Application	Local	Extended	Continuous	Reversible-Long Term	Moderate	Negative	High	High	Low
			Cumulative	Regional	Short	Occasional	Reversible-Long Term	Low	Negative	High	High	Low
	Habitat Fragmentation		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Negative	Low	Low	Moderate
			Cumulative	Regional	Residual	Continuous	Reversible-Long Term	Moderate	Negative	Low	Low	Moderate
7. Small Mammals												
	Increased Mortality	Section E.13.5	Application	Local	Extended	Periodic	Reversible-Short Term	Low	Negative	Moderate	Medium	Low
			Cumulative									
	Habitat Alteration		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Neutral	Moderate	High	Low
			Cumulative									
	Sensory Disturbance		Application	Local	Long	Periodic	Reversible-Short Term	Low	Neutral	High	Low	Low
			Cumulative									
	Movement Obstruction		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Negative	High	Medium	Low
			Cumulative									
	Habitat Fragmentation		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Neutral	Moderate	High	Low
			Cumulative									
8. Northern Goshawk												
	Increased Mortality	Section E.13.5	Application	Local	Short	Isolated	Reversible-Short Term	Low	Negative	High	Medium	Low
			Cumulative	Regional	Extended	Occasional	Reversible-Short Term	Low	Negative	High	Low	Low
	Habitat Alteration		Application	Local	Residual	Continuous	Reversible-Long Term	Moderate	Negative	Low	Medium	Moderate
			Cumulative	Regional	Residual	Continuous	Reversible-Long Term	Moderate	Negative	Low	High	Moderate
	Sensory Disturbance		Application	Local	Long	Isolated	Reversible-Short Term	Low	Negative	Moderate	Medium	Low

Table E.13.6.1 Summary of Impact Ratings on Wildlife Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Project Contribution (Direction)[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
			Cumulative	Regional	Extended	Periodic	Reversible-Short Term	Low	Negative	Moderate	Low	Low
	Movement Obstruction		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Negative	High	Medium	Low
			Cumulative	Regional	Short	Occasional	Reversible-Long Term	Low	Negative	High	Low	Low
	Habitat Fragmentation		Application	Local	Extended	Continuous	Reversible-Long Term	Moderate	Negative	Moderate	Medium	Moderate
			Cumulative	Regional	Residual	Continuous	Reversible-Long Term	Moderate	Negative	Low	High	Moderate
9. Brown Creeper												
	Increased Mortality	Section E.13.5	Application	Local	Short	Isolated	Reversible-Short Term	Low	Negative	High	Medium	Low
			Cumulative	Regional	Short	Occasional	Reversible-Short Term	Low	Negative	High	Medium	Low
	Habitat Alteration		Application	Local	Residual	Continuous	Reversible-Long Term	Moderate	Negative	Low	Medium	Moderate
			Cumulative	Regional	Residual	Continuous	Reversible-Long Term	Moderate	Negative	Low	Low	Moderate
	Sensory Disturbance		Application	Local	Long	Isolated	Reversible-Long Term	Low	Negative	High	Medium	Low
			Cumulative	Regional	Short	Periodic	Reversible-Long Term	Low	Negative	High	Medium	Low
	Movement Obstruction		Application	Local	Extended	Continuous	Reversible-Long Term	Moderate	Negative	High	High	Low
			Cumulative	Regional	Short	Occasional	Reversible-Long Term	Low	Negative	High	High	Low
	Habitat Fragmentation		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Negative	Low	Low	Moderate
			Cumulative	Regional	Residual	Continuous	Reversible-Long Term	Moderate	Negative	Low	Low	Moderate
10. Western Toad												
	Increased Mortality	Section E.13.5	Application	Local	Long	Occasional	Reversible-Long Term	Low	Negative	Moderate	Medium	Low
			Cumulative									
	Habitat		Application	Local	Extended	Isolated	Reversible-Long	Low	Negative	Moderate	Medium	Low

Table E.13.6.1 Summary of Impact Ratings on Wildlife Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Project Contribution (Direction)[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
	Alteration						Term					
			Cumulative									
	Sensory Disturbance		Application	Local	Long	Isolated	Reversible-Short Term	Low	Negative	Moderate	High	Low
			Cumulative									
	Movement Obstruction		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Negative	Moderate	Medium	Low
			Cumulative									
	Habitat Fragmentation		Application	Local	Extended	Continuous	Reversible-Long Term	Low	Negative	Moderate	Medium	Low
			Cumulative									

1. Local, Regional, Provincial, National, Global
2. Short, Long, Extended, Residual
3. Continuous, Isolated, Periodic, Occasional
4. Reversible in short term, Reversible in long term, Irreversible - rare
5. Nil, Low, Moderate, High
6. Neutral, Positive, Negative
7. Low, Moderate, High
8. Low, Medium, High
9. No Impact, Low Impact, Moderate Impact, High Impact

E.14 GREENHOUSE GAS AND CLIMATE CHANGE

E.14.1 Introduction and Terms of Reference

Greenhouse Gases (GHG) absorb heat radiated by the earth and subsequently warm the atmosphere, leading to what is commonly known as the greenhouse effect. Common GHGs include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). This section has been prepared to discuss the GHGs and climate change potential for the Project.

AEW issued the final ToR for the Project on January 24, 2012. The specific requirements for the GHG and climate change components are provided in Section 2.6 and 3.1, and are as follows:

2.6 AIR EMISSIONS MANAGEMENT

[B] Provide emission profiles (type, rate and source) for the Project's operating emissions including point and non-point sources and fugitive emissions (including mine faces), and for construction emissions. Consider both normal and upset conditions. Discuss:

- *b) annual and total greenhouse gas emissions for all stages of the Project. Identify the primary sources and provide examples of calculations;*
- *c) the Project's contribution to total provincial and national greenhouse gas emissions on an annual basis;*
- *d) the Proponent's overall greenhouse gas management plans;*

3.1 AIR QUALITY, CLIMATE AND NOISE

3.1.2 Impact Assessment

[B] Identify stages or elements of the Project that are sensitive to changes or variability in climate parameters, including frequency and severity of extreme weather events. Discuss what impacts the change to climate parameters may have on elements of the Project that are sensitive to climate parameters.

E.14.2 Greenhouse Gas

E.14.2.1 Project GHG Emissions

Greenhouse gases (*e.g.* carbon dioxide [CO_2]) will be produced largely by combustion of diesel by equipment. There are three sources of GHG emissions for the Project:

- fugitive emissions of coal-bed methane;
- combustion of clean coal in the coal dryer; and
- diesel combustion in the mine fleet and haul vehicles.

Greenhouse gas emissions are expressed in carbon dioxide equivalents (CO_2e). Fugitive methane emissions from surface coal mining were estimated using emission factors provided by the Intergovernmental Panel on Climate Change (IPCC 2006). Table E.14.2.1 summarizes fugitive emissions of methane (which has a global warming potential 21 times that of CO_2) from the mine.

Table E.14.2.1 Summary of Fugitive Coal Bed Methane Emissions

	Val D'Or Seam	McLeod Seam	McPherson Seam	TOTAL (Year 2029)
CBM Emission Factor (t/kt)	0.87	0.87	0.87	
Coal Production (RMT/yr)	4,454,000	1,923,000	3,040,000	9,417,000
Methane Emissions (RMT/yr)	3,875	1,673	2,645	8,193
GHG Emissions (CO2e RMT/yr)	81,370	35,133	55,541	172,044

GHG emission estimates for diesel combustion and for the coal dryer are based on the amount of fuel consumed and Environmental Canada emission factors. A summary of direct annual GHG emissions for the Project from both fugitive and combustion sources are shown in Table E.14.2.2. The total equivalent CO_2 emissions from Project operations were estimated to be 358 kt/yr. According to Environment Canada (2011b), total national GHG emissions were 690 Mt in 2009 and Alberta's share was 33.8% or 233 Mt. Therefore, direct GHG emissions from the Project in 2029 will be approximately 0.15% of 2009 Alberta GHG emissions and 0.05% of national emissions.

Table E.14.2.2 Project Total Direct Annual GHG Emissions (for Year 2029)

Source	Annual GHG Emissions (kt CO_2e/yr)
Fugitive Methane	172
Coal Dryer	93
Diesel Combustion	92
Natural Gas Combustion (space heating)	0.58
Total Project	358

Construction phase GHG emissions were estimated by pro-rating the peak GHG emissions from the overall Project using the ratio of material moved during the construction of the initial stretch of haul road (11 km from year 2019 mine plan) to the material moved during the peak year of the Project. The amount of material moved annually during construction of the initial haul road is 1,798,000 m^3 which is 3.8 Mt. The total GHG emissions that can be apportioned to the construction of the initial haul road are approximately 3.8% of the overall Project GHG emissions in 2009, which is 14 kt CO_{2e}/year (0.038 x 358 kt CO_{2e}/year).

GHG emissions during the reclamation phase are assumed to be equal to construction phase emissions.

E.14.2.2 Greenhouse Gas Management Plan

Coalspur's business success is contingent on responsible resource development which requires dedicated stewardship of air issues and air emissions in conjunction with maintaining a competitive export coal operation. Coalspur is committed to responsible environmental management and continues to do their part to minimize impacts. Coalspur will continue to develop effective management and operational approaches to comply with regulations designed to reduce GHG emissions. Coalspur 's greenhouse gas emission goals are:

- to continually improve efficiencies in energy use, thus reducing the GHG footprint in an economically viable way; and
- to deliver on a long term plan that meets industry standards and enhances economic competitiveness.

Coalspur believes that execution of their GHG management programs can be achieved with proactive preparation, planning and continued cooperation with industry regulators and in the communities where they operate.

Coalspur's long-term GHG management options fall into four broad categories. These are:

- continuous improvement in demonstrated, cost-effective technologies (particularly combustion technologies) during the operational phase;
- carbon injection and storage;
- trading of GHG offsets; and
- contribution to the Climate Change and Emissions Management Fund.

Continuous Improvement

Coalspur is continually considering opportunities for GHG reductions. Their approach to managing GHG emissions includes:

- continuous improvement to address direct emissions from their facilities;
- monitor and measure performance, identify design gaps, and identify improvement opportunities;
- review corporate and Project goals for GHG reductions; and
- continue to improve corporate and operational knowledge of viable technologies that lead to emission reduction and policy development.

Design measures to reduce GHG emissions in the Project include:

- optimizing and continuously improving energy efficiency in the design and operation of mine and haul equipment, processes and facilities;
- use of electric shovels and electric draglines in operations, rather than diesel powered equipment;
- use of conveyors to move raw and clean coal; and
- considering emissions as a key criterion during future mine and haul fleet replacement.

Other measures may include optimizing use of natural gas in the coal dryer, optimizing motor sizes and insulating piping to conserve energy.

Carbon Injection and Storage

Existing carbon capture technologies are not viable for projects like Vista where a substantial fraction of emissions are from mobile or fugitive sources. Furthermore, the coal dryer results in low pressure and low concentration CO_2 emissions. Nonetheless, Coalspur will continue to monitor ongoing developments in carbon capture technology and evaluate options as they develop.

Offsets

The *Alberta Climate Change and Emissions Management Act* establishes offset trading as one of a range of mechanisms for achieving compliance with GHG emission reduction obligations. Coalspur will evaluate offset trading opportunities.

Contribute to the Climate Change and Emissions Management Fund

The Province has established a Climate Change Fund contribution price of $15 per tonne CO_2e. Coalspur will evaluate offset purchases and, where appropriate, may use offsets to achieve compliance with their GHG emission reduction targets.

E.14.3 Climate Change

Air quality is strongly dependent on specific weather variables and could, therefore, be sensitive to climate change. Generally, and not necessarily applicable to the RSA, the future climate is expected to be more stagnant due to a weaker global circulation and the currently decreasing frequency of mid-latitude cyclones. The observed correlation between surface ozone and temperature in polluted regions points to a detrimental effect of warming. Warmer temperatures will increase summertime surface ozone in regions with anthropogenic emissions (Jacob and Winner, 2009). At the same time, increased water vapour in the future climate is expected to decrease the ozone background. These two parameters have opposite sensitivities to climate change.

The effect of climate change on particulates is more complicated and uncertain than for ozone. Precipitation frequency is an important factor in mitigation but wildfires fuelled by climate change could become an increasingly important particulate source.

Future warming at boreal latitudes could release additional amounts of soil organic matter to the atmosphere as CO_2 through increased respiration and forest fire frequency (Jacob and Winner, 2009).

E.14.3.1 Projected Climate Change

Climate change may affect construction, operation, decommissioning, and reclamation stages of the Project. The effect of global warming on climate variables in Alberta have been assessed by the Prairie Adaptation Research Collaborative (PARC) using IPCC (IPCC 2001) growth scenarios and various international GCMs (Barrow and Yu 2005).

The climate change assessment for the Project included the following elements:

- determine projections for climate parameters during the Project lifetime;
- identify potential effects of climate change on Project stages; and
- identify implications that climate change may have on the Project.

The existing and projected changes to the selected climate parameters are provided for the region near the Project. The selected parameters are:

- average annual temperature;
- annual precipitation;
- degree days; and
- moisture index (an increase indicates additional moisture stress).

Predicted changes in the 2050s for these parameters near the expected end of the Project lifetime are listed in Table E.14.3.1.

Table E.14.3.1 Projected Climate Parameters near Grande Prairie[(a)] Based on the Median Change Scenario of the Alberta Climate Model (Barrow and Yu, 2005)

Parameter	Baseline Value (1961 – 1990)	Median Prediction, 2050s	Change (%) Baseline to Median
Mean Annual Temperature (K)	1.6	3.7	0.8
Annual Precipitation (mm)	471	506	7
Degree Days > 5°C	1280	1925	50
Annual Moisture Index	2.7	3.9	44

(a) Grande Prairie, farther north than Edmonton, was chosen to reflect effects of higher elevation at the Project

E.14.3.2 Sensitivity to Climate Change

Construction on the Project is largely limited to new haul road corridors in stages through the Project life, the Plant and the conveyor system. Extreme weather conditions may affect fugitive dust emissions and the frequency of windblown dust. However, the impact is expected to be low, occurring either prior to the beginning of operations for construction of the conveyors, plant and the main haul road or during operations for construction of secondary haul roads within the various mine segments. Any increases in dust can be readily managed with appropriate dust control. Therefore, the impact of climate change on construction is expected to be minor.

Increases in the frequency of extreme temperature will result in an increased frequency of high ozone concentrations resulting from increased temperature/radiation and possibly through increased biogenic emissions of precursors.

Increased precipitation may reduce fugitive dust from many aspects of operations. At the same time, increases in annual moisture index and degree days likely more than offset the increased precipitation, causing additional drying. Mitigation by road watering could adapt to changes as they occur. $PM_{2.5}$ emissions, which arise largely from combustion, are not expected to change as much as those of coarser particulate.

For the decommissioning phase of the Project, climate change may impact reclamation and re-vegetation activities, potentially increasing fugitive dust emissions as evidenced by increases in the annual moisture index and degree days in the 2050s. These impacts are anticipated to be low and can be readily managed with appropriate dust control.

Overall, the change in climate will have low to no impact on air quality associated with the Project as potential increases in fugitive dust can be managed through adaptive road watering practices.

E.15 LAND AND RESOURCE USE

E.15.1 Baseline Conditions

The purpose of this section is to identify and assess potential impacts to land and resource use within the local and regional study areas for the Project. The local study area (LSA) boundary matches that of the combined existing mine permit and proposed mine permit amendment. The regional study area (RSA) boundary includes the LSA and additional buffer around the perimeter of the LSA. The lands included in the LSA and RSA are listed in Tables E.15.1.1 and E.15.1.2, respectively and shown on Figure E.15.1.1.

Table E.15.1.1 Local Study Area

	Township	Range	Meridian	Section or Portions of	LSD
Existing Mine Permit	50	23	W5M	25	9, 16
	50	23	W5M	N ½ 34, 35, 36	
	51	22	W5M	6, SW ¼ 7	
	51	23	W5M	1, 2, 3, 4, 5, 8, 9, 10, 11, 12, E ½ 6, E ½ 7, SE ¼ 18, S ½ 13, S ½ 14, S ½ 15, S ½ 16, S ½ 17	
	51	23	W5M	13, 14, 15, 16,17	9,10,11,12
	51	23	W5M	18	9, 10
Proposed Mine Permit Amendment	51	23	W5M	17	13, 14, 15, 16
	51	23	W5M	18	3, 6, 11, 12, 13, 14, 15, 16
	51	23	W5M	S ½ 19	
	51	23	W5M	20	1,2,3,4
	51	24	W5M	13	16
	51	24	W5M	23	9,15,16
	51	24	W5M	24	1,2,6,7,8,10,11,12,13,14
	51	24	W5M	25	4
	51	24	W5M	26	1,2,3,5,6,7,11,12,13
	51	24	W5M	27	9,15,16
	51	24	W5M	34	1,2,3,4,5,6,7,11,12,13

Table E.15.1.2 Regional Study Area Lands

Township	Range	Meridian	Section or Portions of
50	22	W5M	N ½ 19, 30, 31
50	23	W5M	24-28, 31-36
50	24	W5M	35, 36
51	22	W5M	5-8, 17-19
51	23	W5M	1-24, 28-30
51	24	W5M	1, 12, 14, 22-24, 25-29, E ½ 30, SE ¼ 31, 32-36
52	24	W5M	1-5, 10-15, S ½ 23, S ½ 24

E.15.1.1 Land and Resource Use Policies

Existing management plans and policies pertaining to or adjacent to the Project area are described below:

A Coal Development Policy for Alberta was adopted in 1976 with the purpose of guiding the exploration and development of coal resources in the province. Under the Coal Policy, exploration and development of coal deposits are permitted only under strict control to ensure environmental protection and satisfactory reclamation of any disturbed land.

The policy includes a land classification system that considers environmental sensitivity, alternate land uses, potential coal resources and infrastructure. Provincial lands fall into one of four categories with respect to coal exploration and development. Category 4 refers to lands where exploration may be permitted under appropriate control and in which surface or underground mining or in-situ operations may be considered subject to proper assurances respecting protection of the environment and reclamation of disturbed lands. This category covers all lands within the Project area (Figure E.15.1.1).

A Policy for Resource Management of the Eastern Slopes (approved in 1977 and revised 1984) was enacted to provide direction for the management of Alberta's eastern slopes, lands and resources. The policy referred to three broad land use zones which designate large areas of land for varying degrees of protection, multiple use management, or resource development. Within the broad zones, eight detailed land use zones outlined a range of permitted activities that are consistent with the priorities and management objectives of the zone. For each of the eight detailed zones the Province spelled out the intent of the zone and regional objectives (activities) that are considered compatible with the intent of the zone. This information provided resource managers with interim guidance regarding land and resource use decisions until comprehensive sub-regional integrated resource plans could be developed.

According to the Eastern Slopes Policy all lands within the Project area mine are zoned for "Multiple Use". Within this zone, coal exploration and development are considered to be compatible uses.

This policy was superseded by the Coal Branch Sub-regional Integrated Resource Plan (IRP) of 1990.

The Coal Branch Sub-Regional Integrated Resource Plan (IRP) was completed in 1990 (Alberta Forestry, Lands & Wildlife, 1990). It provided a planning framework for the management and use of public land and resources within a planning area that stretches from Hinton to Edson along the Yellowhead corridor, west to the Jasper National Park boundary, and south to the Brazeau River. The plan supersedes the zoning configuration set down in the Eastern Slopes Policy.

The Coal Branch planning area was divided into eight smaller resource management areas (RMAs) but the broad resource management objectives of the Eastern Slopes Policy and the Coal Branch IRP apply to each of the RMAs. The Vista Project area is located in two of these RMAs (Figure E.15.1.2):

- Yellowhead Corridor RMA – The management intent of this RMA is extensive and intensive recreational and tourism opportunities within a multiple use context, and the accommodation of existing municipal development needs. The load-out facility and the northwest two-thirds of Coalspur's proposed conveyor/access/utilities corridor lie within this area. All of the lands in this part of the RMA are zoned for multiple use (Zone 5). In addition to recreation and tourism, watershed values, coal deposits, wildlife habitat, timber and fisheries were noted as important resources.
- McLeod RMA – The management intent of this RMA is timber and coal resource development. Coalspur's proposed processing plant and the mine development are within this RMA, as well as the eastern third of the conveyor/access/utilities corridor. All of the lands in this part of the RMA

are zoned for multiple use (Zone 5). A narrow band just east of the proposed footprint in the McLeod River valley is zoned as Critical Wildlife (Zone 2). Other resource values are also recognized – watershed protection, wildlife habitat, fisheries, historical resources and extensive recreation.

Coalspur's proposed development and environmental management systems are consistent with the management intents of the Coal Branch IRP.

West Yellowhead Commercial Tourism and Recreation Development Project – This Project was initiated in 1999 as an outcome of recommendations of the Northern East Slopes Environment Committee. Project partners included the County, Town of Hinton, FMA holders and several Alberta Government departments. This project assessed a number of potential tourism development nodes in the West Yellowhead Corridor. This plan does not preclude resource development within or adjacent to these nodes; rather, it recognizes and attempts to integrate recreational and tourism opportunities in specific "nodes" within the suite of resource uses already identified. One of the nine nodes is at Pedley (West Yellowhead Corridor Public Information Package, July 1999). Coalspur's proposed load-out facility and conveyor/access corridor lie between the two blocks of the Pedley Recreational Node. Part of CN Rail's proposed rail siding lies within the eastern part of the Node.

Coalspur met with officials of SRD, Yellowhead County and CN Rail on this issue on March 7, 2012. It was concluded that the proposed Project and CN siding developments would not have any impacts on the potential tourism and recreation values identified for this node. Final conclusions would be made when SRD and the County have reviewed the EIA and EPEA application.

Coal Branch Access Management Plan (AMP) and Public Land Use Zones (PLUZ) – The AMP was approved in June 1994 to manage motorized and non-motorized recreation on existing access routes provided by exploration and industrial roads, seismic lines, pipelines and traditionally used trails on public land. The intent is to provide opportunities for compatible motorized and non-motorized recreational use without unduly interfering with the achievement of fish and wildlife management objectives and maintenance of environmental integrity (AFLW, 1994). This plan covers lands to the west and south of the Project. The Coal Branch, Athabasca Ranch and Brule Lake PLUZs were established to provide a basis for planning, management, monitoring and enforcement of recreational access expectations in the region. None of these PLUZs overlap the Vista Project area.

The Province has initiated a Provincial Land Use Framework that is intended to lead to the development of regional-scale lands use plans. The Framework identifies key provincial outcomes including a healthy economy and environment and people friendly communities with ample recreational and cultural opportunities. A regional plan is to be developed for the Upper Athabasca region, originally by 2012 but the Province's website no longer shows any dates for start-up or completion. Objectives of the framework have been released but potential contents of a regional plan have not.

The Local Land Management Plan for the Luscar and Gregg River mine areas was developed to address the eventual return of public uses to those two mines once the lands are released back to the Crown. The process used for this plan could be modified and used for the Project. Coalspur has discussed existing and potential future land use values for the Project in this application and has incorporated these values into the mine's reclamation plan, but the Luscar/Gregg process includes a formal public consultation theme that brings other industrial and recreational users more directly into the decision-making process. This broader scope would be necessary to address other users in the area. Coalspur commits to being part of such a land management planning process, in support of SRD as the land manager and lead.

