Information Series 101

Alberta Plains Coal Regions: Potential feedstock for coal conversion by liquefaction and pyrolysis

J.D. Campbell, M.P. du Plessis
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Alberta Research Council
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Introduction

Coal, believed to be suitable as feedstock for on-site conversion plants, is found in many very large deposits in the Alberta Plains; some of these deposits are difficult of access, others are already dedicated to thermoelectric power production, but many remain uncommitted. The Alberta Research Council presents the following report — an update and expansion of previous issues — as a guide to those coal deposits that are both suitable and available for conversion process.

It is believed that, under conditions foreseeable for the near future in Alberta,

1. the preferred feedstock for on-site coal conversion process should be subbituminous coal;
2. liquefaction (total transformation of coal to liquid hydrocarbon) and pyrolysis (stripping small amounts of valuable fluid hydrocarbon from coal, leaving a solid char residue available for combustion) will be the dominant conversion processes;
3. economic liquefaction process units would each produce more than 50,000 bbl/day for 30 years and would require dedicated coal reserves of about 250 x 10^6 tonnes (about 300 x 10^6 short tons);
4. pyrolysis processes will be mated to major thermoelectric power plants that are sited on dedicated coal reserves of 120 x 10^6 tonnes (about 140 x 10^6 short tons) or more.

Accordingly, the Alberta Research Council and Alberta Energy and Natural Resources direct the attention of interested parties to 15 “Coal Regions” in the Alberta Plains shown on the map (figure 1), summarized in table 1 and described in detail in the Appendix. All 15 of these “Regions” are easily accessible, possess already-developed social infrastructure and contain adequate reserves of subbituminous coal recoverable by current mining technology to support one or more process plants. None of them present insurmountable problems of use-conflict with agriculture, recreation or ecologically fragile environments.

Of the 15 “Coal Regions” thus delineated, 9 are believed to be suited to the liquefaction process industry; they contain adequate reserves and are not dedicated at present to power generation. These regions are numbers 1 through 9 in table 1. The remaining 6 “Regions,” while not specifically excluded from liquefaction, are probably more suitable for power generation and in some cases are already dedicated to that use; these 6 are worth considering as sites for mated power/pyrolysis industry. These regions are numbered 10 through 15 in table 1.

The 15 “Regions” chosen for this report, while not co-terminous with the administrative “Fields” of the Alberta Energy Resources Conservation Board (ERCB, 1982), are designated by reference to ERCB field names and consist of component sub-regions or “Deposits” that are identical to the “Deposits” of the ERCB. For instance, the Region “Mayer-thorpe/Wabamun (pat)” consists of 3 “Deposits” of the ERCB “Mayer-thorpe” Field and 2 “Deposits” of the ERCB “Wabamun” Field.

Each “Deposit” referred to in this report has been assigned an arbitrary consecutive number, from 1 to 57, identified in the Appendix. These numbers are used for reference in the location map (figure 1), and in table 2.

The reserve tonnages reported below for each Region are those quoted by the Alberta Energy Resources Conservation Board for the respective “Deposits” (see ERCB, 1982).

Coal properties

Coal rank (ASTM) in the Alberta Plains ranges from high volatile C bituminous to Lignite A. Highest rank coals occur along the southwestern boundary of the Plains nearest the Rocky Mountain Foothills; decreasing ranks of coal are met at increasing distances eastward and northeastward. None of the Plains coals show caking properties.

All of the coal deposits noted in the Appendix (except the largely unsubstantiated Buffalo Hill Region) happen to be subbituminous B or subbituminous C in rank; these are the Plains coal deposits that are now economically accessible. Considerable tonnages of subbituminous A coals, however, lie in physically or economically inaccessible areas near the Rocky
Mountain Foothills, especially in northwestern Alberta. To facilitate small-scale study, the Alberta Research Council has collected one bulk sample representative of such coals from a collecting locality ("Smoky Tower") in Tp 63, R 2, W 6th Mer (54°26' N; 118°16' W), indicated in figure 1.

The analytical determinations reported in the Appendix for each Region were made in laboratories of the Alberta Research Council; proximate and elemental analyses are given, together with specific gravity and ash-fusion determinations when available. (See also Stansfield and Lang, 1944.)

Geologically, all "Deposits" referred to in this report are part of a single enormous wedge of coal-measures (with a few relatively thin marine bands included) that blankets the central and southern parts of Alberta. Although the "Deposits" occur at three distinct horizons within the wedge, they are so closely spaced in age (latest Cretaceous to earliest Paleocene) that they may be considered almost synchronous. The three horizons are: Oldman Formation (Early Late Cretaceous age); Horseshoe Canyon Formation (Late Cretaceous age); Scollard Member of Paskapoo Formation (latest Cretaceous or Cretaceous-Paleocene boundary age).

Two major experimental and scale-up programs are under way to test Plains coals for their behavior in liquefaction and pyrolysis processes, but results are not yet suitable for publication.

