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# Regional Geologist Summaries

## EXPLORATION AND MINING IN BRITISH COLUMBIA 2012



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Regional Geologist Summaries  
**EXPLORATION AND MINING**  
in British Columbia 2012

# EXPLORATION AND MINING IN THE NORTHEAST REGION, BRITISH COLUMBIA

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## 3.1 SUMMARY AND TRENDS

Metallurgical coal is British Columbia's biggest export commodity, representing over 60% of mineral production in 2011. Metallurgical coke is a solid carbonaceous residue produced from low-ash, low-sulphur bituminous coal and is a key ingredient in steel production where it is used as a reducing agent in the smelting of iron in blast furnaces. As such, global economic trends in metallurgical coal reflect the state of manufacturing and construction sectors. The selling price of metallurgical coal fell from a peak of US\$300/tonne in 2011 to about US\$170/tonne in 2012. As an example of how this affected the Peace River Coalfield in the Northeast Region, Walter Energy Inc's metallurgical and PCI coal prices were down 12% and 15% in the second quarter forcing the company to reduce costs at its Canadian operations by \$14 per tonne. However, the medium-to-long term outlook for metallurgical coal remains positive based on forecast demand from Asia Pacific, primarily China, which is expected to drive global economic growth for the next 15 years despite a slowing domestic growth rate, according to Brad Johnston (General Manager Logistics, Teck Coal Ltd) who spoke at the 2012 BC Natural Resource Forum in Prince George.

Ridley Terminals, the main port servicing the Peace River Coalfield, is in the second year of an expansion project that will double the total annual terminal capacity to 24 Mt by the end of 2014. This expansion will accommodate rising export coal volumes from existing and new mines in Northeast BC. The Canadian National Railway prepared to build five long sidings in 2012 in the Edmonton-Prince Rupert corridor.

In the Northeast Region, 2012 was a record year for exploration investment and activity, due to continued mine development and exploration activity in the coalfield. Operating mines carried out expansion plans, and other projects moved toward opening new mines. As a result of increased investment from intermediate and major international companies, year-on-year exploration expenditure more than doubled (2.7 times) to \$109.3 million; and drilling metreage nearly doubled (1.8 times) to about 120 250 m. This made 2012 a record year for exploration investment and activity in the coalfield.

Exploration highlights included

- completion of Preliminary Economic Assessment (PEA) and Prefeasibility Study for **Carbon Creek** (Cardero Resources Corp);
- initiation of Prefeasibility Study at **Suska** (Xstrata Coal);
- initial stages of Surface Facility Area development and bulk sample excavation at **Murray River** (HD Mining International Ltd);
- update of resource estimate for **Huguenot** (Colonial Coal International Corp);
- drilling programs at **Bullmoose River** and **Wapiti River** (Canadian Dehua International Mines Group Inc ); **Gething** (Canadian Kailuan Dehua Mines Co Ltd ); **Carbon Creek** (Cardero Resources Corp); **Huguenot** (Colonial Coal International Corp); **Murray River** (HD Mining International Ltd); **Wapiti** (Homegold Resources Ltd); **Roman Mountain**, **Roman Northwest**, and **Horizon Ridge** (Peace River Coal Inc/Anglo American plc); **Quintette** (Teck Coal Ltd); **Mink Creek East**, **Mink Creek West**, **Hudette**, **Willow South**, and **Willow West** (Walter Energy Inc); **Suska** and **Sukunka** (Xstrata Coal).

### 3.1.1 Peace River Coalfield

The Peace River Coalfield of northeastern BC extends 360 km along the Northern Rocky Mountain inner foothills from 180 km east of Prince George at Coal Ridge to the Pink Mountain prospect, 130 km north of Hudson's Hope. Macroscopic scale folds and faults generally trend northwest-southeast. Medium- to low-volatile bituminous coal seams of economic thickness and continuity are hosted by the Lower Cretaceous Gething and Gates sedimentary formations. These are mined to produce hard-coking coal (HCC) and ultra low-volatile pulverized coal injection (ULV-PCI) products. PCI coal is a high-rank thermal coal used in blast furnaces for steelmaking. The HCC is internationally sought after for its coking strength under blast furnace conditions. Coals from both formations are relatively low in ash and sulphur, generally averaging 6-15% and 0.3-0.7%, respectively. Some Gething Formation seams have such low ash contents that the run-of-mine (ROM) coal doesn't require further processing. Seams from both formations typically yield low-ash washed coal product.

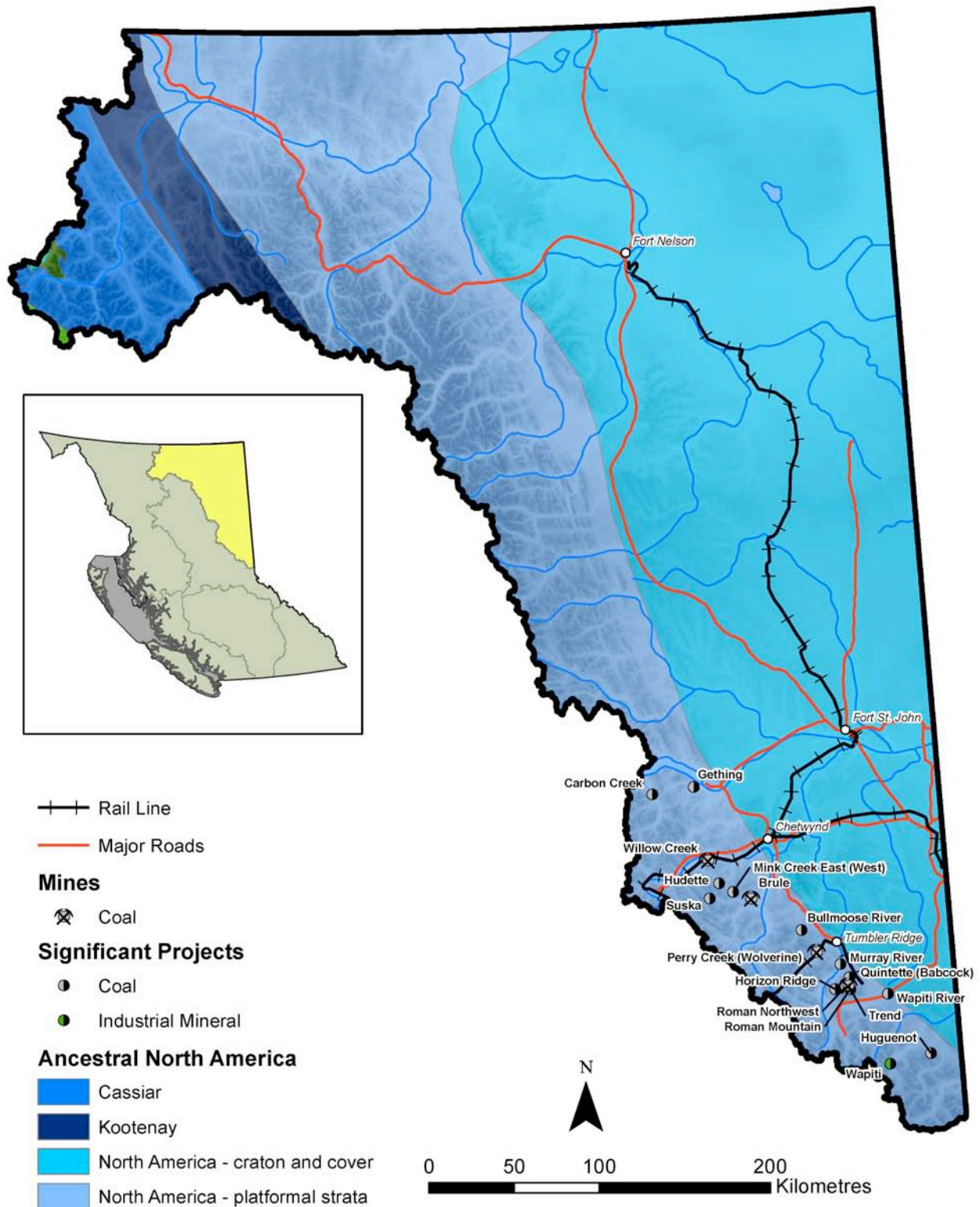
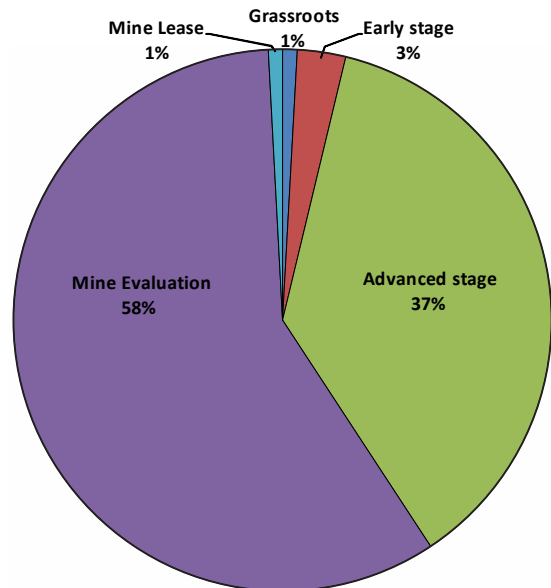