Water for Life Strategy – This strategy outlines policy and province-wide strategy for the management of water resources in the province. The Project area is in the Athabasca drainage and the recently formed Athabasca Watershed Council (AWC) is in the process of developing a state-of-the-watershed assessment that will feed into the Water For Life management planning process. Coalspur has met with AWC on a number of occasions and will continue to inform them of their plans and share data, as related to water management.

Yellowhead County – Coalspur has met several times with County staff and Council to discuss a wide range of topics related to the Project – recreational use, road closures, employment opportunities, emergency response plan and other topics. Coalspur will be signing road use and development agreements with the County that will be consistent with their objectives and development plans.

Hinton and Area Community Sustainability Plan – A Citizens Advisory Committee prepared the Hinton Community Sustainability Plan (CSP) in early 2011 and it was accepted by Hinton Town Council shortly after. Coalspur supports the concept of community sustainability and accepts the values and challenges identified in this plan. Coalspur believes the proposed Project is consistent with the values of environmental protection, quality of life, economic opportunity and balance presented in the Plan. Coalspur intends to participate in ongoing planning and discussions associated with the CSP as an important input to our own plan development and to identify potential early actions that may be appropriate to our own circumstances

West Central Airshed Society – This group is involved with the monitoring and management of the regional airshed as part of the Clean Air Alliance. A Board oversees the society and membership is active in its support. The EIA for the Project accessed data from WCAS to support air quality assessments. Coalspur will support WCAS through membership and participation once approvals have been given for the Project.

Jasper National Park - The eastern boundary of Jasper National Park (JNP) lies 35 km to the east of the existing Mine Permit. Coalspur has provided proposed EIA terms of reference and development plans to JNP personnel directly and through CEAA; there have been no concerns expressed by Parks staff regarding the Vista Project. Coalspur will continue to keep JNP on the contacts list.

The 2000Cheviot Mine Joint Review Panel referenced the Northern East Slopes Regional Strategy as an important piece in regional management of activities. At that time, a provincial/federal group called the Environmental Resources Committee was active, and one of their initiatives was the development of a strategy that would guide the regional management of resource development. This initiative progressed to the production of a final report in 2002, but no apparent action has occurred since. The NES Steering Group no longer meets, and the ERC was dismantled when Alberta Environment was re-organized.

Yellowhead Ecosystem Group (YEG) – This working group, operating through the Foothills Research Institute (FRI), addresses species at risk, water conservation, access management, industrial development, heavy recreation use, forest health issues, and environmental campaigns within the Yellowhead Ecosystem landscape. The Vista Project lies just to the east and outside of this area. Coalspur provided funds to FRI's grizzly bear program which is connected to YEG, in support of their program and in return for access to their extensive grizzly bear data-base.

Provincial Grizzly Bear Recovery Plan (GBRP) – The grizzly bear was listed as a provincially threatened species in June 2010. Alberta's GBRP provides a framework of actions that are needed for the successful recovery of this species. Coalspur's development and reclamation plans address many components of the GBRP.

The Athabasca strain of rainbow trout was recently recommended provincially as a threatened sub-species (ASRD, December 2009). This recommended elevation in status, once accepted by the SRD Minister, will require the province to develop a recovery plan within three years (S. Bradbury, pers. comm. 2010). The recovery plan is already being drafted and, once the Minister signs, will confirm direction for management actions by SRD and industrial operators. Coalspur has been in discussion with SRD regional staff about this and have incorporated actions into the development and environmental management plans to address the change in status. This sub-species exists in several of the streams receiving drainage from the Project.

E.15.1.2 Coal Leases

Coalspur holds Mine Permit No. C 2011-5 issued by the Energy Resource Conservation Board for the development of the Project. Coalspur is requesting an amendment to this permit area in order to expand the development area.

The coal leases within the LSA are provided in Table E.15.1.3 and shown in Figure E.15.1.3. Three companies besides Coalspur hold leases; Nexen Inc. (Nexen), Consolidated Tanager Limited (Tanager), and Mancal Coal Inc. (Mancal). Only two of these companies (Nexen and Tanager) are impacted by the Project footprint. Nexen's leases are to the north and east of Coalspur's leases within the Project, while Mancal's are to the southwest. Tanager's are under the ROM conveyor corridor. Coal leases within the RSA are also held by Coalspur, Tanager, Nexen, and Mancal.

Table E.15.1.3 Coal Leases within the LSA

Disposition	Disposition Holder	Location
013 1307050797	Nexen Inc.	NW 6; N, SW 7 :51-22 W5M LSD 16 1; LSD 13,14, NE 11; LSD 5,6, N, SE 12; LSD 1,2, SW 13, LSD 9-12, S 14 :51-23 W5
013 1307050798	Nexen Inc.	LSD 16 10; 15; LSD 3,5,6, N, SE 16; LSD 7,8, N 17; LSD 1-4 20 :51-23 W5
013 1307050799	Nexen Inc.	18 :51-22 W5 LSD 7,8, N 13; LSD13-16 14; S 23; S 24 :51-23 W5
013 1307050800	Nexen Inc.	LSD 5-8, N 20; 21; S 22 :51-23 W5
013 1307070587	Coalspur Mines (Operations) Ltd.	LSD 16 25; LSD 14, NE 35; LSD 1,5-8, N 36 :50-23 W5 LSD 9,10,15, S, NW 1; LSD 1,6-8, NE 2; SE 11; LSD 3,4 12 :51-23 W5
013 1307070588	Coalspur Mines (Operations) Ltd.	NW 2; LSD 13,14, NE 3; LSD 16 4; LSD 5,6, N, SE, 8; 9; LSD 9,10,15, S, NW 10; LSD 11,12, SW 11 :51-23 W5
013 1308020345	Consolidated Tanager Limited	7; S 18 :51-23 W5
013 1308050904	Coalspur Mines (Operations) Ltd.	LSD 2-5 6 :51-22 W5
013 1308050905	Coalspur Mines (Operations) Ltd.	LSD 4 16; LSD 1,2, SW 17 :51-23 W5
013 1308120624	Coalspur Mines (Operations) Ltd.	LSD 15,16, NW 18;19 :51-23 W5 N 13; N 14; 23; 24 :51-24 W5
013 1311040472	Coalspur Mines (Operations) Ltd.	LSD 9,10,15, S, NW 25; 26; LSD 2,12, SW 36 :51-24 W5
013 1311050576	Coalspur Mines (Operations) Ltd.	LSD 1,6-8, NE 6 :51-22 W5
013 1311050581	Coalspur Mines (Operations) Ltd.	E 6 :51-23 W5
013 1311050582	Coalspur Mines (Operations) Ltd.	LSD 9,10 18 :51-23 W5
013 1399080001	Coalspur Mines (Operations) Ltd.	N 34; LSD 11-13, S 35; LSD 2-4 36 :50-23 W5 LSD 2-5 2; LSD 11,12, S 3; LSD 9,10,15, S, NW 4; 5; LSD 3,4 8 :51-23 W5
013 1399080002	Mancal Coal Inc. c/o Mancal Corporation	LSD 9 25 :50-23 W5

E.15.1.3 Petroleum and Natural Gas Approvals

The LSA has a number of petroleum and natural gas (PNG) licences and leases which are presented in Table E.15.1.4 for the LSA and RSA. Companies with leases and licences impacted by the Project footprint include Cinder Resources Ltd., Canadian Coastal Resources Ltd., Tourmaline Oil Corp. Scott Land and Lease, Rockford Land and Lease Ltd., and joint license holders Suncor Energy Inc. (50%), Manitok Energy Inc. (25%) and Petrus Resources Ltd. (25%). Figure E.15.1.4 shows the location of the PNG licences and leases by disposition holder.

Table E.15.1.4 Petroleum and Natural Gas Leases and Licenses in the LSA and RSA

Approval Type	Disposition	Disposition Holder	Location
5 year Foothills license	055 5505121195	Tourmaline Oil Corp.	TRT 1: 26-28; 35; 36 :50-23 W5 TRT 2: 29-34 :50-23 W5
5 year Foothills license	055 5505121196	Tourmaline Oil Corp.	TRT 1: 20-29; 31; 33-35 :51-24 W5 8;9, 15-17 :52-24 W5 22E; 23; 26; 27 :51-25 W5 TRT 2: 36 :51-24 W5 TRT 3: 22W :51-25 W5
5 year Foothills license	055 5594090055	Suncor Energy Inc. 50% Manitok Energy Inc. 25% Petrus Resources Ltd. 25%	3 :51-23 W5
5 year Northern lease	005 0505110180	Canadian Coastal Resources Ltd.	7 :51-23 W5
5 year Foothills lease	006 0608030509	Standard Land Company Inc.	22;23;24;25 :50-23 W5
4 year Northern license	054 5405121025	Cinder Resources Ltd.	TRT: 1 30;31 :50-22 W5 6 :51-22 W5 1; 8-12; 14-19; 21; 22; 27; 28 :51-23 W5 TRT 2 2-6 :51-23 W5
4 year Northern license	054 5411060358	Scott Land & Lease Ltd.	TRT: 1 13; 23; 24 :51-23 W5 TRT: 2 7; 18 :51-22 W5
4 year Northern license	054 5411100481	Rockford Land Ltd.	13-15; 22-24; 27;34 :51-23 W5
4 year Northern license	054 5411120165	Scott Land & Lease Ltd.	20 :51-23 W5

Table E.15.1.4 Petroleum and Natural Gas Leases and Licenses in the LSA and RSA			
Approval Type	**Disposition**	**Disposition Holder**	**Location**
4 year Northern license	054 5495030161	Suncor Energy Inc. 50% Manitok Energy Inc. 25% Petrus Resources Ltd. 25%	31-32 :50-23 W5 4-6 :51-23 W5
4 year Northern license	054 5497090114	Tourmaline Oil Corp.	7; 18 :51-22 W5
5 year Foothills license	0555509090222*	Scott Land and Lease Ltd.	3; 13; 14 :52-24 W5
PNG lease	001 119168*	Tourmaline Oil Corp.	1; 2 :52-24 W5 36 :51-24 W5
4 year Northern license	0545409110208*	Canadian Coastal Resources Ltd.	8; 17; 19 :51-22 W5
5 year Northern lease	0050508030282*	Scott Land and Lease Ltd.	19 :50-22 W5
5 year Foothills license	0555508020317*	O & G Resource Group	1 :51-24 W5
5 year Foothills license	0555595060067*	Suncor Energy Inc. 50% Manitok Energy Inc. 25% Petrus Resources Ltd. 25%	1 :51-24 W5 36 :50-23 W5
5 year Foothills license	0555507100653*	Standard Land Company Inc.	35 :50-24 W5
5 year Foothills license	0555505050679*	Canadian Natural Resources Ltd.	S24 :52-24 W5
5 year Foothills license	0555505050680*	Canadian Natural Resources Ltd.	S24 :52-24 W5
5 year Foothills license	0555596040063*	Canadian Natural Resources Ltd.	10; 11; 12 :52-24 W5
4 year Northern license	0545497100098*	Canadian Natural Resources Ltd.	29; 30 :51-23 W5
5 year Foothills lease	0060605110279*	Canadian Natural Resources Ltd.	2 :51-24-W5
5 year Foothills license	0555508020316*	Scott Land and Lease Ltd.	36 :50-23 W5

* PNGs located outside the LSA and within the RSA (no impact from the Project)

E.15.1.4 Mineral Development

There are three mineral exploration permits within the LSA, as summarized in Table E.15.1.5. These dispositions are on crown land and are administered by the Government of Alberta.

Table E.15.1.5 Mineral Permits within the LSA

Disposition	Disposition Holder	Location
093 9312010562	Athabasca Minerals Inc.	1-34 :50-23 W5 (all or portions of sections)
093 9312010564	Athabasca Minerals Inc.	6, 7, 13-36 :51-23 W5 (all or portions of sections)
093 9312010565	Athabasca Minerals Inc.	1-36 :51-24 W5 (all or portions of sections)

E.15.1.5 Forestry

The Hinton Division of West Fraser Mills Ltd. (WFM) operates a kraft pulp mill and dimension lumber sawmill in the Town of Hinton. The Project (LSA) and RSA lies entirely within WFM's forest management agreement (FMA) area #8800025 (Table E.15.1.6) which is a small portion of the whole WFM's FMA that is 997,781 ha in size. WFM has had active forestry operations within the LSA with numerous cutover areas with forest plantations established and investments in enhanced silviculture activities.

Table E.15.1.6 Forest Management Agreement in the LSA and RSA

Disposition	Disposition Holder	Location LSA	Location RSA	Expiry
FMA 8800025	West Fraser Mills Ltd.	50; 51-23 W5 51-22 W5 13; 24; 25; 26; 27; 34 :51-24 W5	50; 51-22 W5 50; 51-23 W5 52; 52-24 W5	Apr 30/2028

WFM has two nests of permanent sample plots (PSPs) within Coalspur's proposed Project (LSA) (Table E.15.1.7, Figure E.15.1.5). These PSPs lie within the proposed Vista Project footprint. There are 36 PSPs that also lie within the RSA (outside the LSA) that will not be disturbed by the Vista Project.

Table E.15.1.7 West Fraser Mills Industrial (Permanent) Sample Plots in the LSA

Disposition	Disposition Holder	Location
ISP 010200	West Fraser Mills Ltd.	LSD 4 18 :51-23 W5M
ISP 020540	West Fraser Mills Ltd.	LSD 16 12 :51-23 W5M LSD 1 13 :51-23 W5M LSD 4 18 :51-23 W5M
ISP 020572	West Fraser Mills Ltd.	LSD 4 2 :51-23 W5M LSD 1 3 :51-23 W5M
ISP 020575	West Fraser Mills Ltd.	LSD 13 35 :51-23 W5M
ISP 020595	**West Fraser Mills Ltd.**	LSD 16 8 :51-23 W5M LSD 13 9 :51-23 W5M LSD 4 16 :51-23 W5M LSD 1 17 :51-23 W5M
ISP 020616	**West Fraser Mills Ltd.**	LSD 13 11 :51-23 W5M LSD 4 14 :51-23 W5M LSD 1 15 :51-23 W5M
ISP 020619	West Fraser Mills Ltd.	LSD 1 5 :51-23 W5M
ISP 070239	**West Fraser Mills Ltd.**	NE 10 :51-23 W5M

Bold – impacted by Project footprint

Forested areas represent 67% of the LSA and have an estimated 380,577 m^3 of merchantable timber of which 36,720 m^3 is from unproductive forest (15.5% of the area). The leading tree type within the LSA is pine followed by black spruce, white spruce, aspen, larch, and balsam poplar. Coalspur has entered detailed discussions with WFM to address the harvest of merchantable timber within the proposed Project.

Coalspur began discussions with WFM staff early in the Project's planning process and are nearing completion and agreement on all aspects of mutual interest (*e.g*. roads, timber harvest, timber damages, silviculture investments, PSP plots).

E.15.1.6 Mineral Surface Leases (MSLs), Pipeline Agreements (PLA), and Pipeline Installation Leases

Within the LSA, there are 13 mineral surface lease (MSL) dispositions; two are held by Manitok Energy Inc. (Manitok) and 11 which are held by Tourmaline Oil Corp. (Tourmaline). Both of Manitok's wells are producing with one of those in the Project mining area. Tourmaline has two producing wells (LSD 07-18-51-23-W5M; 15-08-51-23-W5M) and one non-producing well (LSD 11-05-51-23-W5M).

Within the LSA there are 12 pipeline agreements (PLAs). Manitok holds one PLA, Tourmaline holds 10 PLAs, and Yellowhead Gas Co-op Ltd. (Yellowhead) holds one PLA (Table E.15.1.8). The pipelines are connector and feeder pipelines to wellsites with the exception of the main pipeline to the Tourmaline processing plant (PLA 081334) and the Yellowhead's gas co-op pipeline (PLA 972111). There are no major regulated pipelines within the existing mine permit or proposed expansion areas. Tourmaline holds two pipeline installation leases in the LSA.

Table E.15.1.8 identifies MSLs, PLA's, and PILs in the RSA. The dispositions are shown on Figure E.15.1.5a and 5b.

Table E.15.1.8 Mineral Surface Leases and other Public Lands Dispositions – LSA and RSA

Approval Type	Disposition	Disposition Holder	Location	Total Hectares	Expiry
Mineral Surface Lease	**MSL 942398**	**Manitok Energy Inc.**	NE, NW 3 :51-23 W5	1.44	Oct 31/2019
Mineral Surface Lease	MSL 963911	Manitok Energy Inc.	NW, SW 5 :51-23 W5	1.44	Jan 26/2022
Mineral Surface Lease	MSL 111669	Tourmaline Oil Corp.	NW 36 :50-23 W5	1.69	Aug 7/2015
Mineral Surface Lease	MSL 061981	Tourmaline Oil Corp.	SW 1 :51-23 W5	1.78	June 5/2031
Mineral Surface Lease	MSL 081617	Tourmaline Oil Corp.	NW, SW 5 :51-23 W5	2.13	Sept 11/2033
Mineral Surface Lease	MSL 111613	Tourmaline Oil Corp.	SE 6 :51-23 W5	1.74	Aug 2/2015
Mineral Surface Lease	**MSL 062913**	**Tourmaline Oil Corp.**	NE 8 :51-23 W5	1.62	Aug 21/2031
Mineral Surface Lease	MSL 062627	Tourmaline Oil Corp.	NW, SW 9 :51-23 W5	1.65	Aug 15/2031
Mineral Surface Lease	**MSL 061982**	**Tourmaline Oil Corp.**	SW 11 :51-23 W5	1.44	Jun 5/2031
Mineral Surface Lease	MSL 112514	Tourmaline Oil Corp.	NE 16 :51-23 W5	1.16	Oct 18/2011
Mineral Surface Lease	**MSL 062695**	**Tourmaline Oil Corp.**	NW 18 :51-23 W5	1.44	Aug 13/2031
Mineral Surface Lease	**MSL 071775**	**Tourmaline Oil Corp.**	SE 18 :51-23 W5	1.51	Aug 20/2032
Mineral Surface Lease	MSL 112732	Tourmaline Oil Corp.	NE, SE, SW 19 :51-23 W5	1.96	Nov 1/2015
Mineral Surface Lease	MSL 963675*	Manitok Energy Inc.	SW 24 :50-23 W5	1.56	Dec 19/2021
Mineral Surface Lease	MSL 943501*	Manitok Energy Inc.	S 28 :50-23 W5	1.44	Jan 10/2020
Mineral Surface Lease	MSL 082500*	Tourmaline Oil Corp.	NW 31 :50-23 W5	1.82	Oct 26/2033
Mineral Surface Lease	MSL 963867*	ConocoPhillips Canada Resources Corp.	SE 34 :50-23 W5		Apr 16/2022
Mineral Surface Lease	MSL 081879*	Tourmaline Oil Corp.	SE 35; SW 36 :50-24 W5	1.69	Sept 17/2033
Mineral Surface Lease	MSL 061188*	Tourmaline Oil Corp.	E 07 :51-22 W5	1.56	Jun 14/2031
Mineral Surface Lease	MSL 070348*	Richards Oil & Gas Limited	NE 07 :51-22 W5	1.0	Apr 17/2032
Mineral Surface	MSL 073945*	Tourmaline Oil Corp.	SW 35 :50-24 W5	1.69	Jan 6/2033

Table E.15.1.8 Mineral Surface Leases and other Public Lands Dispositions – LSA and RSA

Approval Type	Disposition	Disposition Holder	Location	Total Hectares	Expiry
Lease					
Mineral Surface Lease	MSL 064689*	Richards Oil & Gas Limited	SW 24 :51-23 W5	1.10	Jan 21/2032
Mineral Surface Lease	MSL 062642*	Canadian Natural Resources Limited	NE 30 :51-23 W5	1.47	Jul 20/2031
Mineral Surface Lease	MSL 101402*	Tourmaline Oil Corp.	NE 12 :51-24 W5	1.68	Sep 29/2035
Mineral Surface Lease	MSL 082499*	Tourmaline Oil Corp.	SE 12 :51-24 W5	1.36	Oct 26/2033
Mineral Surface Lease	MSL 060914*	Canadian Natural Resources Limited	NE 29 :51-23 W5	1.54	Mar 14/2031
Mineral Surface Lease	MSL 801527*	Tourmaline Oil Corp.	NW, SW 1 :52-24 W5	2.25	Sep 11/2030
Mineral Surface Lease	MSL 072293*	Canadian Natural Resources Limited	SE 10 :52-24 W5	1.69	Oct 3/2032
Mineral Surface Lease	MSL 064537*	Canadian Natural Resources Limited	SW 11 :52-24 W5	1.44	Dec 11/2031
Mineral Surface Lease	MSL 031365*	Canadian Natural Resources Limited	SE 12 :52-24 W5	2.15	Jun 26/2028
Mineral Surface Lease	MSL 113327*	Canadian Natural Resources Limited	SE 13 :52-24 W5	1.71	Dec 8/2015
Pipeline Lease Agreement	PLA 970575	Manitok Energy Inc.	N, SW 3 :51-23 W5 SE 4 :51-23 W5 SW, NW 5 :51-23 W5 NE, SE 6 :51-23 W5 N 01, SE 12 :051-24 W5	9.72	Indefinite
Pipeline Lease Agreement	**PLA 071477**	**Tourmaline Oil Corp.**	**NE, NW 5 :51-23 W5 NE, SE 8 :51-23 W5 NW, SW 9 :51-23 W5**	**4.18**	**Indefinite**
Pipeline Lease Agreement	PLA 082525	Tourmaline Oil Corp.	NW, SW 5 :51-23 W5	1.08	Indefinite
Pipeline Lease Agreement	PLA 081790	Tourmaline Oil Corp.	SW 5 :51-23 W5 NE, SE 6 :51-23 W5 N, SE 31 :50-23 W5 SW 32 :50-23 W5	6.62	Indefinite
Pipeline Lease Agreement	PLA 082541	Tourmaline Oil Corp.	SW 5 :51-23 W5 N 31 :50-23 W5	1.21	Indefinite
Pipeline Lease Agreement	PLA 090431	Tourmaline Oil Corp.	SW 5 :51-23 W5 NE, SE 6 :51-23 W5	2.79	Indefinite
Pipeline Lease Agreement	PLA 091257	Tourmaline Oil Corp.	SW 5 :51-23 W5 NW 31 :50-23 W5	0.17	Indefinite
Pipeline Lease Agreement	PLA 112285	Tourmaline Oil Corp.	SE 6 :51-23 W5	0.20	Dec 11/ 2011

Table E.15.1.8 Mineral Surface Leases and other Public Lands Dispositions – LSA and RSA