In the last few years, substantial attention has been paid to the petrography of Alberta Plains coals in the laboratories of both the Institute of Sedimentary and Petroleum Geology, Calgary, and the Alberta Research Council, Edmonton. Considerable progress has already been made towards correlating petrographic analysis with performance of the coals in conversion processes (Parkash et al., 1982). Table 2 presents petrographic analyses from Parkash et al. of 10 Alberta Plains coal samples that will serve for the present to demonstrate the range of petrographic variability. It should be noted that, in keeping with their immature rank, these coals contain considerable amounts of imperfectly formed vitrinite retaining much of the original woody (coniferous: Taxodiaceae) structure.

References


Figure 1. Alberta Plains coals for conversion process
<table>
<thead>
<tr>
<th>Region</th>
<th>Deposits</th>
<th>Remaining Reserves</th>
<th>Rank (ASTM)</th>
<th>Geology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Strips Underground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Fox Creek (part)</td>
<td>Giroux; Atikamek; Meekwap W.; Meekwap E.; S. Brush Mt.; Goose R.</td>
<td>755</td>
<td>47</td>
<td>Sub. B</td>
</tr>
<tr>
<td>2. S. Swan Hills (part)</td>
<td>Freeman Ck; Judy Ck; Carson Lk.</td>
<td>295</td>
<td>95</td>
<td>Sub. C</td>
</tr>
<tr>
<td>3. Mayerthorpe/ Wabamun (part)</td>
<td>Rochfort Bridge; Jalna; Evansburg; Stanger; Magnolia</td>
<td>155</td>
<td>605</td>
<td>Sub. B</td>
</tr>
<tr>
<td>4. Wabamun/ Wetaskiwin (part)</td>
<td>Gainford; Whitewood; Sundance; Highvale-Low Water; Keephills; Genesee</td>
<td>1060</td>
<td>376</td>
<td>Sub. B</td>
</tr>
<tr>
<td>5. Wetaskiwin (part)</td>
<td>Thorsby; Wizard Lk; Patience; Falun; Bearhills</td>
<td>404</td>
<td>329</td>
<td>Sub. B</td>
</tr>
<tr>
<td>7. Barrhead/ Morinville (part)</td>
<td>Bloomsbury; Manola; Picardville, George Lk.; Manawan Lk.</td>
<td>525</td>
<td>33</td>
<td>Sub. C</td>
</tr>
<tr>
<td>8. Tofield-Dodds/ Battle River (part)</td>
<td>Tofield, Miquelon; Dusty Lk.; Dinant; Ohaton; Driedmeat Lk.; Meeting Ck.; Heisler</td>
<td>787</td>
<td>935</td>
<td>Sub. C</td>
</tr>
<tr>
<td>9. Battle River (central part)</td>
<td>Donalda, Forestburg; Central Battle R.; Paintearth; Gasby</td>
<td>240</td>
<td>36</td>
<td>Sub. C</td>
</tr>
<tr>
<td>10. Battle River (South part)</td>
<td>Halkirk; Castor; Sullivan Lk.</td>
<td>314</td>
<td>110</td>
<td>Sub. C</td>
</tr>
<tr>
<td>11. Sheerness</td>
<td>Sheerness</td>
<td>140</td>
<td>0</td>
<td>Sub. C</td>
</tr>
</tbody>
</table>
Table 1. (continued)

<table>
<thead>
<tr>
<th>Region</th>
<th>Deposits</th>
<th>Remaining Reserves</th>
<th>Rank</th>
<th>Geology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tonnes x 10⁶</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strip Underground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Drumheller (part)</td>
<td>Munson, Kneehill; Rosedale, Eladesor; E. Coulee, Western Monarch</td>
<td>3 461</td>
<td>Sub. B</td>
<td>Horseshoe Canyon</td>
</tr>
<tr>
<td>13. Blackfoot</td>
<td>Blackfoot</td>
<td>100 22</td>
<td>Sub.B</td>
<td>Horseshoe Canyon</td>
</tr>
<tr>
<td>14. Buffalo Hill</td>
<td>Buffalo Hill</td>
<td>0 440</td>
<td>Sub. A</td>
<td>Horseshoe Canyon</td>
</tr>
<tr>
<td>15. Brooks/ E. Brooks (part)</td>
<td>Bow City - Kitsim; E. Brooks</td>
<td>140 40</td>
<td>Sub. B</td>
<td>Oldman</td>
</tr>
</tbody>
</table>

Table 2. Petrographic analyses of selected Alberta Plains coals (from Parkash et al., 1982)