Figure 3.1. Mines and major exploration projects, Northeast Region, 2012.

### 3.1.2 Summary Figures and Tables

Figure 3.1 shows locations of mines and major exploration projects discussed in this report. Figure 3.2 provides a year-on-year comparison of exploration expenditures. Figure 3.3 sets out the approximate allocation of 2012 expenditures among Grassroots, Early stage, Advanced stage, Mine Evaluation, and Mine Lease exploration in the region. Figure 3.4 compares annual drilling statistics. Table 1 provides summary statistics for the producers, and forecast production. Table 2 lists details of the major exploration programs in 2012. Forecast total production for 2012 is about 5.5 Mt, similar to forecast production in 2011 (5.6 Mt), but greater than the reported 2011 production (3.7 Mt).



**Figure 3.3.** Exploration expenditures in 2012 by exploration stage (Grassroots: initial reconnaissance; Early stage: focused work on a target; Advanced stage: resource delineation, PEA and Prefeasibility; Mine Evaluation: focus on EA certificate, Feasibility studies, social license and government approval; Mine Lease: on-lease infill and mine development exploration). Year-on-year, the combined Grassroots/Early stage categories increased by 4%, the Mine Evaluation stage increased by 20%, the Advanced stage decreased by 14%, and Mine Lease decreased by 10%.

## 3.2 MINES

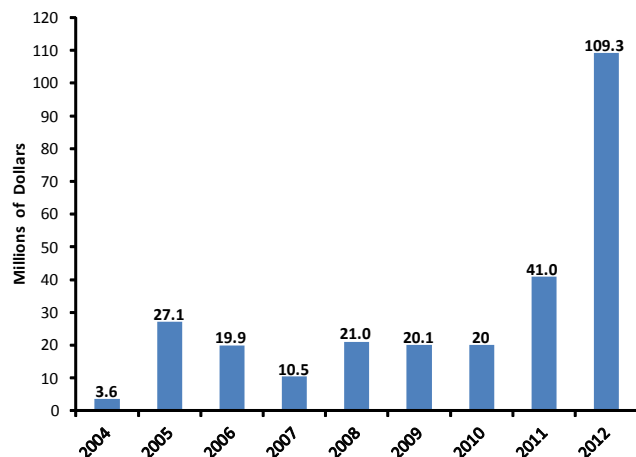
### 3.2.1 Coal

Four open-pit coal mines operated in the Northeast Region in 2012; the **Trend** mine of Peace River Coal Inc, wholly owned by Anglo American plc (Anglo/PRC); and the **Perry Creek** (Wolverine), **Brule**, and **Willow Creek** mines of Western Coal Corp, wholly owned by Walter Energy Inc (WEWC). The latter two operations also produce semi-anthracite ULV-PCI thermal coal in addition to bituminous coal of metallurgical quality.

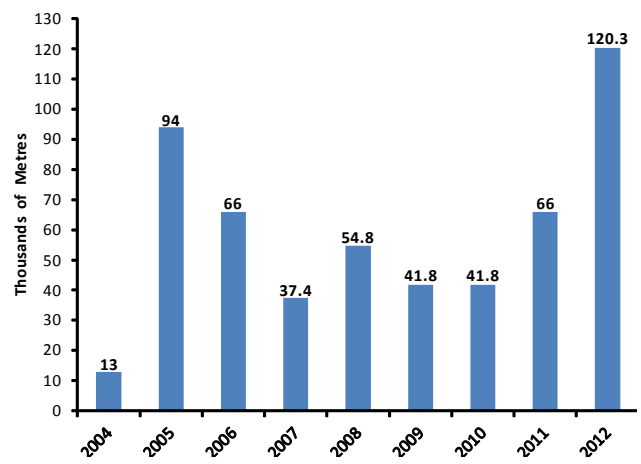
#### 3.2.1.1 South of Tumbler Ridge

Mining continued in Phases 2, 4, 5, and 6 at the **Trend** mine of PRC/Anglo, 25 km south of Tumbler Ridge (Figure 3.5). Production was an estimated 1.4 Mt ROM coal, and 1 Mt washed coal product. With ongoing development to the southeast, and addition of the Roman Mountain expansion (see below), salable tonnage is expected to increase to 2.5 Mt by 2016, and to 4 Mt with the implementation of the Phase-2 mine plan. Reserves are estimated at 22.6 Mt ROM coal (Proven and

Probable), with an additional in-situ mineable resource of 21.2 Mt (Measured and Indicated) and 1.4 Mt (Inferred). South of Babcock Creek, Phases 1, 2 and 3, began in 2006, 2008, and late-2010 respectively. Farther south along strike of the Waterfall Anticline, Phases 4, 5 and 6 have been exhaustively explored and fully permitted. Mining is expected to continue for about another 10 years. Anglo views the mine as an external coal source to buffer against potential supply shortfall in Australia from flooding or labour issues.