Approval Type	Disposition	Disposition Holder	Location	Total Hectares	Expiry
Pipeline Lease Agreement	**PLA 080490**	**Tourmaline Oil Corp.**	NE, NW 8 :51-23 W5 SW 17 :51-23 W5 SE 18 :51-23 W5	2.24	Indefinite
Pipeline Lease Agreement	**PLA 090220**	**Tourmaline Oil Corp.**	NE 8 :51-23 W5 SE, NE 17 :51-23 W5 E 20; 29 :51-23 W5	8.99	Indefinite
Pipeline Lease Agreement	**PLA 081334**	**Tourmaline Oil Corp.**	NE 27 :51-24 W5 SE 34 :51-24 W5 N, SW 22; E 27 :51-24 W5 NE, SE 3 :52-24 W5 NE, SE 34 :51-24 W5	14.85	Indefinite
Pipeline Lease Agreement	**PLA 972111**	**Yellowhead Gas Co-op Ltd.**	NW 34 :51-24 W5	0.07	Indefinite
Pipeline Lease Agreement	PLA 970574*	Manitok Energy Inc.	SW 24 :50-23 W5 SW 28 :50-23 W5 N, SE 31 :50-23 W5 N, SW 32 :50-23 W5	21.08	Indefinite
Pipeline Lease Agreement	PLA 033465*	ATCO Pipelines (North TN8263923)	NW 19 :51-24 W5	1.78	Indefinite
Pipeline Lease Agreement	PLA 062484*	Yellowhead Gas Co-op Ltd	NE, SE 13 :52-24 W5	1.21	Indefinite
Pipeline Lease Agreement	PLA 062539*	Canadian Natural Resources Limited	NE, SE 12 :52-24 W5 SE 13 :52-24 W5	1.07	Indefinite
Pipeline Lease Agreement	PLA 063255*	Canadian Natural Resources Limited	NE 29, N 30 :51-23 W5	8.77	Indefinite
Pipeline Lease Agreement	PLA 063430*	Canadian Natural Resources Limited	NE 1 :52-24 W5 SE 12 :52-24 W5	2.12	Indefinite
Pipeline Lease Agreement	PLA 063441*	Canadian Natural Resources Limited	NE,NW,SW 10 :52-24 W5 NE,NW,SE 13 :52-24 W5 NE,NW,SW 14 :52-24 W5 SE 15 :52-24 W5	17.15	Indefinite
Pipeline Lease Agreement	PLA 063581*	ATCO Pipelines (North TN8263923)	SE 31 :51-24 W5	3.79	Indefinite
Pipeline Lease Agreement	PLA 064171*	Canadian Natural Resources Limited	SW 29, N 30 :51-23 W5	1.22	Indefinite
Pipeline Lease Agreement	PLA 070618*	Canadian Natural Resources Limited	NW 1 :52-24 W5 NE 2 :52-24 W5 SE, SW 11 :52-24 W5 SE, SW 12 :52-24 W5	3.48	Indefinite

Table E.15.1.8 Mineral Surface Leases and other Public Lands Dispositions – LSA and RSA

Approval Type	Disposition	Disposition Holder	Location	Total Hectares	Expiry
Pipeline Lease Agreement	PLA 072401*	Canadian Natural Resources Limited	SE 10 :52-24 W5 SW 11 :52-24 W5	1.07	Indefinite
Pipeline Lease Agreement	PLA 080683*	Tourmaline Oil Corp.	NW, SW 1 :52-24 W5 SW 12 :52-24 W5	1.65	Indefinite
Pipeline Lease Agreement	PLA 080785*	Tourmaline Oil Corp.	35 :50-24 W5 E 1 :51-24 W5	4.88	Indefinite
Pipeline Lease Agreement	PLA 081327*	Tourmaline Oil Corp.	N 01 :51-24 W5	8.10	Indefinite
Pipeline Lease Agreement	PLA 081668*	Tourmaline Oil Corp.	SE 31 :50-23 W5 SW 32 :50-23 W5	1.73	Indefinite
Pipeline Lease Agreement	PLA 081744*	Tourmaline Oil Corp.	SW 35 :50-24 W5	1.65	Indefinite
Pipeline Lease Agreement	PLA 081922*	Tourmaline Oil Corp.	SW 35 :50-24 W5	1.98	Indefinite
Pipeline Lease Agreement	PLA 082527*	Tourmaline Oil Corp.	E 35, SW 36 :50-24 W5	1.34	Indefinite
Pipeline Lease Agreement	PLA 082651*	Tourmaline Oil Corp.	SW 07 :51-23 W5 SE 12 :51-24 W5	0.73	Indefinite
Pipeline Lease Agreement	PLA 820657*	ATCO Gas and Pipelines Ltd. (South)	NW 29 :51-24 W5 SE 31 :51-24 W5	16.70	Indefinite
Pipeline Lease Agreement	PLA 880693*	Yellowhead Gas Co-op Ltd	NE, SE, SW 3 :52-24 W5 SE 10 :52-24 W5 SW 12 :52-24 W5	0.55	Indefinite
Pipeline Lease Agreement	PLA 880916*	Trans Mountain Pipeline ULC	NW 33 :51-24 W5 NE, NW 3 :52-24 W5 SE, SW 4 :52-24 W5 SE 10 :52-24 W5 NE,NW,SW 11 :52-24 W5 SE 13 :52-24 W5	11.24	Indefinite
Pipeline Lease Agreement	PLA 880926*	Trans Mountain Pipeline ULC	SE 31 :51-24 W5 NE, SE 32 :51-24 W5 NW 33 :51-24 W5 NE, NW 3 :52-24 W5 NE, SE, SW 4 :52-24 W5 SE 10 :52-24 W5 NE, NW, SW 11 :52-24 W5 SE 13 :52-24 W5 NW 19 :51-24 W5	116.00	Indefinite

Table E.15.1.8 Mineral Surface Leases and other Public Lands Dispositions – LSA and RSA

Approval Type	Disposition	Disposition Holder	Location	Total Hectares	Expiry
Pipeline Lease Agreement	PLA 980535*	Manitok Energy Inc.	SW 28 :50-23 W5	0.96	Indefinite
Pipeline Lease Agreement	PLA 981862*	Manitok Energy Inc.	E, SW 28 :50-23 W5 SE 33, S 34 :50-23 W5	2.874	Indefinite
Pipeline Lease Agreement	PLA 982035*	Manitok Energy Inc.	SW 24 :50-23 W5	0.20	Indefinite
Pipeline Lease Agreement	PLA 982435*	Manitok Energy Inc.	SW 24 :50-23 W5	2.27	Indefinite
Pipeline Installation Lease	PIL 080687	Tourmaline Oil Corp.	SW 5 :51-23 W5	0.12	Jan 6/2034
Pipeline Installation Lease	PIL 110862	Tourmaline Oil Corp.	SE 6 :51-23 W5	0.06	Dec 12/2015
Pipeline Installation Lease	PIL 080807*	Tourmaline Oil Corp	NW 31 :50-23 W5	0.05	Dec 22/2033
Pipeline Installation Lease	PIL 090438*	Tourmaline Oil Corp	NW 31 :50-23 W5	0.08	Nov 17/2034
Pipeline Installation Lease	PIL 080451*	Tourmaline Oil Corp	SW 32 :50-23 W5	0.10	Aug 20/2033
Pipeline Installation Lease	PIL 080657*	Tourmaline Oil Corp	NE 35 :50-24 W5	0.06	Nov 19/2033
Pipeline Installation Lease	PIL 080475*	Tourmaline Oil Corp	SW 35 :50-24 W5	0.08	Sep 16/2033
Pipeline Installation Lease	PIL 090057*	Tourmaline Oil Corp	NW 31 :50-23 W5	0.03	Feb 17/2034
Pipeline Installation Lease	PIL 870015*	ATCO Gas and Pipelines Ltd. (South)	NW 29 :51-24 W5	0.17	Mar 17/2037
Pipeline Installation Lease	PIL 080390*	Talisman Energy Inc.	NE 3 :52-24 W5	0.10	Jul 20/2033
Pipeline Installation Lease	PIL 080691*	ATCO Pipelines (North TN8263923)	NE 3 :52-24 W5 SE 10 :52-24 W5	0.09	Dec 10/2033
Pipeline Installation Lease	PIL 880069*	Yellowhead Gas Co-op Ltd.	SE 10 :52-24 W5	0.01	Dec 6/2013
Pipeline Installation Lease	PIL 880069*	Canadian Natural Resources Limited	SE 12 :52-24 W5	0.01	Feb 27/2032
Pipeline Installation Lease	PIL 080163*	Tourmaline Oil Corp	SW 12 :52-24 W5	0.04	Mar 5/2033

* Disposition located outside the LSA and within the RSA (will not be impacted by the Project); **Bold** – impacted by Project footprint

Canadian Natural Resources Ltd. (CNRL) has one producing gas well at LSD 03-11-52-25-W5M located outside the LSA (MSL 064537 and road access covered by licence of occupation (LOC 063388)) but within the RSA. Highway 16 access to this well site is currently provided at Pedley. Alberta Transportation requested that this access be closed to public access to accommodate the proposed new highway access for Coalspur's mine and infrastructure.

CNRL has a second MSL, PLA and LOC for a well-site in LSD 8-10-52-24-W5M. They have not developed this site and have indicated that they do not intend to do so. If CNRL's plans change, access to this site could still be available from the north.

E.15.1.7 Licence of Occupation

A number of LOC access roads are located within the LSA. These are held by West Fraser, Tourmaline and Manitok. Several LOCs are also held by Coalspur to access piezometer installations. Coalspur has a number of LOCs under application for additional piezometer installations. LOCs within the LSA and RSA are provided in Table E.15.1.9 and shown on Figure E.15.1.5a and 5b.

Table E.15.1.9 Licence of Occupation in the LSA and RSA

Disposition	Disposition Holder	Location	Use	Total area (ha)	Expiry
LOC 111517	Tourmaline Oil Corp.	NW 36 :50-23 W5 NE 35 :50-23 W5 SE; SW 1 :51-23 W5	Road	3.7	Aug 8/2015
LOC 120295	Coalspur Mines (Operations) Ltd.	NW 36 :50-23 W5	Access to piezometer	0.3	App. Jan 26/ 2012
LOC 810954	**West Fraser Mills Ltd.**	NE, NW 34 :50-23 W5 NW, SW 1 :51-23 W5 NE, NW, SE 2 :51-23 W5 NE 3 :51-23 W5 NE, NW 8 :51-23 W5 NE, NW; SE 9 :51-23 W5 SE, SW 10 :51-23 W5 SW 11 :51-23 W5 SW 17 :51-23 W5 SE 18 :51-23 W5	Road	35.6	Indefinite
LOC 942529	Manitok Energy Inc.	NE, NW 34 :50-23 W5	Road	5.1	Jan 10/2020
LOC 120292	Coalspur Mines (Operations) Ltd.	NW 1 :51-23 W5 NE 2 :51-23 W5	Access to piezometer	0.3	App. Jan 26/ 2012
LOC 061538	**Tourmaline Oil Corp.**	NW 2 :51-23 W5 SW 11 :51-23 W5	Road	0.5	Jun 5/2031
LOC 941658	**Manitok Energy Inc.**	NE 3 :51-23 W5 SE 10 :51-23 W5	Road	0.9	Oct 31/2019
LOC 081779	Tourmaline Oil Corp.	SW 5 :51-23 W5	Road	3.8	Oct 26/2033
LOC 111478	Tourmaline Oil Corp.	SW 5 :51-23 W5 SE 6 :51-23 W5	Road	0.8	Aug 2/2015

Table E.15.1.9 Licence of Occupation in the LSA and RSA

Disposition	Disposition Holder	Location	Use	Total area (ha)	Expiry
LOC 962927	Manitok Energy Inc.	SW 5 :51-23 W5 SE 6 :51-23 W5	Road	4.8	Jan 26/2022
LOC 113007	Tourmaline Oil Corp.	SE 6 :51-23 W5	Road	0.0	Dec 12/2015
LOC 120296	Coalspur Mines (Operations) Ltd.	NE, NW 8 :51-23 W5	Access to piezometer	0.4	Jan 26/2012
LOC 061999	**Tourmaline Oil Corp.**	NE, NW 9 :51-23 W5	Road	0.6	Aug 15/2031
LOC 120288	Coalspur Mines (Operations) Ltd.	SE 9 :51-23 W5 NW, SW 10 :51-23 W5	Access to piezometer	0.4	App. Jan 26/ 2012
LOC 120293	Coalspur Mines (Operations) Ltd.	NE, NW 12 :51-23 W5 SE, SW 13 :51-23 W5	Access to piezometer	0.8	App. Jan 26/ 2012
LOC 910635	**West Fraser Mills Ltd.**	NE 12 :51-23 W5 13 :51-23 W5 NE,SE,SW 14 :51-23 W5 SE, SW 15 :51-23 W5 16 :51-23 W5 SE, SW 17 :51-23 W5 SE 18 :51-23 W5 SE 20 :51-23 W5	Road	155.1	Aug 19/2016
LOC 020939	**West Fraser Mills Ltd.**	SE, SW 14 :51-23 W5	Road	3.4	Oct 3/2027
LOC 3525	**West Fraser Mills Ltd.**	NE, NW, SE 18 :51-23 W5 SE, SW 19 :51-23 W5 NE 13 :51-24 W5 NE, SE, SW 24 :51-24 W5 NE 23 :51-24 W5	Road	123.0	Indefinite
LOC 062045	**Tourmaline Oil Corp.**	NE, NW 18 :51-23 W5	Road	1.6	Aug 13/2031
LOC 071213	**Tourmaline Oil Corp.**	SE 18 :51-23 W5	Road	0.3	Aug 20/2032
LOC 960167	**West Fraser Mills Ltd.**	SW 25 :51-24 W5 SE, SW 26 :51-24 W5	Road	44.2	Jan 25/2021
LOC 981974	**West Fraser Mills Ltd.**	SW 25 :51-24 W5 NE, SE 26 :51-24 W5	Road	12.4	Nov 25/2023
LOC 972363	**West Fraser Mills Ltd.**	NW, SW 26 :51-24 W5	Road	8.7	Jan 27/2023
LOC 972364	West Fraser Mills Ltd.	NE 27 :51-24 W5 SE; SW 34 :51-24 W5	Road	14.4	Jan 27/2023
LOC 990309	West Fraser Mills Ltd.	NW 34 :51-24 W5	Road	4.6	Feb 16/2024
LOC 000967*	Canadian Natural Resources Limited	NE 1 :52-24 W5 SE, SW 12 :52-24 W5	Road	4.14	May 14/2025
LOC 020940*	West Fraser Mills	NW 08 :51-22 W5	Road	4.7	Oct 2/2027

Table E.15.1.9 Licence of Occupation in the LSA and RSA

Disposition	Disposition Holder	Location	Use	Total area (ha)	Expiry
	Ltd.	N 07 :51-22 W5			
LOC 020941*	West Fraser Mills Ltd.	NE 28 :51-23 W5	Road	4.1	Sept 30/2027
LOC 020942*	West Fraser Mills Ltd.	E 30 :51-23 W5	Road	1.3	Sept 30/2027
LOC 030928*	Canadian Natural Resources Limited	SE; SW 12 :52-24 W5	Road	0.462	Jun 26/2028
LOC 060688*	Canadian Natural Resources Limited	NE 29 :51-23 W5	Road	0.93	Mar 14/2031
LOC 060880*	Tourmaline Oil Corp.	NE-07 :51-22 W5	Road	0.92	June 14/2031
LOC 063386*	Canadian Natural Resources Limited	NW 2 :52-24 W5 SW 11 :52-24 W5	Road	1.36	Dec 11/2031
LOC 063782*	Tourmaline Oil Corp.	E 01 :51-24 W5	Road	3.30	Jan 21/2032
LOC 071602*	Canadian Natural Resources Limited	SE 10 :52-24 W5	Road	2.29	Oct 3/2032
LOC 072638*	Tourmaline Oil Corp.	35:050-24 W5 SE 10 :51-24 W5	Road	3.86	Apr 30/2028
LOC 081027*	Talisman Energy Inc.	NE 3 :52-24 W5 SE 10 :52-24 W5	Road	0.13	Jul 20/2033
LOC 081069*	Tourmaline Oil Corp.	SW 35-050-24 W5	Road	2.05	Jul 20/2033
LOC 081390*	Tourmaline Oil Corp.	S 35, SW 36-050-24 W5	Road	2.13	Sep 17/2033
LOC 081778*	Tourmaline Oil Corp.	SW 07 :51-23 W5 SE 12 :51-24 W5	Road	0.87	Oct 26/2033
LOC 081779*	Tourmaline Oil Corp.	N 31-050-23 W5	Road	3.78	Oct 26/2033
LOC 082111*	Tourmaline Oil Corp.	SW 35-050-24 W5	Road	7.35	Jun 11/2033
LOC 100956*	Tourmaline Oil Corp.	N 12, NW 14, S 14 :51-24 W5	Road	8.68	Sep 29/2035
LOC 112962*	Canadian Natural Resources Limited	SE 13 :52-24 W5	Road	0.50	Dec 15/2015
LOC 120285*	Coalspur Mines (Operations) Ltd.	SW 26 :51-24 W5	Access to piezometer	0.08	N/A
LOC 3525*	West Fraser Mills Ltd.	NW 19 :51-23 W5MN 13, N 14, E & SW 22, 23, NE & SW 24 :51-24 W5	Road	123	Indefinite
LOC 4797*	West Fraser Mills Ltd.	NW 3 :52-24 W5 NE, SE, SW 4 :52-24 W5 NE, NW, SW 10 :52-24 W5	Road	12.14	Indefinite
LOC 750673*	TELUS Communications Inc.	NW 33 :51-24 W5 NW 3 :52-24 W5 NE, SE, SW 4 :52-24 W5 NW, SW 10 :52-24 W5	Road	2.45	Indefinite
LOC 801024*	Tourmaline Oil Corp.	NW, SW 1 :52-24 W5 SW 12 :52-24 W5	Road	7.91	Indefinite

Table E.15.1.9 Licence of Occupation in the LSA and RSA

Disposition	Disposition Holder	Location	Use	Total area (ha)	Expiry
LOC 870278*	ATCO Gas and Pipelines Ltd. (South)	NW 29 :51-24 W5	Road	0.08	Mar 3/2037
LOC 910635*	West Fraser Mills Ltd.	N 07 :51-22 W5 N, SW 17 :51-22 W5 18, S 19 :51-22 W5 N 13, NE 14, N 16 :51-23 W5 E 20, 21, N, SW 22, N & SE 23, NW & S 24 :51-23 W5	Road	155.1	Aug 19/2016
LOC 931625*	West Fraser Mills Ltd.	SW, N 19-050-22 W5 N, SE 24-050-23 W5	Road	75.1	Dec 21/2018
LOC 931627*	West Fraser Mills Ltd.	NE 19, 30, SE 31-050-22 W5	Road	10.8	Dec 20/2018
LOC 942529*	Manitok Energy Inc.	E, SW 28-050-23 W5 SE 33, SW 34-050-23 W5	Road	5.12	Jan 10/2020
LOC 960167*	West Fraser Mills Ltd.	N, SW 30 :51-23 W5 N, SW 22, S 25, S 26, SE 27 :51-24 W5	Road	44.2	Jan 25/2021
LOC 962892*	ConocoPhillips Canada Resources Corp	S 34-050-23 W5	Road	2.03	Apr 4/2023
LOC 962927*	Manitok Energy Inc.	NE 36-050-24 W5	Road	4.84	Jan 26/2022
LOC 962931*	Manitok Energy Inc.	NW 01 :51-24 W5	Road	1.2	Jan 26/2022
LOC 970077*	Manitok Energy Inc.	S 01 :51-24 W5	Road	11.26	Jan 26/2022
LOC 971298*	Manitok Energy Inc.	SE 31:50-23 W5 SW 32:50-23 W5	Road	1.34	Jul 17/2022
LOC 971333*	West Fraser Mills Ltd.	W 22 :51-24 W5	Road	3.70	Jul 9/2022
LOC 972361*	West Fraser Mills Ltd.	NE 28 :51-24 W5	Road	4.10	Jan 26/2023
LOC 972361*	West Fraser Mills Ltd.	SE 33 :51-24 W5	Road	4.1	Jan 26/2023
LOC 972362*	West Fraser Mills Ltd.	N, SE 28 :51-24 W5	Road	2.30	Jan 27/2023
LOC 972363*	West Fraser Mills Ltd.	W 26 :51-24 W5	Road	8.70	Jan 27/2023
LOC 972363*	West Fraser Mills Ltd.	SE, SW 35 :51-24 W5	Road	8.7	Jan 27/2023
LOC 972364*	West Fraser Mills Ltd.	27, E 28 :51-24 W5	Road	14.40	Jan 27/2023
LOC 972364*	West Fraser Mills Ltd.	SE 34 :51-24 W5	Road	14.4	Jan 27/2023
LOC 981974*	West Fraser Mills Ltd.	W 25, E 26 :51-24 W5 NE, SE; SW 36 :51-24 W5	Road	12.40	Nov 25/2023
LOC 990269*	West Fraser Mills Ltd.	NE 28 :51-23 W5	Road	5.9	Feb 4/2024
LOC 990309*	West Fraser Mills Ltd.	NE 33 :51-24 W5 NW 34 :51-24 W5 SW 3 :52-24 W5	Road	4.6	Feb 16/2024

Table E.15.1.9 Licence of Occupation in the LSA and RSA

Disposition	Disposition Holder	Location	Use	Total area (ha)	Expiry
		SE 4 :52-24 W5			
LOC 991662*	West Fraser Mills Ltd.	SW 23 :51-24 W5	Road	1.50	Nov 25/2024

* Disposition located outside the LSA and within the RSA; **Bold** – impacted by Project footprint

E.15.1.10 Aggregates

Within the RSA there are a number of Surface Material Leases (SMLs) and Conservation and Reclamation Business Plans (CRPs) (Table E.15.1.10, Figure E.15.1.5a and 5b). There are no SMLs or CRPs in the LSA.

Table E.15.1.10 Surface Material Leases and in the RSA

Approval Type	Disposition	Disposition Holder	Location	Total Hectares	Expiry
Surface Material Lease	SML 990048*	West Fraser Mills Ltd.	SW 26 :51-24 W5	5.77	Sep 8, 2009
Surface Material Lease	SML 920078*	West Fraser Mills Ltd.	NW 17 :51-22 W5	4.99	Aug 3, 2012
Conservation and Reclamation Business Plan	CRP 030051*	West Fraser Mills Ltd.	NW 17 :51-22 W5	-	Aug 3, 2012
Surface Material Lease	SML 800048*	West Fraser Mills Ltd.	S 23 :51-24 W5	14.76	Mar 31, 2015
Conservation and Reclamation Plan	CRP 010004*	West Fraser Mills Ltd.	S 23 :51-24 W5		Mar 31, 2015
Surface Material Lease	SML 090078*	Seabrook Trucking Ltd.	NW 10 :52-24 W5	29.58	n/a
Surface Material Lease	SML 800115*	Canadian National Railway Company	NE, NW 14 :52-24 W5	57.45	Dec 17, 2010
Surface Material Lease	SML 080008*	537042 Alberta Ltd.	NW, SW 14 :52-24 W5	3.86	Dec 15, 2019

* Dispositions outside of the LSA but are within the RSA (no impact from the Project); **Bold** – impacted by Project footprint

E.15.1.8 Major Roads in the LSA and RSA

Highway 16 runs through the LSA and RSA. There are a number of roadways (RDSs) and registered roadways (RRDs) that run through the RSA held by Alberta Transportation, Yellowhead County, and the Town of Hinton (Table E.15.1.11; Figure E.15.1.5a and 5b).