<table>
<thead>
<tr>
<th>Sample No. (Parkash et al.)</th>
<th>Location</th>
<th>Deposit No. (this report)</th>
<th>Rank ASTM</th>
<th>Volume percent maceral composition (mineral-matter-free)</th>
<th>Vitrinite Reflectance (Random) %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vitrinite (Huminite)</td>
<td>Liptinite</td>
</tr>
<tr>
<td>1</td>
<td>Smoky Tower</td>
<td>-</td>
<td>Sub A</td>
<td>70.0</td>
<td>6.4</td>
</tr>
<tr>
<td>2</td>
<td>Egg Lake</td>
<td>34</td>
<td>Sub C</td>
<td>85.0</td>
<td>4.0</td>
</tr>
<tr>
<td>3</td>
<td>Starkey</td>
<td>(near 34)</td>
<td>Sub C</td>
<td>91.5</td>
<td>5.8</td>
</tr>
<tr>
<td>4</td>
<td>Wabamun</td>
<td>16</td>
<td>Sub B</td>
<td>65.0</td>
<td>6.0</td>
</tr>
<tr>
<td>5</td>
<td>Highvale</td>
<td>18</td>
<td>Sub B</td>
<td>74.6</td>
<td>2.1</td>
</tr>
<tr>
<td>6</td>
<td>Forestburg</td>
<td>43</td>
<td>Sub C</td>
<td>92.5</td>
<td>3.8</td>
</tr>
<tr>
<td>Sample No. (Parkash et al.)</td>
<td>Location</td>
<td>Deposit No. (this report)</td>
<td>Rank ASTM</td>
<td>Volume percent maceral composition (mineral-matter-free)</td>
<td>Vitrinite Reflectance (Random) %</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------</td>
<td>---------------------------</td>
<td>-----------</td>
<td>------------------------------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vitrinite (Huminite)</td>
<td>Liptinite</td>
</tr>
<tr>
<td>7     Vesta        44     Sub C</td>
<td>73.3   0.3      8.9        3.3   14.1</td>
<td>0.43 ± 0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8     Heatburg     26     Sub B</td>
<td>74.8   1.0      9.6        2.1   12.5</td>
<td>0.44 ± 0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9     Sheerness    50     Sub C</td>
<td>92.1   4.7      1.5        0.9   0.8</td>
<td>0.38 ± 0.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10    East Coulee  53     Sub B</td>
<td>91.9   4.9      0.6        1.4   1.2</td>
<td>0.46 ± 0.03</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix

Coal regions for conversion, Alberta Plains

First region: Fox Creek (part)

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number</th>
<th>Remaining Reserves</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(figure 1)</td>
<td>Tonnes x 10⁶</td>
<td>Strip</td>
</tr>
<tr>
<td>Giroux</td>
<td>1</td>
<td>110 0</td>
<td>Estimates, especially underground, believed to be much too conservative; numerous dirt partings</td>
</tr>
<tr>
<td>Atikkamek</td>
<td>2</td>
<td>100 0</td>
<td></td>
</tr>
<tr>
<td>Meekwap W</td>
<td>3</td>
<td>130 0</td>
<td></td>
</tr>
<tr>
<td>Meekwap E</td>
<td>4</td>
<td>160 23</td>
<td></td>
</tr>
<tr>
<td>S. Brush Mtn.</td>
<td>5</td>
<td>210 24</td>
<td></td>
</tr>
<tr>
<td>Goose River</td>
<td>6</td>
<td>45 0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>755 47</td>
<td></td>
</tr>
</tbody>
</table>

Mineability: Seams thick; ash content variable; stripping ratios favorable; topography flat to rolling; conventional oil and gas fields can be integrated with mining.

Environmental constraints: low

No agriculture; critical wildlife area limited and clearly segregated; much muskeg; harvesting of productive forest can be integrated with mining.

Socioeconomic constraints: low

Rail line; main highway; local oilfield road network; town of Fox Creek (pop. 2000), an oilfield resupply point; recreation areas clearly segregated.

Typical analyses (Attikamek Deposit)

Proximate (capacity moisture, mineral-matter-free basis)

- Capacity moisture % - 20.3
- Ash (as received) % - (11.5)
- Fixed carbon % - 48.9
- Calorific value Btu/lb -10,440

Ultimate (elemental; water out)

- Sulfur % - 0.6

Significantly comparable coal, available as bulk samples: Highvale Mine, Wabamun Coal Region, Tp 52, R 4, W 5 Mer (53°29'N; 114°34'W).
## Second Region: South Swan Hills

**Rank (ASTM):** Subbituminous C  
**Geology:** Scollard Member Paskapoo Formation latest Cretaceous age  
**Location:** 160 km W of Edmonton, about Tp 64, R 10, W 5 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number (figure 1)</th>
<th>Remaining Reserve</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tonnes x 10⁶ Strip Underground</td>
<td></td>
</tr>
<tr>
<td>Freeman Creek</td>
<td>7</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Judy Creek</td>
<td>8</td>
<td>230</td>
<td>76</td>
</tr>
<tr>
<td>Carson Lake</td>
<td>9</td>
<td>55</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>295</td>
<td>95</td>
<td></td>
</tr>
</tbody>
</table>

**Mineability:**
Seams thick; ash content variable; stripping ratios favorable in places; topography rolling; conventional oil and gas fields can be integrated with mining.

**Environmental constraints:** low to medium
No agriculture; critical wildlife area partly segregated; harvesting of productive forest can be integrated with mining.