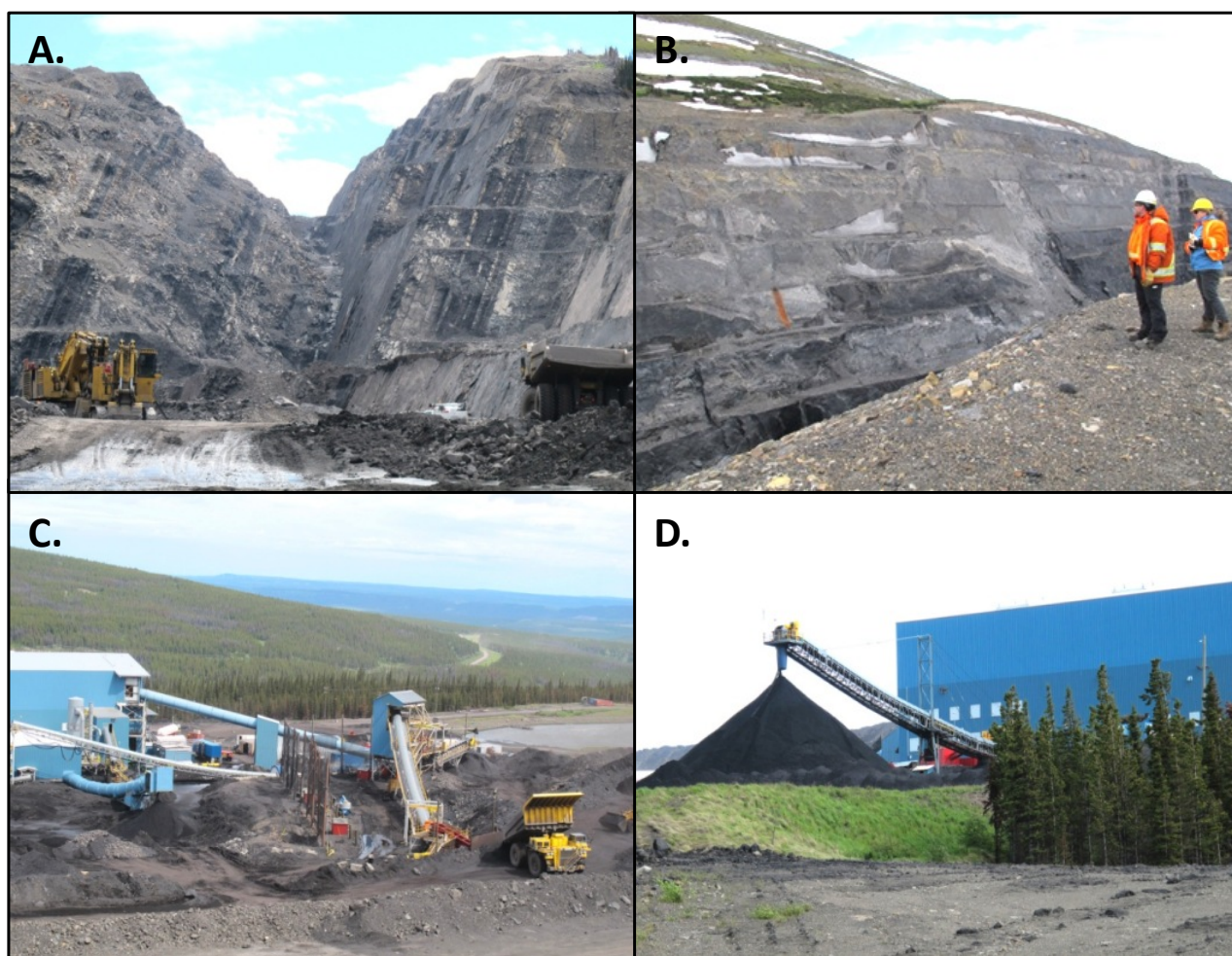
**Figure 3.2.** Annual exploration spending estimates in millions of dollars, Northeast Region (amount for 2010 is a rough estimate).



**Figure 3.4.** Annual exploration drilling estimates in thousands of metres, Northeast Region (amount for 2010 is a rough estimate).

**TABLE 3.1. FORECAST MINE PRODUCTION AND RESERVES, NORTHEAST REGION, 2012**

Mine	Operator	Deposit Type/ Commodity	Actual Washed Coal Production in 2011 (Mtonnes)	Targeted Washed Coal Production in 2012 (Mtonnes)	Proven and Probable Reserves, Mtonnes ROM (effective date)	Measured and Indicated Resource, Mtonnes in- situ mineable inclusive of Reserves (effective date)
Brule	Walter Energy Inc (Western Coal Corp)	ULV-PCI	1.1	1.8	21.1 proven (Dec 31, 2011)	33.6 (Aug 31, 2010)
Perry Creek (Wolverine Project)	Walter Energy Inc (Western Coal Corp)	Hard coking coal (HCC)	1.1	1.8	12.9 proven (Dec 31, 2011)	28.0 (Aug 31, 2010)
Trend	Anglo American plc (Peace River Coal Inc)	Hard coking coal (HCC)	0.9	1.0	22.6 (Dec 31, 2011)	43.8 (Dec 31, 2011)
Willow Creek	Walter Energy Inc (Western Coal Corp)	ULV-PCI, HCC	0.6	0.9 (0.6 PCI, 0.3 HCC)	19.9 (Dec 31, 2011)	51 (Aug 31, 2010)



**Figure 3.5. Trend Mine** – **A.** Phase-1 looking southeast toward Phase-2. Seams A to J in northeast limb of anticline; **B.** Looking at oblique fault intersection with J-seam footwall in Phase-3; **C.** ROM stockpile and wash plant; **D.** Washed coal stockpile ready for trucking to loadout facility.

Hard-coking coal of medium-volatile bituminous rank is being mined from the Lower Cretaceous Gates Formation (D, E, F, G, I, J, and K seams) along the northeast limb of a tight upright fold the Waterfall Anticline. Stratigraphy is continuous in the area with good correlation of coal seams. Cumulative coal thickness is about 16.5 m, excluding the K-seam. Structurally variable seams of the Lower Cretaceous Gething Formation (Bird and GT seams) are also present and can be blended with Gates Formation coals. ROM coal has a 20% ash content that washes to an 8.5% ash coal.

### 3.2.1.2 Wolverine Valley area

The **Perry Creek** mine (Wolverine Project) of (WEWC), 18 km west of Tumbler Ridge, was the company's foremost revenue generator in 2012 (Figure 3.6). Mining operations continued along the axial surface of the Perry Syncline in Phases 3A and 3B, which have been mined at different rates to provide feed to the processing plant and are now offset within the pit. Midway through the year, mining began on Phases 4A and 4B on the gently-dipping southwest limb of the syncline. Stripping of overburden for Phase 4A was at the 1185 m level in late June, with the targeted coal sequence beginning at the 1098 m level, and stripping is expected to continue into January 2013. A 150 m pushback of the highwall is also being investigated as Phase-5, tentatively scheduled for 2018-2019. The average strip ratio for the entire mine is 14:1, with a 1:1 strip ratio in Phases 3A and 3B. Expected production is currently 1.8 Mt washed coal, but the mine is permitted to produce up to 3 Mt/y and has a 3.5 Mt/y loadout facility. The estimated resource is 28.0 Mt in situ mineable coal (Measured and Indicated) including 12.9 Mt ROM coal reserves (Proven). Mining is expected to continue to 2019.