Table E.15.1.11 Major Roads in the LSA and RSA

Disposition	Disposition Holder	Location	Total Ha
RRD 9020989	**Transportation**	NW 34 :51-24 W5 NE; NW; SE; SW 29 :51-24 W5 NE; SE; SW 33 :51-24 W5 NE; NW 34 :51-24 W5 NE; NW; SW 2 :52-24 W5 NE; SE 3 :52-24 W5 NW 28 :51-24 W5	87.96
RRD 2755JY*	Transportation	NW 19 :51-24 W5 SE 30 :51-24 W5	4.44
RDS 090006*	Yellowhead County	NE 11 :52-24 W5 NE, SE 14 :52-24 W5	1.80
RDS 11952*	Transportation	SE 30 :51-24 W5	-
RDS 820029*	Transportation	NE, SE; SW 29 :51-24 W5	306.31
RRD 1285EU*	Transportation	SE 31 :51-24 W5 NE 11 :52-24 W5 SE 13 :52-24 W5 SE, SW 14 :52-24 W5 SE 15 :52-24 W5	12.87
RRD 4490EO*	Transportation	NE; SE 32 :51-24 W5	5.20
RRD 5688KS*	Town of Hinton	NW 19 :51-24 W5	0.60
RRD 6008LZ*	Transportation	NW 2 :52-24 W5 NE 3 :52-24 W5	0.83
RRD 84220522*	Transportation	NE 11 :52-24 W5	0.30
RRD 8621712*	Transportation	NW 19 :51-24 W5	2.09
RRD 9021795*	Transportation	SE 11 :52-24 W5 NE, NW; SW 12 :52-24 W5	135.72
RRD 9523123*	Town of Hinton	NW 19 :51-24 W5	1.18

*Disposition located outside the LSA and within the RSA (no impact from the Project); **Bold** – impacted by Project footprint

E.15.1.9 Rights of Way

Prairie Mines & Royalty Ltd. and the Canadian National Railway Company have major rights of way within the RSA.

E.15.1.10 Area Operating Agreement

Talisman Energy Inc. held an Area Operations Agreement (AOA 060006) with Alberta Sustainable Resource Development (ASRD) covering 13-36; 12-35; 50-23-W5M. The lease expired May 31, 2007.

E.15.1.11 Easements

There are four dispositions for high voltage transmission lines within the LSA and communication cables have one disposition. Altalink Management Ltd. and Fortis Alberta Inc. hold easements (EZEs) and vegetation control easements (VCEs) in the LSA and RSA (Table E.15.1.12; Figure E.15.1.5a and 5b) and TELUS Communications Inc.

Table E.15.1.12 Easements and Vegetation Easements in the LSA and RSA

Disposition	Disposition Holder	Location	Total area (ha)	Purpose
EZE910199	Altalink Management Ltd.	NE, NW 35 :50-23 W5 NE, NW 34 :50-23 W5 SE 1 :51-23 W5	50.2	Powerline
VCE 910027	Altalink Management Ltd.	NE, NW 35 :50-23 W5 NE, NW 34 :50-23 W5 SE 1 :51-23 W5	1.0	Veg Control
EZE910200	Altalink Management Ltd.	NE, NW; SW 6 :51-22 W5	65.7	Powerline
VCE 910028	Altalink Management Ltd.	NE, NW; SW 6 :51-22 W5	2.2	Veg Control
EZE 1496	**FortisAlberta Inc.**	NW 34 :51-24 W5 NE, NW 29 :51-24 W5 SE 31 :51-24 W5 NE; SE 33 :51-24 W5 NE; NW 34 :51-24 W5 NE; NW 2 :52-24 W5 SE 3 :52-24 W5 NE, SW 12 :52-24 W5	1.6	Powerline
EZE 800129	**FortisAlberta Inc.**	NW 34 :51-24 W5 NW 34 :51-24 W5	**0.1**	**Powerline**
EZE 860402	**Altalink Management Ltd.**	NW 34 :51-24 W5 NE, SE; SW 29 :51-24 W5 NE, SE; SW 33 :51-24 W5 NE, NW 34 :51-24 W5 NW 19, NW 28 :51-24 W5	10.3	Veg Control
EZE 890038	TELUS Communications Inc.	NW 34 :51-24 W5 NE 33 :51-24 W5 NW 34 :51-24 W5	0.2	Comm Cable
VCE 110026	FortisAlberta Inc.	NW 34 :51-24 W5 NE, NW 34 :51-24 W5 NE, NW 2 :52-24 W5 NE, SE 3 :52-24 W5 SE 11 :52-24 W5 NE, SW 12 :52-24 W5	8.1	Veg Control
VCE 110049	**Altalink Management Ltd.**	NW 34 :51-24 W5 NW 28 :51-24 W5	1.6	Veg Control

Table E.15.1.12 Easements and Vegetation Easements in the LSA and RSA

Disposition	Disposition Holder	Location	Total area (ha)	Purpose
		NE, SE; SW 33 :51-24 W5 NE, NW 34 :51-24 W5		
EZE 040117*	FortisAlberta Inc.	NW 19 :51-24 W5	0.028	Powerline
EZE 050325*	FortisAlberta Inc.	SE 13 :52-24 W5	1.7	Powerline
EZE 080261*	FortisAlberta Inc.	NE 3 :52-24 W5 SE 10 :52-24 W5	0.54	Powerline
EZE 110138*	Altalink Management Ltd.	W 28 :51-24 W5	14.95	Anchor
EZE 110173*	Altalink Management Ltd.	NE, NW, SW 2 :52-24 W5 SE-3 :52-24 W5 SE 11 :52-24 NE, NW, SW 12 :52-24 W5	13.50	Anchor
EZE 110206*	Altalink Management Ltd.	SE,SW 33 :51-24 W5 NW 28 :51-24 W5	3.27	Anchor
EZE 1496*	FortisAlberta Inc.	NE, NW 29 :51-24 W5 SE 31 :51-24 W5 NE, SE 33 :51-24 W5 NE, NW 34 :51-24 W5 NE, NW 2 :52-24 W5 SE 3 :52-24 W5 NE; SW 12 :52-24 W5	1.56	Powerline
EZE 2215*	FortisAlberta Inc.	NW 2 :52-24 W5 NE 3 :52-24 W5	0.24	Powerline
EZE 3123*	FortisAlberta Inc.	SE, SW 3 :52-24 W5	0.22	Powerline
EZE 800129*	FortisAlberta Inc.	NW 34 :51-24 W5	0.13	Veg Control
EZE 860149*	Altalink Management Ltd.	NE, NW; SW 2 :52-24 W5 SE-3 :52-24 W5 SE 11 :52-24 W5 SW 12 :52-24 W5	5.72	Veg Control
EZE 860402*	Altalink Management Ltd.	NE, SE, SW 29 :51-24 W5 NE, SE, SW 33 :51-24 W5 NE, NW 34 :51-24 W5 NW 19, NW 28 :51-24 W5	10.28	Veg Control
EZE 890038*	TELUS Communications Inc.	NE 33 :51-24 W5 NW 34 :51-24 W5	0.16	Comm. Cable
EZE 890434*	TELUS Communications Inc.	NW 19 :51-24 W5	0.01	Not Defined
EZE 910198*	Altalink Management Ltd.	N 35, N 36-050-24 W5	58.41	Powerline
EZE 910199*	Altalink Management Ltd.	N 31 :50-23 W5 N 32 :50-23 W5	50.20	Powerline

Table E.15.1.12 Easements and Vegetation Easements in the LSA and RSA

Disposition	Disposition Holder	Location	Total area (ha)	Purpose
		N 33 :50-23 W5		
EZE 910200*	Altalink Management Ltd.	SE 07,08 :51-22 W5	65.74	Powerline
VCE 110026*	FortisAlberta Inc.	NE, NW 34 :51-24 W5 NE, NW 2 :52-24 W5 NE, SE 3 :52-24 W5 SE 11 :52-24 W5 NE, SW 12 :52-24 W5	8.09	Veg Control
VCE 110027*	Altalink Management Ltd.	W 28 :51-24 W5	7.62	Veg Control
VCE 110040*	Altalink Management Ltd.	NE, NW, SW 2 :52-24 W5 SE 3 :52-24 W5 SE 11 :52-24 W5 SW 12 :52-24 W5	1.64	Veg Control
VCE 110049*	Altalink Management Ltd.	NW 28 :51-24 W5	1.61	Veg Control
VCE 110049*	Altalink Management Ltd.	NE, SE; SW 33 :51-24 W5 NE, NW 34 :51-24 W5	1.61	Veg Control
VCE 910025*	Altalink Management Ltd.	NW 35, N 36: 50-24 W5	1.52	Veg Control
VCE 910027*	Altalink Management Ltd.	N 31 :50-23 W5 N 32 :50-23 W5 N 33 :50-23 W5	1.01	Veg Control
VCE 910028*	Altalink Management Ltd.	W, SE 08 :51-22 W5 SE 07 :51-22 W5	2.2	Veg Control

*Disposition located outside the LSA and within the RSA (no impact from the Project);. **Bold** – impacted by Project footprint

E.15.1.12 Other Dispositions

There was one miscellaneous permit (MLP) disposition and nine temporary field authorization (TFA) dispositions (Table E.15.1.13) within the LSA. The MLP was held by Geilectric, a wind energy company and expired in November 2011 and is located just outside the LSA within the RSA. In discussions between Coalspur and Geilectric, it was determined that Geilectric wishes to be kept informed of Coalspur's activities but has no concerns with the Vista Project. There are a number of MLPs and miscellaneous leases (MLLs) in the RSA as well.

Most of the temporary field authorizations (TFAs) in the LSA are held by Coalspur to permit geophysical and exploration activities. The remaining TFAs held by Tourmaline and AltaLink will expire by the end of September, 2012 (Table E.15.1.13)

There are two forest grazing licences issued to Penny Dunn (62.12 ha) and Len Ramstad (14.25 ha) within the RSA that expires Aug 31, 2012. There is also an 82.84 ha grazing lease (GRL 31870) held jointly by Kelly Whitney and Jamie Whitney that is located within the RSA (outside of the Project area) that expires July 31, 2012 (Table E.15.1.13).

There are three disposition reservation (DRS) in the RSA with one held by SRD Hinton Office and two by Alberta Transportation.

Figure E.15.1.5a and 5b shows location of dispositions.

Table E.15.1.13 Other Dispositions

Disposition	Disposition Holder	Location	Total area (ha)	Expiry
MLP 080070	Geilectric Inc.	SW 24 :51-24 W5	1.6	Nov 19/2011
MLP 810413*	Dean Woods	NE 29 :51-24 W5	8.09	Dec 18/2013
MLP 860096*	Mario Ouellet	NE 29 :51-24 W5	2.83	Dec 18/2013
MLP 880125*	Kenneth Allan Desjarlais Bonnie Lou Desjarlais	SE 29 :51-24 W5	2.83	Dec 18/2013
MLP 920062*	Cody Desjarlais	SE 29 :51-24 W5	2.83	Dec 18/2013
MLP 950085*	Doug Eccleston	SE 29 :51-24 W5	2.02	Jan 4/2013
MLP 810713*	Nicole K Ouellet	SW 29 :51-24 W5	11.74	Dec 18/2013
MLL 910162*	Marck and Patricia Horvath		0.50	Aug 14/2012
MLL 860126*	Drinnan Recreational Horse Association	SE 29 :51-54-W5	20.85	Mar 25/2017
MLL 2945*	Gordon A. Bancroft Teresa M. Bancroft	NE 3 :52-24-W5	0.4	Sec 31/2018
MLL 930039*	Coalspur Mines (Operations) Ltd.	NE 3 :52-24-W5	0.40	Jul 14/2013
MLL 2472	Pearl Beutel Corinna Knauer Mike Knauer	SW 12 :52-24-W5	7.49	Jan 14/2026
TFA 121705	Coalspur Mines (Operations) Ltd.	SW 4 :51-23 W5 NE 5 :51-23 W5 NE 6 :51-23 W5 SE, SW 8 :51-23 W5	0.0	Feb 1/2013
TFA 121617	Coalspur Mines (Operations) Ltd.	NE 10 :51-23 W5 NW 11 :51-23 W5	0.0	Aug 23/2012
TFA 114690	Coalspur Mines (Operations) Ltd.	SW 10 :51-23 W5	0.0	Sep 1/2012
TFA 121589	Coalspur Mines (Operations) Ltd.	NE 11; 12 :51-23 W5 NW, SE 12 :51-23 W5 SW-13 :51-23 W5 SW 14 :51-23 W5 SE 15 :51-23 W5 SE 16 :51-23 W5 NE, NW 17 :51-23 W5 NE 18 :51-23 W5 SW 20 :51-23 W5	0.0	Jan 29/2013

Table E.15.1.13 Other Dispositions

Disposition	Disposition Holder	Location	Total area (ha)	Expiry
TFA 113833	Coalspur Mines (Operations) Ltd.	NE, NW 12 :51-23 W5 NW 13 :51-23 W5 NW, SW 14 :51-23 W5 SE, SW 15 :51-23 W5 NE, NW 18 :51-23 W5 SE, SW 19 :51-23 W5 NE, NW, SE 24 :51-24 W5 NE 23 :51-24 W5 NW, SE, SW 26 :51-24 W5 NE 27 :51-24 W5 NW, SE, SW 34 :51-24 W5	0.0	Apr 1/2012
TFA 122073	Tourmaline Oil Corp.	NE 16 :51-23 W5	1.2	Aug 30/2012
TFA 122078	Coalspur Mines (Operations) Ltd.	NE 18 :51-23 W5	0.0	Apr 20/2012
TFA 112695	Hinton Wood Products (Diane Renaud)	NE 26 :51-24 W5	0.0	Apr 22/2012
TFA 114831	Altalink Management Ltd.	NW 34 :51-24 W5	0.0	Sep 12/2012
TFA 112695*	Hinton Wood Products (Diane Renaud)	NE 26 :51-24 W5	0.0	Apr 22/2012
TFA 114831*	Altalink Management Ltd.	NE, SE, SW 33 :51-24 W5 NE, NW 34 :51-24 W5 NE, NW, SW 2 :52-24 W5 SE 3 :52-24 W5 SE 11 :52-24 W5 SW 12 :52-24 W5 W 28 :51-24 W5	0.0	Sep 12/2012
TFA 115346*	Altalink Management Ltd.	NE 22, SE 27 :51-24 W5	0.0	Oct 12/2012
TFA 113833*	Coalspur Mines (Operations) Ltd.	NW 13, NW 14, NE 23, NE 24, NW & S 26, NE 27 :51-23 W5 NW, SE 34 :51-24 W5		Apr 1/ 2012
FGL 970006*	Len Ramstad	NW 33 :51-24 W5	14.25	Aug 31/2012
FGL 970007*	Penny Dunn	13; 14; 15-32 :51-24 W5 SW 4 :52-24 W5 SE 5 :52-24 W5	62.12	Aug 31/2012
GRL*	Kelly Whitney Jami Whitney	NE, NW, SW 29 :51-24-W5	82.84	Jul 31/2012
DRS 840317*	SRD Hinton Office, Land Use Area	SE 3 :52-24 W5	29.00	Feb 10/2015

Table E.15.1.13 Other Dispositions

Disposition	Disposition Holder	Location	Total area (ha)	Expiry
DRS 803*	Transportation	NE 10 :52-24 W5	30.86	Apr 4/2016
DRS 060042*	Transportation	NW, SW 10 :52-24 W5 NW, SW 14 :52-24 W5 NE, NW, SE, SW 15 :52-24 W5	134.80	Sep 17/2017

*Disposition located outside the LSA and within the RSA (no impact from the Project)

There are a number of company consultative notations (CNCs) held by Coalspur and Mancal and consultation notations (CNTs) held by SRD Edson Office (Land Use Division and Forestry Department) in the LSA. Within the RSA there are a number of protective notations held by SRD Edson Office (Fish and Wildlife; Lands Division), SRD Hinton Office (Lands Division), and Alberta transportation and Civil Engineering. Mancal has a CNC and the SRD Edson Office (Lands Division; Forestry Division), Alberta Transportation and Civil Engineering, and the SRD Hinton Office (Lands Division) holds CNTs (Figures E.15.1.5a and 5b).

E.15.1.13 Registered Trapline Areas

There are four trapping area (TPA) dispositions within the LSA and RSA (Table E.15.1.14) as shown on Figure E.15.1.6. Three of these overlap the proposed Vista Project footprint. Coalspur has spoken with each of the trap-line owners. TPA #2203 is outside of the proposed Vista Project and RSA as well as any future potential expansion area. The trapper, Dan Berry, did not express any concerns regarding impacts the Vista Project may have on his trap-line. Coalspur will keep the trapper informed of mine planning and regulatory applications.

Table E.15.1.14 Trapper Disposition Holder in the LSA and RSA

Disposition	Disposition Holder	Location in LSA	Location in RSA	Expiry
TPA 2132	**Ted Armstrong**	4; 5; 6; 7; 8; 9; 16; 17; 18; :51-23 W5 3; 4; 5; 6-19 :51-23 W5 SE 19 :51-23 W5 SE; SW 20 :51-23 W5 13 :51-24 W5 1; 2; 3; 4; 8-24 :51-24 W5	31; 32 :50-23 W5 35; 36 :50-24 W5 W 07, N 16, SW 18 :51-23 W5 09, 10, 11, 12-19 :51-23 W5 09, 10, 11, 12, S 20 :51-23 W5 09, 10, 11, 12, S 21 :51-23 W5 01, 12, 13, S, N 14 :51-24 W5 LSD 3-4 24 :51-24 W5	**Jun 30/2012**
TPA 2192	**Ed Poelzer Jr.**	5-19 :51-23 W5 2; 3; 4; 5; 6; 7; 8;-24 :51-24 W5 NE; NW 24 :51-24 W5 NE 23 :51-24 W5 25 :51-24 W5	N 19 :51-23 W5 15, 16, NW 20 :51-23 W5 N 21, 28, 29, 30 :51-23 W5 13, 14, 15, (16-14), N 19, 22, 23, 24, 25, 26, 27, 28 :51-24 W5 29 :51-24- W5	Jun 30/2012

Table E.15.1.14 Trapper Disposition Holder in the LSA and RSA

Disposition	Disposition Holder	Location in LSA	Location in RSA	Expiry
		26 :51-24 W5 27 :51-24 W5 34 :51-24 W5	NE; SE 30 :51-24 W5 3; 4; 5; 6; 11; 12; 14; NE; SE-32 :51-24 W5 33 :51-24 W5 34 :51-24 W5 35 :51-24 W5 36 :51-24 W5 1; 2 :52-24 W5 11; 12; 13; 14: NE; SE; SW-3 :52-24 W5 1; 2; 3; 4; 7; 8; 9-4 :52-24 W5 1; 2-5 :52-24 W5 3; 4; 5; 6; 11; 12; 13; 14; NE; SE-10 :52-24 W5 11; 12;13 :52-24 W5 11; 12; 13; 14; NE; SE; SW-14 :52-24 W5 3: 4; 5; 6; 9; 10; 11; 16; SE-15 :52-24 W5 1; 2; 3-23 :52-24 W5 1; 2; 3; 4; 7; 8 -24 :52-24 W5	
TPA 2412	**Robert Allan Kalio**	15; 16-25 :50-23 W5 2; 7; 10; 15; 16; NW; SW-36 :50-23 W5 35 :50-23 W5 34 :50-23 W5 1; 2; 7; 8 -6 :51-22 W5 NE; NW; SW 6 :51-22 W5 7 :51-22 W5 1; 2; 3; 10; 11; 12; 13; 14; 15 :51-23 W5	05, NW, 15, 16-25 :50-23 W5M SW, 07, 08, NE, NW-26 :50-23 W5 27, 28, 33, S 34 :50-23 W5M 05, 06, 15, 16, NW 05 :51-22 W5 08 :51-22 W5 NW, NE, SE 7 :51-22 W5 17, 18, 19 :51-22 W5 N 13, N 14, N 15, 22, 23, 24 :51-23 W5	**Jun 30/2012**
TPA 2064	Mike Naef	9; 10; 16-25 :50-23 W5 1; 2; 7; 8; 9; 10; 16-36 :50-23 W5	19, 30, 31 :50-22 W5 SW, SE, 09, 10, 11, 16, 25 :50-23 W5 24 :50-23 W5 01,02, 03, 04, 06, 07, 08-26 :50-23 W5 01-27 :50-23 W5 11, 14, SW, SE, NE 05 :51-22 W5	Jun 30/2012
TPA 2203	Dan Berry	Outside LSA and RSA	-	

Bold – impacted by Project footprint

E.15.1.14 Recreation, Residents and Landowners, Other Interest Groups

There are a number of interest groups in the general area of the proposed Vista Project. They are identified in Table E.15.1.15 and the location of several key groups are identified on Figure E.15.1.6.

Table E.15.1.15 Other Land Use Interest Groups

Disposition	Disposition Holder	Comments
Private Campgrounds	**Willowbrook Bungalows and Campsite**	
Residents and Landowners	• Locality of Pedley • Carldale subdivision • East River Road Estates subdivision (ERRE • Rafters Ranch, Maddison Avenue Ranch and adjacent landowners • Town of Hinton • Hamlet of Obed	The town of Hinton holds a 57.3 ha recreation Lease (REC 030004) in the RSA (SE 30:51-24-W5).
Land Use and Not-for-Profit Groups	• Athabasca Bioregional Society • Edson ATV Society and Edson Snowseekers Snowmobiling Club • Foothills Land Management Forum • Friends of the Foothills Society (fotfs) • Hardisty Creek Restoration Project • Hinton ATV Society • Hinton Fish & Game Association • Hinton Mountain Bike Association • Trout Unlimited Canada • Yellowhead Arrow Launchers (YAL)	The Hinton Fish and Game Association holds a 40.5 ha recreation lease (REC 850002) in the LSA and RSA (SW 26 51-24 W5; NE and NW 34 :51-24 W5) for a shooting range.

E.15.1.15 Cultural and Historic Sites

Various cultural sites and historical sites have been identified through consultation with local community groups and historical assessments conducted by resource companies involved in developments within the area. A historical resource impact assessment has been completed on the majority of the Vista Project area. Assessment results are provided in detail in Section E.4 and CR# 4.

E.15.1.16 Unique Sites and Special Features

There are no unique sites or special features located within the LSA.

E.15.1.17 Provincial Wildlife and Environmental Zones

The LSA and portions of the RSA fall within SRDs grizzly bear zone (Figure E.15.1.6). As well, a portion of the SRD's key wildlife and biodiversity zone falls within the LSA and RSA to the southeast and outside the LSA but within the RSA to the northwest. The key wildlife and biodiversity wildlife zones are considered to be a combination of key winter ungulate habitat and higher habitat potential for biodiversity. In some areas this zone consists of important riparian vegetation complexes that are important for biodiversity, while in other areas it indicates important winter ranges for ungulates. SRD has best management guidelines for land users groups in developing management strategies with respect to these zones.

An environmentally significant area zone (ESA #99) is located outside the LSA but within the RSA to the northwest. Under the Environmentally Significant Area Provincial Update 2009 (ESA 2009) ESAs represent places in Alberta that are important to the long-term maintenance of biological diversity, soil, water, or other natural processes, at multiple spatial scales. They are identified as areas containing rare or unique elements in the province, or areas that include elements that may require special management consideration due to their conservation needs. ESAs do not represent government policy and are not necessarily areas that require legal protection, but instead are intended to be an information tool to help inform land use planning and policy at local, regional and provincial scales.