**Socioeconomic constraints:** low to medium
No rail line; secondary highway; local oilfield road network; town of Swan Hills (pop. 1500), an oilfield resupply point; recreation areas clearly segregated.

**Typical analyses** (Freeman Creek Deposit)  
*Proximate* (capacity moisture, mineral-matter-free basis)
- Capacity moisture % - 25.3
- Ash (as received) % - (16.6)
- Fixed carbon % - 40.9
- Calorific value Btu/lb - 8,690

(Significantly comparable bulk coal sample not immediately available.)
Third region: Mayerthorpe/Wabamun (part)

**Rank (ASTM):** Subbituminous B  
**Geology:** Scollard Member Paskapoo Formation, latest Cretaceous age  
**Location:** 75 km W of Edmonton, about Tp 54, R 7, W 5 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number (figure 1)</th>
<th>Tonnes x 10^6</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Strip Underground</td>
<td></td>
</tr>
<tr>
<td>Rochfort Bridge</td>
<td>10</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Jaina</td>
<td>11</td>
<td>31</td>
<td>300</td>
</tr>
<tr>
<td>Evangsburg</td>
<td>12</td>
<td>0</td>
<td>280</td>
</tr>
<tr>
<td>Stanger</td>
<td>13</td>
<td>27</td>
<td>0</td>
</tr>
<tr>
<td>Magnolia</td>
<td>14</td>
<td>94</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>155</strong></td>
<td><strong>602</strong></td>
</tr>
</tbody>
</table>

**Mineability:**  
Seams medium to thick; ash content variable; stripping ratios favorable in places; topography flat.

**Environmental constraints:** low  
Little agriculture; critical wildlife areas limited and clearly segregated; much muskeg; little productive forest.

**Socioeconomic constraints:** low  
Main rail line; main highways; some local roads; established villages (Mayerthorpe, Evangsburg, Entwistle, Wildwood); recreation areas limited and clearly segregated.

**Typical analyses** (Magnolia Deposit)

*Proximate* (Capacity moisture, mineral-matter-free basis)
- Capacity moisture: % - 21.8
- Ash (as received): % - (10.3)
- Fixed carbon: % - 49.3
- Calorific value: Btu/lb - 10,230

*Ultimate* (elemental; Water out)
- Carbon: % - 77.6
- Hydrogen: % - 4.7
- Nitrogen: % - 1.2
- Oxygen: % - 16.3
- Sulfur: % - 0.6

**Significantly comparable coal,** available as bulk samples: Highvale Mine, Wabamun Coal Region, Tp 52, R 4, W 5 Mer (53°29'N; 114°34'W).
Fourth region: Wabamun/Wetaskiwin (part)

Rank (ASTM): Subbituminous B
Geology: Scollard Mbr. Paskapoo Fm., latest Cretaceous age
Location: 70 km W of Edmonton, about Tp 52, R 4, W 5 Mer

Remaining Reserves

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number (figure 1)</th>
<th>Tonnes x 10^6 Strip</th>
<th>Underground</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gainford</td>
<td>15</td>
<td>120</td>
<td>39</td>
<td>The major coal producing region of Alberta Plains; 4 major strip mines and 4 mine-mouth thermoelectric plants in operation or in developmental stages; estimates, especially underground, believed to be too conservative.</td>
</tr>
<tr>
<td>Whitewood</td>
<td>16</td>
<td>96</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Sundance</td>
<td>17</td>
<td>290</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Highvale-Low Water</td>
<td>18</td>
<td>74</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Keephills</td>
<td>19</td>
<td>110</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Genesee</td>
<td>20</td>
<td>370</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1060</td>
<td>376</td>
<td></td>
</tr>
</tbody>
</table>

Mineability:
Seams thick; ash content variable; stripping ratios favorable; topography rolling.

Environmental constraints: low
Poor to fair agriculture; critical wildlife areas limited and clearly segregated; no productive forest.

Socioeconomic constraints: medium
Main rail line; main highways; fair local road network; established villages (Wabamun, Seba Beach); prime recreational area is carefully segregated.

Typical analyses (Whitewood Deposit)

Proximate (capacity moisture, mineral-matter-free basis)
Capacity moisture  % -23.5
Ash (as received)  % - (8.0)
Fixed carbon       % - 46.4
Calorific value    Btu/lb - 9,780

Ultimate (elemental; water out)
Carbon             % - 75.9
Hydrogen           % - 4.6
Nitrogen           % - 1.0
Oxygen             % - 18.3
Sulfur             % - 1.1

Representative coal, available as bulk samples: Highvale Mine, Tp 52, R 4, W 5 Mer (53°29'N; 114°34'W).
Fifth region: Wetaskiwin (part)

**Rank (ASTM):** Subbituminous B

**Geology:** Scollard Member Paskapoo Formation, latest Cretaceous age

**Location:** 50 km SW of Edmonton, about Tp 46, R 26, W 4 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number (figure 1)</th>
<th>Remaining Reserves</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tonnes x 10⁶</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Strip</td>
<td>Underground</td>
</tr>
<tr>
<td>Thorsby</td>
<td>21</td>
<td>94</td>
<td>29</td>
</tr>
<tr>
<td>Wizard Lake</td>
<td>22</td>
<td>100</td>
<td>38</td>
</tr>
<tr>
<td>Patience</td>
<td>23</td>
<td>210</td>
<td>0</td>
</tr>
<tr>
<td>Falun</td>
<td>24</td>
<td>0</td>
<td>200</td>
</tr>
<tr>
<td>Bearhills</td>
<td>25</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>404</td>
<td>329</td>
</tr>
</tbody>
</table>

**Mineability:**
Seams thick, glacially deformed; ash content variable; stripping ratios mostly favorable; topography flat.