HCC of medium-volatile bituminous rank is being mined from the Lower Cretaceous Gates Formation (E2, E3, F, G, J1, J2, J3 seams in descending order) in the Perry Syncline. The 3-ply basal J-seam comprises about 7 m coal thickness, while the remaining seams are average 1 -2.5 m. The J-seams are split by a transgressive lag conglomerate that thickens to the north and east. These seams are easier to mine and process but make softer coking coal, which requires blending with upper seams or Willow Creek coal for the final HCC product. The F-seam also underlies conglomerate and requires precise blasting when mined.

### 3.2.1.3 Chetwynd-Pine River Area

The **Brule** mine of (WEWC) is 37 km south of Chetwynd in the larger Brazion Group of properties that includes **Willow Creek** (Figure 3.7). Mining continued in the Brule Pit in 2012, where the 'Camp pit' phase was completed in September. Phase 2 continued to



**Figure 3.6. Perry Creek Mine** – A. Digging to access G-seam in Phase 3B; B. Preparing to blast in Phase 4A.



**Figure 3.7. Brule Mine** – A. Visitors view the Hitachi EX8000 shovel on a tour of WEWC's Brule mine as part of the NE BC Coal and Energy Forum, Oct 9 2012; B. Hauling a load from Phase 2 of the Brule pit.

the northwest and north with a strip ratio of 10:1. Mining will resume in the original Dillon and Blind pits for four months in 2013 to capture the dump space profile at a strip ratio of 2:1. Current production is 1.8 Mt/y, with a capacity increase to 2 Mt/y expected with improvement programs and equipment upgrades. The estimated resource is 33.6 Mt in-situ mineable coal (Measured) including 21.1 Mt ROM coal reserves (Proven). Mine life is estimated for another 10 years to 2022. The transition from mine-contractor to in-house operation is underway.

The mine produces ULV-PCI coal from three Gething Formation seams within the Owl Creek syncline. Cumulative coal thickness is about 12 m. The Upper 60 seam goes to the wash plant, whereas the Upper and Lower seams need no processing and go directly to loadout. ROM coal is trucked 60 km on the Falling Creek Connector Road to the processing plant and rail loadout facility at the Willow Creek mine.

The **Willow Creek** mine is 38 km west of Chetwynd in the Pine Valley area (Figure 3.8). Mining continued in 2012 at Willow North in the 7N1 and 7N2 pit areas, and in the new 4N1 development area. Production was limited in the first quarter by a scheduled wash plant outage to upgrade HCC processing efficiency. A new rotary breaker was installed at the processing plant in March. The operation also transitioned from a contractor-operated to an owner-operated mine, successfully retaining about 90% of the workforce. Production is targeted at 0.9 Mt, with one-third HCC and two-thirds ULV-PCI coal, and is planned to increase to 1.2 Mt



**Figure 3.8. Willow Creek Mine** – A. View west to 7N1 pit area; B. Mining in 7N2 pit area, 1082 bench.

in 2013. The mine is permitted to produce up to 1.7 Mt/y. The estimated resource is 51.0 Mt in-situ mineable coal (Measured and Indicated), including 19.9 Mt ROM coal reserves (Proven and Probable). Mining is expected to continue another 15 years to 2027. Willow Creek coal at a higher CSR (Coke Strength after Reaction) is marketed at a premium separately from Wolverine project coal. Both Willow Creek and Brule (Upper 60 seam) ROM coal is processed at the Willow Creek site.

Nine economic coal seams (youngest to oldest: numbered 1 - 4, A, 5 - 9) of the Gething Formation occur on the east limb of the 4-km long Pine River anticlinorium and its disharmonic subsidiary synclinal folds. The coal seams are commonly split, with coal units averaging 1.2 m thickness, and a cumulative thickness of about 29 m. Three seams (5, 7, and 8) are ULV-PCI coal. Folding and faulting are more complex in the Willow South area.

### 3.3 MINE EVALUATION

#### 3.3.1 Coal Projects

##### 3.3.1.1 South of Tumbler Ridge

The **Belcourt-Saxon** joint venture project of the Belcourt Saxon Coal Ltd Partnership, Anglo/PLC (50%) and WEWC (50%), was idle again in 2012. A significant exploration program at **Belcourt North/South** was delayed because of permitting issues. A 2009 Anglo/PLC technical report on Belcourt North and South estimates 86.4 Mt in situ reserves (Proven and Probable), and a 171 Mt resource (Measured and Indicated). As of Dec 31, 2011, Walter Energy Inc reported 28.5 Mt reserves (Proven and Probable) for the **Saxon** properties, classified as Prefeasibility, and the resource has historically been reported at 327.5 Mt (Indicated) and 98.6 Mt (Inferred). Phase-1 of the Bel-Sax project, expected to start by 2020 at Belcourt, could have production of 4 Mt/y and be viable for 40 years. Six economic Gates Formation coal seams at Belcourt North average 19.0 m total thickness, and seven seams at Belcourt South average 13.5 m thickness. Structurally, the deposit sits in a northwest trending band of thrust faulted, tight-to-open subsidiary folds along the northeast limb of the Belcourt anticlinorium (Belcourt North), and in an open synclinal structure called the HOLTSLANDER synclinalorium (Belcourt South). The combined Bel-Sax project extends northwest from the Alberta border for about 70 km.

Anglo/PLC's expansion projects near the **Trend** mine are part of a development plan that includes an initial increase in combined washed coal tonnage to 2.5 Mt by 2016, and a further increase to 4 Mt in Phase-2.



**TABLE 3.2. MAJOR EXPLORATION PROJECTS, NORTHEAST REGION, 2012**

<b>Property</b>	<b>Operator</b>	<b>Minfile (NTS ref)</b>	<b>Commodity</b>	<b>Deposit Type</b>	<b>Work Program</b>
Bullmoose River	Canadian Dehua International Mines Group Inc / Canadian Bullmoose Mines Co Ltd	(093P.003,004,006)	metallurgical coal	sedimentary	A, DD (14 171 m), EN, FS
Carbon Creek	Cardero Resources Corp	093O 028, 094B 022 (093O.097, 094B.007)	metallurgical coal	sedimentary	A, CQ, CT, DD (5600 m), EN, RC (3335 m), PEA, PF, FS
Gething	Canadian Kailuan Dehua Mines Co Ltd	093O 030 (093O.098, 099; 094B.008, 009 )	metallurgical coal	sedimentary	A, GD (1770 m), EN, FS
Horizon Ridge	Anglo American plc (Peace River Coal Inc)	093I 032 (093I.085)	metallurgical coal	sedimentary	A, DD (7040 m), TR
Hudette	Walter Energy Inc (Western Coal Corp)	(093O.050)	metallurgical coal	sedimentary	A, CQ, DD (8262 m)
Huguenot	Colonial Coal International Corp	093I 014 (093I.049, 059)	metallurgical coal	sedimentary	CQ, DD (1900 m), EN, RC (500 m)
Mink Creek East	Walter Energy Inc (Western Coal Corp)	(093P.041)	metallurgical coal	sedimentary	A, CQ, DD (3720 m)
Mink Creek West	Walter Energy Inc (Western Coal Corp)	(093P.041)	metallurgical coal	sedimentary	A, CQ, DD (3500 m)
Murray River	HD Mining International Ltd	093I 010 (093P.005, 093I.095)	metallurgical coal	sedimentary	A, BU (100 000 tonnes), DD (375 m), EN
Quintette	Teck Coal Ltd	093I 011 (093I.095, 096)	metallurgical coal	sedimentary	A, CD, CQ, DD (7140 m), EN, GD (300 m)
Roman Mountain	Anglo American plc (Peace River Coal Inc)	093I 030 (093I.086)	metallurgical coal	sedimentary	A, DD (9282 m), TR
Roman Northwest	Anglo American plc (Peace River Coal Inc)	(093I.014, 015)	metallurgical coal	sedimentary	A, DD (4397 m), TR
Suska	Xstrata Coal	093O 050 (093O.049)	metallurgical coal	sedimentary	A, CQ, DD (5000 m), EN, GD (600 m), RC (16 000 m)
Wapiti	Homegold Resources Ltd	093I 008, 022 (093I.047)	upwelling phosphate	sedimentary	A, G, GC (rock), DD (200m), P, TR