E.15.2 Predicted Conditions – Application Case

For all components of Coalspur's existing and proposed amended Mine Permit area and the processing plant and access/conveyor corridor area that will require surface disturbance, Coalspur plans to include all these lands under a common Mineral Surface Lease (MSL) to acquire the surface rights. Coalspur has met with or intends to meet with all identified industrial operators within the LSA that will be potentially impacted by the Vista Project and expects to reach mutual agreements with all operators in a timely manner. Within the RSA, only operators that may be impacted by the proposed Vista Project will be contacted.

E.15.2.1 Coal Leases

The coal leases that fall within the proposed Project Footprint are shown on Figure E.15.2.1. Coalspur has acquired the Nexen leases in a commercial deal dated April 27, 2010 and now owns all affected coal leases. Coalspur has a purchase agreement with Tanager regarding their coal leases (currently held in Escrow) and expects the final condition to be satisfied and ownership formally transferred prior to proceeding with Project development.

E.15.2.2 Petroleum and Natural Gas Licenses and Leases (PNG)

The PNG leases that fall within the proposed Project Footprint are shown on Figure E.15.2.2. Coalspur has held discussion with Tourmaline and Manitok regarding their PNG licences and leases within the LSA and will continue to work towards resolution of any issues that may arise. Coalspur will also enter discussions with all other PNG licence and lease holders within the LSA and find resolution to any issues or conflicts that arise.

E.15.2.3 Mineral Permits

Coalspur and Athabasca Minerals Inc. have discussed their activities and plans for the Vista Project area and do not expect any conflicts.

E.15.2.4 Forestry

Coalspur will apply for a MSL to allow for surface rights for the Project footprint. Coalspur will request this MSL is withdrawn from the WFM FMA. Coalspur has entered detailed discussions with WFM to address harvest of merchantable timber within the proposed Vista Project. Coalspur will ensure that all merchantable timber within the Vista Project footprint is harvested and made available to WFM, and that all other timber within the Vista Project area is accessible to WFM at their convenience. Coalspur will work with WFM on the impacts of Coalspur's activities on harvesting, annual allowable cut, and harvest volumes.

Coalspur expects to reach agreement with WFM regarding timber damages and compensation for enhanced silvicultural investments at the time the mineral surface lease is issued to Coalspur and lands are withdrawn from WFM's FMA. Coalspur will ensure it complies with provincial forestry regulations as applicable to forested lands.

Two cluster of permanent sample plots (ISPs) (ISP 020595 and ISP 020616/070239) established by WFM within the Vista Project footprint will be removed during mining. Coalspur will compensate WFM for the loss of these plots.

WFM expressed interest in reviewing and providing input on Coalspur's reclamation plans and strategies to ensure that effective reforestation would occur and that progressive reclamation would be consistently practiced. Coalspur has reviewed conceptual mine development and reclamation plans with WFM and will discuss the plan in greater detail during the formal application review stage. WFM supports Coalspur's reclamation objectives of reforestation to commercial forest standards, emphasis on native plant species, and planning for progressive reclamation.

E.15.2.5 Mineral Surface Lease, Pipeline Agreement, Pipeline Installation Lease, Licence of Occupation, Easements,

The Vista Project will have an impact on some surface dispositions located within the Project footprint. Coalspur will work with the impacted stakeholders to find acceptable solutions to the conflicting activities. The stakeholders with land use dispositions that will be potentially impacted by the Project include:

- **West Fraser** - Portions of WFM's McPherson Road network will be taken out by Coalspur's activities. Portions of LOC's 020939, 910635, 810954 and 3525 (Figure E.15.2.3a and b) will be disrupted by Coalspur mining activities and alternate access will be required. Coalspur's intention is to provide equivalent replacement of road systems in a timely manner, without increasing the net number of public access roads in the area. WFM has identified an existing road system that, with connection and upgrade would replace the effected portions of the McPherson system. The location of this replacement road system has been discussed with several stakeholders including the trap-line holders, Hinton Fish and Game, Hinton ATV Society and some of the oilfield disposition holders. These stakeholders support this option and Coalspur is confident this will be acceptable with the remainder, but will need to complete discussions with remaining stakeholders

  The main access road from Highway 16 to the plant will cross a number of West Fraser LOC's (four locations and three LOC's). Coalspur has reviewed proposed plans for crossing these roads with West Fraser and have come to tentative agreement on how the intersections will be constructed and how the conveyor system will cross the roads. Detailed design will be confirmed with West Fraser over the next several months.

  Discussions around future mining potential beyond the proposed Vista Project have taken place and a number of options are available. Coalspur's plant site access road has been designed to meet Class 2 standards so that it can be part of these longer term options.

- **CNRL** - has a gas well site east of the Pedley Road and north of Highway 16 that they require continued access to. CN would close the Pedley Road for siding construction and operation; there will be no direct impact on the well site. Coalspur has met with the Lands representative for CNRL and described CN's proposal. Coalspur has identified a few options that would satisfy CNRL. The preferred option is to maintain limited (i.e. gated) Highway access for CNRL on the existing Pedley Road. Further discussion with AT is needed to determine how this could be designed to address AT's requirements.

- **Manitok** –**Manitok** –has one operating well (15-03-51-23-W5M, MSL 942398/LOC 941658) with an associated access road located within the Project disturbance. There is a potential impact to the access road for the wellsite. Coalspur has committed to maintaining appropriate access to this wellsite throughout the life of the Vista Project. Coalspur will continue discussions with Manitok to develop a long term agreement regarding joint planning, information sharing, and cooperation.

- **Tourmaline** – there are five Tourmaline well sites and associated access roads that are within the Project disturbance (MSL 062695/LOC 062045, MSL 062913, MSL 062627/LOC 061999, MSL 061982/LOC 061538 and MSL 071775/LOC 071213) (Figure E.15.2.3b). There are also two pipelines that also fall within the Project disturbance (PLA's 090220 and 071477).

  The main product pipeline for the Tourmaline processing plant located in SE 9-51-24-W5M (PLA 081334) runs generally northwards and crosses the proposed access and conveyor corridor (LSDs 9, 15, 16; Sec. 27- 51-24-W5M and LSDs 2 and 7; Sec. 34- 51-24-W5M). The designs for the access road and clean coal conveyor will incorporate the necessary provisions to enable safe crossing of this pipeline. Coalspur will work with Tourmaline to develop appropriate designs and construction plans to ensure the integrity of the pipeline is not compromised.

  Coalspur has initiated discussions with Tourmaline on a process to share information and jointly address issues related to mining activities and potential impacts on wells and pipelines within the proposed Vista Project. The initial priorities are to develop alternatives for the main raw gas connector pipelines (PLA071477, PLA080220, PLA080490) to relocate adjacent to the ROM conveyor right-of-way along the western edge of the existing Mine Permit boundary. In addition, the currently producing well (15-08; MSL062913) will need to be shut in and abandoned and non-producing well (03-11; MSL061982) will also need to be abandoned as these are located within the active planned pit area. Coalspur and Tourmaline have held a number of discussions and have agreed to develop a formal commercial agreement regarding joint planning and issue resolution for existing production facilities and planned facilities that Tourmaline is currently working to develop. The overall goal is for both companies to coordinate their respective activities throughout the life of the mine to maximize the potential for both to develop their respective resources in an efficient and effective manner.

- **Alberta Transportation/Yellowhead County/CN -** The Pedley Road is a combination County and private (CN) road and private rail crossing in Yellowhead County, running north of Highway 16. CN's main rail line crosses the Pedley Road at a private crossing about 500 m north of the highway – the section from the highway to the crossing is County road; and the section north of this is CN's private road, held under LOC. When CN constructs their new siding to accommodate Coalspur's load-out facility, they propose to close their private Pedley Rail Crossing for safety reasons. The County section of road provided access for two residences on crown leases on the north side of the crossing. Now that Coalspur owns these two residences and the crown leases with the intention of removing the facilities, reclaiming the land and cancelling the crown leases, the County has indicated to Coalspur that there is now no County-related need to keep their segment of the Pedley road open. CNRL uses a portion of the County road to access one of their wells located between the highway and CN's main line.

  Some Carldale and East River Estates residents have expressed concern that, with closure of the Pedley Road to public use, heavy truck traffic currently using the Pedley Road would rely on the Carldale Road, and that this increased traffic through the Carldale subdivision would increase safety issues. These residents expressed that they already have concerns with some heavy trucks travelling through their neighbourhood at high speed and/or with loads greater than the 75% load restriction, and that additional truck traffic would increase their concerns with safety, dust and road damage. At the same time, some Carldale residents are concerned about the unsafe intersection on the Carldale – Hinton road where it is intersected by the unmaintained Pedley road and see closure of the Pedley road as a positive benefit to improve road safety for Carldale residents traveling into Hinton.

Coalspur and CN have discussed this issue with many local residents. Coalspur contracted a local safety services company to conduct a road use survey for 5 days (9 hours per day) in late February 2012 and made these results available to residents to support further discussion. Coalspur then approached many of the truckers identified in the road use survey and asked for their input on closure of the Pedley Road. All of those companies indicated that in the event of road closure, their trucks would use the Hinton route, which is formally designated for truck traffic rather than the Carldale route which is not.

Further discussion is needed. Coalspur hosted information sessions with local residents on April 25/26, 2012 where residents had an opportunity to discuss the Pedley access closure further. CN has indicated they will also be hosting information sessions later this year in Hinton to discuss their siding project with interested stakeholders and intend to discuss the Pedley road closure as well.

- **Altalink Management Ltd./Fortis Alberta Inc. -** These two companies have utilities and vegetation control easements within the Project footprint. Coalspur will contact these companies to mitigate any impacts to these dispositions.

Figure E.15.2.3 shows surface dispositions in relation to the Vista Project.

E.15.2.6 Other Dispositions

Coalspur is currently in Stage 2 of the Alberta Electric System Operator (AESO) Stage Gate process, along with Altalink and Fortis, to have power supplied to the mine before commissioning the process plant and other facilities begins. Altalink will be responsible for the necessary regulatory permits and construction of the transmission lines from the existing 138kV lines on the south side of Highway 16. The transmission lines will be constructed along the mine access road and clean coal conveyor corridor to the process plant area where the 138 to 25kV substation will be located. Coalspur will take the 25kV feed for the mine and process facilities.

E.15.2.7 Trappers

As shown in Figure E.15.2.4, there are four TPAs in the general area of the Vista Project. Three of these overlap the proposed Vista Project. Coalspur has spoken with each of the trap-line owners. A summary of trap-line impacts and discussions is provided below.

TPA #2132: The east half of the existing mine permit overlaps this trap-line with a portion falling within the Vista Project footprint. Coalspur staff spent an afternoon with the trapper driving through the area. The trapper, Ted Armstrong, lives in Hinton and actively traps western portions of the line. He does not trap in the proposed development area and he does not use the access that would be affected by the mine. He expressed that due to West Fraser’s previous harvesting operations, much of the area doesn’t produce the fur-bearers he traps. The trapper verbally indicated that as long as Coalspur is operating in the areas identified in the mine plan, he does not have any concerns with the proposed mine. Coalspur staff will be approaching the trapper again to update status of the application and will identify and address any concerns that may be raised at that time.

TPA #2192: Coalspur's proposed load-out and the western two-thirds of the conveyor/access corridor overlap this trap-line. The trapper, Ed Poelzer Jr, lives in Hinton and actively traps his lines. He indicated that his trapping will not be affected by the mine's infrastructure as long as his access is maintained. He has a cabin on the northeast end of a pond/wetland complex directly east of Coalspur's proposed freshwater supply pond (Figure E.15.2.4). Based on Coalspur's description of the proposed development, the trapper offered a number of comments:

- he wants Coalspur to ensure that the natural pond next to his cabin does not dry up, that it continues to flow. Coalspur's EIA and water management plan address this aspect (Appendix 7-2); and
- the changes that will be made to road access will not likely affect him, but he wants to be notified before the changes are to take place. Coalspur will do so.

Coalspur will meet with the trapper again to update the status of the Project and review the proposed development in greater detail including the results of the EIA.

TPA #2412: The west half of the mine permit and all of the processing plant/infrastructure overlap this trap-line and a portion falls within the Vista Project footprint. The trapper, Robert Kallio, lives in the Edson area and actively traps his line. He identified the following concerns with the proposed development:

- trapping is a lifestyle for him and the mine will affect his ability to enjoy this lifestyle;
- he believes the clearing associated with the mine will eliminate the lands ability to produce the types of fur-bearing animals he harvests and will eliminate his ability to trap for decades;
- changes in access will affect his ability to access some of his traditional trapping areas; and
- harvesting previously conducted by West Fraser reduces his ability to trap successfully in those areas.

The trapper indicated he does not have an issue with development nor with the Vista Project. He just wishes to be fairly compensated.

Coalspur is in the process of reaching written agreement with the trapper so that he can continue to trap those areas outside of the mining footprint and continue to access, either around or through the mine, his traditional trapping areas.

TPA #2064: This trap-line is outside and to the west of the proposed Vista Project. The trapper, Mike Naef, indicated that if future expansion occurs to the west he will want to have direct discussions with Coalspur. In the meantime, Coalspur will keep the trapper informed of status of the regulatory application.

TPA #2203: This trap-line is outside of the proposed Vista Project as well as any future potential expansion. The trapper, Dan Berry, did not express any concerns regarding impacts the Vista Project may have on his trap-line. Coalspur will keep the trapper informed of mine planning and regulatory applications.

E.15.2.8 Recreation, Residents and Landowners, Other Interest Groups

Coalspur has consulted with a number of individuals and interest groups within the general vicinity of the Vista Project. They include private campgrounds, residents and landowners and other types of interest groups. A summary of consultation efforts and status of land use issue resolution is discussed in detail as follows. Figure E.15.2.4 shows location of local interest groups that have been consulted. The proposed MSL for the Vista Mine is shown on Figure E.15.2.5, and shows the relationship to the various land uses within the RSA.

Private Campgrounds

Willowbrook Bungalows and Campsite: Willowbrook is a year-round commercial tourism facility and the owner's residence is located on the south side of Highway 16, about 4.3 km east of the proposed load-out. It is on leased lands. This location was used as a receptor site in the noise and air quality EIAs. The distance from Coalspur's proposed facilities and its nearness to Highway 16 are such that no environmental impacts were identified for this site (CR #8, CR #1). The owners took advantage of a Coalspur Open House and subsequent one-on-one meeting to find out about the Vista Project and had questions about noise and dust. These questions were addressed by Coalspur staff using EIA results and Coalspur will continue to provide updates on the Vista Project to the owners of Willowbrook.

Residents and Landowners

A number of private residences are within the general vicinity of the Vista Project area. All are within Yellowhead County and all along the Highway 16 corridor. There are no private lands in or within 7 km of the existing mine permit. The proposed amendments to the Mine Permit, in particular the access corridor and rail loadout, will be located closer to private lands. Coalspur has contacted or spoken with all residents and land owners in Yellowhead County that could be potentially affected by the loadout and rail siding. A summary of Coalspur's communications with these residents and landowners is provided as follows.

Locality of Pedley: Two residents owned leases at the Locality of Pedley, immediately north of Canadian Nation Railway's (CN's) main line and immediately west of the Pedley Road. These two leases are approximately 3 km from the proposed load-out location. Coalspur recently reached and signed binding purchase agreements with both residents and has since taken over these leases. The lease owners have vacated their premises and Coalspur will be decommissioning the sites in accordance with SRD requirements with a longer term goal of cancelling the leases.

Carldale Subdivision: The Carldale subdivision is located east of the proposed load-out location and is comprised of 29 landowners, most of whom are permanent residents. The nearest resident is about 4.5 km from the load-out and CN's proposed rail siding will end about 1 km from the nearest resident. Seven residences are located along the main Carldale access road and the remainder are on the cul-de-sac spur road. This subdivision was used as one of the receptor sites in the noise and air quality (dust) EIAs.

In addition to Coalspur's well-advertised Open Houses in November 2010, June 2011 and November 2011, letters were sent to each Carldale resident in May of 2011, inviting them to Coalspur's Hinton office to present plans and discuss potential concerns. The Open Houses and these individual meetings were well attended by Carldale and East River Estates residents. Coalspur also hosted a focus-group meeting on March 7, 2012 with three Carldale residents, where plans were discussed in greater detail. Most recently, information sessions with Carldale and East River Estates residents were offered on April 25 and 26, 2011 to all interested residents; letters of invitation were sent to each resident, followed up with phone calls to a number of invited residents to help gauge the level interest in the meetings.

The residents have expressed a range of opinions on the Project, and specifically on the proposed load-out infrastructure locations, ranging from supportive to neutral to concerned. A summary of these opinions, concerns and questions raised as of April 26, 2012 include the following:

- *noise and dust:* Is there potential for increased dust and noise from the load-out? Coalspur's noise and air quality EIA addresses this and the EIAs have identified that there will be no impacts of significance to noise, dust, or other air quality parameters in Carldale (CR #7; CR #1). Some residents are not concerned about these issues because they feel Coalspur's activities would not be noticed alongside the existing presence of highway, CN main line and pulp mill activities;
- *increase in traffic:* Some residents are not concerned about changes in traffic but some are concerned that traffic may increase through Carldale if CN's private Pedley Crossing is closed by CN, affecting neighborhood safety, road dust, road integrity, and neighborhood peacefulness. Coalspur conducted a five-day road use survey. The results suggested an increase in traffic of 8-10 vehicles per 24-hour day in winter. Coalspur presented these data to Carldale residents and the County and have identified possible mitigations including improved signage, providing information to businesses that commonly use the road, physical road changes to reduce truckers' desire to use the road, changing road use to eliminate heavy trucks, bylaw enforcement, and appropriate level of road maintenance. Many of these options would involve County decisions or input from the LOC holder. Discussion with all stakeholders continues. Coalspur has also discussed potential road closure with several of the commercial users of the road; these users represent approximately two thirds of the commercial traffic identified in that road use survey. The results from these discussions indicate that there would likely be no increase in heavy truck traffic through Carldale. ;
- *reduced property values*: What is the potential for reduced real estate values in Carldale? It is expected that real estate values in Carldale are more likely to increase than decrease as a result of the Vista Project;
- *water wells*: Some residents asked if water wells may be affected by mining operations. The EIA concludes there will be no impact to water wells in or near Carldale (CR #3);
- *emergency access:* Losing Pedley Road as an emergency access from Carldale was a concern for some. For others, they saw the road as being unmaintained, frequently blocked by trains, and therefore not reliable as an emergency route. Yellowhead County has indicated this road has no value in their emergency access plan for the East River Road, Carldale, or any other County areas; and
- *air quality*: Exhaust from diesel locomotives during coal loading was a concern for one individual. The EIA concludes this will not result in impacts to baseline air quality (CR #1);

Coalspur continues to exchange information with Carldale residents on an open, good-neighbour basis and considers Carldale residents to be important and constructive stakeholders in the public engagement process.

East River Road Estates subdivision (ERRE): The ERRE consists of approximately 48 residences and businesses, primarily heavy-haul and trucking, along the Yellowhead County's East River Road. The nearest of these residences is 1.6 km to the proposed load-out and was used as a receptor site in the noise and air quality EIAs. ERRE residents were provided the same opportunities to be informed about and provide input on Coalspur's proposed activities as the Carldale residents. The list of questions and concerns raised by ERRS residents is contained within the list addressed Carldale (above), except that there were no concerns expressed about traffic or diesel exhaust. The assessment of impacts and mitigation resulted in the same conclusions as those summarized for Carldale.

Rafters Ranch: The Rafters Ranch, Madison Avenue Stables and a third residence are located just north of Highway 16, at their nearest approximately 4.5 km east of the proposed load-out site. The third residence was used as a receptor site in the noise and air quality EIAs. The distance from Coalspur's proposed facilities and its nearness to Highway 16 are such that no impacts were identified for these sites.

Coalspur has provided information to, and spoken with, all three residents and responded to their questions about noise and dust.

Town of Hinton: The nearest Hinton residence, located in the east end of East Hardisty, is 4.9 km from the proposed load-out site, 11.9 km from the nearest active mining, and 10.8 km from the processing plant site. Coalspur has provided many opportunities to share Vista Project information with all Hinton residents, including the three sets of Open Houses (a fourth to be held in June 2012), several articles in the local papers, and many individual meetings with local residents and community groups. Many residents have taken advantage of these opportunities to find out more about the Vista Project. For example, at Coalspur's first two-day Open House in Hinton, 224 people stopped by. Initial concerns focused on long-term potential mining near the Town limits but as discussions progressed concerns focused on the following:

- *potential for increased noise and dust*: The EIA provided substantive focus on these aspects (CR #7; CR #1);
- *socio-economic impacts*: Do existing infrastructure and services have the capacity to handle additional people? If not, how can the capacity be increased to address this? The socio-economic component of the EIA addresses this item (CR #8);
- *environmental questions*: Watershed protection, wildlife impacts, and recreational impacts were concerns. These questions are answered in the relevant EIA component (CR #2; CR #13);
- *future expansion*: If the current proposed mine plan is accepted, how will future expansion plans affect the community? Will residents have an opportunity to provide input to these future plans? Coalspur has made considerable efforts to explain to residents that future potential expansion would have to go through a separate EIA, public engagement process, aboriginal consultation, and regulatory review. Coalspur has recorded all of these concerns about future expansion and will be using these comments when it begins to develop plans for future expansion ;
- *aesthetic impacts:* Most residents have shown no concern over the proposed highway overpass of the conveyor but several residents have noted concern about the visual aesthetic impact of the clean coal conveyor crossing over Highway 16. The concern was that the conveyor would interfere with the view of the mountains at certain points travelling west along Highway 16. Coal dust is also a concern for some. Coalspur took photos along the highway and over-laid drawings of the conveyor, then also collected photos of similar over-head structures along Highway #1 in Banff National Park. Two of these were printed on the front page of the Hinton Parklander and were also presented personally to several of the residents and to three grade seven public school classes to provide a clearer vision of how it could look..

Hamlet of Obed: The Hamlet of Obed and residences located south of Highway 16 from the Hamlet are, at their nearest, almost 20 km to the proposed load-out site. No impacts were identified. One Obed resident raised concern about the visual aesthetics effect of the over-head highway 16 conveyor crossing – the concern was that the conveyor would interfere with the view of the mountains at certain points travelling west along Highway 16. Coalspur took photos along the highway and over-laid drawings of the conveyor, then also collected photos of similar over-head structures along Highway #1 in Banff National Park. These were presented to the resident to provide a clearer vision of how it could look. The resident remained concerned but noted appreciation for the efforts made.

Land Use and Not-for-Profit Groups

Coalspur has identified a range of not-for-profit groups who have expressed interest in land use aspects of the Vista Project. Coalspur has approached each of these groups, and a description of the communications between Coalspur and each group are provided below:

Athabasca Bioregional Society (ABS): The mandate of the ABS is "to protect, preserve and restore the Athabasca Watershed through advocacy, education and community projects". Coalspur spoke over the phone or in meetings with three persons involved directly with ABS, all local Hinton or County residents. These contacted individuals were also members of the Athabasca Watershed Council and Keepers of the Athabasca, and Coalspur understands that the detailed comments provided by these individuals would generally reflect these other groups as well. An ABS member did provide a number of comments specific to their group and are provided as follows:

- the individual commented that, in his opinion, coal will likely see decreasing use and demand world-wide in the next decade or so, due to a realization and acceptance that the environmental footprint of coal is not sustainable. Coalspur responded that market analysts forecast a very different scenario ;
- the Vista Project will have negative socio-economic and environmental impacts to Hinton and area, but if the Town is willing to accept these impacts, ABS will not get directly involved in the regulatory process. Coalspur responded that socio-economic and environmental impacts have been fully assessed and that with proper public engagement, planning and mitigation, these impacts can be effectively managed to the benefit of the community; and
- the individual asked if Coalspur was aware of any coal mines potentially starting up near Switzer Park or Folding Mountain, and asked for instructions on how to find the owners of coal leases on-line. Coalspur provided information on how to access publicly available data on government websites.