**Environmental constraints:** severe
Prime agricultural region.

**Socioeconomic constraints:** medium
Main rail line; main highways; good local road network; several large towns and cities; prime recreational area would have to be carefully segregated.

**Typical analyses (Wizard Lake Deposit)**

*Proximate (capacity moisture, mineral-matter-free basis)*
- Capacity moisture: % - 21.8
- Ash (as received): % - (7.6)
- Fixed carbon: % - 48.5
- Calorific value: Btu/lb - 10,390

*Ultimate (elemental; water out)*
- Carbon: % - 77.9
- Hydrogen: % - 5.0
- Nitrogen: % - 1.2
- Oxygen: % - 15.7
- Sulfur: % - 0.3

*Ash-fusion data (degrees Celsius)*
- Softening Temperature: Low 1110, High 1326
- Softening Interval: 50
- Flowing Interval: 56

**Significantly comparable coal,** available as bulk samples:
Highvale Mine, Wabamun Coal Region, Tp 52, R 4, W 5 Mer (53°29'N; 114°34'W).
Sixth Region: Red Deer (part)

**Rank (ASTM):** Subbituminous B  
**Geology:** Scollard Member Paskapoo Formation, latest Cretaceous age  
**Location:** 135 km S of Edmonton, 145 km NE of Calgary, about Tp 39, R 23, W 4 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number</th>
<th>Number</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(figure 1)</td>
<td>Tonnes (x 10^6)</td>
<td>Strip</td>
</tr>
<tr>
<td>Tees, Heatburg,</td>
<td>26</td>
<td>246</td>
<td>95</td>
</tr>
<tr>
<td>Haynes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Ardley</td>
<td>27</td>
<td>310</td>
<td>170</td>
</tr>
<tr>
<td>Goosequill,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rumsey, Elnora</td>
<td>28</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>South Ardley</td>
<td>29</td>
<td>49</td>
<td>27</td>
</tr>
<tr>
<td>Trochu</td>
<td>30</td>
<td>32</td>
<td>48</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>644</td>
<td>340</td>
<td></td>
</tr>
</tbody>
</table>

**Mineability:**  
Seams medium to thick; ash content variable; stripping ratios marginal; topography flat to rolling.

**Environmental constraints:** medium to severe  
Fair-to-prime agricultural land; river canyon has critical wildlife areas and picturesque, high, unstable or very unstable walls.

**Socioeconomic constraints:** low  
Main rail line; highways; good local road network; several large towns and cities nearby; recreation areas clearly segregated.

**Typical analyses** (North Ardley Deposit)  
**Proximate (capacity moisture, mineral-matter-free basis)**  
- Capacity moisture: % - 21.8  
- Ash (as received): % - (8.2)  
- Fixed carbon: % - 48.4  
- Calorific value: Btu/lb - 10,180

**Ultimate (elemental; water out)**  
- Carbon: % - 77.7  
- Hydrogen: % - 5.0  
- Nitrogen: % - 1.3  
- Oxygen: % - 15.6  
- Sulfur: % - 0.4

**Volume-weight relation** (solid coal as in seam)  
- Percentage of ash: 8  
- Specific gravity: 1.34

**Ash-fusion data** (degrees Celsius)  
- Softening Temperature  
  - Low: 1110℃  
  - High: 1321℃  
  - Softening Interval: 44  
  - Flowing Interval: 67

**Representative coal**, available as bulk samples; Sissors' Mine, Tp 39, R 23 W 4 Mer (52°18'N; 113°14'W).
Seventh Region: Barrhead/Morinville (part)

Rank (ASTM): Subbituminous C
Geology: Horseshoe Canyon Formation, late Cretaceous age
Location: 40 km N of Edmonton, about Tp 57, R 26, W 4 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number (figure 1)</th>
<th>Remaining Reserve</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tonnes x 10⁶ Strip Underground</td>
<td></td>
</tr>
<tr>
<td>Bloomsbury</td>
<td>31</td>
<td>65</td>
<td>0</td>
</tr>
<tr>
<td>Manola</td>
<td>32</td>
<td>25</td>
<td>9</td>
</tr>
<tr>
<td>Pickardville,</td>
<td></td>
<td></td>
<td>Estimates, especially underground, believed to be too conservative.</td>
</tr>
<tr>
<td>George Lake</td>
<td>33</td>
<td>215</td>
<td>24</td>
</tr>
<tr>
<td>Manawan Lake</td>
<td>34</td>
<td>220</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>525</td>
<td>33</td>
</tr>
</tbody>
</table>

Mineability:
Seams moderately thick; ash content low; stripping ratios favorable; topography flat; roof conditions favorable.