Table 2 continued on following page

TABLE 3.2 (CONTINUED)

Property	Operator	Minfile (NTS ref)	Commodity	Deposit Type	Work Program
Wapiti River	Canadian Dehua International Mines Group Inc	093I 013 (093I.009, 010, 015, 016)	metallurgical coal	sedimentary	A, DD (20 921 m), EN
Willow South	Walter Energy Inc (Western Coal Corp)	093O 008 (093O.069, 059)	metallurgical coal	sedimentary	A, CQ, DD (3575 m)
Willow West	Walter Energy Inc (Western Coal Corp)	093O 008 (093O.060)	metallurgical coal	sedimentary	A, DD (2676 m)

**Work Program Abbreviations:**

A = access (trail, road construction on claims); BU (X tonnes) = bulk sample (weight in tonnes if known); CD = condemnation drilling; CQ = coal quality testing; CT = carbonization test (coal); DD (Xm) = diamond drilling (totalling X metres); EN = environmental baseline studies/monitoring, remediation work; FS = Feasibility studies; G = geology, mapping, etc.; GC = geochemical sampling (rock, silt, soil, etc.); GD = geotechnical drilling; P = prospecting; PEA = Preliminary Economic Assessment, scoping study; PF = Prefeasibility studies; R = reclamation; RC = reverse circulation drilling; TR = trenching

The **Roman Mountain** project sits in a tight syncline (Murray Syncline) 1 km southwest of Trend mine (Figure 3.9). The syncline has a 4 km strike length, is cored with Gates Formation conglomerate and coal seams, and features steep reverse faults with associated folds and tectonically thickened coal. A trenching and drilling program was permitted in September to delineate coal seam repetition, upgrade Gething Formation seams on either fold limb, and provide better coal quality data using PQ air-coring and triple-tube system to maximize core recovery. Caribou mitigation and monitoring plans were revised over the year to coincide with the PCNP interim guidelines. The planned contour mine, with an expected 15-year life and annual production of 2.5 Mt, will encompass both limbs of the syncline. The current in situ mineable resource is 26.7 Mt (Measured and Indicated). A suspension on the 2009 Environmental Assessment (EA) application was lifted in April, and a decision is expected by the end of 2012.

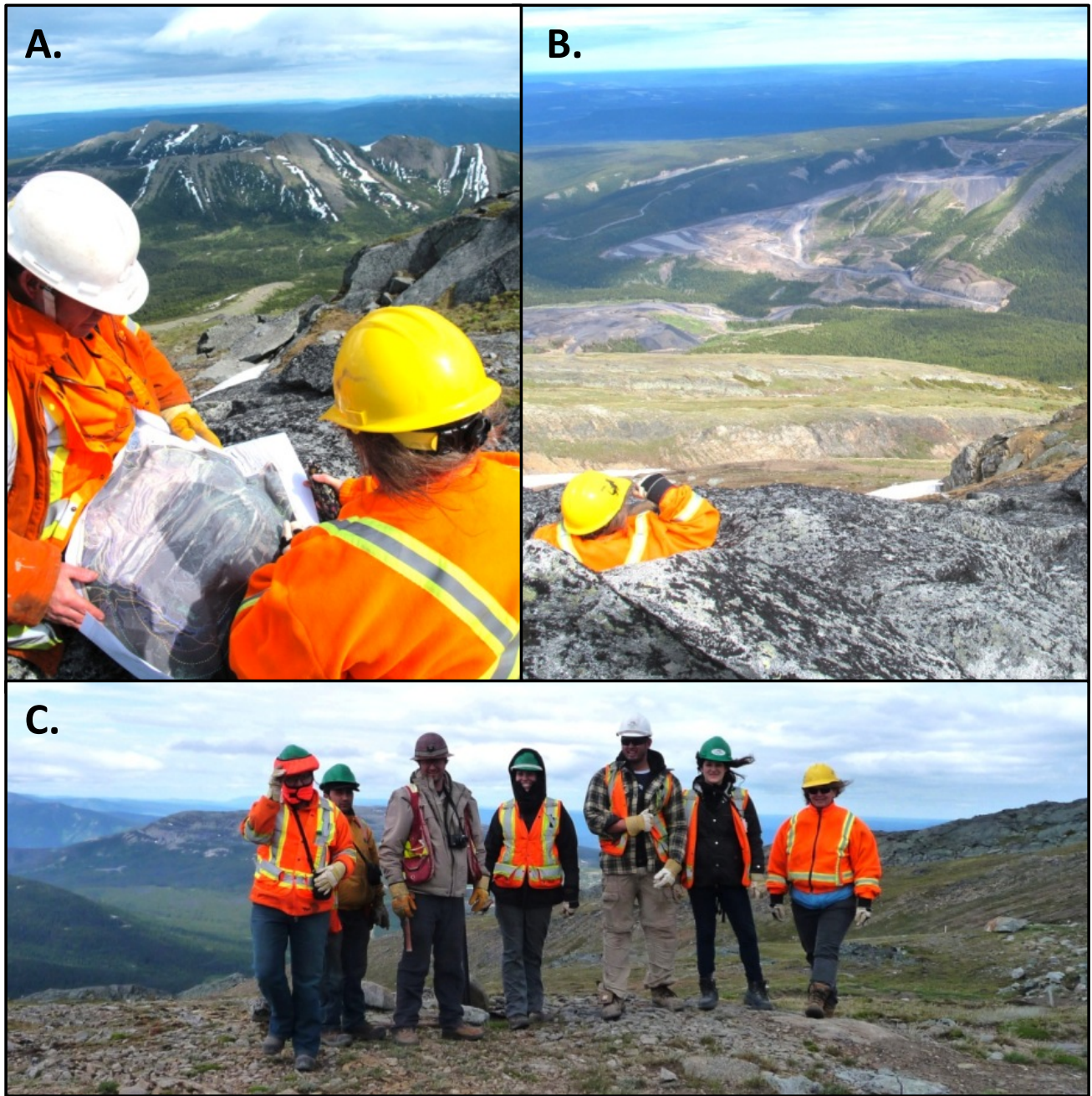
Other Anglo/PRC expansion projects include **Roman Northwest** and **Horizon Ridge**. Both projects have approved drilling and trenching programs. **Roman Northwest** is 4 km northwest of Roman Mountain on Mt. Kostuik. A new geological interpretation suggests the deposit sits within a tight chevron fold sequence. The **Horizon Ridge** project (formerly the Five Cabin Coal Project), 8 km west of the Trend Mine, sits in a broad asymmetric syncline containing both Gates and Gething coal seams with potential for a 1.6 Mt /y underground operation over 20 years. The project is in the Pre-Application stage of the EA process.