Edson ATV Society and Edson Snowseekers Snowmobiling Club: Coalspur met with an executive member of Edson ATV Society and reviewed their trail system. There were no issues or conflicts identified beyond those already identified by the Hinton ATV Society.

Foothills Land Management Forum (FLMF): Coalspur spoke with a member of this group and met with the Executive Director for FLMF in Coalspur's Hinton office. FLMF is a consortium of industrial operators and Aseniwuche Winewak Nation and focuses on integrated land management, particularly on access management. Coalspur is already doing what FLMF is doing, integrating the access of a number of industrial and recreational users to minimize environmental impacts due to industrial activities. FLMF's area of interest is in a zone between Hinton and Grande Cache, well outside of the Vista Project.

Friends of the Foothills Society (fotfs): The fotfs is a not-for-profit organization that self-identifies as a citizens' awareness and industry-advisory group regarding conservation and enhancement of natural, historical, cultural and recreational resources on the landscape surrounding Hinton. Their website (www.fotfs.org) and individuals note a strong interest in Coalspur's Vista Project, particularly Coalspur's coal leases in Vista South and future potential expansion west of the Vista Project. Coalspur has spoken with a number of individual members but has not been able to identify a formal spokesperson. Coalspur has offered to meet with membership to discuss the proposed mine and future potential growth but a meeting has yet to be scheduled. Several of their members have attended Coalspur's open houses and some are on Coalspur's mailing list.

Hardisty Creek Restoration Project (HCRP): This Project involves the re-establishment of fisheries passage and habitat within the Hardisty Creek watershed. It involves local volunteers, Trout Unlimited Canada, Foothills Research Institute, Hinton Fish & Game Association, and other industry partners and has been active since 2002. Coalspur spoke with one of the members of HCRP. Coalspur's Vista Project and future potential expansion are outside of the Hardisty Creek watershed. The spokesperson explained that the mandates of this group, while focussed on the Hardisty Watershed, are similar to those of the

Athabasca Watershed Council, Trout Unlimited, Athabasca Bioregional Society and other groups who have provided more detailed thoughts on the Vista Project.

Hinton ATV Society: Coalspur representatives met with the Hinton ATV president. Coalspur reviewed their trail maps and discussed their uses in relation to the Vista Project. The president had a number of questions and concerns with the Vista Project as follows:

- how many of their trails would be affected by the Vista Project? Their trails map showed that portions of three trails may be affected to some degree by the Vista Project. One trail cannot be avoided. These trails are used by Society members but they have no dispositions or approvals from SRD to use them. These trails will likely also be on the Edson ATV club's map. The president indicated these trails were not their more commonly used trails. Coalspur's response was that there were options for rerouting these trails around the mine's active areas, that would be discussed once SRD and others have provided their input to this; and
- how will Coalspur mitigate the loss of these trails? Coalspur indicated the footprint and MSL will be minimized to minimize impacts to trails and other forms of public access.

Hinton Fish & Game Association: This Association is based in Hinton with over 500 members. Their club facilities and shooting ranges are east of Hinton along Highway 16 (Figure E.15.2.4). Coalspur has discussed the Vista Project with Association executive and individual members on many occasions and they have several questions and concerns with the Vista Project particularly in terms of infrastructure and hunting and fishing. Their concerns are as follows:

- *infrastructure*: The association has a recreational lease (REC 850002) which contains their club house, indoor archery range, outdoor shooting ranges, storage buildings and some of their outdoor archery trails. They access this site from Highway 16 via a County road within the highway right-of-way and on an easement (EZE 860402) outside the highway right-of-way. They have a second easement (EZE 800129) and gas pipeline (PLA 972111) within their recreational lease to address the power-line and gas-line. Some of their archery trails extend to the west and south, outside the lease. Coalspur's proposed conveyor, access road, highway approach and power-line rights of way provide some challenges and opportunities regarding some of these features.

  Coalspur has been in discussions with the Club over the past 16 months. The existing approach from Highway 16 and their access road to the range and facilities will be impacted by Coalspur's proposed access road. At the same time, the Association membership size has grown such that the existing highway access does not meet existing Highway standards and will likely need to be upgraded. As outlined in the TIA (Appendix 8), Coalspur proposes to take out their access and replace it with a new highway approach about 150 m west of the current location, and to construct a tie-in road that will provide access to their facilities. Coalspur and the Association have reached tentative agreement on this proposal, pending AT's review of the Project. Coalspur expects to reach a formal agreement with the Association in the near future. Coalspur's revised intersection and Association facility access plans will also meet the highway access requirements related to the increased membership of the Association and eliminate this potential problem. The County maintains the approach to the Fish & Game Association facilities. The County is supportive of the proposed plans, as long as it suits the needs of the Association. The County has been kept fully informed about the expected agreement between the Association and Coalspur on highway access and has requested that the Association provides it with a formal notice on the future of its segment of access once a final agreement is in place and the revised access has been completed.

- *hunting and fishing*: Association members actively hunt in the Vista Project area. They also fish in some of the local creeks, but their concerns generally focussed much more on hunting and public access.

Coalspur has proposed a mineral surface lease boundary that uses a combination of legal subdivision, natural landscape features and reasonable safety factors. This results in a boundary that closely follows the proposed footprint of the mine and conveyor/access corridor without compromising public or mine safety. Public access will need to be controlled in areas of active mining. The mining and reclamation schedule has been mapped out to clearly show when and where reclamation can take place (Section F). Progressive reclamation will take place when mined lands are no longer being mined or backfilled.

Coalspur's main access road will be open for public and other industrial access. To ensure public and mine safety, the access corridor will be posted as "no hunting". ATV access will not be permitted on the access road but will be accommodated at designated crossings.

Hinton Mountain Bike Association: Coalspur met with two executive members of the bike club; both also attended earlier Coalspur open houses. It was confirmed that none of the bike club's trails were within or close to the Vista Project development. One loop of one of their trails is near other Coalspur coal leases that may be included in potential future mine expansion, considerably further to the west of the proposed development. The two club members did not express any other concerns with the Vista Project.

Trout Unlimited Canada (TUC): TUC is involved with the conservation, protection and restoration of cold-water ecosystems. Coalspur met with their spokesperson for the Yellowhead chapter of TUC and received several concerns and recommendations regarding the protection of fish habitat and native fish species (focussed on Athabasca rainbow trout and bull trout) in the Vista Project area. Key points addressed included habitat protection during mine operations, effective baseline monitoring, effective monitoring during mining, regulatory enforcement of habitat impacts, and cumulative effects within the McLeod subwatershed.

Coalspur's responses to these discussions are provided in the proposed surface water management and hydrology reports (Section E.6; CR #6; Appendix 8), aquatic monitoring and fisheries management plans (Section E.2; CR #2).

Yellowhead Arrow Launchers (YAL): The YAL are one of many clubs that operate under and are members of the Hinton Fish & Game Club. The Hinton Fish and Game Association (Hinton FG) president and executive speak on behalf of the Archers and the many other affiliated clubs that operate out of the club facilities east of Hinton. At one of the many meetings Coalspur has had with Hinton FG, one of the YAL members in attendance indicated that, while the Hinton FG executive spoke on behalf of the Archers, there may be specific issues where the Archers would add their own voice. Of note, the archery club has some trails and target locations that are outside of the Hinton FG lease (REC850002); these are important to the Archery club members and they want to make sure their interests are fully considered. Coalspur continues to meet with Hinton FG Association but are cognisant that the archery club may choose to add their voice on some items at some point. In the latest meetings, YAL members were pleased with the design accommodations and efforts made by Coalspur regarding archery trails and target locations nearest Coalspur facilities, even though these archery assets are located outside the existing Association lease.

E.15.2.9 Unique Sites and Special Features

There are no unique sites or special features within the LSA. Historical resource sites are discussed in Section E.4.

E.15.2.10 Provincial Environmental Zones

Coalspur will consider the values of the wildlife zones and environmentally significant area in the design of its development program. The Vista Project falls within the grizzly bear zone but outside the environmentally significant area and key wildlife and biodiversity zone. CR# 13 and Section E.13 address wildlife management, diversity, and mitigation strategies.

E.15.2.11 Cultural and Historic Sites

Coalspur can proceed with development of the Vista Project only when regulatory agencies are satisfied that adequate mitigation strategies are in place for any identified historic resources and clearance is obtained from ACCS under the *Historical Resources Act*.

Coalspur will continue to communicate with all Aboriginal groups associated with the Vista Project through their ongoing consultation program for the life of the Vista Project and address any concerns as they arise.

E.15.2.12 Traditional Land and Resource Use

Coalspur has been working with the aboriginal communities in the area for the past year. As part of the proposed Vista Project a Traditional Land Use and Ecological Knowledge assessment has been conducted. This report is included as CR# 11 and summarized in Section E.11.

E.15.3 Mitigation and Monitoring

E.15.3.1 Mitigation

Mitigation proposed to address specific environmental concerns (such as air, noise, and water quality) associated with land use in the area are found throughout Section E. A brief summary of some of the mitigation that Coalspur will undertake includes:

- continue to communicate with existing land disposition holders, Aboriginal groups, and interest groups;
- construct the Highway 16 intersection and Gun Range access road to ensure the Hinton Fish and Game Association's access needs are addressed;
- shift the clean coal conveyor west in the vicinity of the Gun Range, to address Association concerns, and construct an earthen berm along a segment of the conveyor to address visual and noise issues at Association facilities;
- minimize the physical footprint and shrink the mineral surface lease as much as safety permits, to reduce land area restrictions for public access;
- continue to communicate with West Fraser regarding salvage of merchantable timber, access planning and management during the Project, and compensation (*e.g.* silviculture investments, timber damages);
- continue with Coalspur's public engagement program; and
- continue to work with municipal and provincial government authorities on capacity building of services and infrastructure.

E.15.3.2 Monitoring

- Coalspur will continue with on-going consultation with parties affected by the Vista Project and address concerns as they arise.

E.15.4 Summary of VEC

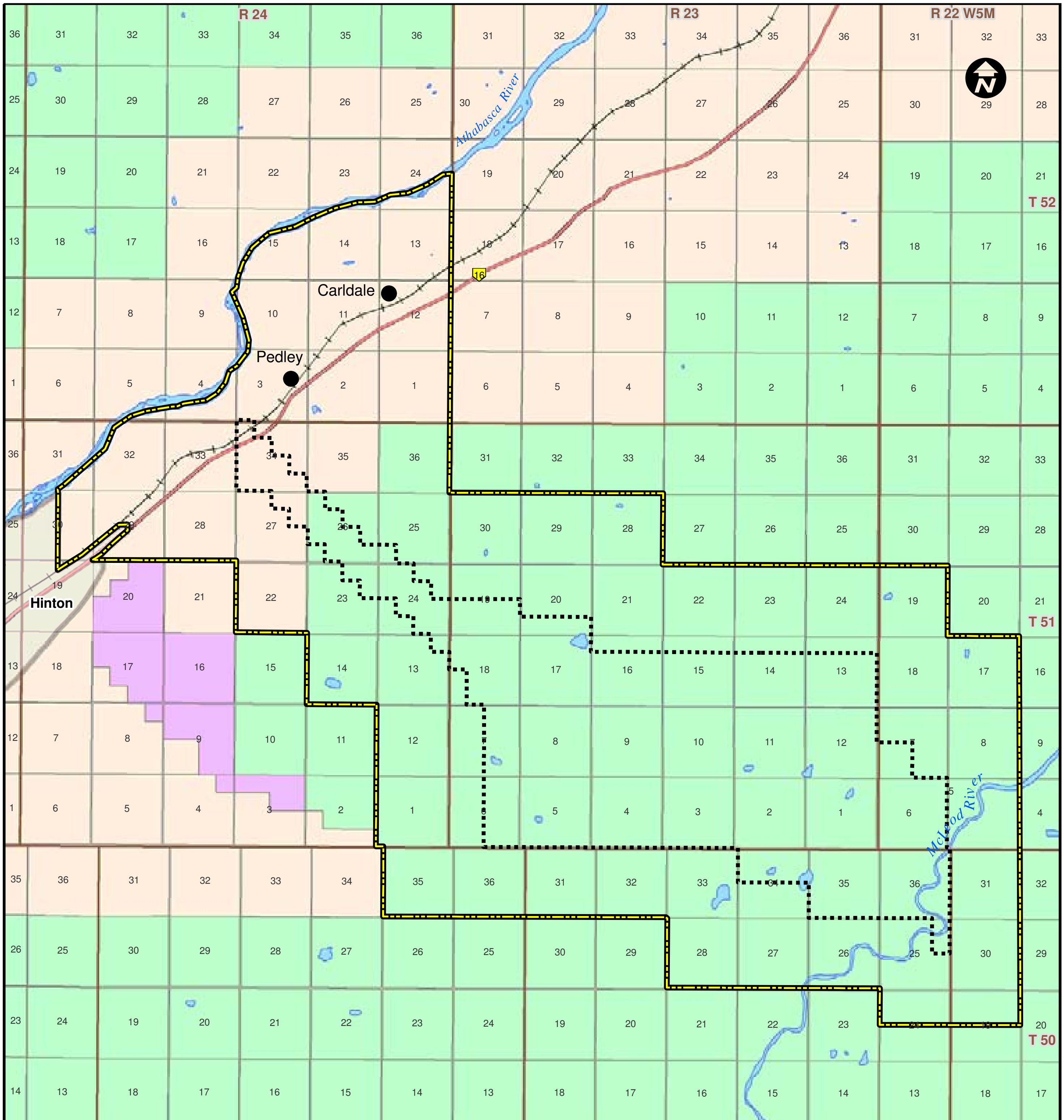
Coalspur identified potential land and resource users within the LSA area and adjacent lands through their ongoing public engagement program, Coalspur's identification of land uses, and consultation with potentially affected Aboriginal groups. Coalspur will work cooperatively and jointly with all potentially affected stakeholders and interest groups to find resolution to land use conflicts. Characterization of the residual and cumulative effects of the Vista Project on land and resource use are presented in Table E.15.4.1. With mitigation, the residual and cumulative effects of the Vista Project on land and resource use are considered to be neutral or positive and the overall impact rating is low.

Table E.15.4.1 Summary of Impact Rating on Land and Resource Use Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or effect	Mitigation/ Protection Plan	Type of Impact or Effect	Geographic Extent[1]	Duration[2]	Frequency[3]	Reversibility[4]	Magnitude[5]	Effect direction[6]	Confidence Rating[7]	Probability of Occurrence[8]	Impact Rating[9]
1. Compatibility with land use planning												
	Compliance with land use planning	- Receipt of necessary permit(s) and working agreement(s).	Residual Project Effect	Local	Long-term	Continuous	Reversible	Moderate	Positive	High	High	No impact
			Cumulative Effect	Local	Long-term	Continuous	Reversible	Moderate	Positive	High	High	No impact
2. Compatibility with existing land uses and dispositions												
	Change in ability to use land (*e.g.*, change in trapping usage)	- Continuation of Coalspur's consultation with Trappers; - Continue to work with West Fraser on access and compensation for lost forestry investments; - Communication with existing land disposition holders and other types of interest groups - Continue to communicate with Aboriginal groups	Residual Project Effect	Local	Long-term	Continuous	Reversible	Moderate	Neutral	High	High	No impact
			Cumulative Effect	Local	Long-term	Continuous	Reversible	Moderate	Neutral	High	High	Low impact
3. Compatibility with municipal and provincial development plans												
	Change in municipal and Provincial support programs and community infrastructure	- communications with municipal and provincial governments to address capacity building of support facilities (e.g. housing, policing, emergency, community support functions and infrastructure)	Residual Project Effect	Local	Long-term	Continuous	Reversible	Moderate	Neutral	High	High	Low impact
			Cumulative Effect	Local	Long-term	Continuous	Reversible	Moderate	Neutral	High	High	Low impact

1. Local, Regional, Provincial, National, Global
2. Short, Long, Extended, Residual
3. Continuous, Isolated, Periodic, Occasional
4. Reversible in short term, Reversible in long term, Irreversible - rare
5. Nil, Low, Moderate, High
6. Neutral, Positive, Negative
7. Low, Moderate, High
8. Low, Medium, High
9. No Impact, Low Impact, Moderate Impact, High Impact

FIGURES



Legend

- COAL POLICY CATEGORY 1
- COAL POLICY CATEGORY 2
- COAL POLICY CATEGORY 3
- COAL POLICY CATEGORY 4
- Land Use RSA
- Land Use LSA

0 1 2 4
Kilometres

Coalspur

Vista Coal Project

TITLE:

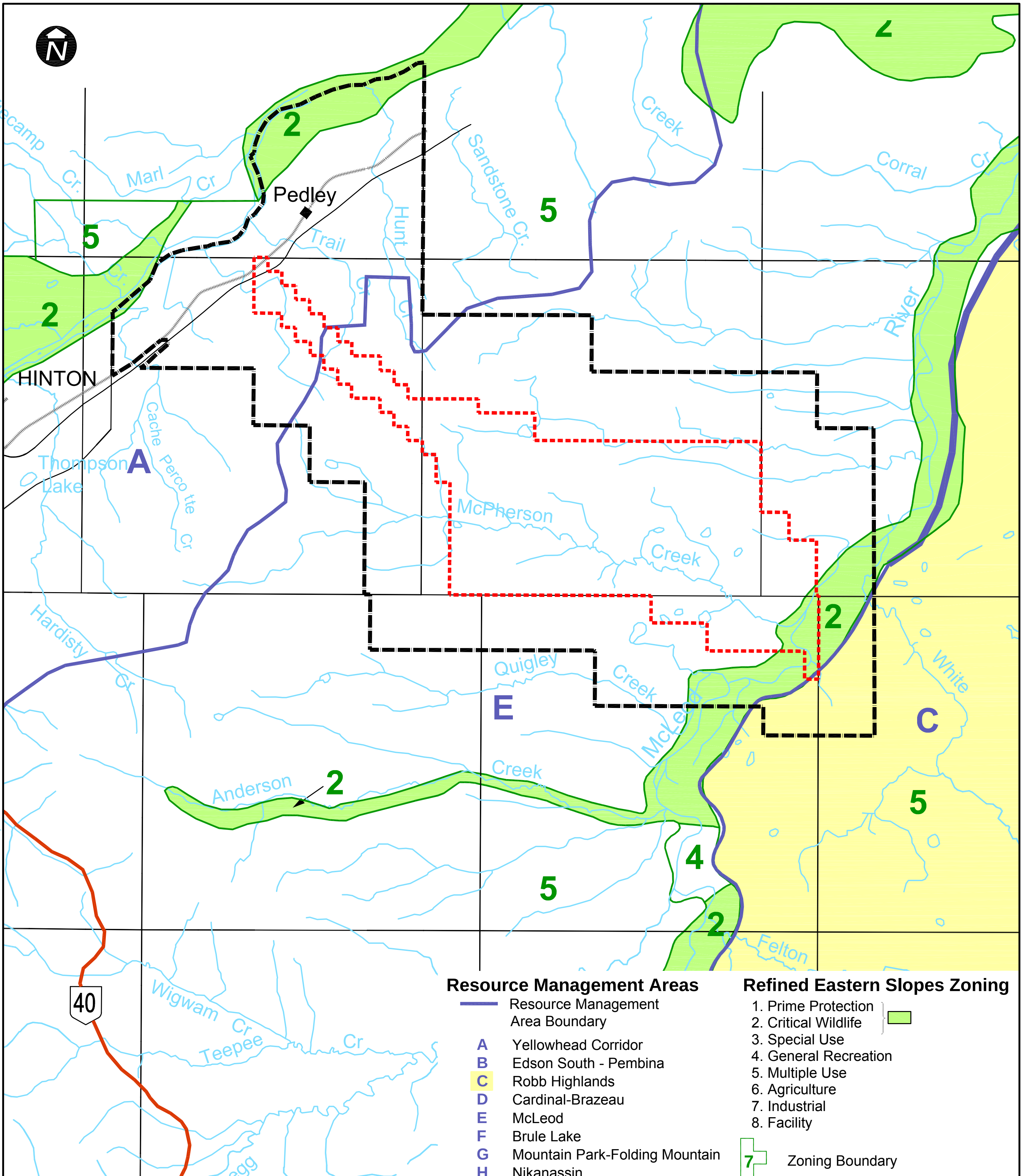
Coal Policy Categories

DRAWN:	PS
CHECKED:	DM
DATE:	Apr 13/12
PROJECT:	10-036

FIGURE:

E.15.1.1

REF: SRD, 2011



Coalspur

Vista Coal Project

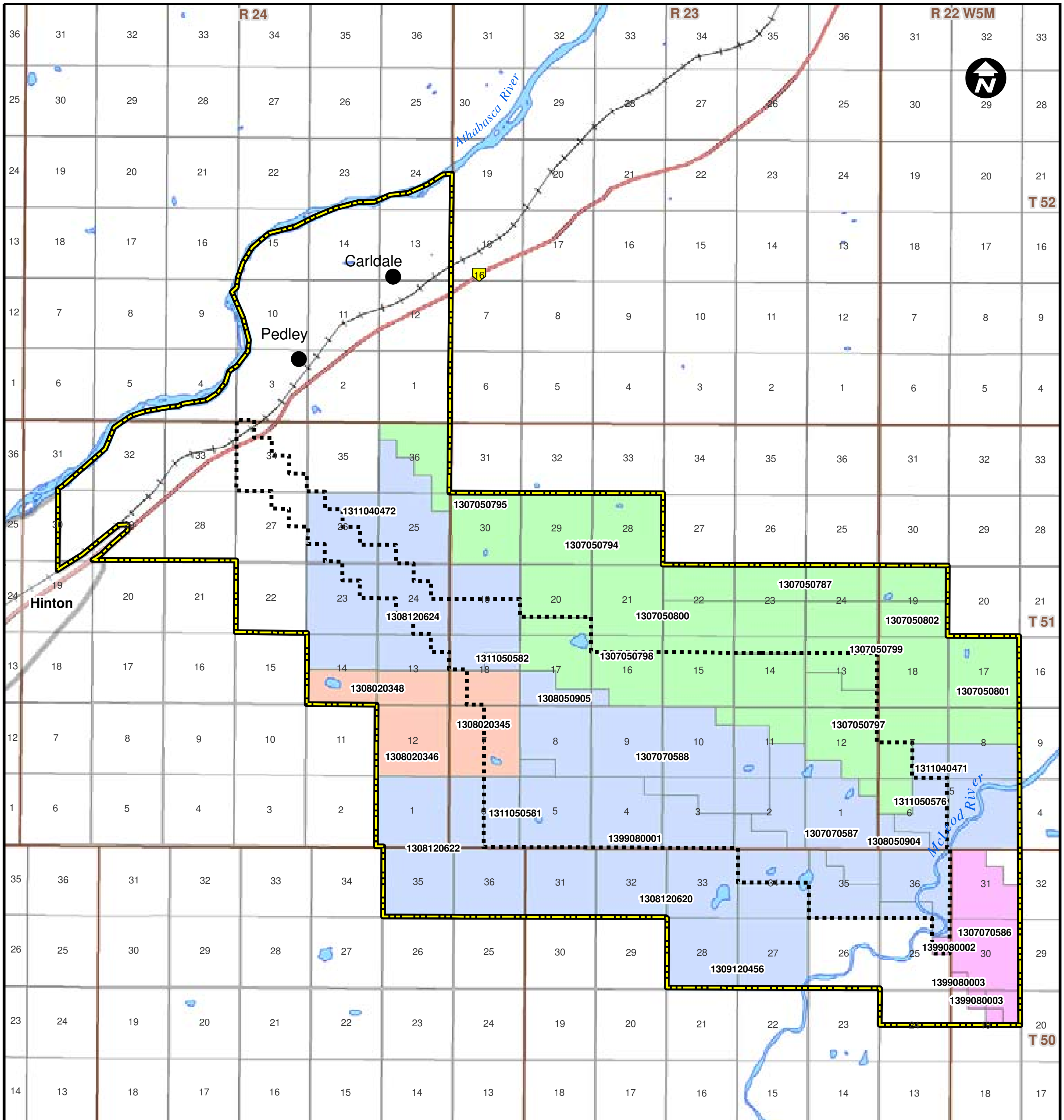
Millennium EMS Solutions Ltd.