Environmental constraints: medium
Good to prime agricultural land.

Socioeconomic constraints: low
Rail lines; highways; good local road network; towns and cities; recreation areas clearly segregated.

Typical analyses (Picardville Deposit)
Proximate (capacity moisture, mineral-matter-free basis)

<table>
<thead>
<tr>
<th>Capacity moisture</th>
<th>% - 29.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash (as received)</td>
<td>% - 6.8</td>
</tr>
<tr>
<td>Fixed carbon</td>
<td>% - 41.2</td>
</tr>
<tr>
<td>Calorific value</td>
<td>Btu/lb - 9,110</td>
</tr>
</tbody>
</table>

Ultimate (elemental; water out)

<table>
<thead>
<tr>
<th>Carbon</th>
<th>% - 75.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>% - 4.7</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>% - 1.4</td>
</tr>
<tr>
<td>Oxygen</td>
<td>% - 18.3</td>
</tr>
<tr>
<td>Sulfur</td>
<td>% - 0.5</td>
</tr>
</tbody>
</table>

Representative coal, available as bulk samples: Egg Lake Mine, Tp 57, R 26, W 4 Mer (53°53'N; 113°44'W).
Eighth Region: Tofield-Dodds/Battle River (part)

**Rank (ASTM):** Subbituminous C  
**Geology:** Horseshoe Canyon Formation, late Cretaceous age  
**Location:** 85 km SE of Edmonton, about Tp 46, R 18, W 4 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number</th>
<th>Tonnes x 10⁴</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>(figure 1)</td>
<td></td>
<td>Strip Underground</td>
<td></td>
</tr>
<tr>
<td>Tofield,</td>
<td>35</td>
<td>33</td>
<td>140</td>
</tr>
<tr>
<td>Miquelon</td>
<td>36</td>
<td>390</td>
<td>0</td>
</tr>
<tr>
<td>Dusty Lake</td>
<td>37</td>
<td>6</td>
<td>530</td>
</tr>
<tr>
<td>Dinant</td>
<td>38</td>
<td>140</td>
<td>11</td>
</tr>
<tr>
<td>Ohaton</td>
<td>39</td>
<td>100</td>
<td>170</td>
</tr>
<tr>
<td>Driedmeat Lake</td>
<td>40</td>
<td>45</td>
<td>84</td>
</tr>
<tr>
<td>Meeting Creek</td>
<td>41</td>
<td>73</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>787</td>
<td>935</td>
<td></td>
</tr>
</tbody>
</table>

**Mineability:**  
Seams moderately thick; ash content low; stripping ratios favorable; topography mostly flat; roof conditions favorable.

**Environmental constraints:** severe  
Prime agricultural land; water deficit.

**Socioeconomic constraints:** low  
Rail lines; highways; good local road network; towns and cities; recreation areas limited and clearly segregated.

**Typical analyses** (Dinant Deposit)  
*Proximate* (capacity moisture, mineral-matter-free basis)  
- Capacity moisture: % - 28.0  
- Ash (as received): % - (5.2)  
- Fixed carbon: % - 41.9  
- Calorific value: Btu/lb · 9,210

*Ultimate* (elemental; water out)  
- Carbon: % - 75.2  
- Hydrogen: % - 5.0  
- Nitrogen: % - 1.5  
- Oxygen: % - 17.7  
- Sulfur: % - 0.6

**Volume-weight relations** (solid coal as in seam)  
- Percentage of ash: 5 - 10  
- Specific gravity: 1.30 - 1.33

**Ash-fusion data** (degrees Celsius)  
- Softening Temperature  
  - Low: 1082  
  - High: 1304  
- Softening Interval: 50  
- Flowing Interval: 39

**Significantly comparable coal,** available as bulk samples:  
Vesta Mine, Battle River Region, Tp 40, R 15, W 4 Mer (52°27'N; 112°10'W).
Ninth Region: Battle River (central part)

Rank (ASTM): Subbituminous C
Geology: Horseshoe Canyon Formation, late Cretaceous age
Location: 170 km SE of Edmonton, about Tp 40, R 16, W 4 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number</th>
<th>Remaining Reserve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(figure 1)</td>
<td>Tonnes x 10^6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strip</td>
</tr>
<tr>
<td>Donalda</td>
<td>42</td>
<td>7</td>
</tr>
<tr>
<td>Forestburg</td>
<td>43</td>
<td>23</td>
</tr>
<tr>
<td>Central Battle River</td>
<td>44</td>
<td>87</td>
</tr>
<tr>
<td>Paintearth</td>
<td>45</td>
<td>39</td>
</tr>
<tr>
<td>Gadsby</td>
<td>46</td>
<td>81</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>240</td>
</tr>
</tbody>
</table>

Mineability:
Seams moderately thick; ash content low; stripping ratios favorable; topography flat; roof conditions favorable.