Restart of the Teck's **Quintette** mine project, 20 km south of Tumbler Ridge, remained on hold awaiting a Mines Act Permit Amendment (MAPA) and a First

Nations third party review (Figure 3.10). The mine operated from the early 1980s until August 2000. The new mine plan, based on a 2010 Feasibility Study and new geological interpretation, is focused on reopening the Windy and Window pits on the northwest and northeast sides of Babcock Mountain. By maximizing the use of existing infrastructure and processing plant, the mine is expected to produce between 3 - 3.5 Mt of washed coal annually over a 15 - 17 year mine life, employing 500 people. The MAPA was submitted for pre-screening in April, the Feasibility Study was submitted for review in September, and a final caribou mitigation plan was submitted to the Province in October. Production is anticipated for 2013, depending on a positive Feasibility decision. New mining equipment, breaker station, service truck shop, facility refurbishment, and accommodations are required.

This summer, the development program at Quintette included geotechnical drilling, installation of groundwater wells, trail construction, and drilling on Mt. Babcock to define coal seam characteristics, and to conduct subsurface foundation investigations. The program was run from Aug 1 to Oct 31, during the caribou low-risk timing window. Dismantling and stockpiling of the old 13 km conveyor from the Mesa Pit is completed. The estimated resource is 180.5 Mt (Measured and Indicated), and 136.5 Mt (Inferred) of raw coal. Babcock Mountain is a box-fold in the Waterfall anticline trend, having a coal sequence similar to that of the Trend mine (D to K seams).

Ten km southwest of Tumbler Ridge at the **Murray River** project, HD Mining International Ltd (a joint venture of Dehua and Huiyong Holdings Group) initiated



**Figure 3.9. Roman Mountain** – A. Geologist David Thompson and BC Senior Minerals Coal Geologist Janet Riddell getting oriented on Roman Mountain; B. Janet looking east from Roman Mountain at Trend Mine Phases 4-6; C. Team of Anglo/PRC Geologists with Janet Riddell and BC Regional Geologist Paul Jago on Roman Mountain (photo by David Thompson).

the excavation of a 100 000 tonne bulk sample as part of their Surface Facility Area development program (Figure 3.11). The Surface Facility includes a North Shaft Site and a South Decline Site. Development work included the completion of two settling ponds and accessorial discharge systems, a waste rock facility at the north site, a steel bridge structure for the decline portal, geotechnical drilling in the proposed portal location, and hydrogeological drilling in the proposed area for coarse coal rejects and wash plant. The company plans a dual shaft method for the underground longwall mining operation, wherein a large-diameter vertical shaft up to

11.5 m wide intersects a 5 x 5 m decline shaft grading at 16° to a depth of 500 m. The vertical shaft will provide ventilation and access for workers and equipment. The decline shaft will house a 1600 m conveyor. Coal seams are expected at depths between 500 m to over 1000 m. Construction is targeted for completion by 2014. Production is estimated at 6 Mt/y over a 31 year mine life. Reserves are reported at 789 Mt of proven deposit, and the resource at 3180 Mt (Inferred). The project is in the Pre-Application stage of EA, and baseline studies are underway. An initial workforce of 201 Huiyong Holdings miners was approved by Human Resources and Skills



**Figure 3.10. Quintette** – View of Mt. Babcock from 5 km to the south on Roman Mountain.



**Figure 3.11. Murray River** – **A.** Stripped and graded North Shaft site with soil stockpile and Quintette Mine in the background 3 km to the southeast; **B.** HD Mining Engineers discuss North Shaft site with Janet Riddell.

Development Canada (HRSDC) under the Temporary Foreign Worker Program. Seventeen workers arrived by late November and 60 more were scheduled to arrive in December. In late November the company announced a \$15 million housing project in Tumbler Ridge linked to the proposed mine, and signed an MOU with Northern Lights College to develop a curriculum to train Canadian workers in the longwall mining method. A 1981

Quintette Coal Ltd report on the area describes a northwest-trending asymmetrical syncline-anticline pair called the Shikano structure, and a secondary fold pair called the M-9 extension. Minor thrust faults related to folding are present. Six continuous Gething Formation coal seams (D, E, F, G, J, and K) with dips generally ranging from 15-40° have an average combined thickness of 17.9 m.

### 3.3.1.2 Wolverine Valley area

WEWC's Wolverine Project in the Perry Creek/Mast Creek area includes the **EB (Mt. Spieker)** and **Hermann projects**. Exploration has been completed in both these areas; Hermann is in the Prefeasibility stage, whereas EB is a development project. Both have approved EA Certificates. The EB pit design was being reassessed/expanded at a higher coal price in 2012. Production of 1 Mt/y is expected with mine life of 10 years (at EB) and 5-10 years (at Hermann). As of Dec 31 2011, estimated reserves were 9.9 Mt ROM coal (Proven) for EB and 9.1 Mt ROM coal (Proven and Probable) for Hermann. Production could commence at EB as early as 2013 and before 2019, and Hermann will follow with mining anticipated to continue past 2030.

In November, Hillsborough Resources Ltd and partner Vitol Ankor International B.V. submitted a revised Project Description to the EA office for the **Echo Hill** (formerly **Wapiti**) thermal coal project, 36 km northeast of Tumbler Ridge. An earlier proposal for a combined mine and 184-MW electric power plant operation was dismissed after the 2007 Provincial Energy Plan required new electricity sources to have “net-zero” greenhouse gas emissions. The new \$35 million proposal is for a contour highwall and auger mining operation with 1 Mt/y production of thermal coal for the Asian market. Hillsborough anticipates a mine life of 10 - 14 years which will provide 120 local jobs. The power generation component to the project has been dropped. A resource estimate of 80.1 Mt (Measured and Indicated) and 35.2 Mt (Inferred) was provided in a 2007 technical report. The project is currently in the Pre-Application stage of the EA process. Three coal seams occur in the 460 m thick Upper Cretaceous Wapiti Group. A series of northwest-trending open folds are present as are small-scale subsidiary folds and two high-angle thrust faults. A single flat-lying coal seam underlying local mesas is targeted for the mining operation. In late 2011, the company established a long-term services agreement with Ridley Terminals (until the end of 2021).