TITLE:

Coal Branch Sub-Regional IRP
Resource Management Areas

FILE: Final Docs\Application\Land Resource Base.DWG
DRAWN: JG
CHECKED: DM
DATE: Apr 30/12
PROJECT: 10-036

FIGURE:
E.15.1.2



Legend

Owner

- COALSPUR MINES LTD.
- CONSOLIDATED TANAGER LIMITED
- MANCAL COAL INC.
- NEXEN INC.

- Land Use RSA
- Land Use LSA

0 1 2 4
Kilometres

Coalspur

Vista Coal Project

TITLE:

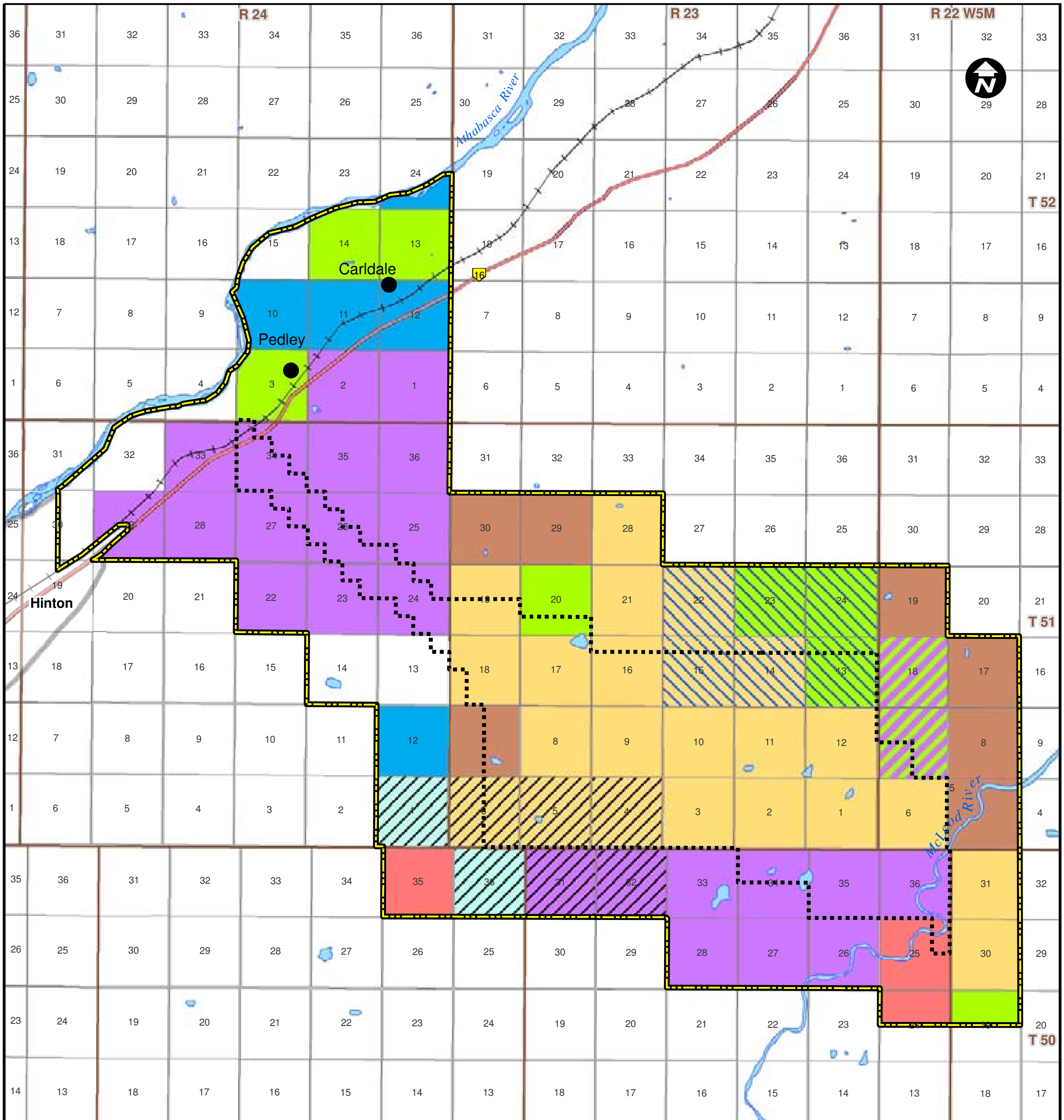
Baseline Case Coal Leases

DRAWN:	PS
CHECKED:	DM
DATE:	Apr 13/12
PROJECT:	10-036

FIGURE:

E.15.1.3

REF: Caltech & Abadata, 2012



Legend

PNG by Owner

- Canadian Coastal Resources Ltd.
- Canadian Natural Resources Ltd.
- Cinder Resources Ltd.
- Manitok Energy Inc.
- Standard Land Company Inc.
- Tourmaline Oil Corp.
- Scott Land and Lease Ltd.
- Rockford Land Ltd.
- Suncor 50% Manitok 25% Petrus 25%

- Land Use RSA
- Land Use LSA

0 1 2 4
Kilometres

REF: Caltech & Abadata, 2012

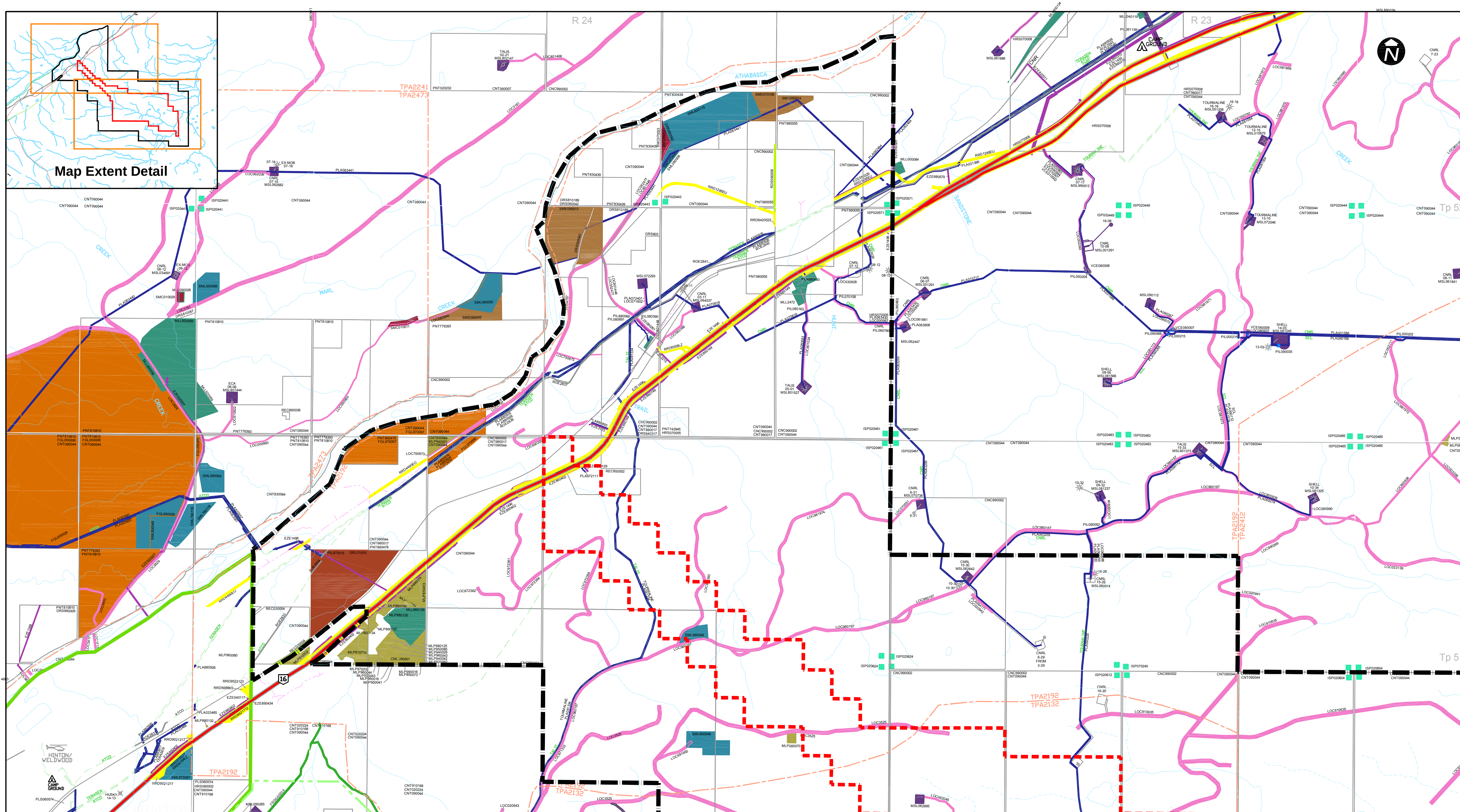
Coalspur

Vista Coal Project

TITLE:
Baseline Case Petroleum and Natural Gas (PNG) Leases

DRAWN:	PS
CHECKED:	DM
DATE:	Apr 17/12
PROJECT:	10-036

FIGURE:
E.15.1.4



Legend

- Land Use RSA
- Land Use LSA
- Hinton Boundary
- Primary Highway
- Foreign (EGIS) Pipelines
- Trapping Area Boundary

Disposition Type

EZE/VCE	LOC	PLA
FGL	MLL	RDS
FRD	MLP	RRD
GRL	MSL	SMC
ISP	PIL	SME
		SML

0 0.5 1 2km

Scale 1 : 50 000

REF: Caltech Surveys Ltd., 109-3538M01.dwg, Compiled Plan Showing Vista, March 19, 2012.

Coalspur

Vista Coal Project

TITLE:

Baseline Case Dispositions in the LSA and RSA

FILE: ...\Final Docs\Application\Land Base.dwg

DRAWN: JG

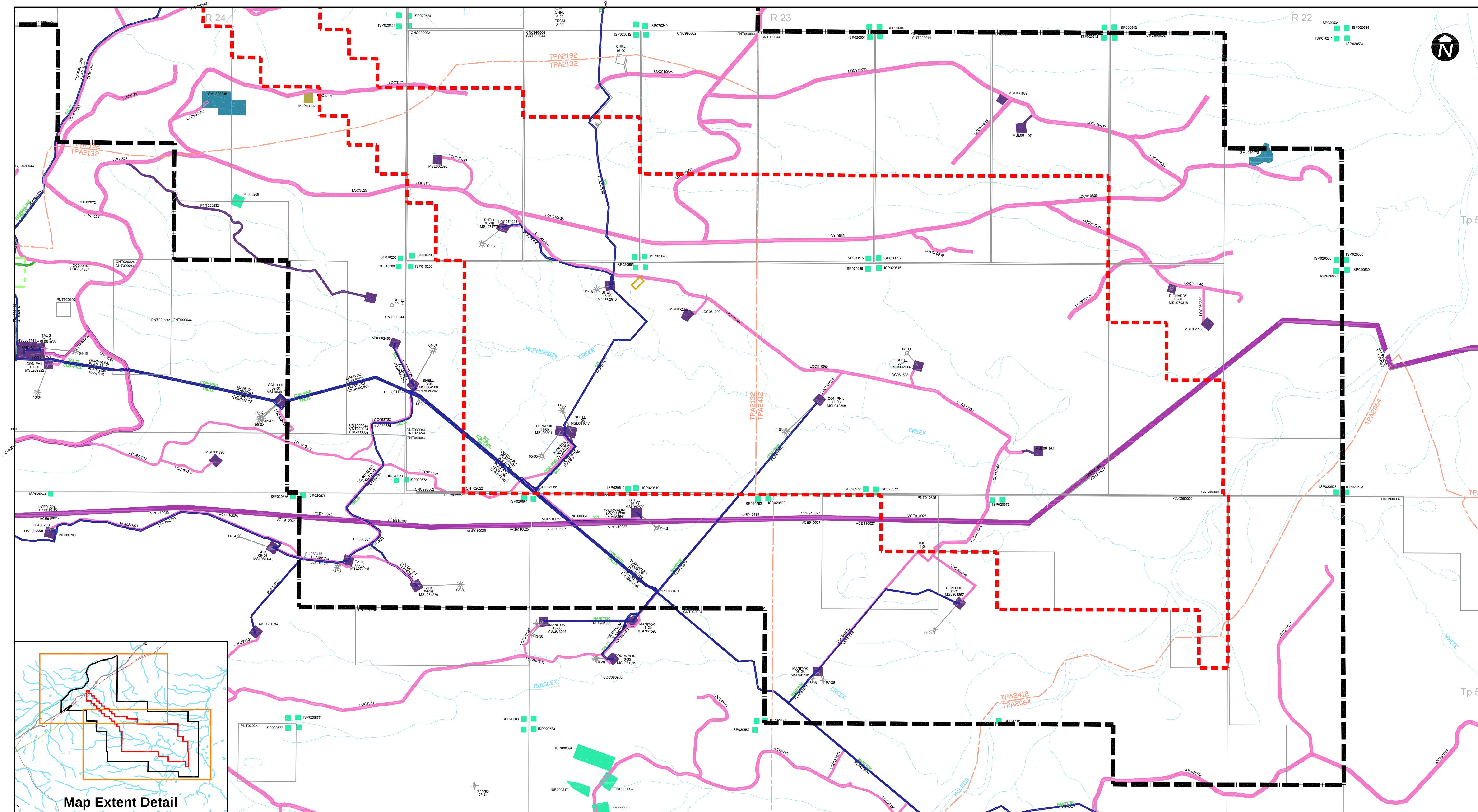
CHECKED: SR

DATE: Apr 25/12

PROJECT: 10-036

FIGURE:

E.15.1.5a



Legend

- Land Use RSA
- Land Use LSA
- Hinton Boundary
- Primary Highway
- Foreign (EGIS) Pipelines
- Trapping Area Boundary

Disposition Type

EZE/VCE	LOC	PLA
FGL	MLL	RDS
FRD	MLP	RRD
GRL	MSL	SMC
ISP	PIL	SME
		SML

REF: Caltech Surveys Ltd., 109-3538M01.dwg, Compiled Plan Showing Vista, March 19, 2012.

0 0.5 1 2km
Scale 1 : 50 000

Coalspur

Vista Coal Project

TITLE:

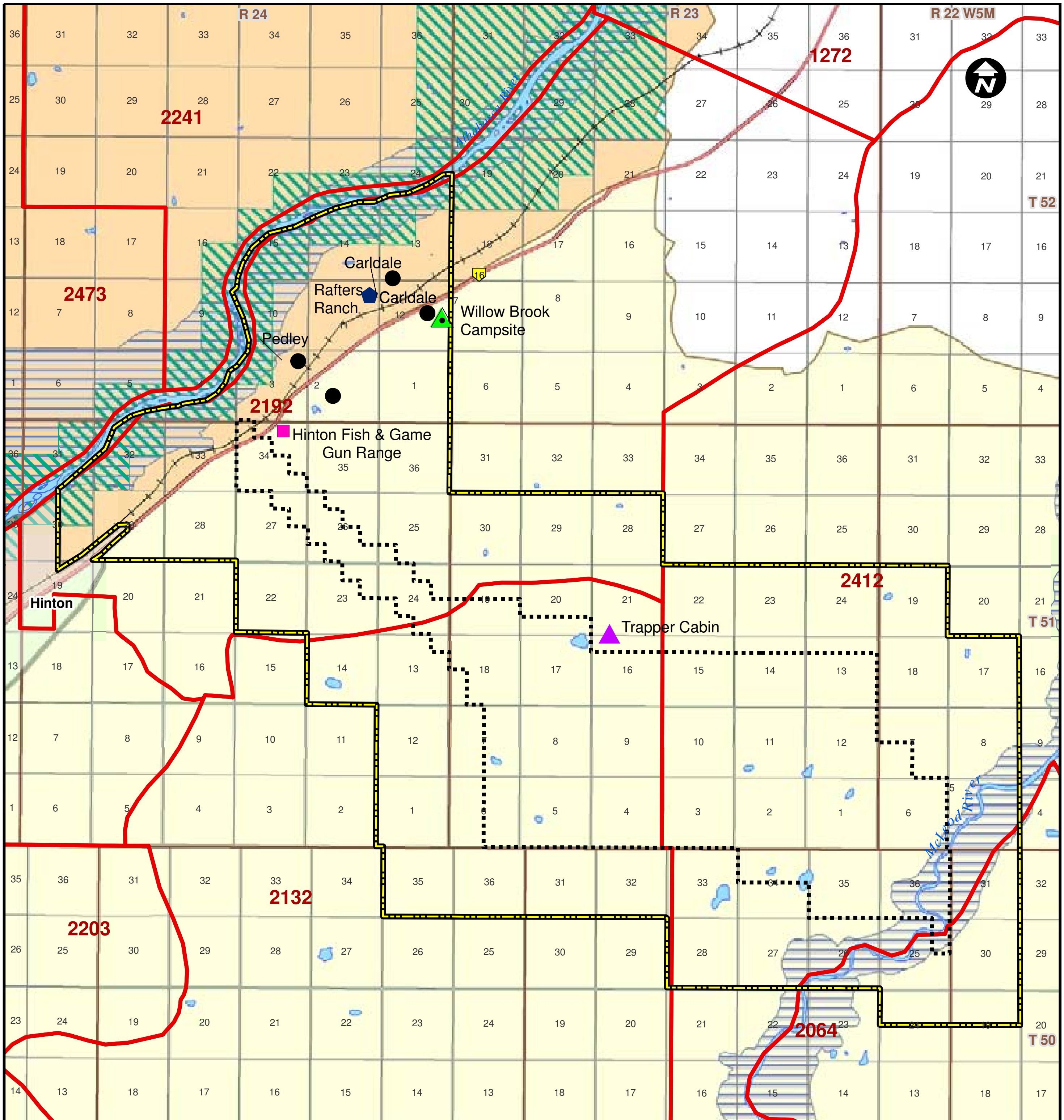
Baseline Case Dispositions in the LSA and RSA

FILE: ...\Final Docs\Application\Land Base.dwg

DRAWN:	JG
CHECKED:	SR
DATE:	Apr 25/12
PROJECT:	10-036

FIGURE:

E.15.1.5b



Legend

- Trapper Areas
- 2132 Trapper Disposition Number
- Environmentally Significant Areas (2009) Level of Significance - Provincial
- Key Wildlife and Biodiversity Zone
- Land Use RSA
- Land Use LSA

Grizzly Bear Zone by Type

- Core
- Secondary

0 1 2 4
Kilometres

REF: SRD, 2011

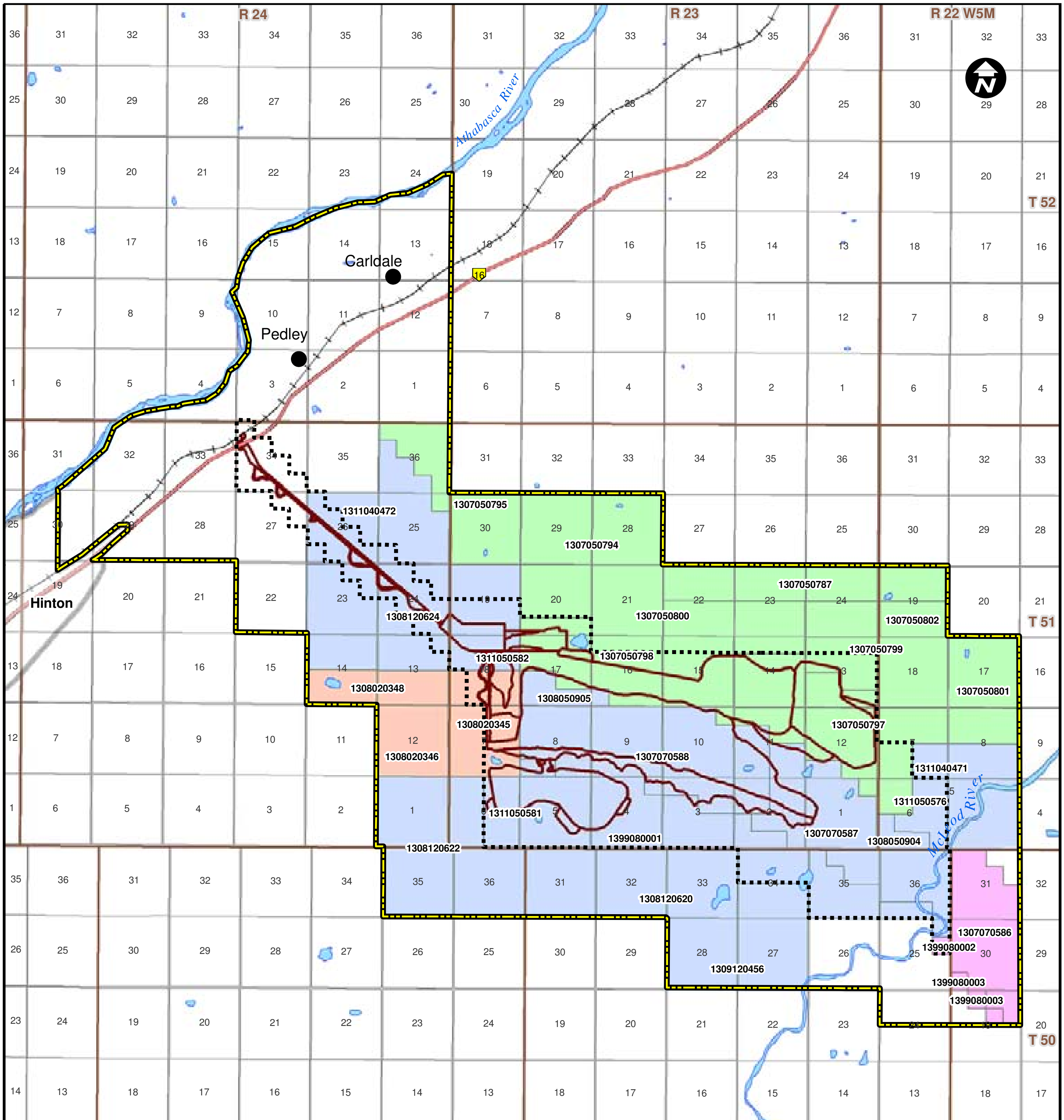
Coalspur

Vista Coal Project

TITLE:
Baseline Case Trapper Dispositions, Other Interest Groups, and Wildlife/Environmental Areas

DRAWN:	PS
CHECKED:	DM
DATE:	Apr 17/12
PROJECT:	10-036

FIGURE:
E.15.1.6



Legend

Owner

- COALSPUR MINES LTD.
- CONSOLIDATED TANAGER LIMITED
- MANCAL COAL INC.
- NEXEN INC.