Environmental constraints: medium
Fair to good agricultural land; critical wildlife areas limited and clearly segregated; water deficit.

Socioeconomic constraints: low
Rail lines; highways; good local road network; established towns (Forestburg, Halkirk); recreational areas limited and clearly segregated.

Typical analyses (Central Battle R. Deposit)
Proximate (capacity moisture, mineral-matter-free basis)
Capacity moisture % - 28.4
Ash (as received) % - (6.3)
Fixed carbon % - 41.1
Calorific value Btu/lb - 9,180

Ultimate (elemental; water out)
Carbon % - 75.4
Hydrogen % - 5.1
Nitrogen % - 1.4
Oxygen % - 18.6
Sulfur % - 0.6

Representative coal, available as bulk samples: Vesta Mine, Tp 40, R 15, W 4 Mer (52°27'N; 112°10'W).
Tenth Region: Battle River (south part)

Rank (ASTM): Subbituminous C
Geology: Horseshoe Canyon Formation, late Cretaceous age
Location: 175 km SE of Edmonton, 180 km NE of Calgary, about Tp 38, R 15, W 4 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number (figure 1)</th>
<th>Remaining Reserve</th>
<th>Tonnes x 10^6</th>
<th>Strip</th>
<th>Underground</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halkirk</td>
<td>47</td>
<td></td>
<td>42</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Castor</td>
<td>48</td>
<td></td>
<td>82</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sullivan Lake</td>
<td>49</td>
<td></td>
<td>190</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>314</td>
<td>110</td>
<td></td>
</tr>
</tbody>
</table>

Mineability:
Seams medium to thick; ash content mostly low; stripping ratios favorable; topography flat; roof conditions favorable.

Environmental constraints: medium
Fair to good agricultural land; critical wildlife areas limited and clearly segregated; water deficit.

Socioeconomic constraints: low
Rail lines; highways; good local road network; established towns; recreational areas limited and clearly segregated.

Typical analyses (Castor Deposit)
Proximate (capacity moisture, mineral-matter-free basis)
Capacity moisture % - 31.7
Ash (as received) % - 6.2
Fixed carbon % - 38.3
Calorific value Btu/lb - 8,560

Ultimate (elemental; water out)
Carbon % - 78.9
Hydrogen % - 5.1
Nitrogen % - 1.4
Oxygen % - 19.1
Sulfur % - 0.6

Significantly comparable coal; available as bulk samples: Vesta Mine, Battle River Region, Tp 40, R 15, W 4 Mer (52°27'N; 112°10'W).
Eleventh region: Sheerness

Rank (ASTM): Subbituminous C
Geology: Horseshoe Canyon Formation, late Cretaceous age
Location: 165 km ENE of Calgary, about Tp 29, R 13, W 4 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number (figure 1)</th>
<th>Remaining Reserve</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheerness</td>
<td>50</td>
<td>140</td>
<td>0</td>
</tr>
</tbody>
</table>

Mineability:
Seams thick; ash content low; stripping ratio very favorable; topography flat.

Environmental constraints: low to medium
Poor to fair agricultural land; severe water deficit.

Socioeconomic constraints: low
Rail lines; highways; good local road network; established towns and villages (Hanna, Sheerness).

Typical analyses
Proximate (capacity moisture, mineral-matter-free basis)
Capacity moisture % - 29.4
Ash (as received) % - (5.9)
Fixed carbon % - 40.4
Calorific value Btu/lb - 8,750

Ultimate (elemental; water out)
Carbon % - 74.2
Hydrogen % - 4.8
Nitrogen % - 1.4
Oxygen % - 19.8
Sulfur % - 0.6

Representative coal, available as bulk samples: Sheerness Mine, Tp 29, R 13, W 4 Mer (51°28'N; 111°42'W).
Twelfth Region: Drumheller (part)

Rank (ASTM): Subbituminous B (some Subbituminous A)
Geology: Horseshoe Canyon Fm., late Cretaceous age
Location: 105 km NE of Calgary, about Tp 26, R 19, W 4 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number (figure 1)</th>
<th>Tonnes x 10^6 Strip</th>
<th>Underground</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Munson, Kneehill</td>
<td>51</td>
<td>0</td>
<td>280</td>
<td>Underground estimates believed to be too conservative by one order of magnitude.</td>
</tr>
<tr>
<td>Rosedale, Eladesor</td>
<td>52</td>
<td>3</td>
<td>138</td>
<td></td>
</tr>
<tr>
<td>East Coulee, Western Monarch</td>
<td>53</td>
<td>0</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td></td>
<td>461</td>
<td></td>
</tr>
</tbody>
</table>

Mineability:
Seams thick, nearly flat-lying; ash content low; no strippable deposits; deep coulees allow level entry; roof conditions favorable.