### 3.3.1.3 Hudson's Hope area

In June 2011, Cardero Resources Corp acquired Coalhunter Mining Corp, and the advanced-stage **Carbon Creek** project, 48 km west of Hudson's Hope (Figure 3.12). Coalhunter was renamed Cardero Coal Ltd, a wholly owned subsidiary, and remains operator of the



**Figure 3.12. Carbon Creek** – A. Orofino Drilling Ltd drill using HQ3 system; B. Cardero geologists in core shed reviewing drill logs with Janet Riddell; C. Gething Formation coal seam no. 31 in core.

project. In January, Cardero Resources Corp (75%) and the Carbon Creek Partnership (25%) released a PEA study, followed by a Prefeasibility study in September. The PFS significantly upgrades reserves and resource to 121 Mt (Proven and Probable) and 468 Mt (Measured and Indicated), and proposes a combined surface and underground (room-and-pillar) operation with average annual production of 4.1 Mt washed coal over an initial 20 years. The operation will be divided into a Central Surface Mine and North Mine areas. Products will be 60% HCC, 34% PCI and semi-soft coking coal, and 6% oxidized thermal coal. Cardero proposes to transport washed coal by 15-17 Kt payload barge on Williston Lake from Carbon Inlet to Mackenzie for rail load-out. First production is planned for fourth quarter 2014, with a projected 876 jobs. The mine will be unique in the region as the plant design does not require a tailings impoundment, as the waste rock will be sufficiently soft to compress and add to coarse coal rejects. The 2012 exploration program included: resource and expansion drilling; large-diameter drilling for coal quality; and geotechnical, hydrogeological, and gas desorption test work. It was the last major program prior to completion of a Feasibility Study in 2013, followed by a Mines Act Permit Application. The project is in the Pre-Application

phase of the EA process. In May, the company announced a 15 year shipping agreement with Ridley Terminals starting in 2014. The property consists of a gentle doubly-plunging syncline between two anticlinal belts. Minor folds are associated with steep thrust faults. Over 30 Gething Formation coal seams have been identified on the property, with 16 economic seams averaging 1.5 m thickness. The deposit shows good continuity and simpler geometry than many other deposits in the coalfield.

At the **Gething** property of Canadian Kailuan Dehua Mines Co Ltd, 25 km west of Hudson's Hope, a 30-hole geotechnical drilling program was conducted to identify ground conditions and geotechnical constraints for the engineering of a Mine Surface Facility (Figure 3.13). Holes drilled for bulk sampling and Seismic Cone Penetration testing ranged from 30 - 80 m depth. A single hydrological hole was drilled to 500 m depth. The project has an estimated resource of 98 Mt (Inferred) and is expected to produce 2 - 4 Mt of washed coal annually for 30 - 40 years from the Trojan and Superior seams of the Gething Formation by means of underground (room-and-pillar or longwall) mining and coal processing. The Trojan seam is historically reported at 2.1 - 2.6 m thickness in the Dowling Creek area. Structurally, the



**Figure 3.13. Gething Creek** – *Amblydactylus gethingi* fossil trackway located about 3 km southwest of the Gething property.

area consists of a north-northwest trending, gently-dipping broad syncline, flanked by sharply faulted anticlines on the east and west. The project is in the Pre-Application stage of the EA process.

### 3.4 EXPLORATION HIGHLIGHTS

#### 3.4.1 Coal Projects

##### 3.4.1.1 South of Tumbler Ridge

In September, Colonial Coal International Corp provided an updated resource estimate of 189.4 Mt (Measured and Indicated), and 194.7 Mt (Inferred) for the **Huguenot** prospect, 82 km southeast of Tumbler Ridge. The estimate includes 2011 drilling results for the North Block, delineates and updates historical results for the Middle and South Blocks, and incorporates underground resources of 97.2 Mt (Measured and Indicated), and 156.5 Mt (Inferred). The 2012 exploration program included resource drilling, large-diameter drilling for coal quality, and rotary pilot holes. Drilling was helicopter-supported as there is no ground access above 1400 m elevation due

to classification as a wildlife high alpine sensitivity area. Environmental baseline studies and data collections are ongoing. Coal measures are in the Gates Formation on the northeast limb of the Belcourt anticlinorium, where 4 of 9 total seams represent 78% of the resource. Cumulative seam thickness in the North Block averages 24.1 m. The area is the historic Holtslander South area of the Belcourt Coal Joint Venture.

Canadian Dehua International Mines Group Inc (Dehua) commenced an exploration program at **Wapiti River** (40 km southeast of Tumbler Ridge) consisting of 55 drill holes ranging from 500 - 1300 m in depth, to understand subsurface and coal characteristics. The company envisions an underground longwall and room-and-pillar operation producing 8 Mt of washed coal annually, and estimates an HCC resource of 7000 Mt at the prospect. Drilling was planned to continue to 2013, then a Feasibility Study initiated. Environmental baseline studies began in May. The property is centered on the Duke Mountain Block of the Monkman developed prospect. Twelve Gates Formation coal seams have historically been reported at Monkman, with the upper 3 seams generally less than 1 m thick, and the lower 9 seams (B1 to B9) ranging from 1.6 to 5.2 m. The property consists of a major northwest trending anticlinorium bounded and cut by a series of northwest and southwest dipping thrust faults. The historic Wapiti Block sits on the moderately-dipping northeast limb of the anticlinorium.

Colonial Coal International Corp awaits granting of coal licenses and appropriate work permits to proceed with exploration on the **Flatbed** property located 20 km south of Tumbler Ridge. A potential underground operation would mine flat-lying coal seams of the Gates formation at 400 m depth, increasing to an estimated 1200 m at the southern end of the property.

##### 3.4.1.2 Wolverine Valley area

Exploration continued at the **Bullmoose River** project of Dehua and Canadian Bullmoose Mines Co Ltd, 26 km west of Tumbler Ridge. Drilling programs for 2011/12 included up to 139 holes ranging in depth from 500 m to 1300 m, with similar objectives as above described for the Wapiti River project. An underground longwall and room-and-pillar mine is proposed, with annual production of 2 - 3 Mt washed coal and a mine life of 30 - 40 years. Drilling will continue into 2013 and a Feasibility Study will be initiated. The regional Bullmoose thrust fault lies 5 km southwest of the project, and the Mt. Spieker and Sukunka (Bullmoose) trend, 9 km west of the project, consists of a broad syncline cut by southwest dipping thrust faults. Surface geology in the project area includes the Hulcross, Boulder Creek, and Hasler formation rocks which sit stratigraphically above buried Gates formation. Coal seams are historically reported in both the Gates (4 or 5 seams ranging from 0.5 to 4 m thick) and Upper Gething formations (up to 3

seams including the Bird seam, which is 0.5-3.5 m thick). Environmental baseline studies are underway.