- Land Use RSA
- Land Use LSA
- Proposed Development

0 1 2 4
Kilometres

Coalspur

Vista Coal Project

TITLE:

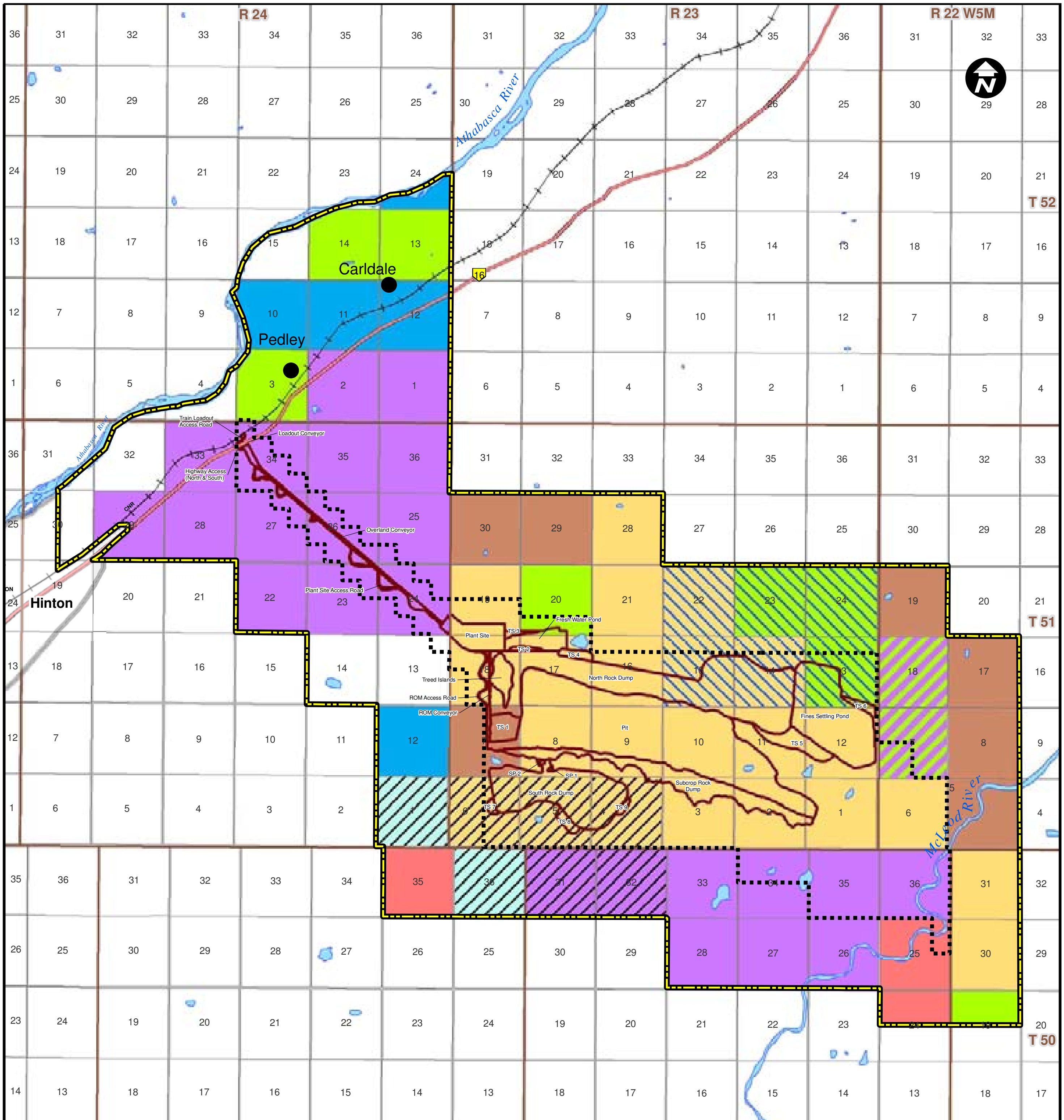
Application Case Coal Leases

DRAWN:	PS
CHECKED:	DM
DATE:	Apr 13/12
PROJECT:	10-036

FIGURE:

E.15.2.1

REF: Caltech & Abadata, 2012



Legend

PNG by Owner

- Canadian Coastal Resources Ltd.
- Canadian Natural Resources Ltd.
- Cinder Resources Ltd.
- Manitok Energy Inc.
- Standard Land Company Inc.
- Tourmaline Oil Corp.
- Scott Land and Lease Ltd.
- Rockford Land Ltd.
- Suncor 50% Manitok 25% Petrus 25%

- Land Use RSA
- Land Use LSA
- Proposed Development

0 1 2 4
Kilometres

REF: Caltech & Abadata, 2012

Coalspur

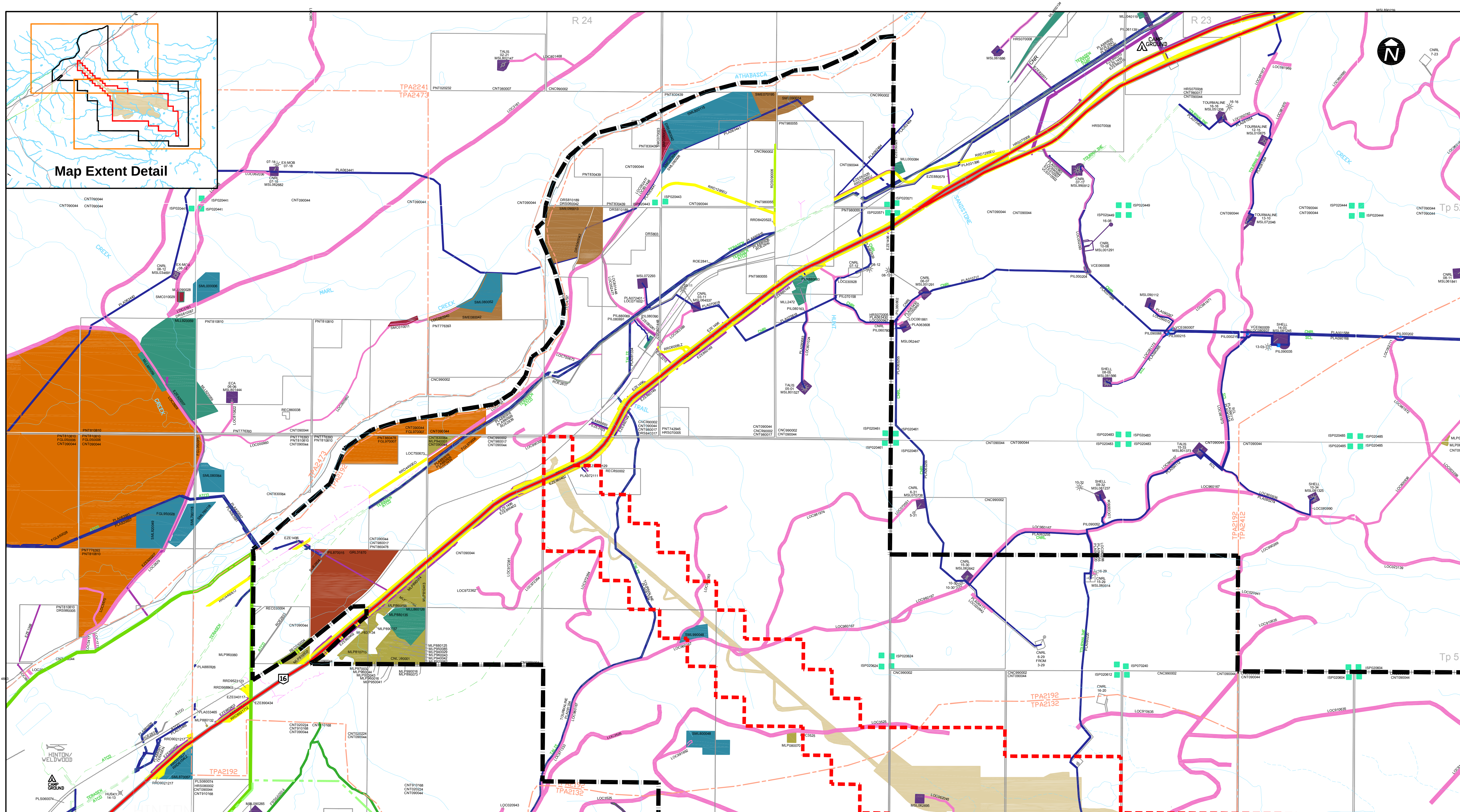
Vista Coal Project

TITLE:

Application Case Petroleum and Natural Gas (PNG) Leases

DRAWN:	PS
CHECKED:	DM
DATE:	Apr 17/12
PROJECT:	10-036

FIGURE: **E.15.2.2**



Legend

- Land Use RSA
- Land Use LSA
- Hinton Boundary
- Primary Highway
- Foreign (EGIS) Pipelines
- Trapping Area Boundary

Disposition Type

EZE/VCE	LOC	PLA	Project Footprint
FGL	MLL	RDS	
FRD	MLP	RRD	
GRL	MSL	SMC	
ISP	PIL	SME	
		SML	

0 0.5 1 2km

Scale 1 : 50 000

REF: Caltech Surveys Ltd., 109-3538M01.dwg, Compiled Plan Showing Vista, March 19, 2012.

Coalspur

Vista Coal Project

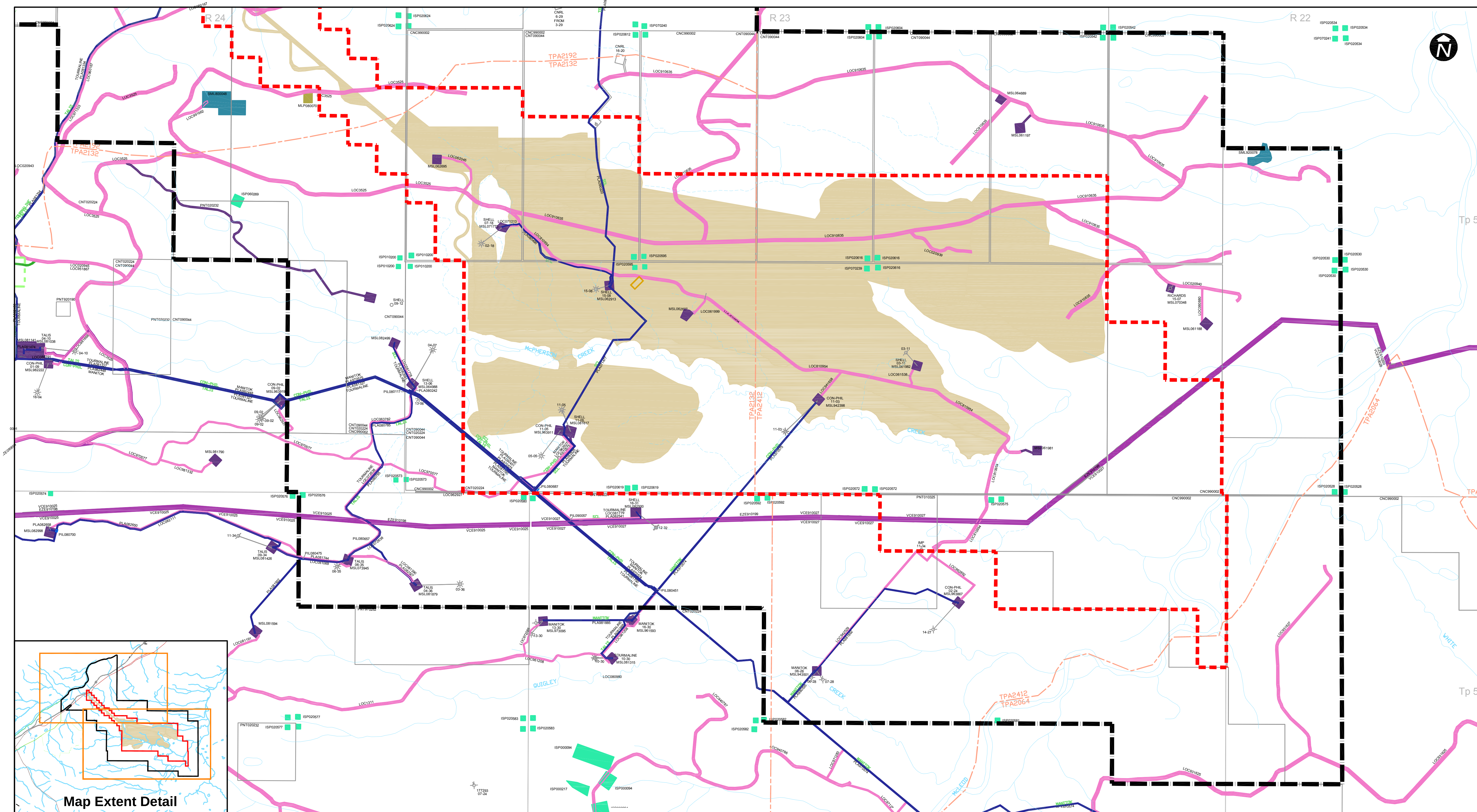
TITLE:

Application Case Dispositions in the LSA and RSA

FILE: ...\Final Docs\Application\Land Base.dwg

DRAWN:	JG
CHECKED:	SR
DATE:	Apr 25/12
PROJECT:	10-036

FIGURE: **E.15.2.3a**



Legend

- Land Use RSA
- Land Use LSA
- Hinton Boundary
- Primary Highway
- Foreign (EGIS) Pipelines
- Trapping Area Boundary

Disposition Type

EZE/VCE	LOC	PLA	Project Footprint
FGL	MLL	RDS	
FRD	MLP	RRD	
GRL	MSL	SMC	
ISP	PIL	SME	
		SML	

REF: Caltech Surveys Ltd., 109-3538M01.dwg, Compiled Plan Showing Vista, March 19, 2012.

0 0.5 1 2km

Scale 1 : 50 000

Coalspur

Vista Coal Project

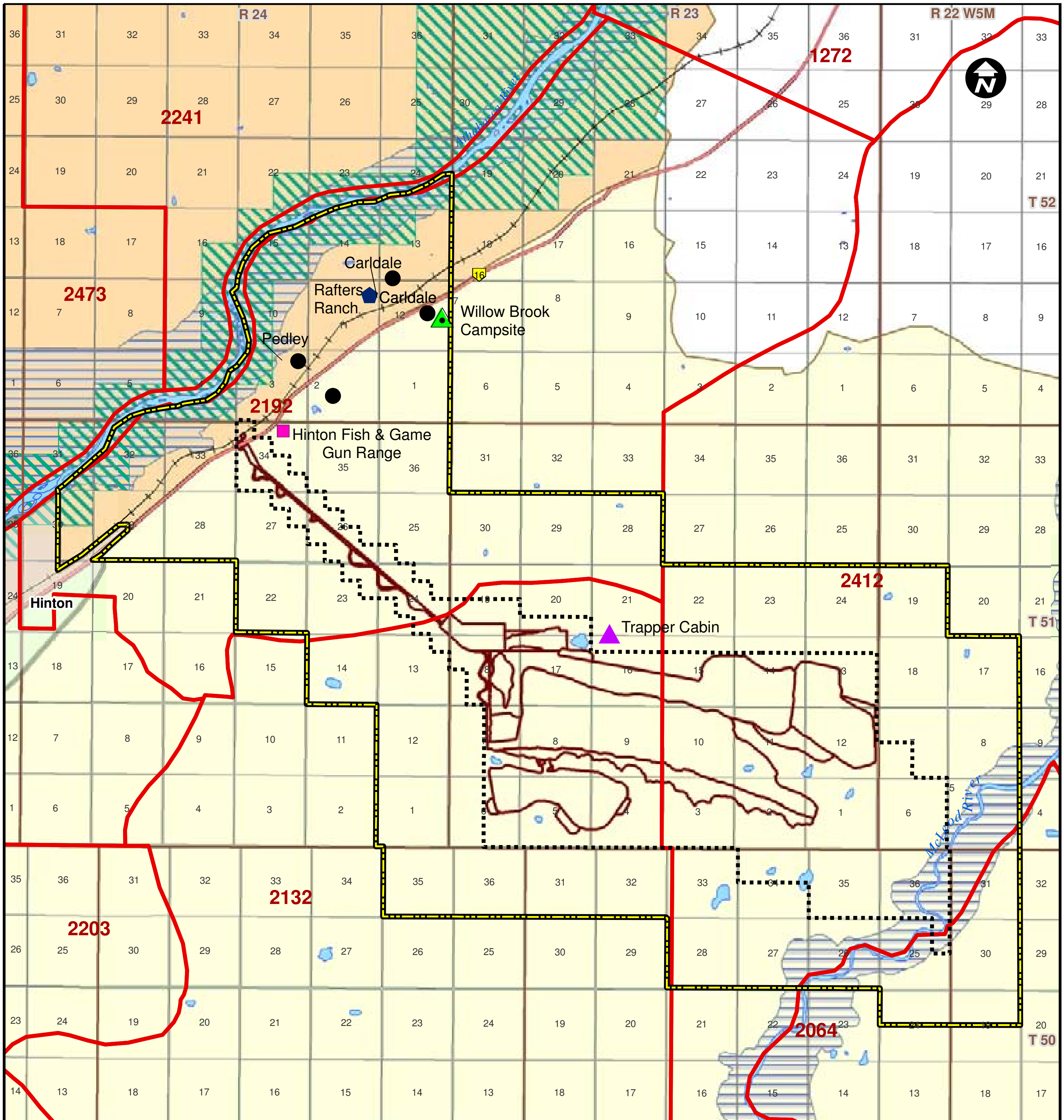
TITLE:

Application Case Dispositions in the LSA and RSA

FILE: ...\Final Docs\Application\Land Base.dwg

DRAWN: JG
CHECKED: SR
DATE: Apr 25/12
PROJECT: 10-036

FIGURE:
E.15.2.3b



Legend

- Trapper Areas
- 2132 Trapper Disposition Number
- Environmentally Significant Areas (2009) Level of Significance - Provincial
- Key Wildlife and Biodiversity Zone

Grizzly Bear Zone by Type

- Core
- Secondary

- Land Use RSA
- Land Use LSA
- Proposed Development

0 1 2 4
Kilometres

Coalspur

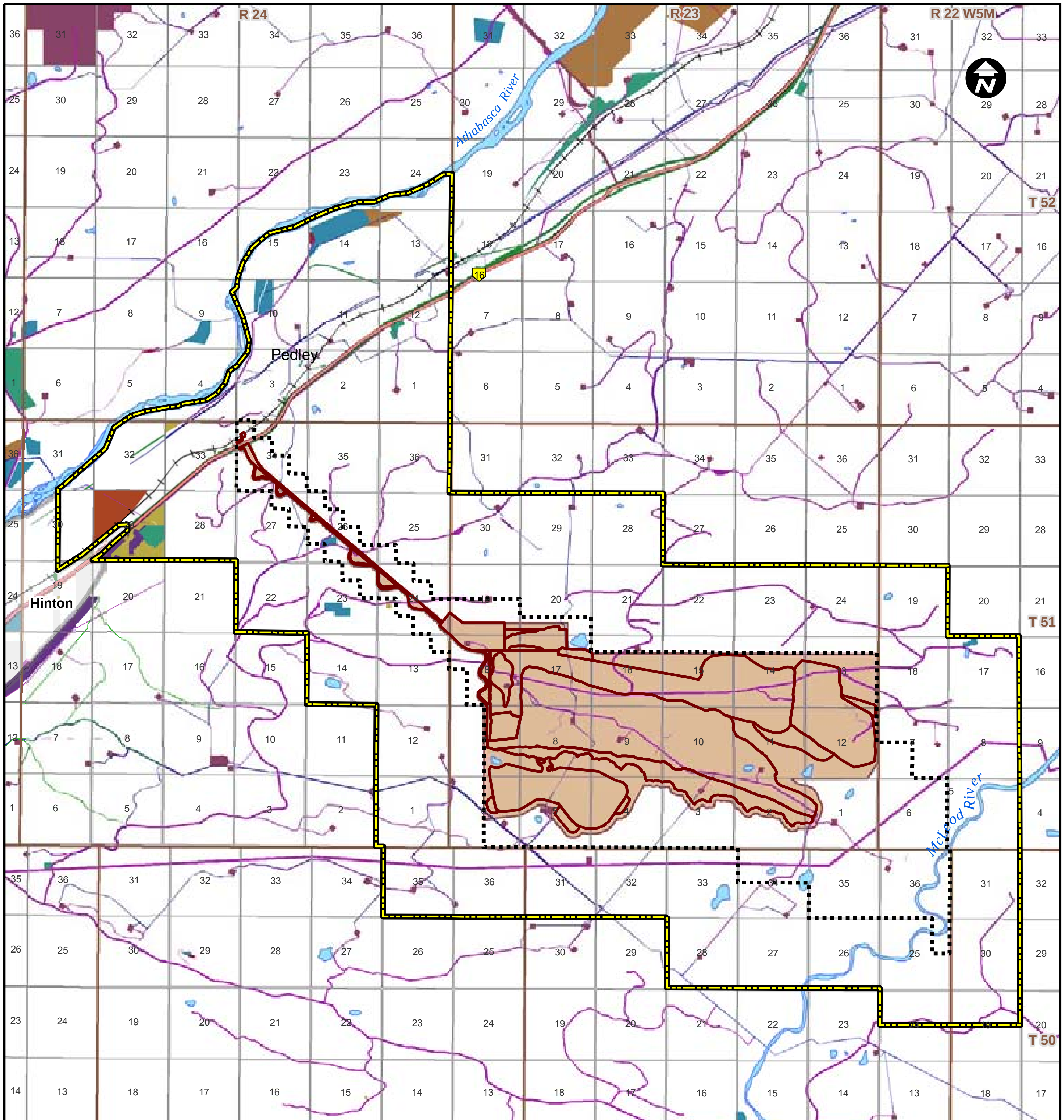
Vista Coal Project

TITLE:
Application Case Trapper Dispositions, Other Interest Groups, and Wildlife/Environmental Areas

DRAWN:	PS
CHECKED:	DM
DATE:	Apr 17/12
PROJECT:	10-036

FIGURE:
E.15.2.4

REF: SRD, 2011



Disposition Type

EZE	PLA
FRD	RDS
GRL	RRD
LOC	SMC
MLL	SME
MLP	SML
MSL	

- Land Use RSA
- Land Use LSA
- Proposed Development
- Proposed MSL

0 1 2 4
Kilometres

Coalspur

Vista Coal Project

TITLE:

Proposed MSL for the Project

DRAWN:	PS/JG
CHECKED:	DM
DATE:	Apr 27/12
PROJECT:	10-036

FIGURE: **E.15.2.5**

REF: SRD, 2011