Environmental constraints: low
Cover (300-500 feet) need not be disturbed.

Socioeconomic constraints: low
Main rail line; highways; good local road network; established mining city (Drumheller); recreation areas can be clearly segregated.

Typical analyses (Rosedale Deposit)
Proximate (capacity moisture, mineral-matter-free basis)
Capacity moisture % - 21.6
Ash (as received) % - (5.0)
Fixed carbon % - 47.3
Calorific value Btu/lb - 10,410

Ultimate (elemental; water out)
Carbon % - 77.0
Hydrogen % - 5.0
Nitrogen % - 1.5
Oxygen % - 16.0
Sulfur % - 0.6

Volume-weight relation (solid coal as in seam)
Percentage of ash 5-10-15
Specific gravity 1.32-1.36-1.40

Ash-fusion data (degrees Celsius)
Softening Temperature Softening Interval Flowing Interval
Low 1010 High 1298 33 61

Representative coal, available as bulk samples:
Atlas Mine, Tp 27, R 18, W 4 Mer (51°17'N; 112°31'W).
Thirteenth Region: Blackfoot

**Rank (ASTM):** Subbituminous B  
**Geology:** Horseshoe Canyon Formation, late Cretaceous age  
**Location:** 100 km ESE of Calgary, about Tp 21, R 20, W 4 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number (figure 1)</th>
<th>Remaining Reserve</th>
<th>Note</th>
</tr>
</thead>
</table>
| Blackfoot | 54 | 100 | 22 | Underground estimates believed to be conservative; seams continuous westward to Buffalo Hill Region.

**Mineability:**
Seams thick; ash content moderate; stripping ratio favorable within bounds of Bow River Valley; topography in valley rolling.

**Environmental constraints:** medium  
Good agricultural land.

**Socioeconomic constraints:** low  
Main rail line; main highway; some local roads; established towns (Bassano, Cluny, Gleichen); Indian lands.

**Typical analyses**  
*Proximate* (capacity moisture, mineral-matter-free basis)
- Capacity moisture  % - 20.0
- Ash (as received)  % - (10.5)
- Fixed carbon  % - 47.4
- Calorific value  Btu/lb - 10,240

(Significantly comparable bulk coal sample not immediately available.)
### Fourteenth Region: Buffalo Hills

- **Rank (ASTM):** Subbituminous A (probably)
- **Geology:** Horseshoe Canyon Formation, late Cretaceous age
- **Location:** 85 km SE of Calgary, about Tp 18, R 23, W 4 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number (figure 1)</th>
<th>Remaining Reserve Tonnes x 10^6</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffalo Hill</td>
<td>55</td>
<td>0</td>
<td>440</td>
</tr>
</tbody>
</table>

**Mineability:**

- Entirely underground with vertical hoisting shafts required; deeper (more than 400 m) than any mine ever in Alberta Plains.

**Environmental constraints:** low

- Cover need not be disturbed.

**Socioeconomic constraints:** low

- Rail line; highway; good local road network; established town (Vulcan).

(Aanalyses confidential; not available; coal reported to be Subbituminous A in rank.)

(Significantly comparable bulk coal sample not immediately available.)
Fifteenth Region: Brooks/East Brooks (part)

Rank (ASTM): Subbituminous B
Geology: Oldman Formation, late Cretaceous age
Location: 250 km SE of Calgary, about Tp 17, R 15, W 4 Mer

<table>
<thead>
<tr>
<th>Deposits</th>
<th>Number (figure 1)</th>
<th>Remaining Reserve</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tonnes x 10⁶ Strip Underground</td>
<td></td>
</tr>
<tr>
<td>Bow City -</td>
<td>56</td>
<td>67</td>
<td>38 Two ‘Fields’ (ERCB) necessary for one viable operation.</td>
</tr>
<tr>
<td>Kitsim</td>
<td>57</td>
<td>76</td>
<td>0</td>
</tr>
<tr>
<td>East Brooks</td>
<td>57</td>
<td>76</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>140</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

Mineability:
Medium-thin seams; medium-large stripping ratios; topography flat.

Environmental constraints: medium
Some irrigation agriculture; some critical wildlife areas (antelope).

Socioeconomic constraints: low
Main rail line; main highway; good local road network; established town (Brooks).

Typical analyses (Bow City - KitSim Deposit)
Proximate (capacity moisture, mineral-matter-free basis)
Capacity moisture % - 20.0
Ash (as received) % - (11.9)
Fixed carbon % - 45.6
Calorific value Btu/lb - 10,680

Ultimate (elemental; water out)
Carbon % - 78.6
Hydrogen % - 5.5
Nitrogen % - 1.7
Oxygen % - 15.0
Sulfur % - 1.0

(Significantly comparable bulk coal sample not immediately available.)
Acknowledgment
This work forms part of the ENR-ARC Coal Conversion Research Program supported jointly by the Alberta Research Council (ARC) and the Alberta/Canada Energy Resource Research Fund administered by Alberta Energy and Natural Resources (ENR).