### **3.4.1.3 Chetwynd-Pine River Area**

Xstrata Coal further established their role in the Peace River Coalfield after the 2011 acquisition of First Coal Corp's tenures and Cline Mining Corp's **Lossan** deposit, a 185 Mt resource (Measured and Indicated) 49 km southwest of Chetwynd. In March, Xstrata acquired the **Sukunka** deposit from Talisman Energy, a 236 Mt resource (Measured and Indicated) 56 km south of Chetwynd. Additionally, it was announced that JX Nippon Oil and Energy of Japan would acquire a 25% stake in Xstrata's western Canadian operations to form a joint venture wherein Xstrata will operate and manage the assets while JX Nippon acts as the exclusive marketing agent in Japan. During a trade mission to Asia in May, the BC Premier announced the joint venture's investment of \$35 million to conduct a Prefeasibility Study of the newly named **Suska** (formerly Lossan) coal project, to be completed in the first half of 2013. A 70-hole drilling program (Phase-1) was conducted at **Suska** to confirm historical data, collect geological and coal quality information, upgrade the resource, and test a grassroots area south of the Brazion River. Twelve groundwater monitoring wells were also drilled for baseline studies. Drilling confirmed the reported seams (No. 1, 2, 3, 4, and 5 with increasing depth) trending northwest along Axis Creek where five conceptual pits have been historically developed. Seam thickness is variable, with the No. 1 split seam 8 - 15 m thick at the south part of the trend, and No. 3 and 5 seams expected to thicken to the north. The Gething Formation seams occur within the Lossan-Axis synclinal fold pair. In the south, chevron folds and thrust faults are predominant; in the north the major structure is a synclinorium. Phase-2 drilling as proposed will consist of 150 holes and run from January to March 2013. Coal product is expected to be 60% HCC and 40% PCI. Baseline studies started in Dec 2011.

A similar 64-hole drilling program with eight monitoring wells was permitted for **Sukunka** (Sukunka Bullmoose) in November with work to begin in 2013. The program is designed to confirm historic drilling and fill gaps in the data. A combined surface and underground longwall operation is envisioned beginning with surface mining at the north part of the property, followed by underground mining to the southeast below Bullmoose Mountain. Mining will target the upper and lower Chamberlain seam of the Gething Formation, historically reported as a continuous seam with a total thickness of 1.4 - 8.3 m. The property consists of a series of northwest-trending gentle folds within a broad synclinorium, and northwest-trending, southwest-dipping thrust faults with greater concentration to the north. Xstrata has no current plans to develop the 41 Mt resource (Measured and Indicated) acquired from First Coal Corp

at **Goodrich Central South**, located 52 km southwest of Chetwynd.

WEWC continued exploration programs at the Brazion Group expansion projects in the Falling Creek and Willow Creek areas. At **Mink Creek East** and **Mink Creek West**, 36 km southwest of Chetwynd, 37 holes were drilled for preliminary coal quality information and coal seam characteristics. At **Hudette**, located 15 km south of Willow Creek, 38 holes were drilled to determine structure and characteristics of the Brenda upper and lower seam. At **Willow South**, 18 holes were drilled to determine fault structure and seam characteristics; 17 holes were drilled for coal quality sampling of seams No. 5-7. At **Willow West**, 15 holes were drilled to confirm fold structure and the presence of upper seams.

### **3.4.1.4 Hudson's Hope area**

Jameson Resources Ltd acquired Dunlevy Energy Inc at the end of 2011, along with the **Dunlevy** project, located 44 km northwest of Hudson's Hope. The company also acquired certain assets of Nexx Coal Inc including the **Graham River**, **Peace Reach**, and **Carbon East** projects in the Peace Reach area. Prospecting and hand trenching along existing road cuts at **Dunlevy** exposed Gething Formation coal seams of about 2 m thickness. An exploration program consisting of drilling, geophysics, and coal quality test work is awaiting permit. Mapping and prospecting was carried out on each of the four projects.

From June to September, Anglo/PRC and contractor Plateau Minerals Ltd conducted a mapping and prospecting program at **Williston North** (Pink Mountain), the northernmost prospect of the Peace River Coalfield, 160 km northwest of Fort St. John. Gething Formation coal seams, 1-2 m thick, were identified in the southeastern part of the property, warranting further work. Historically, 19 coal seams have been reported in the area, with 4 main seams averaging about 7 m cumulative thickness.

## **3.4.2 Industrial Mineral Projects**

### **3.4.2.1 South of Tumbler Ridge**

Homegold Resources Ltd conducted a mapping, hand-trenching, geochemical sampling, and small drilling program at the **Wapiti** phosphate project, located 76 km south of Tumbler Ridge. Four holes were drilled using a hand-portable Gopher drill. Stratiform pelletal phosphate and phosphatic pebble conglomerates occur within the Whistler Member of the Triassic Sulphur Mountain Formation, Spray River Group. Structurally the area is similar to the coal belt with northwest trending tight

anticlines and relatively broad synclines. The main ore mineral in upwelling phosphate deposits is microcrystalline francolite, a carbonate-rich variety of fluoroapatite. Phosphorus has agricultural and industrial chemical applications.

### 3.4.2.2 Liard Basin Area – Ancestral North America

In September, Camisha Resources Corp entered into an agreement to acquire Prima Fluorspar Corp and the **Liard Fluorspar** property, located 212 km west-northwest of Fort Nelson, with the resulting company to be renamed Prima Fluorspar Corp. The property has a historical resource estimate (non NI-43-101 compliant) of 3.2 Mt averaging 32% fluorite based on 61 drill holes. The company plans to confirm and expand the historical resource with 80 - 100 shallow drill holes in 2013, and a PEA for an open pit operable resource is anticipated for fourth quarter 2013. Historical metallurgical testing indicates acid-grade fluorspar (selling at \$550-\$600 per tonne as of September 2012) could be produced using conventional flotation methods. Fluorspar is used in the production of hydrofluoric acid, fluorocarbons (aerosols, refrigerant), fluoropolymers (Teflon, Gor-Tex), aluminum, steel, petroleum, enriched uranium, concrete, and medicines.

A series fluorspar prospects and showings occur in an 18 km long belt trending northward from Liard Hot Springs Provincial Park. The belt is concentrated in a 2-4 km wide zone in the core of a gently south-plunging open anticline. The deposits occur as irregular lenticular replacement bodies or cementing angular-clast breccias along the unconformable contact between Middle Devonian Dunedin Formation limestone and Upper Devonian Besa River Formation argillite. Mineralization typically consists of dark purple to black fluorite and witherite ( $\text{BaCO}_3$ ) to about 60%, with the remainder barite, quartz and calcite. A  $332 \pm 56$  Ma fission-track age of fluorite from the Gem showings (White, 1988) overlaps the Devonian-Mississippian age of most other carbonatite-syenite systems in the province (Pell, 1994, p. 27), suggesting the Liard fluorspar deposit is part of the Rocky Mountain Carbonatite Belt. A carbonate-related origin for the Rock Canyon Creek fluorite-REE showing in the East Kootenay region has also been suggested (Graf, 1985; Hora and Kwong, 1986; Pell, 1987).

## 3.5 OUTLOOK FOR 2013

Several mine development and advanced projects are expected to reach significant benchmarks in 2013 including potential mine development at **EB**; a decision on the Feasibility Study and the Mines Act Permit Amendment at **Quintette**; completion of a Feasibility Studies and Mines Act Permit Applications for **Carbon**

**Creek and Roman Mountain**; ongoing Surface Facility Area development and excavation of bulk sample at **Murray River**; completion of Prefeasibility Study at **Suska**; Feasibility Studies to be initiated at **Wapiti River** and **Bullmoose River**; and a PEA to be completed at **Liard Fluorspar**. Other major coal projects including **Huguenot**, **Belcourt**, **Sukunka**, and **Gething** are expected to advance to Feasibility.

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